SECTION 270528 — CABLE TRAY FOR TELECOMMUNICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to the work of this Section.

1.2 SUMMARY

A. Provide all materials and labor for the installation of a cable tray system for communications infrastructure. This section includes requirements for providing a cable tray system for communications circuits. These requirements are in addition to any that may exist in Section 27 – “Cable Tray.”

B. Related Sections

1. Division 7 Section — "Firestopping"
2. Division 10 Section — "Cutting and Patching"
3. Division 27 Section — "Basic Electrical Materials and Methods"
4. Division 27 Section — "Raceway and Boxes for Communications Circuits"
5. Division 27 Section — "Inside Plant Communications Circuits"
6. Division 27 Section — "Outside Plant Communications Circuits"
7. Division 27 Section – “Telecommunications Room Requirements”
8. Division 27 Section – “Backbone Cabling Requirements”
9. Division 27 Section – “Horizontal Cabling Requirements”

1.3 REFERENCES

A. The applicable portions of the following specifications, standards, codes and regulations shall be incorporated by reference into these specifications.

1. General:

   a. National Electrical Code (NEC)
   b. National Electrical Safety Code (NESC)
   c. Washington Industrial Safety and Health Act (WISHA)
   d. Occupational Safety and Health Act (OSHA)
   e. ASTM A123 – Specification for Zinc (Hot Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip.
   f. ASTM A653 – Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot Dip Process, Structural (Physical) Quality.
   g. ASTM A1011 – Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low Alloy and High-Strength Low-Alloy with Improved Formability.
h. ASTM A1008 – Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low Alloy and High-Strength Low-Alloy with Improved Formability.

i. ASTM B633 – Specification for Electrodeposited Coatings of Zinc on Iron and Steel

j. NEMA VE 1 – Metallic Cable Tray Systems

k. NEMA VE 2 – Cable Tray Installation Guidelines

2. Communications:
   a. TIA/EIA - 568: Commercial Building Telecommunications Cabling Standard
   b. TIA/EIA - 569: Commercial Building Standard for Telecommunication Pathways and Spaces
   c. TIA/EIA - 606: The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
   d. TIA/EIA - 607: Commercial Building Grounding and Bonding Requirements for Telecommunications
   e. ISO/IEC IS 11801: Generic Cabling for Customer Premises
   f. BICSI: BICSI Telecommunications Cabling Installation Manual
   g. BICSI: BICSI Telecommunications Distribution Methods Manual (TDMM)

1.4 DEFINITIONS

A. “EMT shall mean Electrical Metallic Tubing.

B. “RMC” shall mean Rigid Metal Conduit.

C. “Raceway” shall mean any enclosed channel for routing wire, cable or busbars.

D. “TMGB” shall mean Telecommunications Main Grounding Busbar. There is typically one TMGB per building, located in the main telecommunications room. This busbar is directly bonded to the electrical service ground.

E. “TGB” shall mean Telecommunications Grounding Busbar. There is typically one TGB per telecommunications room. The TGB is connected both to the TMGB and to building structural steel or other permanent metallic systems.

F. “TBB” shall mean Telecommunications Bonding Backbone. The TBB is a conductor used to connect TMGBs to the TGBs.

G. “Pullbox” shall mean a metallic box with a removable cover, used to facilitate pulling cable through conduit runs longer than 100’ or in which there are more than 180 degrees of bends. Pullboxes shall have no more than one conduit entering and one conduit exiting the box.

H. “Junction box” shall mean a pullbox wherein a conduit run transitions from a feeder conduit to multiple distribution conduits.

1.5 SYSTEM DESCRIPTION

A. Furnish, install, and place into satisfactory and successful operation all materials, devices, and necessary appurtenances to provide a complete, permanent Cable Tray infrastructure for communications circuits as hereinafter specified and/or shown on the Contract Documents. The Cable Tray system shall support an ANSI/TIA/EIA and ISO/IEC compliant communications Structured Cabling System (SCS) as specified in Inside Plant Communications Circuits.
B. The work shall include materials, equipment and apparatus not specifically mentioned herein or noted on the plans but which are necessary to make a complete working ANSI/TIA/EIA and ISO/IEC compliant Cable Tray system.

1.6 SUBMITTAL INFORMATION

A. Product Data Submittals: Provide submittal information for review before materials are delivered to the job site. Provide product data submittals for all products at the same time.

1. Submit a letter stating that the materials will be provided as specified, and specifically listing any items that will not be provided as specified. The letter shall also state that the Contractor has reviewed the specified items and agrees that they are applicable to this project in all respects.

2. For those items noted as allowing “or equal,” and which are not being provided as specifically named, submit standard manufacturer's cut sheets or other descriptive information, along with a written description detailing the reason for the substitution.

3. Provide standard manufacturer's cut sheets and the operating and maintenance (O&M) instructions at the time of submittal review for each device in the system, regardless of whether it is submitted as specified or as an approved equal. These instructions shall detail how to install and service the equipment and shall include information necessary for rough-in and preparation of the building facilities to receive the materials.

B. Closeout Submittals: Provide submittal information for review as follows:

1. O&M Manual for Communications - At the completion of the project, submit O&M information from product data submittals (above), updated to reflect any changes during the course of construction, to the Designer in the telecommunications-specific O&M Manual for Communications binder labeled with the project name and description.

2. Records - Maintain at the job site a minimum of one set of Record Drawings, Specification, and Addenda. Record Drawings shall consist of redline markups of drawings, specifications and spreadsheets.
   a. Document changes to the system from that originally shown on the Contract Documents and clearly identify system component labels and identifiers on Record Drawings.
   b. Keep Record Drawings at the job site and make available to the Owner and Designer at any time.
   c. Keep Record Drawings current throughout the course of construction. (“Current” is defined as not more than one week behind actual construction).
   d. Show identifiers for major infrastructure components on Record Drawings.

1.7 SEQUENCING

1.8 CONTRACTOR WARRANTY:

A. Provide a Contractor-endorsed two-year service warranty against defects in materials and workmanship.

1. Provide labor attributable to the fulfillment of this warranty at no cost to the Owner.

2. The Contractor Warranty period shall commence upon Owner acceptance of the work.

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials shall consist of tray sections, tray fittings, connectors, supports, expansion joints, blind end plates, barrier strips, radius drops, bonding conductors and other incidentals and accessories as required. Provide all incidental
and/or miscellaneous hardware not explicitly specified or shown on the Contract Documents that is required for a fully operational and warranted system.

B. Unless specifically stated as “Or equal”, equivalent items are not acceptable. Provide items as specified.

C. Physically verify existing site conditions prior to purchase and delivery of the materials.

D. Cable tray components shall be manufactured by a single manufacturer. Components shall not be intermixed between different manufacturers.

1. The cable tray manufacturer shall be one of the following:
   a. GS Metals
   b. Cablofil

2. Substitution is not acceptable unless the cable tray manufacturer has been pre-approved prior to bidding. Contractors, in order to obtain approval for cable tray manufacturer substitution, shall submit their request for substitution to the Engineer at least two weeks prior to the bid date. Approval or denial of a substitution request will be based upon the sole judgment of the Engineer.

E. For a given manufacturer, all components shall be part of a single cable tray product line – components shall not be intermixed between a manufacturer’s cable tray product lines.

1. The cable tray product one shall be one of the following:
   a. For GS Metals: Flextray Series
   b. For Cablofil, Inc.: EZ Tray CF54/xxx Series

2.2 MATERIALS AND FINISH

A. General: Except as otherwise indicated, provide metal cable runways of types, classes and sizes indicated with splice connectors, bolts, nuts and washers for connecting units.

B. Welded Wire (Basket Tray): Cable tray shall be constructed of welded wire mesh (high strength steel wires) with a continuous safety edge wire lip. Cable tray shall be complete will all tray supports, materials, and incidental and miscellaneous hardware required for a complete cable tray system.

1. Finish: Carbon steel with electro-plated zinc galvanized finish.

2. Width: Widths shall be as shown on the Contract Documents. Where cable tray width is not shown on the Contract Documents, it shall be sized according to the amount of cable to be placed in the trays (as shown on the Contract Documents) plus an additional 100% for future expansion capability.

3. Depth: 2 inches.

4. Mesh: 2 x 4 inches.

5. Width: 12 inches

6. Fittings: Fittings shall be field fabricated from straight sections using manufacturer-approved tools and in accordance with manufacturer’s instructions.

C. Solid Bar Style (Ladder Tray): Cable tray shall be ladder type with 1-1/2 inch stringer height with welded rungs

1. Stringer side rail shall confirm to the minimum chemical and mechanical properties of ASTM A36 structural steel.
2. Cable runway rungs shall be constructed from ASTM A1011 SS Grade 33 structural steel. Each rung shall be 1/2 inch by 1 inch steel c-channel shape with radius edges.

3. Runway shall be 12 inches wide and installed as shown on drawings.

D. Grounding/bonding: In accordance with ANSI/NFPA 70 Section 318-7, cable tray shall be complete with bolted splicing hardware for grounding/bonding throughout the entire cable tray system.

E. Cable tray installed in each MDF/IDF should be Ladder type.

F. All other horizontal Cable Tray should be Basket type.

G. All Cable Tray should be UL listed and have UL compliance.

2.3 FIRESTOPPING MATERIAL

A. Firestopping material: Conform to both Flame (F) and Temperature (T) ratings as required by local building codes and as tested by nationally accepted test agencies per ASTM E814 or UL 1479 fire test in a configuration that is representative of the actual field conditions. Manufactured by:

1. Specified Tech. Inc.

2.4 LABELING AND ADMINISTRATION

A. Labels: As recommended in ANSI/TIA/EIA 606. Permanent (i.e. not subject to fading or erasure), permanently affixed, and created by a hand-carried label maker or a computer/software-based label making system. Handwritten labels are not acceptable.

1. Hand-carried label maker: Brady: ID Pro Plus (or approved equal).

2. Labels: Brady: Bradymaker Wire Marking Labels WML-511-292 (or approved equal)

3. Label Clips: Cablofil, Inc. (regardless of cable tray manufacturer)

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor is solely responsible for the safety of the public and workers in accordance with all applicable rules, regulations, building codes and ordinances.

B. All work shall comply with applicable safety rules and regulations including OSHA and WISHA. All work shall comply with the requirements of the National Electrical Safety Code (NESC) and the NEC except where local codes and/or regulations are more stringent, in which case the local codes and/or regulations shall govern.

C. All work shall comply with the standards, references and codes listed in PART 1 -- REFERENCES above. Where questions arise regarding which standards, references, or codes apply, the more stringent shall prevail.

D. All work shall comply with the requirements and recommendations of the product manufacturers. Where questions arise regarding which requirements and recommendations apply, the more stringent shall prevail.

E. Replace and/or repair to original (or better) condition any existing structures, materials, equipment, etc. inadvertently demolished or damaged by the Contractor during the course of construction at no additional cost to the Owner.

F. Install the cable tray system in a manner ensuring that communications circuits, when installed, are able to fully comply with the ANSI/TIA/EIA and other references listed in Part 1 — References, above.
G. Remove surplus material and debris from the job site and dispose of legally.

3.2 EXAMINATION

A. Examine surfaces and spaces to receive cable tray for compliance with installation tolerances and other conditions affecting performance of cable tray installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Notify the Engineer/Owner of conditions that may adversely affect the installation, subsequent use, or cause the tray (or circuits to be subsequently installed in the tray) to not comply with ANSI/TIA/EIA standards.

3.3 INSTALLATION

A. Provide cable tray, in the locations and widths shown on the Contract Documents and in accordance with manufacturer’s requirements and industry practices (NEMA VE 2). Ensure that the cable tray equipment complies with the requirements of NEC, and applicable portions of NFPA 70B and NECA’s “Standards of Installation” pertaining to general electrical installation practices.

   1. Cable tray shall be installed plumb, level and square with finished building surfaces.
   2. Provide factory-manufactured connection hardware between each cable tray segment. Cable tray segments shall be mutually aligned. Connection hardware shall be installed according to the manufacturer’s requirements.
   3. Cable tray elevation changes shall be gradual.

B. Slots/sleeves: Provide slots/sleeves where required and where shown on the Contract Documents. Provide rotohammering, core drilling and saw cutting where required for installation. Seal and firestop (firestop only if fire rated barrier) between slot/sleeve and cable tray.

C. Cable Tray Routing:

   1. Route cable tray as shown on the Contract Documents. Where not shown on the Contract Documents, route cable tray in the most direct route possible, parallel to building lines.
   2. Do not route cable tray through areas in which flammable material may be stored or through wet, hazardous or corrosive areas.

D. Cable Tray Clearance Requirements:

   1. Clearance requirements for cable tray accessibility:
      a. Maintain a clearance of 6” between top of cable tray and ceiling structure or other equipment or raceway.
      b. Maintain a clearance of 8” between at least one side of cable tray and nearby objects.
      c. Maintain a clearance of 6” between bottom of cable tray and ceiling grid or other equipment or raceway.

   2. Clearance requirements from sources of electromagnetic interference (EMI):
      a. Maintain a clearance of 5” or more from fluorescent lighting.
      b. Maintain a clearance of 12” or more from conduit and cables used for electrical power distribution.
      c. Maintain a clearance of 48” or more from motors or transformers.
      d. Pathways shall cross perpendicularly to electrical power cables or conduits.
3. Maintain a clearance of at least 6 inches from parallel runs of flues and steam or hot-water pipes or other heat sources operating at temperatures above one-hundred degrees Fahrenheit.

E. Cable Tray Fittings: Provide field-fabricated fittings from straight sections of cable tray using manufacturer-approved tools and in accordance with manufacturer’s instructions. Bends shall be long radius. Short radius bends and T-sections shall not be used unless specifically called out on the Contract Documents.

F. Cable tray supports shall be provided where shown on the Contract Documents. Where not shown on the Contract Documents, supports shall be provided according to the manufacturer’s recommendations.

1. Supports shall be attached to structural ceiling or walls with hardware or other installation and support aids specifically designed for the cable tray and designed to support the cable tray’s weight and required cable weight and volume.

2. Where cable trays abut walls, provide wall-mounted supports.

3. Do not attach cable tray supports to ceiling support system or other mechanical support systems.

G. Load span criteria: Install tray supports in accordance with the load criteria of L/240, and as shown on the Contract Documents.

H. Cable tray shall be installed free of burrs, sharp edges, or projections which may damage cable insulation.

I. Wire-type cable tray shall be cut with a manufacturer-approved cutter with “offset cutting blade” jaws and a minimum 24 inch handle.

1. The choice and position of the jaws at the point where the cut is to be made shall allow shearing as close as possible to the intersection of the steel wires.

2. Cuts shall ensure the integrity of the galvanic protective layer.

J. Supports: Trays shall be supported at 6 foot intervals as shown on the Contract Documents, or more frequently if required by the manufacturer.

K. Expansion Joints: Provide cable tray sliding or offsetting expansion joints/fittings where shown on the Contract Documents and where cable tray crosses building expansion joints. Provide bonding jumper except where expansion joints are specifically approved for bonding.

L. Thermal contraction and expansion: Install cable tray sections with gap settings between cable tray sections that are appropriate for the range of thermal expansion and contraction expected for the space during construction and also during normal occupancy and operation.

M. Blind End Plates: Close unused openings using factory-made blind end plates.

N. Barrier Strips: Provide barrier strips as shown on the Contract Documents.

O. Radius Drops: Provide cable tray radius drops where shown on the Contract Documents and where cable trays cross other telecommunications cable trays or ladder rack.

3.4 GROUNDING AND BONDING

A. Grounding/Bonding: Grounding and bonding work shall comply with the Uniform Building Code, Uniform Fire Code, WAC, National Electrical Code, and UL 467, ANSI/TIA/EIA standards and the references listed in PART 1 – REFERENCES above, as well as local codes which may specify additional grounding and/or bonding requirements.
B. Bond metallic raceway (including cable tray) together and to the nearest TGB (as provided under Division 27 Section — “Grounding and Bonding for Telecommunications”). Ensure that bonding breaks through paint to bare metallic surface of painted metallic hardware.

C. Cable tray bonding splices: Provide cable tray splices according to manufacturer requirements to create a continuous bonding conductor throughout the entire cable tray.

D. Bonding conductors:
   1. Bond distribution conduits to cable tray.
   2. Provide bonding jumpers at expansion joints, sleeves and any other locations where electrical continuity is interrupted.
   3. Provide bonding conductor between cable tray and the electrical power distribution system grounding infrastructure.

3.5 FIRESTOPPING

A. Only employees trained/certified by the firestopping manufacturer shall apply firestopping materials.

B. Maintain the fire rating of all penetrated fire barriers. Fire stop and seal all penetrations made during construction.
   1. Provide firestopping material for through and membrane penetrations of fire-rated barriers.
   2. Install firestops in strict accordance with manufacturer’s detailed installation procedures.
   3. Install firestops in accordance with fire test reports, fire resistance requirements, acceptable sample installations, manufacturer’s recommendations, local fire and building authorities, and applicable codes and standards referenced in PART 1 – REFERENCES. Apply sealing material in a manner acceptable to the local fire and building authorities.
   4. For demolition work, apply firestopping to open penetrations in fire rated barriers where cable is removed. Apply firestopping regardless of whether or not the penetrations are used for new cable or left empty after construction is complete.
   5. Firestopping material used to seal open penetrations through which cable passes shall be re-usable/re-enterable.

3.6 CLEANING AND PROTECTION

A. On completion of installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and in accordance with accepted industry practice, that ensure coatings, finishes, and cabinets are without damage or deterioration at the time of Substantial Completion.
   1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.7 TESTING

A. Test cable trays to ensure electrical continuity of bonding and grounding connections. Demonstrate compliance with maximum grounding resistance per NFPA 70B, Chapter 18.
3.8 LABELING AND ADMINISTRATION

A. Provide the following two labels, alternating one label every 10 feet, along the entire length of the cable tray:

1. Label #1: Label shall read “TELECOMMUNICATIONS / LOW VOLTAGE CABLING ONLY”.

2. Label #2: Label shall read “WARNING! CABLE TRAY SERVES AS A TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT DISCONNECT!”

END OF SECTION
SECTION 270543 - UNDERGROUND DUCT BANKS AND UTILITY STRUCTURES:

PART 1 - GENERAL

1.1 RELATED ITEMS
   A. Drawings and General and Supplementary Conditions apply to this section. Refer to the following for additional requirements:
      1. Earthwork.
      2. Firestopping.
      3. Raceways and Boxes.

1.2 Related Sections:
   1. Division 7 Section — "Firestopping"
   2. Division 10 Section — "Cutting and Patching"
   3. Division 27 Section — “Telecommunications Room Requirements”

1.3 SUMMARY
   A. This Section includes the following:
      1. Conduits in direct-buried duct banks.
      2. Conduits in concrete-encased duct banks.
      3. Manholes and manhole accessories.

1.4 SUBMITTALS
   A. Product Data: For the following:
      1. Manhole hardware.
      2. Duct-bank materials, including spacers and miscellaneous components.
      3. Warning tape.
      4. Grounding and bonding.

   B. Shop Drawings: Show fabrication and installation details for underground conduits and utility structures and include the following:
      1. For manholes:
         a. Conduit sizes and locations of conduit entries.
         b. Reinforcement details.
         c. Manhole cover design.
         d. Step details.
         e. Grounding details.
f. Dimensioned locations of cable rack inserts, pulling-in irons, and sumps.

For precast manholes, Shop Drawings shall be signed and sealed by a qualified professional engineer, and shall show the following:

g. Construction of individual segments.
h. Joint details.
i. Design calculations.

C. Coordination Drawings: Show duct bank profiles and coordination with other utilities and underground structures. Include plans and sections drawn to scale, and show all bends and location of expansion fittings.

D. Product Certificates: For concrete and steel used in underground precast manholes, according to ASTM C 858.

E. Product Test Reports: Indicate compliance of manholes with ASTM C 857 and ASTM C 858, based on factory inspection.

1.5 QUALITY ASSURANCE

A. Devices and Accessories (Including Conduits for Communications and Telephone Service): Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with ANSI C2.

C. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver conduits to Project site with ends capped. Store nonmetallic conduits with supports to prevent bending, warping, and deforming.

B. Store precast concrete units at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

C. Lift and support precast concrete units only at designated lifting or supporting points.

1.7 COORDINATION

A. Coordinate layout and installation of conduits and manholes with final arrangement of other utilities and site grading, as determined in the field.

B. Coordinate elevations of conduits and duct bank entrances into manholes with final profiles of conduits as determined by coordination with other utilities and underground obstructions. Revise locations and elevations from those indicated as required to suit field conditions and to ensure conduit runs drain to manholes and as approved by University of Pittsburgh and Engineer.
1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Furnish cable-support stanchions, arms, insulators, and associated fasteners in quantities equal to 5 percent of amount installed.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Underground Precast Concrete Utility Structures:
   a. Carder Concrete Products.
   b. Christy Concrete Products, Inc.
   c. Elmhurst-Chicago Stone Co.
   d. Riverton Concrete Products.
   e. Rotondo Precast/Old Castle.
   f. Utility Vault Co.
   g. Wausau Concrete Co.
   h. AC Miller.

2. Frames and Covers:
   a. Campbell Foundry Co.
   b. East Jordan Iron Works, Inc.
   c. McKinley Iron Works, Inc.
   d. Neenah Foundry Co.

2.2 CONDUIT

A. Conduit and fittings are specified in "Raceways and Boxes."

B. CSSD requires a minimum of two (2) 4" conduits. Specific project plans will identify the required number of conduits. All underground conduits must be Schedule 40 (thick-walled PVC) or Schedule 80 encased in a 4,000 minimum psi concrete, to a minimum thickness of 6” from any conduit. Concrete encasement shall be reinforced with ½” steel rebar. The top of the encasement shall be a minimum of 36” below grade and a magnetically detectable tape (minimum width 1”) is to be buried 6” below finished grade and following the centerline of the encasement. Conduits within the encasement are to be spaced 6” apart on center. Direct-buried conduit is not acceptable unless approved by CSSD. The distance between telecommunications manholes shall be no greater than 400 feet. All conduit segments are to be supplied with a nylon pull rope or ribbon of sufficient tensile strength to facilitate the installation of cable or PVC innerduct.
2.3 PRECAST MANHOLES

A. Precast Units: ASTM 478, with interlocking mating sections, complete with accessories, hardware, and features as indicated. Include concrete knockout panels for conduit entrance and sleeve for ground rod. The size for the vaults is 6’ X 8’ X 7’ height with a 30” manhole.

B. Design and fabricate structure according to ASTM C 858.


D. Joint Sealant: Continuous extrusion of asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

E. Source Quality Control: Inspect structures according to ASTM C 1037.

F. Covers are to be indented with the word "University of Pittsburgh Telecommunications" which shall be cast on the upper side of each cover.

2.4 CAST-IN-PLACE MANHOLES

A. Loading: AASHTO HS20 traffic load.

2.5 TELECOM IN-GROUND PULL BOXES

A. The Contractor shall furnish all labor and material to construct the pull boxes, complete with all appurtenances at the locations and as shown in detail on the drawings. Pull boxes shall be precast reinforced composite. Pull boxes shall be as manufactured by Quazite Composite Co., or equal as approved by the Architect.

B. The locations of the pull boxes indicated on the drawings are approximate. Exact locations shall be determined at the job site.

C. Excavation, shoring, bracing, backfilling, grading, etc., shall be in accordance with the applicable portions of the "Excavating and Backfilling" section of the specification. Pull boxes shall not be installed until final conduit grading has been determined including any field changes required by underground interferences. Shop drawings shall be submitted for all pull ox details.

D. The pull boxes shall be of size shown on the drawings. The pull boxes shall be complete with the proper size openings for all conduits. The pull boxes shall be furnished with dowel rods at all openings as required to reinforce conduit envelopes. Refer to underground conduit herein for required reinforcing.

E. Pull box covers shall be heavy-duty type, suitable for occasional heavy vehicles. Covers are to be indented with the word "University of Pittsburgh Telecommunications" which shall be cast on the upper side of each cover. The cover shall be of a gasketed waterproof locking type.
F. Pull boxes shall be constructed of an aggregate consisting of sand and gravel bound together with a polymer and reinforced with continuous woven glass strands. The material shall have the following Mechanical properties:

- Compressive Strength - 11,000 psi.
- Tensile Strength - 1,700 psi.
- Flexural Strength - 7,500 psi.

ACCESSORIES

G. Conduit Spacers: Rigid PVC interlocking spacers, selected to provide minimum conduit spacings and cover depths indicated while supporting conduits during concreting and backfilling; produced by the same manufacturer as the conduits.

H. Manhole Frames and Covers: Comply with AASHTO loading specified for manhole.

1. Provide cast iron covers with the engraved word “University of Pittsburgh Telecommunications” as required.
2. Manhole Frames and Covers: ASTM A 48; Class 30B gray iron, 30-inch size, machine-finished with flat bearing surfaces.

I. Sump Frame and Grate: ASTM A 48, Class 30B gray cast iron.

J. Pulling Eyes in Walls: Eyebolt with reinforcing-bar fastening insert 2-inch- diameter eye and 1-by-4-inch bolt.

1. Working Load Embedded in 6-Inch, 4000 psi Concrete: 13,000-lbf minimum tension.

K. Pulling and Lifting Irons in Floor: 7/8-inch- diameter, hot-dip-galvanized, bent steel rod; stress relieved after forming; and fastened to reinforced rod. Exposed triangular opening.

1. Ultimate Yield Strength: 40,000-lbf shear and 60,000-lbf tension.

L. Bolting Inserts for Cable Stanchions: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch ID by 2-3/4 inches deep, flared to 1-1/4 inches minimum at base.

1. Tested Ultimate Pullout Strength: 12,000 lbf minimum.

M. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch bolt, 5300-lbf rated pullout strength, and minimum 6800-lbf rated shear strength.

N. Cable Stanchions: Hot-rolled, hot-dip-galvanized, T-section steel; 2-1/4-inch size; punched with 14 holes on 1-1/2-inch centers for cable-arm attachment.

O. Cable Arms: 3/16-inch- thick, hot-rolled, hot-dip-galvanized, steel sheet pressed to channel shape; 12 inches wide by 14 inches long and arranged for secure mounting in horizontal position at any location on cable stanchions.
P. Cable-Support Insulators: High-glaze, wet-process porcelain arranged for mounting on cable arms.

Q. Grounding Materials:

1. Ground Rods: Copper clad, 3/4 inch in diameter by 120 inches in length.
2. Ground Wire: No. 4 AWG minimum, stranded, hard-drawn copper conductor.
3. Connector Products:
   a. Comply with IEEE 837 and UL 467 listed for use for specific types, sizes.
   b. Bolted Connectors: Bolted pressure type connector or compression type. Use only approved connectors. "Split-Bolts" are not approved connectors.
   c. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

R. Ladder: UL-listed, hot-rolled, hot-dip galvanized steel ladder specifically designed for manhole use. Minimum length equal to the distance from the manhole floor to grade. Each manhole to contain its own ladder.

S. Conduit-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F. Capable of withstanding temperature of 300 deg F without slump and of adhering to clean surfaces of plastic conduits, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.

T. Conduit Duct Plugs:

1. Duct plugs shall be manufactured from high impact plastic components and shall be corrosion proof.
2. Duct plugs shall contain a durable elastic compressible gasket which will make it effective as a long term or temporary seal. They shall be removable and reusable.
3. They shall meet or exceed the following mechanical requirements:
   a. Air Pressure 7.5 psi
   b. Water Head 15 ft.
   c. Pull Out 100 Kgf

4. Duct plugs shall be equipped with a rope tie device on the back compression plate to allow the securing of a pull rope. This will allow excess rope slack to be stored within the conduit.

U. Warning Tape: Underground-line warning tape specified in Section 2.2, “CONDUIT”.

2.6 CONSTRUCTION MATERIALS

A. Dampproofing: Bituminous Dampproofing.

B. Mortar: Comply with ASTM C 270, Type M, except for quantities less than 2.0 cu. ft. where packaged mix complying with ASTM C 387, Type M, may be used.
C. Brick for Manhole Chimney: Sewer and manhole brick, ASTM C 32, Grade MS or approved grade rings.

PART 3 - EXECUTION

3.1 APPLICATION
   A. Manholes: Underground precast concrete utility structures.

3.2 EARTHWORK
   A. Excavation and Backfill: Comply with "Excavation, Backfilling, and Compacting for Utilities" Section, but do not use heavy-duty, hydraulic-operated, compaction equipment.
   B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
   C. Restore all areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching.
   D. Restore disturbed pavement.

3.3 CONDUIT INSTALLATION
   A. Slope: Pitch conduits a minimum slope of 1:300 down toward manholes and away from buildings and equipment. Slope conduits from a high point in runs between two manholes to drain in both directions.
   B. Curves and Bends: Use manufactured long sweep bends with a minimum radius of 24 inches.
   C. Use solvent-cement joints in conduits and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent conduits do not lie in the same plane.
   D. Conduit Entrances to Manholes: Space end bells approximately 10 inches o.c. for 5-inch conduits and vary proportionately for other conduit sizes. Change from regular spacing to end-bell spacing 10 feet from the end bell without reducing conduit line slope and without forming a trap in the line. Grout end bells into manhole walls from both sides to provide watertight entrances.
   E. Building Entrances: Make a transition from underground PVC to rigid galvanized steel conduit 5 feet from exterior wall of the building. Use fittings manufactured for this purpose. Follow the appropriate installation instructions below:
      1. Concrete-Encased Conduit: Install reinforcement in conduit banks passing through disturbed earth near buildings and other excavations. Coordinate duct bank with
structural design to support duct bank at wall without reducing structural or watertight integrity of building wall.

2. Waterproofed Wall and Floor Penetrations: Install a watertight entrance-sealing device with sealing gland assembly on the inside. Anchor device into masonry construction with one or more integral flanges. Secure membrane waterproofing to the device to make permanently watertight.

F. Concrete-Encased, Nonmetallic conduits: Support conduits on spacers, spaced as recommended by manufacturer and coordinated with conduit size, conduit spacing, and outdoor temperature. Install as follows:

1. Separator Installation: Space separators close enough to prevent sagging and deforming of conduits and secure separators to earth and to conduits to prevent floating during concreting. Stagger spacers approximately 6 inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around conduits or conduit groups.

2. Concreting: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto conduits. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application. Pour each run of envelope between manholes or other terminations in one continuous operation. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing rod dowels extending 18 inches into concrete on both sides of joint near corners of envelope.

3. Reinforcement: Reinforce duct banks where they cross disturbed earth and where indicated.

4. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.

5. Minimum Clearances between Conduits: 3 inches between conduits and exterior envelope wall, 3 inches between conduits for like services, and 4 inches between power and signal conduits.

6. Depth: Install top of duct bank at least 30 inches below finished grade in non-traffic areas and at least 36 inches below finished grade in vehicular traffic areas, unless otherwise indicated.

G. Nonmetallic Conduits - No Encasement (with approval from CSSD): Support conduits on spacers, spaced as recommended by manufacturer and coordinated with conduit size, conduit spacing, and outdoor temperature. Install as follows:

1. Separator Installation: Space separators close enough to prevent sagging and deforming of conduits and secure separators to earth and to conduits to prevent floating during backfilling. Stagger spacers approximately 6 inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around conduits or conduit groups.

2. Backfilling: Spade backfill carefully to prevent voids under and between conduits and exterior surface of envelope. Do not allow a heavy mass of backfill to fall directly onto conduits. Comply with "Earthwork Section", but do not use heavy-duty hydraulic-operated compaction equipment.

3. Reinforcement: Reinforce duct banks where they cross disturbed earth and where indicated.
4. Minimum Clearances Between Conduits: 3 inches between conduits and exterior envelope wall, 1-1/2 inches between conduits for like services, and 4 inches between power and signal conduits.

5. Depth: Install top of duct bank at least 30 inches below finished grade in nontraffic areas and at least 36 inches below finished grade in vehicular traffic areas. If depth cannot be met, contact Owner for variance before proceeding.

H. Warning Tape: Bury magnetically detectable warning tape approximately 6 inches below finished grade to make it more easily detectable. Align tape parallel to and within 3 inches of the centerline of duct bank.

I. Sealing: Provide temporary closure at terminations of conduits and innerducts that have cables pulled. Seal spare conduits and innerducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.

J. Pulling Cord: Install 100-lbf-test nylon cord in conduits, including spares.

3.4 MANHOLE INSTALLATION

A. Elevation: Install manholes with rooftop at least 13 inches below finished grade.

B. Drainage: Install drains in bottom of units where indicated. Coordinate with drainage provisions indicated.

C. Access: Install cast-iron frame and cover.
   1. Install brick chimney to support frame and cover and to connect cover with roof opening. Provide moisture-tight masonry joints and waterproof grouting for cast-iron frame to chimney.
   2. Install precast collars and rings to support frame and cover and to connect cover with roof opening. Provide moisture-tight masonry joints and waterproof grouting for cast-iron frame to chimney.
   3. Set frames in paved areas and traffic ways flush with finished grade. Set other frames 1 inch above finished grade.

D. Damp proofing: Apply damp proofing to exterior surfaces of units after concrete has cured at least three days. Apply bituminous damp proofing. After conduits have been connected and grouted, and before backfilling, damp proof joints and connections and touch up abrasions and scars. Damp proof exterior of manhole and handhold chimneys after brick mortar has cured at least three days.

E. Hardware: Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.

F. Field-Installed Bolting Anchors: Do not drill deeper than 3-7/8 inches for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

G. Grounding: Install ground rod through floor in each structure with top protruding 4 inches above floor. Seal floor opening against water penetration with waterproof non-shrink grout.
Ground exposed metal components and hardware with bare-copper ground conductors. Train conductors neatly around corners. Use cable clamps secured with expansion anchors to attach ground conductors.

H. Precast Concrete Manhole Installation: Unless otherwise indicated, comply with ASTM C 891.
   1. Install units’ level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
   2. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

3.5 FIELD QUALITY CONTROL
   A. Testing: Demonstrate capability and compliance with requirements on completion of installation of underground conduits and utility structures. Manhole grounds shall measure 10 ohms or less.
   B. Grounding: Test manhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified. Record test procedures used, test results that comply with requirements, and results of failed tests and corrective action taken to achieve test results that comply with requirements.
   C. Conduit Integrity: Pull aluminum or wood test mandrel through conduit to prove joint integrity and test for out-of-round conduit. Provide mandrel equal to 80 percent fill of the conduit. If obstructions are indicated, remove obstructions and retest.
   D. Correct installations if possible and retest to demonstrate compliance. Remove and replace defective products and retest.

3.6 CLEANING
   A. Pull leather-washer-type conduit cleaner, with graduated washer sizes, through full length of conduits. Follow with rubber conduit swab for final cleaning and to assist in spreading lubricant throughout conduits.
   B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION 270543
SECTION 271100 – TELECOMMUNICATION ROOM REQUIREMENTS

This documentation shall include but not limited to all cabling, conduits, data outlets, distribution patch panels, equipment racks and wire management systems as required for a fully tested and certified data network based on a structure cabling end-to-end implementation. CSSD shall be responsible for providing all active telecommunications electronics for both the data and voice networks, e.g. UPSs, data routers, data switches, wireless access points, voice switches, and telephony peripherals.

No deviation from this standard shall be incorporated without written direction from the University’s Computing Services and Systems Development group.

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division I Specification Sections, apply to this Section.

B. Related Sections:

1. Division 27 Section – “Underground Duct Bank”
2. Division 27 Section – “Cable Tray for Telecommunications”
3. Division 27 Section – “Backbone Cabling Requirements”
4. Division 27 Section – “Horizontal Cabling Requirements”

1.02 SUMMARY

A. The work covered under this section consists of the furnishing of all necessary labor, supervision, materials, and equipment to fit out the MDF/IDF rooms as shown on the drawings.

B. MDF/IDF rooms must be located within 90 meters or 292.5 feet of the most-distant telecommunication outlets they will serve. It is preferable to have the MDF/IDF room centrally located on a floor and all IDF's vertically stacked within the building. Cable runway/ basket tray system is required within the room and for cable distribution throughout the floor. All MDF/IDF room doors must open into a common accessible hallway and not require passage through any occupied space. The MDF/IDF rooms are dedicated to telecommunications equipment only and are not to be shared with storage, equipment, or other utilities. No plumbing or mechanicals are to be mounted in or pass through the MDF/IDF rooms unless specifically required for the space.

C. For the Main Distribution Frame (MDF), CSSD requires a room sized at 20’ x 20’. Proper cooling and ventilation, power, grounding, lighting, VCT-SD (Static Dissipating) flooring, and security are required. A finished ceiling is not required, unless the area above the space acts as a plenum. Plywood is not required on the walls as all equipment and cable will be housed in racks/cabinets. Provide a cable runway system to include, but not limited to straight sections of continuous raceway, field formed horizontal and vertical bends, tees, drop outs, supports and accessories, core drills and conduits in telecommunication rooms as indicated on drawings. No other utilities are to reside in the MDF. Specifics are to be determined in collaboration with CSSD based on the telecommunications delivery for the building.
D. For the Intermediate Distribution Frame (IDF), CSSD requires a room sized at 10’ x 10’ with proper cooling and ventilation, power, grounding, lighting, VCT-SD (Static Dissipating) flooring, and security. A finished ceiling is not required, unless the area above the space acts as a plenum. Plywood is not required on the walls as all equipment and cable will be housed in racks/cabinets. Provide a cable runway system to include, but not limited to straight sections of continuous raceway, field formed horizontal and vertical bends, tees, drop outs, supports and accessories, core drills and conduits in telecommunication rooms as indicated on drawings. For multiple IDFs, a vertically stacked riser is required. These requirements apply to all IDFs. No other utilities are to reside in the IDFs. Specifics are to be determined in collaboration with CSSD based on the telecommunications delivery for the building.

E. Provide wire management in the rooms as indicated on the drawings.

F. Provide equipment racks and all necessary hardware in the rooms as indicated on the drawings.

1.03 REFERENCES

A. ASTM A36 – Specification for Carbon Structural Steel

B. ASTM A1011 – Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability (Formerly ASTM A570)

C. ASTM A513 – Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing

D. ASTM B633 - Specification for Electro-deposited Coatings of Zinc on Iron and Steel

E. ANSI/ TIA/ EIA 568B. Commercial Building Telecommunications Cabling Standard

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

G. ANSI/TIA/EIA 606 & 607 – Grounding Specification

H. NFPA 70, National Electrical Code

1.04 SUBMITTALS

A. Submittal Drawings: Submit drawings of runway and accessories including connector assemblies, clamp assemblies, brackets, splice plates, splice bars, grounding clamps and hold down plates showing accurately scaled components.

B. Product Data: Submit manufacturer’s data on cable runway system including, but not limited to, types, materials, finishes and inside depths.

1.05 RECORD DOCUMENTS

A. When all work has been completed and prior to final acceptance, the Contractor shall furnish to the engineer a complete set of CAD marked drawings clearly showing the contract work and labeling.
B. Mark up a clean set of Specifications to indicate approved substitutions, change orders, and actual equipment and materials used.

**PART 2 - PRODUCTS**

**2.01 GENERAL**

A. Product: New, free from defects and listed by UL when an applicable UL Standard exists. Provide product of a given type from one manufacturer.

B. Regardless of the length or completeness of the descriptive paragraph herein, provide product complying with the specified manufacturer’s published specifications to insure a complete system.

**2.02 CABLE RUNWAY SYSTEMS**

A. Manufacturers: Chatsworth

B. General: Except as otherwise indicated, provide metal cable runways of types, classes and sizes indicated with splice connectors, bolts, nuts and washers for connecting units.

C. Runway Types: Material specifications for each runway type are as follows:

1. **Solid Bar style runway**: Runway shall be ladder type with 1-1/2 inch stringer height with welded rungs.
2. **Stringer side rail**: Shall conform to the minimum chemical and mechanical properties of ASTM A36 structural steel.
3. **Cable runway rungs**: Shall be constructed from ASTM A1011 SS Grade 33 structural steel. Each rung shall be 1/2 inch by 1 inch steel c-channel shape with radius edges.
4. **Runway**: Shall be 12 inches wide and installed as shown on drawings.

D. Ground runway sections to grounding bus bar located in MDF/IDF Room per ANSI/TIA/EIA 606 & 607 specification.

**2.03 EQUIPMENT RACKS**

A. Manufacturers: Panduit. CSSD’s preferred local distributor for infrastructure materials is Anixter. CSSD will provide all racks/cabinets.

B. Racks shall be UL listed and of aluminum construction with a black polyurethane or mil finish. Rack base shall be pre-drilled and secured to the floor. Racks shall have 12/24 mounting screws included in the package.

C. Rack rails shall be spaced for 19” mounting rail-to-rail and shall be of a U shaped construction with 12/24 pre-tapped holes in the EIA-310-E standard hole pattern on both the front and rear.

D. Rack shall be 84” high. In certain cases where physical restrictions apply, racks/cabinets may be shorter in height.

E. Each rack is served by a TrippLite PDU power strip. **CSSD will provide the power strip(s).**

F. Ground all racks to grounding bus bar located in MDF/IDF Room.

G. All cabling (fiber and copper) will be supported via appropriate horizontal and vertical wire
management per CSSD’s specifications: Solid Bar Ladder Tray in the MDF, Basket Tray throughout the Floor. "J" Hooks or Bridal Rings are not acceptable.

H. Positioning of rack(s) within the room will be determined by CSSD.
I. All racks shall be securely bolted to the floor of the MDF/IDF room per CSSD’s layout and instructions.

2.04 POWER DISTRIBUTION
A. The Contractor shall provide power receptacles in the MDF/IDF room as per CSSD specifications for the project. CSSD will list the number, source (normal power, optional standby power, UPS power), voltage, amperage, phasing, and locations of the power receptacles in the room. Receptacles for power to the UPS shall be mounted to the overhead ladder tray, above the back of the rack, facing back, with sufficient clearance to prevent interference with cable installation or rack access. Receptacles are to be labeled with panel number, breaker number, and circuit ID. Normal installation is two, single phase, 120v, 30 amp circuits with an L5-30 (Locking) Receptacle, above each rack/cabinet. One circuit is fed by Optional Standby Power, if available. One circuit is fed by Normal (House) power.

B. CSSD will provide cut sheets and single-line diagrams as necessary to facilitate the installation and placement of appropriate power for any CSSD-provided devices that require hard-wired power.

C. CSSD shall specify the location(s) for any wall-mounted ‘courtesy’ receptacles in the MDF/IDF room.

D. All receptacles shall be installed in compliance with local and national electrical codes.

E. Overhead lighting per current University specifications is to be installed in the MDF/IDF room. The room is to be illuminated to 50 foot candles at 3 feet above floor level. Provide an occupancy sensor switch within the room to control only the lights in the MDF/IDF room.

2.05 ESD CONTROL FLOORING
A. The Contractor shall provide and install ESD Control Flooring. The solid, homogeneous ESD Control Vinyl Tile shown in the finish schedule or listed herein shall be Roppe StatDefend STATIC DISSIPATIVE VINYL TILE as manufactured by Roppe Corporation, Fostoria, Ohio. It shall be constructed of first-quality materials and shall be smooth and free from imperfections which detract from its appearance. The StatDefend solid vinyl tile shall conform to ASTM F-1700, Class 1, Type A. The resistance of the Stat Defend conductive floor shall be less than an average of 1,000,000 ohms and shall be more than an average of 25,000 ohms as tested in accordance with NFPA 99 2-6.3.8, ASTM F-150, and ESD S7.1 at 100 or 500 volts. The tile shall be 1/8” (3.175mm) in thickness, and of size 12” x 12” and in color per architect’s recommendation. Roppe RO0605 or ROP604 ESD adhesive must be used with this product. Roppe vinyl welding beads, .160” in diameter, are available in matching colors. Armstrong Excelon SDT comparable ESD flooring is acceptable.

B. Flooring must be grounded per manufacturer’s specification.

2.06 HVAC GUIDELINES
A. Cooling and ventilation are required in the MDF and the IDF. Capacity and type of unit to be determined by MEP engineer.

B. Room temperatures must be maintained at 64° F to 75° F at 30% to 55% relative humidity.
2.07 CEILING

A. Drop ceilings are not required in any MDF/IDF room, unless the space above MDFs/IDFs is a plenum. If the area above MDFs/IDFs acts as a plenum a ceiling is required as a means to contain dust and particulates.

B. Cable distribution system is required within the MDF/IDF room.

2.08 DOOR and PHYSICAL SECURITY

A. The minimum door dimensions are 3’6” wide by 7’ tall and are to swing out of the MDF/IDF room.

B. The primary method of securing the MDF/IDF rooms is via the University of Pittsburgh Police Department of Integrated Security RS/2 keycard system. If conditions do not permit this door security, then a Unican five-button lock is required.

2.09 SIGNAGE

A. The outside of each MDF/IDF room requires a sign indicating the room number in accordance with the building signage standard.

2.10 FIRE PROTECTION

A. Fire protection must be provided in the MDF/IDF rooms in accordance with the campus fire codes.

PART 3 – EXECUTION

3.01 GENERAL

A. Coordinate incorporation of the Work specified herein with other project work so as to facilitate a cohesive final product.

B. All work shall be installed in a neat and workmanlike manner.

C. Strictly adhere to all industry, manufacturers Category 6A UTP (500 MHz) installation practices when installing telecommunications raceway.

D. Reference the BICSI TDDM manual for acceptable installation methods.

3.02 DELIVERY, STORAGE AND HANDLING

A. Ship product in its original container, to prevent damage or entrance of foreign matter.

B. Handling and shipping in accordance with manufacturer’s recommendation.

C. Provide protective covering during construction, to prevent damage.

D. Replace at no expense to Owner, product damaged during storage, handling or the course of construction.
3.03 INSTALLATION

A. Mount raceways plumb and level.

B. Cable runway fitting supports shall be located such that they meet the strength requirements of straight sections. Install fitting supports per NEMA VE-2 guidelines, or in accordance with manufacturer's instructions.

C. Cable runway shall be installed as indicated on drawings. No diagonal routing will be acceptable.

D. Support: Raceway shall be supported from walls and shall not attach to floor mounted equipment racks, and according to manufacturers recommendations and load capacities.

E. Cutting: Raceway shall be cut to a smooth, even surface. Cuts shall be made with a fine tooth hacksaw, and a miter box.

F. Ground all runway tray, racks, flooring, and equipment per TIA/EIA and NEC codes.

END OF SECTION
This documentation shall include but not limited to all cabling, conduits, data outlets, distribution patch panels, equipment racks and wire management systems as required for a fully tested and certified data network based on a structure cabling end-to-end implementation. CSSD shall be responsible for providing all active telecommunications electronics for both the data and voice networks, e.g. UPSs, data routers, data switches, wireless access points, voice switches, and telephony peripherals.

No deviation from this standard shall be incorporated without written direction from the University’s Computing Services and Systems Development group (CSSD).

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Telecommunications Systems Drawings and general provisions of the contract including general supplementary and special conditions and Division 1 Specification Sections, apply to this section.

B. Related Sections:

1. Division 27 Section – “Underground Duct Banks and Utility Structures”
2. Division 27 Section – “Cable Tray for Telecommunications”
3. Division 27 Section – “Telecommunications Room Requirements”
4. Division 27 Section – “Horizontal Cabling Requirements”

1.02 SUMMARY

A. This specification describes the actions to be taken, tasks to be performed and responsibilities of the certified Communications Contractor in order to provide and install a complete Backbone Cabling System. Unless otherwise noted all following sections which describe such actions, tasks, and responsibilities refer to the Contractor.

B. MDF/IDF Rooms will be served by means of copper and optical fiber backbone cabling.

C. Demarcation Point shall be serviced from various providers with optical fiber and copper cables. Contractor shall coordinate the installation of these services to insure no service disruption and extend all services as described on planning documents.

D. No terms used in this specification are intended to indicate that work or equipment called for shall be less than completely executed or installed or that the system shall be less than complete in any respect.

1.03 SUBMITTALS

A. General: Submit the following in accordance with the Conditions of the Contract and Specifications Sections.

1. Product data for each type of product specified. Product data shall consist of cut sheets, shop drawings, or other drawings that show the dimensions of the specified components
in the intended configuration. For installed electrical components such as Uninterruptible Power Supply (UPS), systems Automatic Transfer Switches (ATS) or Power Distribution Units (PDU), electrical single-line diagrams are also required. If CSSD is ordering any equipment for a given project, CSSD shall provide cut sheets and other relevant drawings so that they may be incorporated into the construction drawings.

2. The Contractor shall provide a complete set of drawings that detail the full scope of the work to be performed. This shall include all building systems that land in or pass through the space where the work is to be performed. This could include but is not limited to electrical, plumbing, HVAC, lighting, and physical security work. Additionally, a set of drawings shall be provided which detail any demolition or site preparation work that must be performed prior to construction. Electronic format (PDF files or CAD drawings) is preferred for all drawings; however, printed drawings are acceptable.

3. The Contractor shall meet with representatives from the University’s CSSD and Facilities Management groups to review scope of work and submittals prior to beginning any work.

1.04 QUALITY ASSURANCE
A. UL Compliance: Provide cables that have passed the UL VW-1 flame test. All cables shall be rated for the environment where they will be installed.

1.05 ABBREVIATIONS
A. Utilize the following abbreviations for the Drawings and Specifications.
   1. MDF – Main Distribution Frame
   2. IDF – Intermediate Distribution Frame

1.06 SCHEDULING
A. Coordinate the work with the General and Sub-contractors, and the scheduled work of the other trades. Size and bend radius of all raceway must adhere to all EIA/TIA standards and manufacturers requirements.

B. Schedule installation of all work to minimize the possibility of damage during construction.

1.07 RECORD DOCUMENTS
A. When all work has been completed and prior to final acceptance, the Contractor shall furnish to CSSD a complete set of CAD marked drawings clearly showing the contract work and labeling.

B. Mark up a clean set of specifications to indicate approved substitutions, change orders, and actual equipment and materials used.

C. The Contractor shall meet with representatives from the University’s CSSD and Facilities Management groups during construction, to review progress and address issues.
PART 2 - PRODUCTS

2.01 GENERAL

A. Product: New, free from defects and listed by UL when an applicable UL Standard exists. Provide product of a given type from one manufacturer.

B. All cable shall be installed in a neat and workmanlike manner.

C. Regardless of the length or completeness of the descriptive paragraph herein, provide product complying with the specified manufacturer’s published specifications.

D. Provide product specified with the quality and standards established.

E. All abandoned backbone, vertical, fiber & riser copper shall be removed completely, per NEC 770.25 and 800.25, to each termination point, up to, and including the Fiber LIU or copper Patch Panel.

2.02 ACCEPTABLE MANUFACTURERS

A. Model numbers and manufacturers included in this specification are listed to establish a standard of product quality.

B. Other qualified manufacturers will be considered subject to prior approval of complete technical data, samples, and, if requested, results of independent testing laboratory tests of proposed equipment.

C. All copper cable, connectors, and hardware shall comply with the warranty requirements of Section 271500 – Horizontal Cabling Requirements.

D. Manufacturers: General is the primary manufacturer for vertical copper cable. Panduit is the secondary manufacturer for copper riser cable and is acceptable. Panduit or AFL is the primary manufacturer for fiber cable and General is the secondary for fiber cable. CSSD’s preferred local distributor for infrastructure materials is Anixter.

2.03 EQUIPMENT

A. Optical Fiber Distribution Cable-Multimode (General, Panduit, or AFL) CSSD’s preferred local distributor for infrastructure materials is Anixter.

1. Physical Specifications: Multimode Cable – 50 micron, tight buffered (900 micrometers), laser-optimized, optical cable with extended bandwidth (OM4). Maximum attenuation of 3.50dB/km at 850 nm and 1.50dB/km at 1,300 nm. Minimum Modal Bandwidth: 3500 MHz-km at 850 nm, 500 MHz-km at 1,300 nm for Overfilled Launch and 4700 MHz-km at 850 nm for “Laser” Launch. EIA/TIA 568-B.3, IEEE 802 compliant. Link distance support for 10GBase-SR of 550 meters, 10GBase-LX4 of 300 meters, 10GBase-LRM of 220 meters, 40GBase-SR4 of 150 meters, and 100GBase-SR10 of 150 meters.

2. Refractive index profile: Graded index.


4. Fiber Count: as specified by CSSD per project requirement.

5. Optical Fiber Connectors Multimode: Panduit LC Connectors or AFL FuseConnect LC Connectors. Mated pair insertion loss shall be less than 0.75 dB. Connector shall accept both 250 and 900-micron fiber coatings. Fiber Optic Connector utilizes a zirconia
ferrule for fiber alignment. The connector has push-pull hardware for easier connections, as well as high optical stability. Each optical fiber strand shall be secured to the ferrule with anaerobic epoxy and the end faces are to be polished appropriately. Connector must be compliant with TIA/EIA 568-B.3. Under no circumstances are “crimp-and-cleave” type connectors acceptable for terminating multimode fiber.

B. Optical Fiber Distribution Cable-Single Mode (General, AFL, or Panduit) - CSSD’s preferred local distributor for infrastructure materials is Anixter.

1. Physical Specifications: Singlemode Cable – 8.3/125 micron, tight buffered (900 micrometers) optical cable. Maximum attenuation of 1.0 dB/km at 1300 nm, 1.00dB/km at 1,550 nm. EIA/TIA 568-B.3, IEEE 802 compliant.
2. Refractive index profile: Graded index.
3. Jacket: UL listed, non-conductive, ONFP rated.
4. Fiber Count: as specified by CSSD per project requirement.
5. Single Mode: Panduit LC Connectors or AFL FuseConnect LC Connectors. Fiber Optic Connector utilizes a zirconia ferrule for fiber alignment. Insertion loss average shall be 0.15 dB. The connector has push-pull hardware for easier connections, as well as high optical stability. Each optical fiber strand shall be secured to the ferrule with anaerobic epoxy and the end faces are to be polished appropriately. Connector must be compliant with TIA/EIA 568-B.3. Under no circumstances are “crimp-and-cleave” type connectors acceptable for terminating singlemode fiber.

C. Copper Distribution Cable: CSSD’s preferred local distributor for infrastructure materials is Anixter.

1. Outside Plant: General is the primary manufacturer; Essex is the secondary manufacturer and is acceptable; pair count as specified by CSSD per project requirement.
2. Inside Plant/Riser Rated: Panduit is the primary manufacturer; General is the secondary manufacturer and is acceptable; pair count as specified by CSSD per project requirement.
3. CAT 5E (25 pair) cable is the standard for Vertical Backbone copper cabling from each MDF to each IDF.

D. Optical Fiber Interconnect/Rack Mount - Panduit - CSSD’s preferred local distributor for infrastructure materials is Anixter.

1. Provide rack mounted optical fiber cabinet(s) and appropriate adapters in each MDF/IDF Room as indicated on drawings per CSSD construction requirements. Panel(s) shall come with rack mounting brackets that allow it/them to be mounted on a 19” rack.
2. Panel shall contain rear corner slots for cable entry, wire retainers for holding the buffered fiber in place, and fiber storage drums for maintaining a minimum bend radius of 1.5 in. (3.81 cm) for the buffered fiber.
3. Provide SC duplex adapter panels and blank filler panels for all unused openings.
4. Provide ST adapter panels and blank filler panels for all unused openings.
5. All connectors must have appropriate dust covers in place as soon as termination is completed, and termination work should be scheduled at a point in the construction timeline to minimize the possibility of the new connectors becoming contaminated with dust and construction debris.
6. Provide a minimum 30 feet service loop on all fiber cables inside each MDF/IDF room. CSSD will provide guidance on the location of the service loop.
7. Provide only Velcro type wire wraps in all MDF/IDF Rooms. No tape or plastic wraps shall be permitted. Velcro wire ties shall be installed ‘hook side out’.
8. CSSD will provide a single optical fiber cabinet for each MDF/IDF (Panduit Part
#MRE3. Additional optical fiber cabinets are the responsibility of the EC.

E. CAT 5E Patch Panels (Copper Riser): Panduit Part Number (#DPA245E88TGY) CSSD’s preferred local distributor for infrastructure materials is Anixter.

1. Panel(s) shall come with rack mounting brackets that allow it/them to be mounted on a 19” rack.
2. Wiring blocks shall be available for 24 pairs. (A single 25 pair CAT 5E copper cable should be installed from each MDF to each IDF.)
3. Connecting blocks shall be available as kits that include the wiring blocks, the proper number of connecting blocks and label strips for 24 pair sizes.
4. Connecting Blocks shall be 4 pair configuration. Provide all connecting blocks to terminate 24 pair.
5. Wiring blocks shall be fire-retardant molded plastic block with horizontal strips, each of which secures and organizes cable pairs.
6. Connecting blocks shall be rated EIA/TIA Category 5E compliant.
7. Connecting blocks shall accept 22-26 (0.4-0.65mm) solid copper conductors and 22-26 (0.4-0.65mm) 7-stranded copper conductors.
8. Provide only Velcro type wire wraps in all MDF/IDF Rooms. No tape or plastic wraps shall be permitted. Velcro wire ties shall be installed ‘hook side out’.
9. Binder can forgo the last pair (Violet Slate).
10. CSSD will provide a single 24 Port Patch Panel for each MDF/IDF. Additional 24 Port Patch Panels are the responsibility of the EC.

G. Inner Duct – (Inside Plant) Carlon, eABF, or Pyramid - CSSD’s preferred local distributor for infrastructure materials is Anixter. (Both Inside & Outside Plant) – Must be a ducted tube (microcell) capable of being pushed without air 200 feet. Each microcell must be capable of carrying at least (48) strands of fiber.

1. All optical fiber shall be installed in Inner Duct Ducted Tube (microcell) raceway. All Inner Duct will be UL listed and shall be 1.25” diameter.
2. The standard number of microcells for the ducted cell Inner Duct to each IDF is nine.
3. Each IDF should have an individual nine microcell, ducted tube, Inner Duct from the MDF.
4. The Backbone Inner Duct into the MDF from the Outside Plant should contain nineteen microcells.
5. Inner Duct will be plenum rated, UL listed, and contain a factory installed pull tape.
6. Inner Duct shall be corrugated, orange in color and labeled “Danger Optical Fiber” a minimum of every 50 feet.
7. Inner Duct must be labeled with cable count at far-and-near end points. Specific labeling requirements will be provided by CSSD.

H. Cable Runway System

A. Manufacturers: Chatsworth

B. General: Except as otherwise indicated, provide metal cable runways of types, classes and sizes indicated with splice connectors, bolts, nuts and washers for connecting units.

C. Runway Types: Material specifications for each runway type are as follows:

1. Solid Bar style runway: Runway shall be ladder type with 1-1/2 inch stringer height with welded rungs.
2. Stringer side rail shall conform to the minimum chemical and mechanical properties of ASTM A36 structural steel.

3. Cable runway rungs shall be constructed from ASTM A1011 SS Grade 33 structural steel. Each rung shall be 1/2 inch by 1 inch steel c-channel shape with radius edges.

4. Runway shall be at least 12 inches wide and installed as shown on drawings.

D. Ground runway sections to grounding bus bar located in MDF/IDF Room per ANSI/TIA/EIA 606 & 607 specification.

PART 3 – EXECUTION

3.01 GENERAL

A. Coordinate incorporation of the work specified herein with other project work so as to facilitate an industry standard final product.

B. All cable shall be installed within industry best practice and standards.

C. Strictly adhere to all industry and manufacturer’s installation practices when installing optical fiber cabling, maximize duct and raceway utilization and maintain 40% fill factor.

D. As all fiber/copper cable is to be terminated in the racks/cabinets, no plywood is required on the walls.

E. Contractor will be responsible for all consumables required to perform an industry standard installation as part of the base bid and in accordance with CSSD standards.

3.02 DELIVERY, STORAGE AND HANDLING

A. Ship product in its original container, to prevent damage or entrance of foreign matter.

B. Handling and shipping in accordance with manufacturer’s recommendation.

C. Provide protective covering during construction, to prevent damage or entrance of foreign matter.

D. Replace, at no expense to Owner, product damaged during storage, handling or the course of construction.

E. Any remaining consumables will be packaged and delivered to CSSD within two weeks of project completion.

F. All job sites are to be properly secured, with access limited only to authorized persons. The Contractor shall be responsible for securing the job site at the end of each work day.

3.03 INSTALLATION

A. Install copper distribution cables and associated equipment in accordance with industry standards and manufacturer’s written recommendations.

B. Install copper cable without damage to pairs, or jacket. Ensure that manufacturer’s recommended pulling tensions are not exceeded. Do not at any time bend cables to smaller radii than recommended by manufacturer.
C. All copper pairs must be terminated, usable, and meet specifications. Do not splice fiber or copper cable runs between MDF and IDFs.

D. At each MDF/IDF room, coil a minimum of ten feet of copper cable as a Service Loop for future relocation.

E. Install optical distribution fiber, copper distribution cables, and associated equipment in accordance with industry standards and manufacturer’s written recommendations.

F. Install optical distribution fiber cable without damage to fibers, cladding or jacket. Ensure that manufacturer’s recommended pulling tensions are not exceeded. Do not at any time bend cables to a smaller radius than recommended by manufacturer.

G. Optical fiber: No splicing is allowed, with the exception of a transition splice at each end of a run if armored cable is used for inter-building runs. Such splices are to be made inside of the building at each end, in a location to be determined by CSSD. Pre-connectorized or field connectorization is acceptable. Connector installation shall be anaerobic epoxy and the end faces are to be polished appropriately. “Crimp and cleave” type connectors are not acceptable under any circumstances.

H. All optical fiber cables shall be installed in plenum rated microcell innerduct. Install optical fiber cable simultaneously where more than one cable is being installed in the same raceway or innerduct. Use an approved pulling lubricant where necessary.

I. All fibers must be terminated, usable, and meet specifications.

J. At each MDF/IDF room, coil a minimum of thirty feet of optical fiber cable for future relocation. Properly support innerduct and cable along the entire pathway. CSSD will provide guidance on the placement of service coils.

K. Clean optical fiber cable and components of dirt and construction debris upon completion of installation and termination. Install dust covers on fibers after cleaning.

3.04 LABELING

A. Securely label all cables at each entry and exit point of conduit, innerduct, or raceway. Label the inner duct with “Fiber Optic Cable” cable number, fiber count, starting location, end location, and installation date. Label the copper cable with starting location, end location, pair count, and installation date.

Rack-mount units

"Rack" in this context could refer to a relay rack or an enclosed cabinet. Each rack is assigned a row number and a rack number, based on the ID of the room where it is located. These numbers start at 1 and increment sequentially as needed. Row and rack numbers will be determined by CSSD, but normally run from left to right in a given row and rows run front to back.

Fiber termination bays in a given rack are numbered starting at 1, which would be at the top of the rack, and incrementing as more bays are added, working down from the top. Existing devices (electronics, Ethernet patch panels, etc) in a given rack do not interfere with the numbering of the fiber termination bays.
A room ID (EHB4A, for example) is a combination of the two-letter building code assigned by CSSD ("EH" for Old Engineering Hall) and the MDF/IDF room number ("B4A" in this example). CSSD will provide actual building code.

In the "EHB4A" example above, the first rack in the first row in that room would be "EHB4A-R1-1", with the "R" indicating that the unit is a rack.

A rack mounted fiber termination bay ID follows the form:

(Room_ID)-R(Rack_Row_ID)-(Rack_ID)-(Position_in_Rack)

Extending the examples above, the first (uppermost) fiber termination bay in the first rack in the first row in room EHB4A would be "EHB4A-R1-1-1". The next bay below this one, in the same rack, would be "EHB4A-R1-1-2". The first bay in the next rack in that row would be "EHB4A-R1-2-1" and the first bay in the first rack in the next row would be "EHB4A-R2-1-1".

Additional notes

1. Fiber to multiple locations, such fiber from an MDF to several IDFs in the same building, may terminate in the same bay in the MDF, if necessary. The bay needs to be labeled appropriately to denote which panels within the bay terminate fiber to each specific location. Label is to include both endpoints of the fiber terminations.
2. Labels are to be made using a label printer. Hand-written labels are not acceptable.
3. Notations made to the legend card (if applicable) in a given bay should also be made using a label printer.
4. If the finish of a termination bay prevents adhesive labels from sticking properly, the relevant area of the finish may be lightly sanded to allow for a better contact between the label and the surface. This problem is common on bays that have a textured finish.

B. Provide typed label on each patch panel designating port signal. Provide an 80 pound paper stock utilizing 10 point block sans serif font, unless manufacturer supplied labels and schemes are included with products. Panels shall be properly labeled on front and back with the cable number and port connections for each port.

C. Provide labeling compliant with ANSI/TIA/EIA 606 standards and per Owner’s requirements.

D. Provide logical and legible cable wiring label permanently affixed for easy identification.

1. Labels on cables to be adhesive strip type covered with clear heat-shrink tubing. Factory stamped heat shrink tubing may be used in lieu of the adhesive strip style.
2. Wiring designator to be an alphanumeric code unique for each cable.
3. Labels shall not be handwritten.

3.05 TESTING

A. Testing is crucial in assuring the overall integrity and satisfactory performance of the intrabuilding backbone system.

B. Prior to usage, test all equipment and components in accordance with manufacturers’ published test procedures. In addition, test optical fiber cable in accordance with TIA/EIA 568-B.3 at both 850 nm and 1300 nm window for multimode optical fiber. Record and submit an electronic copy of all results, as specified in section 3.08. Multimode optical fiber is to be tested at 850 and 1300 nm, and single mode optical fiber is to be tested at 1310 and 1550 nm.

C. Any cable, which fails any test, must be removed, replaced, and re-tested at no additional cost to the Owner.

D. The optical fiber tests shall include but not limited to:
1. **Backbone Link Measurement**
   a. Each strand of the backbone optical fiber cabling link segment shall be tested in two directions for end-to-end attenuation. Testing shall be performed at both operating wavelengths to account for attenuation deltas associated with wavelength. Multimode optical fiber strands shall be tested at 850 nm and 1300 nm in accordance with ANSI/EIA/TIA-526-14A, Method B, One Reference Jumper. Singlemode optical fiber strands shall be tested at 1310 nm and 1550 nm, in accordance with TIA/EIA-526-14A, method B.
   b. Because backbone length will vary depending upon site conditions, the link attenuation equation should be used to determine acceptance values based upon this standard’s component requirement at each of the applicable wavelengths, ANSI/EIA/TIA – 568.B.1 11.3.3.4.

E. The copper distribution cable tests shall include but not limited to:

1. **Pair Integrity**
   a. Continuity to the remote end
   b. Shorts between any two or more conductors
   c. Crossed pairs
   d. Reversed pairs
   e. Split pairs
   f. Power faults
   g. Ground faults
   h. Foreign voltage
   i. Sheath continuity
   j. Any other miswiring

2. Record and submit a hard copy of all results.

3.06 **TEST EQUIPMENT**

A. Thirty days prior to start of testing, provide a list of test equipment make, model numbers, adaptors and calibration dates that will be used. Test equipment to be of the kind and quality recommended by the manufacturer of the components being tested.

B. Notify the Owner and engineer seven (7) working days prior to testing dates. Owner or Owner’s representative shall have the right to witness any/all testing. Upon completion of testing, all test results and a statement of certification shall be forwarded to the engineer for approval. Failure to comply may result in Contractor performing all tests in the presence of the Owner or Owner’s representative at no additional cost.

C. Equipment listed by manufacturer and model number establishes a standard of quality; other approved equal equipment will be acceptable.

D. Contractor, at his own expense, shall perform all tests directed by an inspection authority, Engineer, or as required by the Manufacturer.

E. Furnish the following equipment if needed. Equipment to be available for the entire test period through final System testing:
   1. Ladders and scaffolding necessary to inspect cable in cable trays and ceiling mounted junction boxes.
   2. Optical Time Domain Reflectometer (OTDR). OTDR must do Tier 1 and Tier 2.
3. Optical Power Meter. 850/1300nm LED light source. For single mode fiber, 1,310/1,550 nm laser light source for testing purposes.
4. Test-All 25-Independent Technologies Inc.
5. Fluke Level III Cable Tester

3.07 FINAL INSPECTION AND TEST

A. Upon completion of installation, initial adjustments, tests and measurements specified above, and submission and review of the results, a final inspection and test will be observed by the Owner, Owner’s Representative, or Engineer no earlier than two weeks after receipt of the written results.

B. Provide a minimum of one person for inspection and two persons for testing familiar with aspects of the System to assist.

C. The process of testing the System may necessitate moving and adjusting certain components.

D. Testing includes operation of each major system and any other components deemed necessary. Perform tests and provide required test equipment, tools and material required to make any necessary repairs, corrections, or adjustments.

E. The following procedures will be performed on each System:
   1. Inspection of the methods and means employed to incorporate the System within the facility.
   2. Verification of proper operation, from controlling devices to controlled devices.
   3. Verification of proper adjustment, balance, and alignment of equipment for optimum quality and to meet the manufacturers published specifications.
   4. Other tests on equipment or systems deemed appropriate.

F. In the event the need for further adjustment or work becomes evident during testing, the Contractor is to continue his work until the System is acceptable at no addition to the contract price. If approval is delayed because of defective equipment, or failure of equipment or installation to meet the requirements of these specifications and any extension of the inspection and testing period is required, the contract price will be reduced for the additional time and expenses of the Owner, at the standard rate in effect at that time.

3.08 DOCUMENTATION

A. Test documents shall be provided by the installer to CSSD in electronic format, delivered either via electronic mail, or on appropriate storage media (CD-ROM, USB flash drive, etc). PDF documents are preferred, but other industry-standard formats are acceptable. The documents should include the following:
   1. Fiber test results.
   2. Copper test results.

END OF SECTION
This documentation shall include but not limited to all cabling, conduits, data outlets, distribution patch panels, equipment racks and wire management systems as required for a fully tested and certified data/voice network based on a structure cabling end-to-end implementation to be installed by the Contractor. CSSD shall be responsible for providing all active telecommunications electronics for all networks, e.g. UPSs, data routers, data switches, wireless access points, voice switches, and telephony peripherals.

No deviation from this standard shall be incorporated without written direction from the University’s Computing Services and Systems Development group (CSSD).

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Telecommunications Systems Drawings and general provisions of the contract including general supplementary, special conditions and Division 1 Specification Sections apply to this section.

B. Related Sections:

1. Division 27 Section – “Underground Duct Banks and Utility Structures”
2. Division 27 Section – “Cable Tray for Telecommunications”
3. Division 27 Section – “Telecommunications Room Requirements”
4. Division 27 Section – “Backbone Cabling Requirements”

1.02 SUMMARY

A. This specification describes the actions to be taken, tasks to be performed and responsibilities of the Certified Cabling Contractor in order to provide and install a complete Warranted Horizontal Structured Cabling Panduit System. A Certification Plus System Warranty shall provide a complete system warranty to guarantee end-to-end high performance cabling systems that meet application requirements. The guarantee shall include cable and connectivity components and have one point of contact for all cabling system issues. The system shall be warranted for a period of at least 20 years. Unless otherwise noted all following sections, which describe such actions, tasks, and responsibilities refer to the Contractor.

1. A factory registered Panduit PCI contractor shall complete network installation. The contractor shall have completed standards based product and installation training. A copy of the PCI Contractor Registration shall be submitted in the proposal.

2. A factory registered Panduit PCI contractor shall have a Superintendent on the job with at least 10 years’ experience.

3. A factory registered Panduit PCI contractor shall have at least one BICSI RCDD on staff locally.

4. A factory registered Panduit PCI contractor shall be Union Affiliated.

B. No terms used in this specification are intended to indicate that work or equipment called for shall be less than completely executed or installed or that system shall be less than complete in any respect.
C. Demarc and IDF(s) will be served by means of copper and optical fiber backbone cabling. See specification section 271300.

D. Install the cabling plant constructed in a physical star topology. Serve information outlets from IDF(s) by means of unshielded twisted pair (UTP) Category 6A copper, with 568B pin configuration.

E. Provide, install, terminate, test, and label cable to each information outlet as indicated on drawing.

1.03 ABBREVIATIONS

A. Utilize the following abbreviations for the Drawings and Specifications

1. NEC National Electrical Code
2. ANSI American National Standards Association
3. NFPA National Fire Protection Association
4. IEEE Institute of Electrical and Electronic Engineers
5. NEMA National Electrical Manufacturers Association
6. UL Underwriters’ Laboratories, Inc.
7. ASTM American Society of Testing Materials
8. ASA American Standards Association
9. ICEA International Cable Engineers Association
10. EIA Electronic Industries Association
11. TIA Telecommunications Industries Association
12. FCC Federal Communications Commission
13. OSHA Occupational Safety and Health Act
14. OEM Original Equipment Manufacturers
15. EC-Sub Teledata Contractor for Electrical Contractor
16. EC Electrical Contractor

1.04 DEFINITIONS

A. Utilize the following definitions for the Drawings and Specifications

1. “PROVIDE” or “FURNISH” means to supply, purchase, transport, place, erect, connect, test and turn over to Owner, complete and ready for regular operation, the work referred to.
2. “SUPPLY” means to purchase, procure, acquire, and deliver complete with related accessories.
3. “INSTALL” means to move from property line, set in place, join, fasten, attach, set up or otherwise connect together before testing and turn over to the Owner. Installation is to be complete and ready for regular operation.
4. “WIRING” or “CABLING” includes the furnishing of all fittings, conductors, connectors, grounding accessories, tape, connections, splices, labeling, and all other items necessary for such work.
5. “CONDUIT” and “CABLE SUPPORTS” include furnishing of all fittings, hangers, supports, sleeves, grounding etc.,
6. “AS DIRECTED” means as directed by the Owner or their representative.
7. “ACCEPTED” means as accepted by the Owner or their representative.
8. “CONCEALED” means embedded in masonry or other construction, installed behind wall furring or within double partitions, or installed within hung ceilings.
9. “EXPOSED” means not installed underground or “CONCEALED” as defined above.
10. “EQUAL” means equivalent as approved by the Owner or their representative.
11. “TMGB” means Telecommunication Main Ground Buss.
12. “TGB” means Telecommunication Ground Buss
1.05 PROJECT DRAWINGS AND SPECIFICATIONS

A. The Drawings and Specifications are not intended to define all details, finish materials, and special construction, which may be required or necessary.

B. The Drawings diagrammatically show cabling and arrangements of equipment fitting the space available without interference. The Contractor shall verify the work of all other trades and shall arrange their work to avoid conflicts. If conditions exist which make it impossible to install work as shown, recommend solutions and/or submit drawings to the Engineer for approval, showing how the work may be installed.

C. It is the intent of the Drawings and Specifications to provide a complete and workable System ready for the Owner’s use. Any item not specifically shown on the drawing or called for in the Specifications, but normally required to conform to the intent, is to be considered as part of the Contract. The Drawings and Specifications are not intended as a complete materials list of items required by the Contract.

1.06 SUBMITTALS

A. General: Submit the following in accordance with the Conditions of Contract and Supplementary Conditions Specifications Sections.

B. Submittals shall be made as complete systems including all required accessories and special installation tools (i.e. termination hardware).

C. Product information including the following cable transmission characteristics:

1. Mutual Capacitance
2. DC Resistance
3. Characteristic Impedance
4. Attenuation
5. Near-end Crosstalk (NEXT)
6. Far-end Crosstalk (FEXT)
7. Nominal Velocity of Propagation and Propagation Delay
8. Attenuation to Crosstalk Ratio (ACR)
9. Return Loss
10. Delay skew

D. Manufacturers’ complete installation instructions including the following information:

1. Minimum bend radius
2. Maximum pulling tension
3. Recommended installation pulling points (i.e. every 270 degrees of bend in the raceway, or every 150 feet of raceway)
4. Recommended pulling lubricants

E. Provide information regarding all termination and connectors that shall be required for a complete installation.
F. Product Data. CSSD’s preferred local distributor for infrastructure materials is Anixter.

1. Provide manufacturer’s product data sheets for the following equipment for approval to CSSD no later than thirty (30) days after issuance of notice but prior to commencement of work to proceed.

- Patch Panels (fiber, UTP, etc.)
- Wall Jacks
  - Faceplates
  - Cable (fiber, UTP, etc.)
  - Patch cords
  - Racks
  - Cable Management Devices
- Labeling

All other equipment identified or inferred. Submit complete list for Engineer/Owner approval.

1.07 PERMITS, CODES AND INSPECTIONS

A. General: Contractor shall obtain and pay for all permits and inspections necessary for the warranty and execution of any/all work pertaining to the installation and shall submit final approval certificates to the Owner or their representative.

B. Codes: The Telecommunications System installation shall comply fully with all local, county, and state laws, ordinances, and regulations applicable with electrical installations.

C. The Telecommunications System shall be in compliance with the requirements of the latest revisions of:

1. American National Safety Institute (ANSI)
3. Americans with Disabilities Act (ADA)
4. Building Officials and Code Administrators (BOCA)
5. Building Industry Consulting Service International (BICSI)
6. BICSI’s Telecommunications Distribution Methods Manual (TDMM)
7. Electronics Industries Association (EIA)
8. Federal Communications Commission (FCC)
9. Institute of Electrical and Electronic Engineers (IEEE)
10. Legislative Act 235 (1965) - Handicapped
11. National Board of Fire Underwriter’s (NBFU)
12. National Cable Television Association (NCTA)
13. National Electrical Manufacturer’s Association (NEMA)
15. National Electrical Code (NEC)
16. Society of Cable Television Engineers (SCTE)
17. Telecommunications Industries Association (TIA)
18. Underwriters Laboratories (UL)
19. All requirements of the electrical and utility companies.
20. All approved published instructions set forth by equipment manufacturers.
D. At the completion of the work, submit all certificates issued by approved agencies to indicate conformance of all work with the approved requirements, as well as any additional certificates as may be required for the performance of this contract work.

E. Should any change in Drawings or Specifications be required to comply with governmental regulations, the Contractor shall notify the engineer prior to execution of the work. The work shall be carried out according to the requirements of such code in accordance with the instructions of the engineer and at no additional cost to the Owner.

1.08 QUALITY ASSURANCE

A. Provide work complying with all applicable codes, standards, and manufacturers’ requirements.

B. UL Compliance: Comply with applicable requirements of UL Standard 910 “Test Method for Fire and Smoke Characteristics of Cable Used in Air Plenum Spaces”. Provide products that are UL-listed and labeled as such.

C. Comply with the following Telecommunications Industry Association (TIA) and Electronic Industries Association (EIA) Standards:

1. TIA/EIA 568-B.1 568-B.2 & 568-B.3 “Commercial Building Telecommunications Cabling Standard”
2. TIA/EIA 569-A “Commercial Building Standard for Telecommunications Pathways and Spaces.
3. TIA/EIA 606 “The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings”

1.09 VISITING PREMISES

A. General: The Bidder shall visit the project site prior to submitting the Bid, in order to verify conditions on the job site applicable to this work. Notify Engineer in writing of discrepancies, conflicts, or omissions promptly upon discovery.

B. By submission of a bid, the Contractor is attesting that responsible personnel did, in fact, visit the site during the bidding period and verified all existing pertinent conditions.

1.10 COOPERATION AND COORDINATION WITH OTHER TRADES

A. Coordinate the work with the General and Electrical Contractors, and the scheduled work of all other trades.

1.11 RECORD DOCUMENTS

A. When all work has been completed and prior to final acceptance, the Contractor shall:

a. Furnish to CSSD and the engineer a complete set of CAD marked drawings clearly showing all contract work and labeling.

b. Mark up a clean set of Specifications to indicate approved substitutions, change orders, and actual equipment and materials used.
A. At the conclusion of the work, prepare warranty manuals in accordance with the following information.

B. Any material or equipment that does not comply with the requirements of the Contract Documents or which is damaged prior to acceptance will be deemed as defective and shall be removed and properly replaced at no additional cost to the Owner.

C. Warranty and Certification of the Structural Cabling System:

1. The Contractor shall provide a minimum twenty year product and performance warranty that all cable, connectors, and connecting hardware shall be free from defects in material, workmanship and fabrication.

2. The system shall be certified by the cable/component manufacturer and warranted for the specified performance for a minimum of twenty years. The Contractor shall conform to the manufacturer’s certification program including submittal of all required documentation to the manufacturer.

3. The Contractor shall obtain, from the manufacturer, a Registration Document and Certificate for the specific installation. Upon receipt of the Registration Document and Certificate, the Contractor shall forward a copy to the Engineer and deliver the original to the Owner.

D. Provide complete warranty information for each item to include date of beginning of warranty, names, addresses, telephone numbers, and procedures for filing a claim to obtain warranty service.

E. Within the warranty period, answer service calls within eight hours, and correct the deficiency within twenty-four hours.

PART 2 - PRODUCTS

2.01 GENERAL

A. Product: New, free from defects and listed by UL when an applicable UL Standard exists. Provide product of a given type from one manufacturer.

B. Regardless of the length or completeness of the descriptive paragraph herein, provide product complying with the specified manufacturer’s published specifications.

C. All abandoned horizontal copper & fiber cable shall be removed completely, per NEC 770.25 and 800.25, to each termination point, up to and including the Wall Jack and Patch Panel.

2.02 ACCEPTABLE MANUFACTURERS

A. Model numbers and manufacturers included in this specification are required as the CSSD standard. CSSD’s preferred local distributor for infrastructure materials is Anixter.

B. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. All proposed equipment shall
be equivalent in every way to that of the equipment specified and subject to approval. If products of alternate manufacturers are selected from the approved manufacturers list, they must be equal to or exceed the standards and quality criteria set forth in this document. Alternate manufacturers must submit catalog cuts and samples for approval 10 days prior to bid date.

2.03 EQUIPMENT

A. General: The items indicated below shall not be construed as a “bill of materials”. They represent items of significance used during the design of the Horizontal Cabling System. Where the items indicated are one portion of an assembly, the entire assembly shall be provided unless specified otherwise. Where items do not have a manufacturer or part number listed, no particular items have been selected at this time. CSSD’s preferred local distributor for infrastructure materials is Anixter.

B. Two post 84” x 19” Relay Rack: Panduit (Part #CMR-19X84) CSSD will provide all Relay Racks (or Cabinets) unless otherwise noted on the drawings.

a. Relay Racks or Cabinets will be installed by the EC.

b. Racks shall be supported at the top by a 12” wide Solid Bar Type Ladder Tray, which will be secured to the walls of the MDF/IDF at both ends of the Ladder Tray. CSSD should be consulted as to proper installation points of the Ladder Tray.

c. Two 120v, 30 amp, single phase, electrical circuits with L5-30 (Locking) Receptacles shall be mounted on the Ladder Tray above each rack.

   i. One circuit shall use Optional Standby Power if available.

   ii. One circuit shall use House (Normal) Power.

   iii. If Optional Standby Power is not available, only one circuit is required.

d. The Receptacles should be facing to the rear of the Racks.

e. The Contractor is responsible for the Ladder Tray.

C. 48 Port Patch Panels – UTP: Panduit (Part #DPA486X88TGY)

1. Provide necessary panels equipped with 110-style termination made of fire retardant UL 94V0 rated thermoplastic.

2. Panel circuit boards shall be fully enclosed front and rear for physical protection.

3. Panels shall have port identification numbers on both the front and rear of the panel.

4. Panels shall provide wiring identification & color code and maintain a paired punch down sequence that does not require the overlapping of cable pairs. Panels shall be available in T568B wiring schemes.


6. Panels shall include rear cable management brackets to facilitate cable terminations.

7. Cables shall route from right and left of patch panels to facilitate terminations.

8. No 110 Connecting Blocks are acceptable.

9. CSSD will provide the first 48 Port Patch Panel as part of the Relay Rack Kit. The EC is responsible for all remaining 48 Port Patch Panels.

E. Cable Management

1. Depending on the density of cables in the IDF, multiple racks may be required.

2. Patch cord organizers create defined pathways for patch cords. Horizontal organizers shall be provided above and below every rack mounted patch panel. Vertical organizers shall be provided on each rack as indicated on the drawings.
Patch cord organizers, when properly installed, shall play a key role in creating a clean installation and allow easy access when circuits are moved, added or changed.

CSSD will provide a single Horizontal Organizer as part of the Rack Kit. Additional Horizontal Organizers are the responsibility of the EC. One Horizontal Organizer is required per 48 Port Patch Panel.

F. Cable Runway Systems

1. Manufacturers: Chatsworth

2. General: Except as otherwise indicated, provide metal cable runways of types, classes and sizes indicated with splice connectors, bolts, nuts and washers for connecting units.

3. Runway Types: Material specifications for each runway type are as follows:

   i) Welded Wire (Basket Tray): Cable tray shall be constructed of welded wire mesh (high strength steel wires) with a continuous safety edge wire lip. Cable tray shall be complete will all tray supports, materials, and incidental and miscellaneous hardware required for a complete cable tray system.

      (1) Finish: Carbon steel with electro-plated zinc galvanized finish.

      (2) Width: Widths shall be as shown on the Contract Documents. Where cable tray width is not shown on the Contract Documents, it shall be sized according to the amount of cable to be placed in the trays (as shown on the Contract Documents) plus an additional 100% for future expansion capability.

      (3) Depth: 2 inches.

      (4) Mesh: 2 x 4 inches.

      (5) Width: 12 inches

      (6) Fittings: Fittings shall be field fabricated from straight sections using manufacturer-approved tools and in accordance with manufacturer’s instructions.

   ii) Solid Bar Style (Ladder Tray): Cable tray shall be ladder type with 1-1/2 inch stringer height with welded rungs

      (1) Stringer side rail shall confirm to the minimum chemical and mechanical properties of ASTM A36 structural steel.

      (2) Cable runway rungs shall be constructed from ASTM A1011 SS Grade 33 structural steel. Each rung shall be 1/2 inch by 1 inch steel c-channel shape with radius edges.

      (3) Runway shall be 12 inches wide and installed as shown on drawings.

4. Ground runway sections to grounding bus bar located in MDF/IDF Room per ANSI/TIA/EIA 606 & 607 specification.
Basket tray is the delivery system for horizontal cabling throughout the floor.

Ladder tray is the delivery system for cabling in each MDF/IDF.

J- Hooks or bridal rings are not acceptable.

G. UTP Cable – Plenum Rated: General GenSpeed 10,000 is the primary manufacturer; Panduit TX6A 10Gig UTP Copper Cable is the secondary manufacturer and is acceptable. Cabling is distributed via cable tray throughout the floors.

1 Category 6A - Physical Specifications: 4-23 AWG unshielded twisted pairs, characteristic impedance @ 1.0 –500 Mhz 100 ± 15 %, nominal mutual capacitance 14 nF/1000 ft @ 1khz. Maximum capacitance unbalance (pair-to-ground) 400 pF/1000 ft. EIA/TIA 568-B.2-10 compliant

2 Category 6A – Cable Construction: Consists of 23-AWG solid-copper conductors insulated with color-coded FEP (all pairs & jacket) compounds and sheathed with a LSPVDF outer jacket. Plenum UL910, CMP rated.

3 Category 6A – TIA/EIA Internal Channel Test Limits over Category 6A cabling (568-B.2-10) at 500 MHz:
   a. Frequency Range 1-500 MHz
   b. Propagation Delay 536 nSec
   c. Attenuation 49.4 dB
   d. NEXT 26.1 dB
   e. Power-sum NEXT 23.2 dB
   f. ACR -23.2 dB
   g. Power-sum ACR -26.1 dB
   h. ELFEXT 9.3 dB
   i. Power-sum ELFEXT 6.3 dB
   j. Return Loss 6.0 dB

4 Cables for data/voice cabling shall be color blue.

5 Cables for wireless access point station cabling shall be color green.

6 All MDF/IDF patch cords (Category 6A patch cords, blue for data/voice and green for Wireless Access Points, to cross-connect from patch panel to data switch) are the responsibility of the contractor.

Alternate UTP Cable: (Panduit Part #PUP6ASD04BU-UG, No Substitutions)

Ideal for distances up to 60 meters, offering a smaller cable diameter compared to Category 6 UTP cable; cable diameter 0.240 in (6.1mm) nominal.

H. Faceplates

1 Provide Panduit faceplates for single gang and double gang installation.

2 Panduit faceplates shall accept modular 8 position/8 conductor information jacks.

3 Color, finish, and design shall be white, E/I, or building location requirements.

4 See drawings for faceplate configurations.

I. Faceplates-Wall Phones

1 Provide Panduit stainless steel faceplates for single gang installation.

2 Faceplates shall accept modular 8 position/8 conductor information jacks.

J. Modular Jacks Faceplates shall accept modular 8 position/8 conductor information jacks.
All information outlets are 8-position/8-conductor high-density non-keyed modular information jacks designed for networking applications using transmission rates with frequencies up to 100 MHz.

Category 6A jacks (Panduit Part #CJ6X88TGEI) shall be compatible with IEEE 802.3 applications. Fully supports 10 Mbps, 100 Mbps, and Gigabit Ethernet applications at 328 ft (100 m) over UTP.

Each jack shall be an individually constructed unit and shall snap mount in an industry standard keystone opening.

Jacks shall have a temperature rating of -10 °C (14°F) to 60°C (140 °F) in conformance with ANSI/TIA/EIA-568-B.2-10.

Pin/pair assignment shall be T568-B and Jack shall be marked as such.

Jacks shall utilize a paired punch down sequence. Cable pairs shall be maintained up to the IDC, terminating all conductors adjacent to its pair mate to better maintain pair characteristics designed by the cable manufacturer.

Jacks shall terminate 22-26 AWG stranded or solid conductors. Jacks shall terminate insulated conductors with outside diameters up to .050”.

Jacks shall accept snap on icons for identification or designation of applications.

Jacks shall be supplied with installed dust covers to protect the jack opening and internal elements during installation until the jack is in use.

Jacks shall be UL VERIFIED for TIA/EIA 568-B.2-10 Category 6A electrical performance. Jacks shall be UL LISTED 1863 and CSA certified. Jacks shall be made by an ISO 9002 Certified Manufacturer.

Jacks shall be keystone type for poke-thru locations only. Quantity and location as per drawings.

Provide 20 additional jacks as maintenance spares.

K. Drawing Nomenclature

The following are examples of drawing nomenclature for Data & Voice Jack locations:

a. ▲ 1/0 – [1 Data – 1 Cable]

b. ▲ 1/1 – [1 Data/1 Voice (Standard Wall Jack) – 1 Cable] or simply ▲

c. ▲ 2/0 – [2 Data – 2 Cables]

d. ▲ 2/1 – [2 Data/1 Voice – 2 Cables]

e. ▲ 3/0 – [3 Data – 3 Cables]

f. ▲ 2/2 – [2 Data/2 Voice – 2 Cables]

g. ▲ 3/2 – [3 Data/2 Voice – 3 Cables]

h. ▲ 1/2 – [1 Data/2 Voice – 2 Cables]

i. ▲ 0/1 – Wall Phone Jack – 1 Cable] or simply ▲

Voice requirements are still needed for electronics estimates by CSSD and are therefore required on the drawings.
PART 3 – EXECUTION

3.01 GENERAL

A. Coordinate incorporation of the Work specified herein with other project work so as to facilitate a cohesive final product.

B. All cable and equipment shall be installed in a neat and workmanlike manner.

C. Strictly adhere to all Industry and manufacturers’ installation practices when installing UTP Category 6A cabling.

3.02 DELIVERY, STORAGE AND HANDLING

A. Ship product in its original container, to prevent damage or entrance of foreign matter.

B. Handling and shipping in accordance with manufacturer’s recommendation.

C. Provide protective covering during construction, to prevent damage or entrance of foreign matter.

D. Replace at no expense to Owner, product damaged during storage, handling or the course of construction.

3.03 INSTALLATION

A. The installation recommendations contained within ANSI/TIA-568-B and ANSI/TIA-569, BICSI/TDMM and manufacturer recommendations are mandatory minimum standards and requirements.

B. Mount equipment and enclosures plumb and level.

C. Cables shall be installed without damaging conductors or jacket.

D. Ensure that minimum manufacturer’s recommended pulling tension and bending radius specification are not exceeded.

E. Pull cables simultaneously where more than one cable is being installed in the same raceway.

F. Cables shall be run from the serving MDF/IDF rooms using Avenue and Streets design.

G. All avenues and streets shall run perpendicular to building structure. No diagonal routing shall be acceptable.

H. No splicing of copper cable shall be allowed.

I. Provide a minimum service loop of ten feet at both ends of cable runs. The total cable distance shall not exceed 90 meters in the permanent link.
J. Provide Velcro type tie wraps to bundle and manage cabling in all telecommunication rooms. Plastic cable ties or tape are not acceptable.

3.04 LABELING

A. Provide labeling to correspond between workstation jacks and respective patch panel port per CSSD’s direction in accordance with current University labeling scheme.

Label: o[BldgId]-[BldgId][MDF/IDF]-nnnn
Example: oeh-eh110f-0025

B. Provide labeling to the front of the faceplate, on both ends of each cable, to the front of the patch panel. Install in a plumb, level, and permanent manner. All terminations shall be made in room number order.

C. Provide labeling compliant with ANSI/TIA/EIA-606. Handwritten labels are not acceptable.

D. Provide logical and legible cable wiring label permanently affixed for easy identification.

1. Labels on cables to be adhesive strip type covered with clear heat-shrink tubing. Factory stamped heat shrink tubing may be used in lieu of the adhesive strip style.
2. Wiring designator to be unique for each cable.
3. Locate the cable designator at the origination and destination of each circuit within 3 inches of the point of termination or connection.

E. Prior to final acceptance, the Contractor shall furnish, to both Facilities Management and CSSD, a comma separated value (CSV) file or spreadsheet containing the wire number, cable type, room number, cubicle number, or general location of the station data jack for all cables installed in accordance with University current labeling scheme. Contractor shall also provide CSSD with as-built drawing identifying wire numbers by room.

F. Mark up a clean set of specifications to indicate approved substitutions, change orders, and actual equipment and materials used.

3.05 EMI/RFI AVOIDANCE

A. To avoid electromagnetic interference (EMI) cables shall be routed in such a way as to maintain the following minimum distance from possible sources of EMI.

(In certain instances, especially in Lab environments, cable installation in the Basket Tray will need to be run in a staggered, serpentine, pattern to avoid EMI/RFI. CSSD should be contacted to verify if this is required.)

B. Three inches from power lines of 2 KVA or less installed in conduits or grounded flexible metallic raceway in ceilings and below access floors.

C. Three inches from fluorescent fixtures with remotely installed ballasts.

D. Five inches from power lines 2 KVA or less.
E. Twelve inches from power lines 2 KVA to 5 KVA.

F. Twelve inches from high voltage lighting, including fluorescent lighting.

G. Forty six inches from transformers or motors.

H. Maintain a minimum twelve-inch separation between telecommunications cables running exposed in ceiling or floor spaces and parallel electrical cables/conduits.

I. Telecommunication cables that must cross electrical cables/conduits shall do so only at 90 degree angles.

3.06 HORIZONTAL WIRING, AND COMPONENTS

A. General: Provide proper cabling, connections, and terminations.

1. Take precaution to prevent and guard against electromagnetic and electrostatic interference. For example, in Laboratories, safeguards should be taken that cables be unevenly staggered, and not run in a straight line.

2. Avoid cable stress due to cable twist during pulling or installation, tension in suspended cable runs and tightly cinched cable ties.

3. Isolate cables and wires of different signals or different levels; and separate, organize, and route to restrict channel crosstalk or feedback oscillation.

4. Make connections with approved mechanical connectors properly applied with proper tooling.

5. Cover edges of cable and wire pass-through holes in chassis, housings, boxes, etc., with rubber grommets, nylon grommeting or waterfall type fittings.

6. Provide splice free wiring and cabling from origination to destination.

B. UTP Connector Terminations:

1. Pair twist is to be maintained as close as possible to the point of termination to lessen near end crosstalk. (NEXT)

2. Untwisting of pairs is not to exceed 13mm (1/2 inch) for Category 6A cable.

3. Install connecting hardware in a manner to provide a well-organized installation with cable management and in accordance with manufacturer’s guidelines.

4. Stripping of wire jackets shall not exceed 13mm (1/2 inch) to terminate individual pairs.

C. Patch Panels - UTP

1. Panels shall be installed to provide minimal signal impairment by preserving wire pair twists as closely as possible to the point of mechanical termination. The amount of untwisting in a pair as a result of termination to the patch panel shall be no greater than 0.5 inches (13 mm).

2. Stripping of wire jackets shall not exceed 13mm (1/2 inch) to terminate individual pairs.

3. Panels shall be installed according to manufacturer’s instructions and properly mounted to a rack, cabinet, bracket or other appropriate mounting device.

4. Panels shall be installed such that cables terminated to the panel can maintain minimum bend radius of at least 4 times the cable diameter into the IDC contacts. Cables shall be terminated on the panels such that there is no tension on the conductors in the termination contacts.

D. Horizontal UTP Cabling:
1. Horizontal cable shall be no greater than 292 ft., (90 meters) inclusive of all slack, from the outlet to the horizontal cross connect. The length of jumpers, patch cords and equipment cables in the MDF/IDF rooms shall not exceed 20 feet (10 meters).
2. Prevent near end crosstalk (NEXT) by keeping the amount of untwisting of the pairs to a minimum when terminating to the connecting hardware.
3. Install cable so that the pulling tension applied to the cable does not exceed 25ftlb or the manufacturer’s guidelines whichever is lesser.
4. Install cable so that a radius bend of no less than four (4) times the cables outside diameter is maintained.

E. Wireless Access Point UTP Cabling:

1. A quantity of two (2) Green Category 6A (500 Mhz) plenum cables runs, each with a 10 ft. cable coil, must be installed to each identified Access Point (AP) location. See drawings for locations.
2. All cables will be installed directly to AP locations from IDF closets as identified by CSSD. Cables will be installed horizontally along floor cable tray through existing drop ceilings and hardwall ceilings, and vertically through existing riser shafts. All telecommunications cable runs must comply with current electrical, telecommunications, and fire codes. Cable lengths must not exceed 292’ (90 m) per Category 6A standards.
3. From each AP both Category 6A cables (primary and secondary station cable) shall be terminated onto a Panduit 24 port patch panel (provided by CSSD, installed by contractor) in IDF relay rack. The Contractor is responsible for additional 24 Port Patch Panels, if required, for Wireless Access Points. Wiring must be installed in accordance with University wire management specifications.
4. Green Category 6A modular jacks are required for termination of Green Category 6A cables at the AP locations and at the patch panel locations. Green modular jacks are to be mounted in Dual Port Surface Housings located at each AP location. The primary station cable and secondary station cable are to be terminated, tested, and labeled; testing results are to be provided to CSSD per University telecommunications infrastructure specifications.
5. All required wall and floor/ceiling penetrations must be in accordance with current electrical, telecommunications, and fire codes. Cable support hardware is required for horizontal and vertical cabling per University telecommunications infrastructure specifications.
6. All cables and APs are to be identified per University designated labeling scheme.
7. Wireless access points and peripherals will be provided by CSSD according to current University specifications. Installation will be performed by contractors at specified locations using mounting brackets. Two (2) 3’ White Category 6A patch cords from Dual Port Surface Housing jacks to AP will be installed for each AP.
8. Access Point antennas, if required, will be provided by CSSD. Installation will be performed by contractor and mounted to AP, wall, or acoustical ceiling per manufacturer’s instructions. If specified by Facilities Management, exposed APs and/or antennae may require painting to match area finishes.

3.07 TESTING

A. Notify Owner/Owner representative ten (10) business days prior to testing. Owner has right to witness any/all testing. Test UTP Category 6A cable in accordance with TIA/EIA 568-B2.10 and manufacturer’s specifications. Any measurement reported by the field tester shall have a specified accuracy (level III). Record and submit to CSSD Network Engineering/Telecommunications a soft and hard copy of all test results. Failure to notify
owner of testing will result in the Contractor having to retest all cables prior to final acceptance.

B. Contractor shall perform channel test for all horizontal links. Any cable, which fails any test, must be removed, replaced, and re-tested at no additional cost to the owner.

C. Primary Field Test Parameters for Category 6A shall include but not limited to:

<table>
<thead>
<tr>
<th></th>
<th>Parameter</th>
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<tbody>
<tr>
<td>1</td>
<td>Wire Map</td>
</tr>
<tr>
<td>2</td>
<td>Characteristic Impedance</td>
</tr>
<tr>
<td>3</td>
<td>DC Loop Resistance</td>
</tr>
<tr>
<td>4</td>
<td>Length</td>
</tr>
<tr>
<td>5</td>
<td>Propagation Delay</td>
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<tr>
<td>6</td>
<td>NEXT, NEXT @ Remote</td>
</tr>
<tr>
<td>7</td>
<td>Return Loss (RL), RL @ Remote</td>
</tr>
<tr>
<td>8</td>
<td>Delay Skew</td>
</tr>
<tr>
<td>9</td>
<td>Attenuation</td>
</tr>
<tr>
<td>10</td>
<td>Attenuation-to-Crosstalk Ratio (ACR), ACR @ Remote</td>
</tr>
<tr>
<td>11</td>
<td>ELFEXT, ELFEXT @ Remote</td>
</tr>
<tr>
<td>12</td>
<td>Power Sum ACR, PSACR @ Remote</td>
</tr>
<tr>
<td>13</td>
<td>Power Sum ELFEXT, PSELFEXT @ Remote</td>
</tr>
<tr>
<td>14</td>
<td>Average Noise</td>
</tr>
<tr>
<td>15</td>
<td>Power Sum NEXT, PSNEXT @ Remote</td>
</tr>
</tbody>
</table>

Final test results must include data and wireless jack ID, and room number.

D. Testing includes operation of each major system and any other components deemed necessary. Perform tests and provide required test equipment, tools and material required to make any necessary repairs, corrections, or adjustments.

E. No later than two (2) weeks upon completion of testing, a statement of certification shall be forwarded to the engineer/owner for approval.

3.08 FINAL INSPECTION

A. Upon completion of installation, initial adjustments, tests and measurements specified in Part 3, and submission and review of the results, a final inspection and test will be observed by the Owner, Owner’s Representative, or Architect no earlier than two weeks after receipt of the written results.

B. Provide a minimum of one person for inspection and two persons for testing familiar with aspects of the System to assist at no additional cost to the contract.

C. Contractor, at his own expense, shall perform all tests directed by an inspection authority, Engineer, or as required by the Manufacturer.

D. The process of testing the System may necessitate moving and adjusting certain components.

E. In the event the need for further adjustment or work becomes evident during testing, the Contractor is to continue his work until the System is acceptable at no addition to the contract price. If approval is delayed because of defective equipment, or failure of equipment or installation to meet the requirements of these specifications and any extension of the inspection and testing period is required, the contract price will be reduced for the additional time and expenses of the Owner, at the standard rate in effect at that time.
END OF SECTION