DIVISION 27 COMMUNICATIONS

The communications systems must support Tyndall AFB as an Installation of the Future.

Designs must incorporate resilience, sustainability, and SMART systems focusing on areas of mission resiliency, equipment resiliency, future mission adaptability, cybersecurity and maintainability.

Design telecommunications infrastructure to meet the needs of the activity and supporting facilities in accordance with this document. A/E contractor generated final drawings and specifications for design-bid-build and design-build projects must be stamped by a Building Industry Consulting Service International (BICSI)-Registered Communications Distribution Designer (RCDD).

All flood-sensitive equipment including communications, controls and electrical power supply equipment must be located no lower than the adopted DFE for Tyndall AFB, or be flood-proofed to an elevation 1 foot above the DFE.

Equipment must not be located within depressional areas and must be elevated a minimum of 1 foot above finished grade.

325 CS owned UPS (Uninterruptable Power Supplies) shall not be utilized by any outside entity.

27 05 00 Outside Plant (OSP) System

27 05 13 OSP Cable

- All cables must be labeled within 3 feet of entering/exiting a maintenance hole (MH) or hand hole (HH) and within 3 feet of a splice case.
- Ensure that a maintenance loop (minimum of 35 feet of cable) is placed in every other MH.
- Backbone cables must meet specifications that support transmission of Dense Wave Division Multiplexed high bandwidth links and manufacturer must meet a minimum 20-year warranty and applications assurance.

27 05 13.1 Copper Cable

- Copper cable performance specifications for outside plant copper cable are to meet or exceed specifications identified in Balanced Twisted-Pair Cable Characteristics, Appendix E of the *BICSI Outside Plant Design Reference Manual*, 6th edition (or current version).

27 05 13.2 Optical Fiber Cable

- Optical fiber performance is to meet current International Telecommunications Union Standard ITU-T G.652.D and BICSI Optical Fiber Cable Performance by Type (Table 2.1) in *OSP Design Reference Manual* 6th edition or latest version.
- Newly installed Information Transfer Building (ITB)-to-ITB cables must contain a minimum of 144 single-mode fiber strands.
- New ITB-to-Edge Building fiber optic cables must contain a minimum of 36 single-mode fiber strands.
- Jetted fiber optic cable (FOC) design may use either traditional “off the shelf” Optical Fiber Nonconductive Riser loose tube cable or specialized compact jacketed FOC depending on the design of the micro-duct pathway being used. Both are acceptable.

- Multimode will be installed only when required by occupant's connectivity requirements.

27 05 13.3 Tracer Wire

- Tracer wires must be installed between new or existing manholes, as part of new duct bank runs or with new cable installations when using existing assets.

27 05 28 OSP Pathways

27 05 28.1 Underground Pathways

- Jetted Micro-Duct Systems (JMDS) must be used for all new underground pathways.
- JMDS must be added to Maintenance Hole Duct System (MHDS) rather than innerducts when space is available.
- JMDS spans must not exceed 2000 ft. length without entry into a MH or HH and must be accessible in each MH or HH with slack spanning three or four walls.
- In conduit spans where copper cables are to be used, conduit section lengths between MH, HH or above ground enclosure must not exceed 600 feet.
- New MHDS conduit installations must provide a minimum of two 4-inch Schedule 40 PVC bell-end conduit for standard installation. Under roadways Schedule 80 PVC bell-end conduit must be used.
- When copper cable is used as a part of an OSP technical solution, a minimum of two 4-inch Schedule 40 PVC conduits must be used.
- Edge Buildings (EBs) must be connected to an ITN by a single cable route and entry conduit.
- Each ITN shall be connected to at least two other ITNs via physically diverse (separated by a minimum of 40 feet) cable routes, where physical diversity starts at the end of the entry conduit when direct buried or at the first manhole after leaving a building if the manhole is within 50 feet of the building
- All new conduit installed must transition into the HH or MH at a depth of 36 inches below the surface where hazards are identified. Hand trenching may also be required.
- All duct openings from newly installed JMDS, duct with new geotextile fabric innerduct and duct with new tracer wire shall be sealed.
- A minimum of one caution tape shall be installed at minimum depth of 6 inch above the installed duct structure.
- For trenches under asphalt and concrete surfaces, new conduit shall be encased within 3000 psi concrete.
- All underground pathways should be targeted at a minimum depth of 36-48 inches, unless the pathway is under any paved surfaces/roadway. Should the pathway be under a paved surface/ roadway, the depth should be targeted at a minimum of 72 inches.

27 05 28.2 Direct Buried Pathways

- No Direct Burry allowed

27 05 28.3 Directional Boring

- The use of boring technologies combined with the installation of roll pipe (high-density polyethylene standard inside diameter 11) to cross under roads and parking lot surfaces may be used only with proper justification and appropriate levels of Installation approval.
- Sleeveless or uncased boring (placing fiber directly in a bore without use of roll pipe or duct) must not be used.

27 05 28.4 Innerduct

- The installation of Jetted Micro-Duct Systems (JMDS) innerduct shall be the preferred method of innerduct installation.
- Geotextile multiple cell innerduct may be used in conduits designated for placement of copper cables where design requires multiple copper cables in a single 4-inch conduit.

27 05 29 OSP Spaces

27 05 29.1 Maintenance Holes/Hand Holes

- MH and HH enclosures must be made of concrete, manufactured and installed to meet American Society for Testing and Materials design and installation practices and manufacturer's installation recommendations.
- MH size must be 6 feet wide by 8 feet length by 7 feet deep
- HH size must be 3 feet wide by 5 feet length by 4 feet deep.
- MH and HH must have factory installed knockouts for duct penetrations.
- Duct penetrations into an existing MH or HH must either enter through an existing knockout or via a core drilled in the wall.
- MH or HH that supports a new conduit and building entrance must be located within 50 feet of the building entrance.
- A new concrete MH or HH and associated hardware must have the following:
  - Round cast iron cover/ring full sized (36"), galvanized hinged lids, rated for roadway traffic, and sized to accommodate the full build-out of the duct system.
  - Industry standard covers, collars, and associated hardware. While these covers are not required to be lockable, they are required to be to accept industry standard compliant lockable covers that may be installed in the future.
- Bell-end conduit connectors must be installed flush to the concrete walls. All voids (in the concrete walls) created by the installation of duct are required to be sealed with concrete.

- Galvanized steel cable rack and steps must be installed to support cable routed in MHs and HHs and for supporting cable slack coils.
- MH or HH must have an integral halo grounding system installed.
- Bond lids and cable racks to the halo-ground system inside MH or HH.

27 05 30 OSP Splicing and Termination Hardware

- Terminate OSP cable with metallic/conductive members on a protected entrance terminal (PET).
- Terminate the copper backbone cable originating in the main Telecommunications Room (TR) or main cross-connect in each TR on 66-type, insulation-displacement wiring blocks mounted on the backboard.
- Provide 66-type terminal blocks on the same backboard as the PET and in each TR for copper backbone distribution.
- OSP cable runs must use continuous fibers with no intermediate patches or cross connects.
- OSP continuous cable runs must use fusion splices.
- OSP continuous cable runs must not use mechanical splices.
- Weather-proof fiber optic splice case enclosures must be used for OSP applications (manhole, handhole) and for building basements which have damp environments.
- Direct Buried and aerial splices must not be installed.
- Use a non-bonded splice case for the transition from OSP rated cable to interior rated cable.

27 05 33 OSP Grounding and Bonding

- Comply with NFPA 70 or current version for grounding and bonding requirements for exposed cable.
- Connect all metallic shields and strength members for outside plant cable entering a building to the telecommunications grounding busbar with a properly labeled No. 6 AWG or larger ground wire.
- Terminate all incoming OSP copper cables on UL-listed primary protector blocks, located within the building entrance terminal cabinet. Provide protector blocks equipped with 5-pin solid state, gas, or hybrid protector modules for the number of pairs terminated.

27 05 35 OSP Commissioning

- All installed backbone and horizontal telecommunications cabling and connecting hardware must meet minimum performance requirements and be tested in accordance with ANSI/TIA-568-C or current version. Provide report of all tests results and certifications to the proponent and telecommunications manager upon completion.
- All fiber optic cabling and connecting hardware must be tested. Perform all required testing to ensure minimum performance requirements are met in accordance with ANSI/TIA-568.3-D or current version.
- All coaxial cabling and connecting hardware must be tested. Perform all required testing to ensure minimum performance requirements are met in accordance with ANSI/TIA-568-C.4 or current version.
- The contractor must submit for Government review a draft test plan of all proposed cabling and equipment being installed.

After the contractor has completed the installation and testing of the ITS, the contractor must submit a test report for all fiber and copper cabling. The contractor's RCDD must approve both the test plan and the test report before submitting to the government.

- The test plan must include, along with all testing system reports, a complete project test summary spreadsheet with indexed room numbers, outlet labels, jack labels and the pass/fail status, and causes for failures along with a total number of outlets installed, jacks/cable runs installed and the total number of jacks/cables runs that passed and failed the tests.
- All failed tests require the contractor to correct the failures prior to turning over the system. Tier 2 testing, data, analysis is required by the government at the contractors' expense if Tier 1 testing does not prove adequate for identifying causes of failures, and if the government is responsible for paying for any repairs not within the original scope of contract.

27 10 00 STRUCTURED CABLING SYSTEM

27 10 05 Telecommunication/Equipment Rooms

- Telecommunications Entrance Facility (EF)
  - The EF is defined as the space housing the point of entrance of the telecommunications service, as well as the space where the inter-building backbone and intra-building backbone facilities join.
- Telecommunications Room (TR)
  - A TR is defined as an architectural space designed to contain telecommunications equipment, cable terminations, and cross-connect cabling.
  - The TR contains the telecommunications equipment for connecting the horizontal cabling to the backbone cabling system.
  - The TR may also function as the telecommunications EF.
- Equipment Room (ER)
  - An ER is defined as an architectural, environmentally controlled, centralized space for telecommunications equipment that usually houses a main or intermediate cross-connect.
  - All or any subset of the functions of a TR or EF may be provided by an ER.
- Work Area
  - A work area is defined as the building space where the occupants interact with the telecommunication terminal equipment.

27 10 05.1 Communications Entrance Facility

- The EF houses the Building Entrance Terminal, which is the demarcation point between the OSP cabling and the inside plant (ISP) distribution cabling.
- Per the National Electrical Code (NEC), non-building-rated OSP cable must transition to inside-rated cable within 50 feet from the building entrance. This applies to all OSP cable except when an appropriate electrical metallic tubing (EMT) pathway is used.
- For non-building OSP rated cable that must extend distance greater than 50 feet from the entrance point into the building, the cable must be continuously enclosed in a rigid or an intermediate metal conduit.
- Above-ground building entry (AGBE) must consist of the following infrastructure attached to the building exterior wall:
  - Exposed, UV rated, Schedule 80, PVC conduits

  - An exterior rated NEMA 3 or better pull box
  - All mounting hardware be of the same finish, manufacturer, length and installed at uniform distances
  - Installation of a wall penetration and conduit sleeve through the building exterior wall
- Silicon must be installed to all of the following points of the building's exterior surface:
  - All penetrations, including bolt holes and conduit penetrations
  - All seams at surface mounted materials; including where exterior rated pull box meets the wall
  - All materials identified in this section be constructed from a paintable material and be installed plumb, level, sealed, and with measures taken to ensure all work performed to the building's exterior surfaces is water tight
- In the installation of a new AGBE the quantity and size of the conduit or roll pipe entering the AGBE must equal the amount leaving the AGBE and penetrating the building exterior wall.
- A subterranean building entry (SBE) is the preferred method of buildings installation entrance pending Base Area Network design. A SBE must include:
  - Access to the lowest floor space immediately inside the building's exterior wall
  - The ability to core drill the floor of this space
  - The installation of conduit end 4 inches above finished floor
  - Concrete to seal the space around the conduit penetration
  - The anchoring of conduit into place

27 10 05.2 Grounding and Bonding

- Comply with NFPA 70 or current version for grounding and bonding requirements. Provide a telecommunications bonding and grounding system in accordance with ANSI/TIA-607-C or current version.
- Bond all telecommunications racks and supporting metallic structures (cable trays, ladders, conduits and baskets). Non-continuous distribution systems (such as stub-ups or J-hooks) do not require bonding.
- Telecommunications main grounding busbar must be predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, 1/4 by 4 inches in cross section, length as determined by electrical requirements.
- The busbar must be listed by a nationally recognized testing laboratory for use as telecommunications main grounding busbar and must comply with ANSI/TIA-607-C or current version.

27 10 05.3 Architectural and Environmental Considerations

- There must be at least one TR or ER per floor.
- Multiple rooms may also be required if the horizontal cable length (including slack) exceeds 295 feet.
- Size ERs and TRs in accordance with ANSI/TIA-568.2-D or current version, except that the minimum TR size for U.S. Department of Defense (DoD) buildings is 10 feet by 8 feet.
- TRs for each serving area must be no larger than 10,000 square feet as stipulated in ANSI/ TIA-568.2-D or current version.
- Provide adequate space in TRs to facilitate tenant owned data and telecommunications systems, and other low voltage systems such as fire alarm, closed-circuit television, and electronic security systems.

- Provide backboards in accordance with ANSI/TIA-569-D or current version. Backboards must be fire-retardant-treated wood, bearing the manufacturer's stamp. If painted, the manufactures fire rated stamp must remain visible. Cover a minimum of two adjacent walls with backboards.
- Design telecommunication spaces to meet the HVAC requirements of ANSI/TIA-569-D or current version, including the Class B requirements for temperature and humidity as outlined in ASHRAE TC 9.9 or current version.

27 10 05.4 Communications Electrical Protection

- Provide protected terminals in accordance with ANSI/TIA-758-B or current version.
- Equip protected terminals with modules to protect the ISP cabling and equipment from power surges.
- Provide 66 type Insulation Displacement Connector (IDC) terminal blocks or cable studs.

27 10 05.5 Communications Cabinets, Racks, Frames, and Enclosures

- Provide 19 inch floor-mounted equipment racks located at or near the centerline of the telecommunication spaces.
- Provide a minimum space of 36 inches, both in front and back of the cabinet, and a minimum side clearance of 24 inches on at least one end of the cabinet or row of adjacent cabinets.
- When sharing a communications room with customer network equipment, use enclosed 24-inch-wide lockable cabinets that have cooling fans and internal rails to support the 19-inch equipment.
- Do not collocate commercial communication equipment in the same ER/TR with base or customer network equipment.
- If space is desired within a comm rack owned by 325 CS, a CIPS (Cyberspace Infrastructure Planning System) ticket must be submitted to the 325 CS. The CS reserves the right to deny space into 325 CS owned communications rack, cabinets, frames, enclosures, etc.

27 10 05.6 Communications Termination Blocks and Patch Panels

- For copper patch panels, use 8-position, 8-contact (8P8C) modular jacks, with rear-mounted 110-type IDC terminations, CAT6 rated for the unshielded twisted-pair (UTP) system being installed using T568A pin/pair.
- Provide modular jacks that conform to the requirements of ANSI/TIA-568.2-D or current version, rated for use with the installed cable plant and terminated using T568A pin/pair configuration.
- Use duplex LC connectors on 19-inch rack-mounted panels for ISP or SC duplex for OSP, unless otherwise directed.
- Provide a 3-foot slack loop of fiber within each panel; include strain relief for cables within the panel.
- Provide proper termination, splice storage, routing, radius limiting, cable fastening, storage, and cross connection in all patch panels.
- Fiber Optic Distribution Panel (FODP) must be wall-mount or rackmount depending on its location.
- Fiber optic pigtail assemblies must be factory made pigtail FOC assemblies with one end blunt (splice end) and the other end with factory terminated connectors.
- Fiber optic pigtail assemblies must be manufactured with the same cable type, performance characteristics as the installed cable to which it is splicing.
- FODP size must be 4 RU and capable of terminating 144 strands unless otherwise stated.
- New FODPs must be from the same original equipment manufacturer as reused existing FODPs.

27 10 05.7 Communications Cable Management and Ladder Rack •

Install horizontal cable management panels above and below each patch panel.

- The required ratio of horizontal cable management to patch panels is 1:1.

27 10 20 Communications Pathways

- Provide 6 inch wide vertical cable management between racks and at the end of racks when required to protect, manage, and organize cables.
- For intra-building backbone distribution, provide a minimum of two 4-inch conduits between TRs located on the same floor or pathway that provides equivalent capacity (for example, the cable tray installed to support the backbone and horizontal distribution).
- In multistory buildings, provide a minimum of three 4-inch conduits, sleeves, or an equivalent sized slot between stacked TRs on successive floors in accordance with ANSI/TIA-569-D or current version.

27 10 20.1 Conduits and Backboxes for Communications Systems

- Design conduit systems in accordance with ANSI/TIA-569-D or current version.
- Install EMT conduit from the cable backbone distribution system, whether cable tray or enclosed duct, to each outlet unless a conduit-less system is approved by the telecommunications manager.
- Provide a minimum of 1-inch EMT conduit for standard outlets.
- Coordinate conduit bend radii with cable bend radius.
- Do not use flexible metal conduit for telecommunications wiring except when installing floor-access boxes in a raised floor, where the floor-access box may be relocated within a specified service area. In this case the length of the flexible metal conduit must not exceed a length of 20 feet for each run per ANSI/TIA-569-D or current version.
- When justified, an in-slab or below grade conduit system used in the telecommunications design must comply with NFPA 70 or current version and use cables that are listed and rated for wet locations.
- Use an optimal conduit fill ratio of 40% for conduit sizing. Do not exceed a fill ratio of 50%.
- Place pull and splice boxes in conduit runs in accordance with ANSI/TIA-569-D or current version.

27 10 20.2 Cable Trays for Communications Systems

- The DoD-required horizontal pathway is a ceiling distribution system employing a centralized cable tray system originating in the telecommunications space and continuing out into the serving areas.
- Use cable trays for horizontal distribution to the maximum extent possible (80 to 90% of the horizontal cable length).
- The remaining pathway to the work area outlet may be implemented in a variety of ways combining conduit, non-continuous cable supports, and stub-ups/outs.
- Use solid bottom, slotted bottom, or welded wire cable trays to provide a centralized cable management/distribution system.
- Design cable trays to accommodate an initial calculated fill ratio of 25%
- The maximum fill ratio of any cable tray is 50% to allow for future growth within the cable tray.
- The maximum fill depth of any cable tray is 6 inches.
- Provide and maintain a minimum of 12 inches of access headroom above a cable tray system or cable runway.

27 10 20.4 Hangers and Supports for Communications Systems

- The use of “J” hooks, flexible cable tray(s), and alternative support systems specifically certified for the cable used is permissible to support cable extensions from the cable tray.

Do not exceed a 50% fill ratio for the “J” hooks.

- Support must be provided for horizontal cabling to distribution areas in cable tray(s).
- Non-continuous cable supports are not allowed in the following locations:
  - In place of the cable tray system or as the sole distribution system in place of home-run conduit. Design non-continuous cable supports to support the category-rating of the cable. Supports must not exceed 20 cables or 50% of the fill capacity, whichever is less.
  - That exceed 50 feet total length through a non-continuous cable support system.
  - Ceilings in which Infection Control protocol affects ceiling tile removal
  - In areas where the cable must be protected.
  - When using non-continuous cable supports, provide in accordance with ANSI/TIA-569-D or current version

27 10 20.5 Sleeves and Sleeve Seals for Communications Pathways and Cabling

- Duct seals must be installed in all ends of any newly installed conduits.
- Duct seals must be installed in the ends of all existing conduits where new cabling is installed.
- Duct seals must be installed in innerducts if conduit contains new or existing innerduct.
- If multicell fabric innerduct is installed, the manufacturer installation instructions must be followed for cutting and coiling geotextile ends, for tying off pull strings, and for the installation of duct seal.
- Firestop materials must be installed on both sides of an interior wall and all floor penetrations, including any remaining space within conduits, sleeves, per established industry standards including the NEC, NESC, and NFPA.

27 10 30 Communications Backbone Distribution System

27 10 30.1 Communications Copper Backbone Cabling

- Provide multi-pair, single jacket, armored, gel filledvoice backbone cable that meets the requirements of Insulated Cable Engineers Association S-80-576 or current version and ANSI/TIA-568-2 or current version for riser-rated UTP cable.
- Use solid untinned copper, No. 24 AWG conductors.
- For facilities that will use unified communications (voice, video, and data over Internet Protocol (IP), provide a minimum 25-pair copper backbone to each TR. Provide additional cable counts if needed to support legacy system requirements..
- For facilities using legacy systems, provide copper backbone cables sized to support no more than 1.5 pairs for every outlet connected to the serving TR.

27 10 30.2 Communications Optical Fiber Backbone Cabling

- The minimum cable size between closets must be 12 strands.
- Single-mode cable must be minimum of OS1.
- Multimode cable must be OM3.

27 10 40 Communications Horizontal Distribution System

27 10 40.1 Communications Copper Horizontal Cabling

- Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications

  ER. This cabling and its connecting hardware are called a ”permanent link,” a term that is used in the testing protocols.

- Horizontal distribution cable must be four-pair UTP, CAT 6 (not CAT 6A), with 100 ohm impedance.
- Horizontal distribution cable must meet performance specifications as identified ANSI/TIA/ EIA568.4 D or current version.

27 10 40.2 Communications Optical Fiber Horizontal Cabling

- Cabling must meet or exceed the manufacturer’s specifications and ANSI/TIA-568.4 D or current version to include cable, component standards, cable transmission performances, max cable bend radius and cable pull strength/pull tensions.

27 10 45 Work Area Cabling

27 10 45.1 Communications Faceplates and Outlet

- Provide single gang, four position, modular faceplate for each work area outlet.
- Standard configuration is two RJ-45 modular jacks and two blanks for future applications.
- Provide unkeyed CAT6 modular jacks in accordance with ANSI/TIA-568.2-D or current version and terminated with T568A pin/pair configuration to meet special EMSEC requirements within classified processing areas.
- Provide unkeyed duplex LC connectors and adapters in accordance with ANSI/TIA-568.2-D or current version.
- Terminate fiber optic cabling at both ends using duplex LC connectors to meet special EMSEC requirements within classified processing area.
- Label all fiber optic and copper cable in accordance with ANSI/TIA-606-B or current version.

27 10 48 Cable Splicing and Terminations

27 10 48.1 Communications Copper Cable Splicing and Terminations

- Cable connecting hardware must comply with ANSI/TIA-568.4 D or current version, IDC type with modules designed for punch-down caps or tools.
- Cables must be terminated with connecting hardware of same category or higher.

27 10 48.2 Communications Optical Fiber Splicing and Terminations

- Fiber optic splicing must be fusion splicing.
- The splicing of all fiber strands must use the fiber optic color code standard ensuring all fiber strands are kept in a straight-through configuration through the splice.
- Indoor rated fiber optic splice case enclosures must be used for wall-mounted and rack-mounted applications.
- Field terminated fiber optic connectors must conform to ANSI/TIA-568.2-D or current version.

- Field terminated fiber optic connector insertion loss must not exceed 0.25 dB maximum.
- Field terminated fiber optic connectors must conform to ANSI/TIA-455-21 or current version connector durability with a maximum insertion loss change not to exceed 0.3 dB after 200 insertions.
- Field terminated fiber optic connectors must conform to ANSI/TIA-604-3 or current version intermateability standards.
- Comply with current versions of TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

27 10 50 Specialty Distribution Systems

27 10 50.1 Cable Television, Closed-Circuit Television Communications

- Use either a 75-ohm broadband quad-shield coaxial cable or single-mode FOC system.
- Provide plenum cables as required in accordance with the current version of NFPA 70, UFC 3-60001, *Fire Protection Engineering for Facilities.*
- System must comply with the current versions of ANSI/TIA-568.2-D and NFPA 70.
- System must operate within the 5 to 1000-Megahertz (MHz) bandwidth using 1,000 MHz passive devices and a minimum of 750 MHz active devices. Provide a minimum signal level of 0 decibel millivolts (dBmV) (1,000 microvolts) and a maximum of 15 dBmV at 55 and 750 MHz at each outlet.
- For coaxial systems less than 295 feet from headend equipment to the TR, or from TR to TR, provide RG-11 coaxial trunk cable.
- Use RG-6 coaxial cables for drops from the TR (or headend) to the wall outlet. Do not use RG-59.

27 10 60 Radio Frequency Systems

27 10 60.1 Wireless Access Points

- Provide two twisted-pair cables, CAT6 or CAT6A terminated on standard 8-pin modular connectors or two fiber multimode optical fiber strands, OM3 or higher for each wireless access point.
- Include the cable tray and conduit or J-hooks to support the cable connected to the WAP.
- CAT6A patch panels are required if CAT6A is used for wireless access point connections.

27 10 60.2 Cellular Systems

- LTE/5G wireless access via active or passive repeater systems must be included within building designs.

ACRONYMS AND ABBREVIATIONS

AFB	Air Force Base
AFCEC	Air Force Civil Engineer Center
AGBE	above-ground building entry
AHU	air-handling unit
BAN	Base Area Network

BICSI	Building Industry Consulting Service International
CE COINE	Civil Engineer Community of Interest Network Enclave
CMMS	Computerized Maintenance Management System
Cx	Commissioning
DB	Direct Buried
DFE	Design Flood Elevation
DoD	U.S. Department of Defense
EAMS	Enterprise Asset Management System
EF	Entrance Facility
EMCS	Energy Management and Control System
EMT	electrical metallic tubing
ER	Equipment Room
FDD	Fault Detection and Diagnostics
FOC	fiber optic cable
FODP	Fiber Optic Distribution Panel
FRCS	facility-related control systems
ft^2	square foot (feet)
HH	hand hole
HVAC	heating, ventilation, and air conditioning
IDC	Insulation Displacement Connector
IP	Internet Protocol
ISP	Inside Plant
ITB	Information Transfer Building
ITS	intelligent transportation systems
JMDS	jetted micro-duct systems
MH	maintenance hole
MHDS	maintenance hole duct system
NEC	National Electrical Code

NIST	National Institute of Standards and Technology
O&M	operation and maintenance
OSP	Outside Plant
PET	protected entrance terminal
RCDD	Registered Communications Distribution Designer
SBE	subterranean building entry
SMART	Self-Monitoring Analysis and Reporting Technology
TEF	Telecommunications Entrance Facility
TR	Telecommunications Room
UFC	Unified Facilities Criteria
UFGS DIV25	Unified Facilities Guide Specifications, Division 25
UL	Underwriters Laboratories
UOC	Utilities Operations Center
UPS	uninterruptable power supply
USAF	U.S. Air Force
UTP	unshielded twisted-pair
VAV	variable air volume