



Facilities Planning and Construction

Design & Construction Standards

DIVISION 27 – Communications

Preface

The Texas Tech University System's 'Design and Construction Standards', as administrated by Facilities Planning and Construction, are intended to serve as guidelines to the Design Professional and Construction Management teams for design development and construction administration of Texas Tech University System (TTUS) Capital Projects. They communicate the minimum expectations and requirements relative to specific building systems, design provisions, general specification requirements, and administrative procedures for new facilities being constructed on Texas Tech University System (ASU, MSU, TTU, TTUHSC, and TTUHSC El Paso) campuses. Several, but not all requirements for each component Institution or Agency within the TTU System are covered. Design Professionals, Construction Managers at Risk and/or Design-Build Firms shall also refer to provisions covered in their service Agreements, as well as within the project's Basis of Design (BOD) document.

In addition, the 'Design and Construction Standards' shall also be utilized in conjunction with the approved project specific Program and Schematic Design development. In the event of conflict between this document and specific project requirements, Design Professionals, Construction Managers at Risk and/or Design-Build Firms shall contact Facilities Planning & Construction for clarification.

The guidelines within the 'Design and Construction Standards' are not intended to prohibit the use of alternative design solutions, methods, systems, products or devices not covered in this document. Offered alternatives deviating from or not covered in these standards shall be documented by the Design Professional and/or Construction Management teams and submitted to Facilities Planning & Construction for approval prior to implementation.

Throughout the 'Design and Construction Standards' there are references to manufacturer specific products. These are to be considered the 'Basis of Design' to establish the expected minimum quality requirements. Design Professionals are encouraged to identify and include equivalent products and/or manufacturers offering comparable products to facilitate open bidding environments.

PART 1 - GENERAL

1.1 SCOPE

- A. Description: The work of this Section includes the wire, cable, racks, patch panels, connecting devices, cable support D-rings, all installation and testing for wiring systems and components to be used as signal pathways for high-speed data transmission.
- B. The Contractor shall furnish and install all wiring and components to support data systems.
- C. The Contractor shall use the exact materials specified (no equivalent material substitutions are allowed) and shall submit for compliance inspection by Telecommunications Services prior to commencing installation or use of materials.
- D. Installation of all communication outlets at offices, exam rooms, etc. as indicated on the drawings.
- E. Installation of multi-mode and single-mode fiber in Communications Rooms.
- F. The Contractor shall furnish and install self-supporting, 19" EIA floor racks, cable pathways, and power distribution units in each Communications Room.
- G. The Contractor shall furnish and install patch panels in the racks in each Communications Room. Provide the quantity of patch panels as required to connect all data cables.
- H. The wiring components shall consist of jacks, faceplates, wire and all accessories required to properly install the wiring and devices.
- I. The UTP wiring, jacks, and patch panels shall be of a consistent category throughout the entire installation – either ALL Cat5e, or ALL Cat6. Use of Cat6 (*Alternate) materials shall be requested in writing to the Managing Director of Telecommunications for approval.
- J. The Contractor shall furnish all the labor and materials to perform all the work required for the complete and prompt execution of items described or shown in or reasonably implied in the drawings and specifications.
- K. The Contractor agrees to furnish the specified products and services in strict accordance with the conditions, requirements, drawings, and specifications.

1.2 TTU FACILITIES AND PLANT OPERATIONS OPERATING PROCEDURES

- A. All cabling projects must conform to TTU OP 61.12 (<http://www.depts.ttu.edu/opmanual/OP61.12.pdf>) in its entirety. If the contractor has any problems accessing this document, notify Telecommunications Services and a copy of TTU OP 61.12 will be provided.
- B. All contractors are required to submit a \$100 deposit for each key issued for interstitial and mechanical room access. This deposit will be refunded when the issued key is returned.

1.3 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Specification Sections.

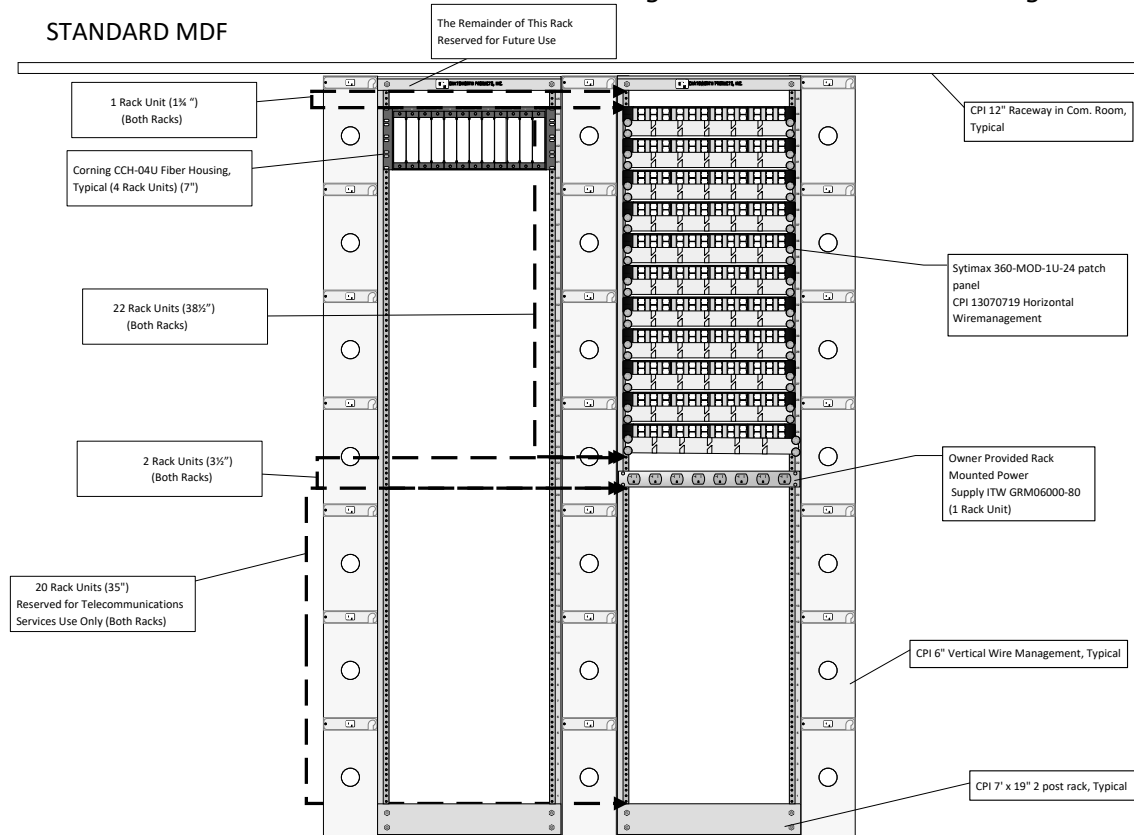
- B. Product Data: Submit for review complete manufacturer's product cut sheets for each component specified; these must include detailed manufacturer's specifications and data on features, ratings, and performance. Include dimensioned plan and elevation views of components. Show access and working-space requirements.
- C. Qualifications:
1. Cabling contractor must provide at least 5 references with names and contact information of previous installations of \$10,000 or more.
 2. Cabling contractor must provide documentation showing 10 years or more experience installing data network cabling.
 3. Cabling contractor must provide proof of certifications (i.e. DCIC) and/or proof of data training received within the last five years.
- D. Cable Certification Tests: Submit complete field test reports to Telecommunications for review and acceptance as described herein. UTP cable certification must be performed with a Fluke DTX1800 tester. Tests results shall be identified by the corresponding labeled Cable ID and must include wire map, resistance, length, propagation delay, impedance, return loss, attenuation, and cross-talk. Test results must be provided in a .FLW file format. Fiber cable certification must be performed with an OTDR (Optical Time-Domain Reflectometer), tested from each end. Test results must include both wavelengths for single mode fiber (1310nm/1550nm), and multimode fiber (850nm/1300nm). Test results must be provided in a .TRC file format. Test results described herein shall be provided to TTU Telecommunications via DVD or CD.
- E. Cable Schedules: Submit for review complete final schedule of cables as specified. Provide a CD copy of final comprehensive schedules for the Project in the software and format selected by the Owner.
- F. Listing: Contractor shall provide to the owner for its records the following:
1. MDF (Main Distribution Frame) and IDF (Intermediate Distribution Frame) Diagrams - Includes position of all racks, components, cable trays, and apparatus.
 2. Fiber Riser Distribution Plan.
 3. Cable Tray, Conduit, and Raceway Plans.
 4. Wire and Fiber test results as specified above.

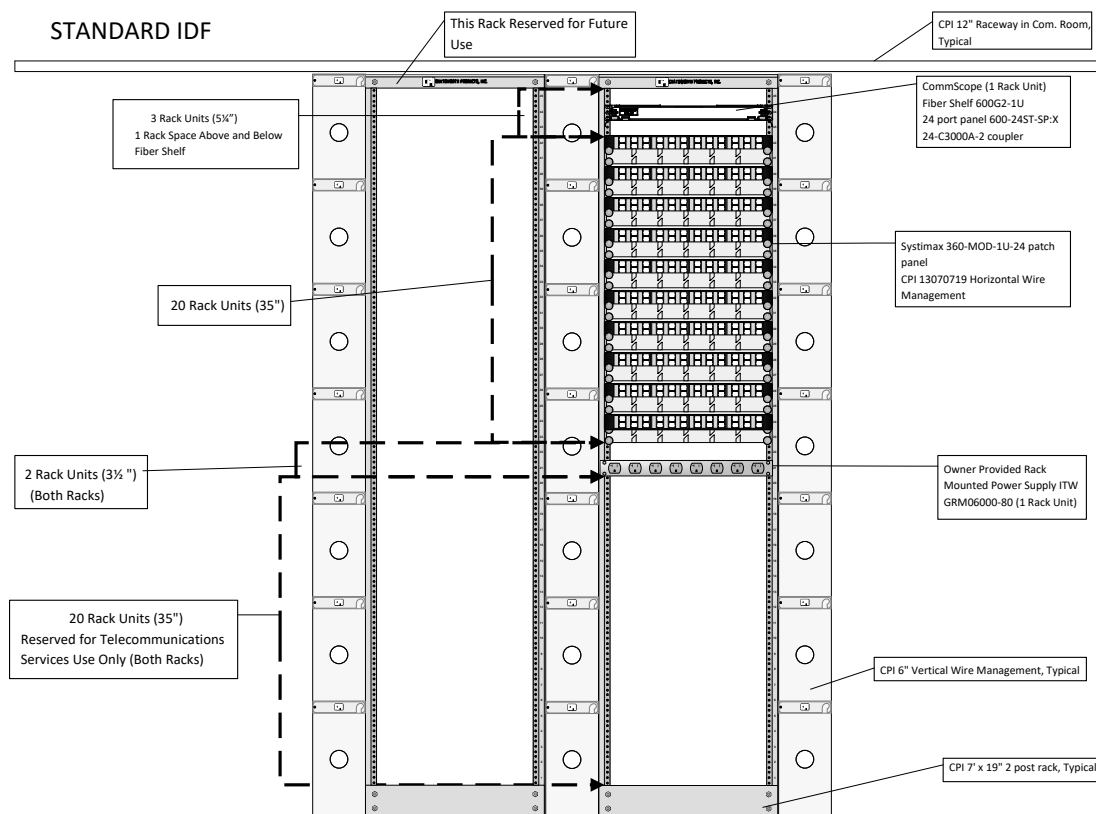
PART 2 - PRODUCTS

2.1 RACKS AND HARDWARE

- A. Communications Rooms
1. Provide and install multiple standard 7-foot EIA 19" rack (CPI 55053-503): heavy-duty aluminum, holes drilled and tapped in each Communications Room. The number of racks requested, will be determined and specified by Telecommunications, based upon the amount of equipment to be installed, the amount of cabling to be terminated, the prospect of future growth, and the overall size of the Communications Room.
 - a. See <http://www.net.ttu.edu/ae> for Communications Rooms design criteria.
 - b. Verify the exact placement of racks within each room with Telecommunications.
 - c. Telecommunications will supply the number of racks required for each new installation, or renovation of a Communication Room.
The contractor will provide diagrams of the Communication Room layout to Telecommunications for review and approval, prior to the installation.
 2. Secure racks to the floor.
 3. Label the top of each rack alphabetically, from left to right, beginning with 'Rack A'.

4. Provide and install vertical cable Management (CPI 11729-503) (NO SUBSTITUTIONS) along the full length of each rack on each side.
5. Provide and install single or multiple rack mount fiber patch panels at the highest available position within the rack for the MDF (Main Distribution Frame) Communications Room. Provide and install single or multiple rack mount fiber patch panels at the highest available position within the rack for each IDF (Intermediate Distribution Frame) Communications Room. The type of fiber enclosure will be specified by Telecommunications, and will be based on the number of fiber strands that will be terminated, and the prospect of future growth.
6. Provide and install UTP 24 port patch panels and wire management (Systimax 360-MOD-1U-24 and CPI 13070719) (NO SUBSTITUTIONS) at the highest available position within the racks. One T568B Cat5e modular jack is required at the patch panel - CommScope MPS100E-003 - Electrical Black (***Alternate Cat6:** CommScope MGS400-003 - Electrical Black). Exact quantities for all outlets will be provided through drawings or information provided by Telecommunications Services. Label each fiber and UTP patch panel alphabetically, top to bottom. This shall be done for each rack and for all Telecommunications rooms where cabling is installed. See the supplied Communication Room Layout to determine the placement and number of patch panels to be installed on each rack.
7. Installed MDF and IDF racks shall be configured as show in the drawings below.





B. RACK AND CABLE LADDER SPECIFICS

1. Each Rack will have a vertical cable Management CPI 11729-503 along the full length of each rack on each side. Each Rack will be Heavy Duty Aluminum CPI Racks (CPI 55053-503) (NO SUBSTITUTIONS). Rack Color, and wall mount or two post, and the racks size will be specified based on the Communication Room Installation / Renovation.
2. CPI 10250-112 9'11.5" x 12" cable runway (NO SUBSTITUTIONS) must be used to interconnect and support the rack installation to the walls, as well as for the establishment of the cable pathway to the racks once the cabling is inside the Communication Room.
3. CPI cable runway and mounting brackets shall be used to stabilize and secure the top of the racks to the wall. This may also be required to establish pathways for the data cables to the data racks within the Communication Room, and / or to establish a pathway from the racks to Communication Services' (voice) 66 Blocks.
4. See Communications Room layouts at <http://www.net.ttu.edu/ae> for exact placement of the racks within the Communication Room.

2.2 FIBER OPTIC INSTALLATION

A. INSTALLATION REQUIREMENTS

1. Terminate all fiber strands unless otherwise directed.
2. Multimode cable fiber size: 62.5/125 μm . Single-mode cable fiber size: 8.3/125 μm .
3. Maximum fiber attenuation: For multimode .35 dB loss per 100 meters @ 850nm and .10 dB loss per 100 meters @ 1300nm. For Single-mode .10 dB loss per 100 meters @ 1310 and .050 dB per 100 meters at 1500nm.
4. Attenuation loss is to be tested and is to be no more than 0.75 dB per mated pair. A single jumper cable must be used when determining the reference value. Total maximum attenuation loss will be dB loss for fiber, based on distance, plus dB loss for each mated pair minus the reference value.
5. Where conduit is not available, contractor must use plenum rated innerduct to protect the fiber cable.
6. No single run of multimode fiber is to exceed two (2) kilometers.
7. Manufacturer's recommended bend radius shall be adhered to at all times.
8. Cabling to be connected in a straight pattern (not turned over) from origination to termination point.
9. Terminating points shall be clearly marked indicating where each strand pair terminates at the opposite end (source and destination). A legend is to be provided at each fiber patch panel and shall be tagged with readable, non-fading, printed letters. Each legend will include complete terminating endpoints.
10. Contractor must provide a minimum of a fifty (50) foot service loop at each end of termination. Above the room location a service loop should be attached at the top of the deck, suspended from a j-hook directly above the outlet location, or if provided, within, and at the edge of the tray, accessible for its future use. On the rack side, the service loop should be made as part of its path to the rack, and accessible for future use.
11. A 3/4 inch sheet of fire retardant treated (Benjamin Moore 220 Latex Fire Retardant Coating M59, or equivalent coating both sides of the sheet) plywood shall be provided for the fiber service loops. D-rings shall be used to support fiber service loops and for fiber installation support, such as between floors.
12. All cables being run for horizontal distribution within the plenum areas must be bundled together with cable ties every 6 feet, and supported by cable trays, and/or structures attached directly to the building structure/upper decking in the plenum areas or crawl spaces. Where cable trays and conduit is not provided, wiring shall be attached and supported to upper decking by way of J-hooks or bent steel rods installed between decking grooves, or comparable support devices, attached directly to the existing building structure decking or like framework. Wiring will not be supported by ceilings, ceiling hangers, or to existing electrical, plumbing, or air ventilation structures or to existing conduit.
13. Wiring must be routed so that it does not interfere with access to panels, switches, valves or other maintenance systems.
14. Use provided sleeves through all firewall and/or floor interconnects.
15. Labeling (source and destination) of fiber conduits shall be attached on both sides of the firewall, in obvious observable locations, and at every 50 feet.
16. After installation is complete, any debris resulting from the fiber or UTP installations must be removed, with the area left as clean as before the installation started.

B. FIBER OPTIC SPECIFICS

1. External building fiber connections shall be installed as shown in the construction drawings. Fiber shall be 12 strands of Corning Altos All-dielectric Gel-free 8.3/125 micron single-mode outside plant (OSP) fiber terminated with ST connectors in the appropriate fiber distribution centers.
2. Internal building vertical risers shall be 24 strands of Corning MIC (multi-fiber indoor/outdoor fiber) multi-mode fiber run from the Main Distribution Facility (MDF) to each Intermediate Distribution Facility (IDF) communication room as shown in the

construction drawing. All multi-mode vertical riser fiber to be terminated with ST connectors.

3. Fiber labeling is to be coordinated with Telecommunications Services prior to the installation of the fiber.

C. FIBER TESTING REQUIREMENTS

1. Perform continuity test on all fiber and connections.
2. All installed fibers must be certified via the use of an OTDR.
3. Certification of fiber shall report the loss ratio of each fiber, to be included as part of these data results.
4. A printed report for each fiber segment tested shall be supplied.
5. A summary of all fiber tests, including dB loss for each fiber segment shall be supplied in printed and spreadsheet format.
6. At completion, provide Telecommunications Services with the tested length and decibel (dB) loss of each cable run.

2.3 CATEGORY 5E/6 INSTALLATION

A. UTP CABLE INSTALLATION REQUIREMENTS

1. Install and terminate white Belden 1701A Datatwist350 UTP Category 5e – plenum rated cable (***Alternate Cat6:** white Belden 3633 UTP Category 6 – plenum rated cable) (NO Substitutions allowed without documented written approval). Connection locations and exact quantities for all outlets will be provided through drawings or information provided by Telecommunications Services.
2. Provide one CommScope M12SP Duplex (2-hole) face plate (Stainless Steel) for each outlet location, and one T568B Cat5e modular jack for each data outlet - CommScope MPS100E-003 – Electrical Black (***Alternate Cat6:** CommScope MGS400-003 – Electrical Black). Provide a CommScope M14SP (4-hole) face plate (Stainless Steel), when more than 2 outlets are required at a given location. Provide a CommScope M16SP (6-hole) face plate (stainless Steel), when more than 4 outlets are required at a given location. Provide CommScope Gray blanks (M20AP-270270 – Blank Inserts) for all unused ports. When specifically requested, by Telecommunications, with alternate pricing selected, use one CommScope M12L-246 Ivory Duplex (2-hole) plastic face plate for each outlet location. With this substitution, provide a CommScope M14L-246 – Ivory (4-hole) plastic face plate when more than 2 outlets are required at a given location. With this substitution, provide a CommScope M16L-246 – Ivory (6-hole) plastic face plate when more than 4 outlets are required at a given location.
3. Provide two blue, non-booted Cat5e UTP patch cables, for each data outlet (***Alternate Cat6:** blue, non-booted Cat6 UTP patches cables). Telecommunications Services will provide the required patch cable lengths, not to exceed 14' each. Cables may be requested in lengths of 3, 4, 5, 6, 7, 10 and 14 feet. Cable Vendor must provide a cut sheet or sample of the patch cable, and get a breakdown of required cable lengths for all patch cables, prior to the order. Deliver patch cables to Telecommunications Services where they will be checked for proper length and wiring.
4. No single Cat5e or Cat6 run shall exceed 100 meters.
5. Use existing conduit and cable trays where applicable, including trays provided in any modular or system furniture.
6. Wiring to be connected in a straight pattern (not turned over) from origination to termination point. Cable pairs shall be zip tied and each cable labeled on the back of each patch panel.
7. TWISTED PAIRS MUST REMAIN TWISTED TO WITHIN 1/4" OF CONNECTOR. This is required for high-speed data networks.
8. The punch down jacks and punch down patch panel cross connects shall be designed so installer will always punch down the cable pairs according to EIA/TIA 568B specifications.

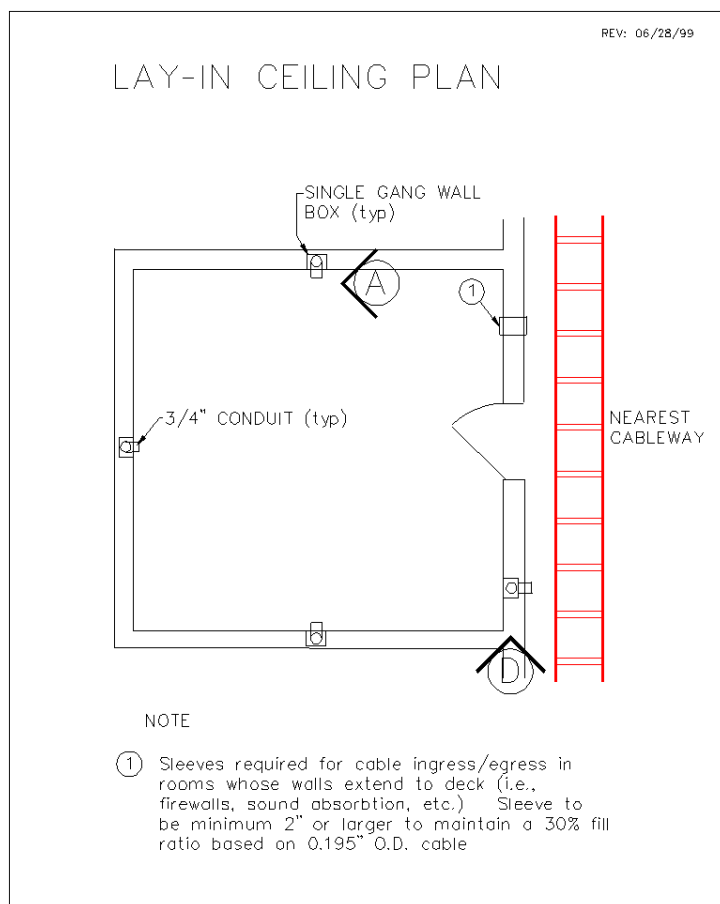
From left to right: pairs 1 (Blue), pair 2 (Orange), pair 3 (Green), and pair 4 (Brown). The white striped lead shall be punched down first, followed by its corresponding solid color.

Pins	Wire Color
1 & 2	White Orange & Orange
3 & 6	White Green & Green
4 & 5	Blue & White Blue
7 & 8	White Brown & Brown

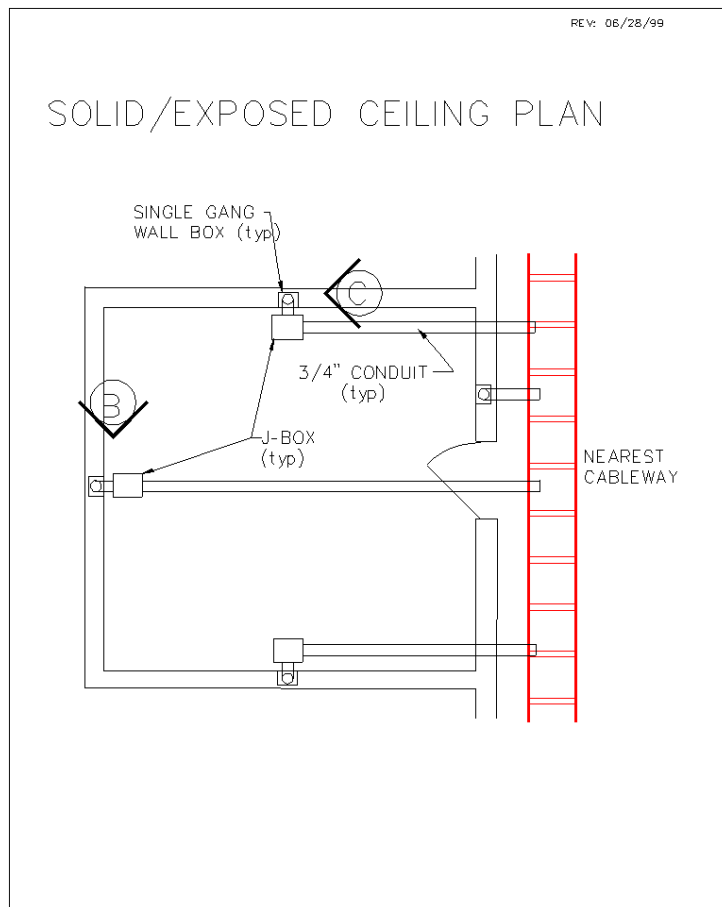
9. Data outlets located in the building walls shall be flush mounted, with single gang electrical boxes and appropriately marked face plates. Height positions for all electrical boxes shall be standardized with other electrical boxes in the same rooms and within the same areas of the outlet requests. Location of cabling termination points in power poles, around built-in desks, and any other special situations, shall be verified with Telecommunications Services.
10. Wiring will not be installed near fluorescent lighting, high-voltage sources, electrical motors, or other sources of interference. Recommended distances for UTP cabling shall be at least 1 ft. for florescent lighting (unshielded), and 3 ft. for transformers or motors (unshielded).
11. Splices within cable runs are not acceptable because it may compromise the integrity of the wiring for high-speed data transmission.
12. All cables being run for horizontal distribution within the plenum areas must be bundled together neatly and untangled, with cable ties every 12 feet. Cabling shall lie flat within and be supported by cable trays, and/or structures attached directly to the building structure/upper decking in the plenum areas or crawl spaces.
13. Where cabling trays and conduit are not provided, wiring shall be attached and supported to upper decking by way of J- Hooks or bent steel rods installed between decking grooves, or comparable support devices, attached directly to the existing building structure decking or like framework. Wiring will not be supported by ceilings, ceiling hangers, or to existing electrical, plumbing, or air ventilation structures or to existing conduit. Wiring must be routed so that it does not interfere with access to panels, switches, valves or other maintenance systems.
14. Contractors must adhere to manufacturers' requirements for bending radius and pulling tensions for all cable runs.
15. All conduits must have bushings at the end of the conduit to prevent cable jacket tears. Where cable is being run from one conduit to another, the cable vendor must insure that twists do not occur during the cable installations as this can cause kinking and tangling of the cabling within the cable run.
16. After installation is complete, any debris resulting from cable installation must be removed, with the area left as clean as before the installation started. On projects which contain renovations, any existing cable set for demolition as part of the project, must be removed from the outlet to the Patch Panel. Cable ties removed as part of the cable removal process must be replaced to the cable distribution pathways. The ID's and location of each cable (both room and patch panel termination location) must be given to Telecommunications Services. In addition the cable label port ID on the patch panel must also be removed.
17. Seal all wall penetrations with Fire Stop red caulk (MetaCaulk 1000) or other pre-approved fire stop installation.

B. WALL MOUNTED OUTLET BOXES & CONDUIT

1. Either of two types of wall mounted boxes may be used for data communications;
 - a. A 4"x4" sized, wall box with a proper, square cornered, single-gang, dry wall flange attached.
 - b. A 2"x4" sized, single-gang wall box.
2. Conduit shall be rigid, 3/4" diameter with nylon pull string installed. Should exceptional construction requirements not permit 3/4" conduit, installer should notify TTU Telecommunications Services for direction.
3. Conduit from outlet wall boxes will not be combined with other conduit runs.
4. Refer to drawing "LAY-IN CEILING PLAN" and associated section drawings for conduit run details within rooms having lay-in ceilings.



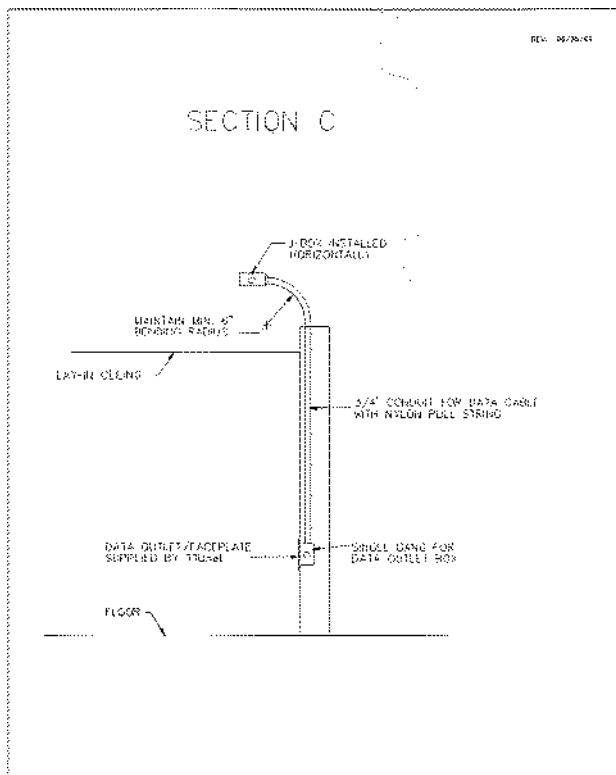
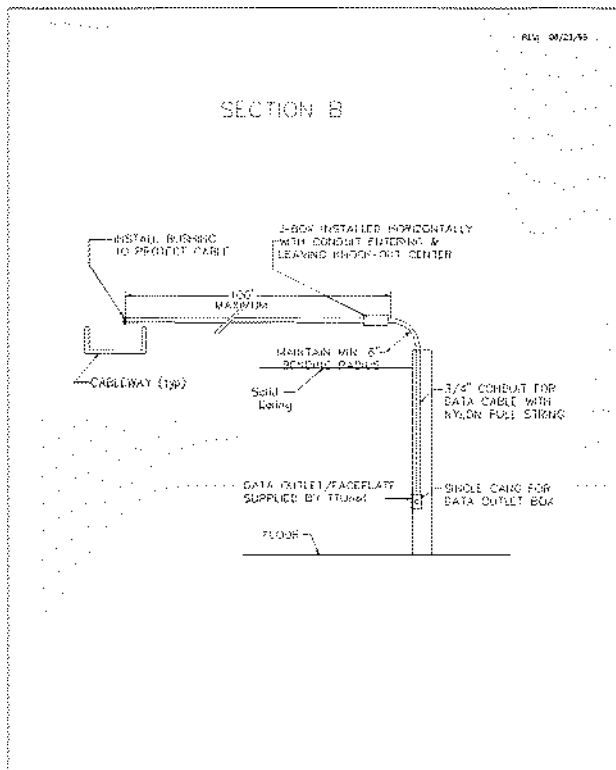
5. Refer to drawing "SOLID/EXPOSED CEILING PLAN" and associated section drawings for conduit run details within rooms having solid and/or exposed ceilings.



6. Rooms with lay-in ceilings and with walls extending to the deck above must be provided with a sleeve for cable runs to the closest cableway. The sleeve must have a 2" minimum I.D. or larger. In all cases a 30% fill ratio based on cable specified herein must be maintained.
7. Plans should indicate with an open (non-filled) triangle all wall box locations. Two information outlets in each wall box location will be assumed, unless otherwise noted on the plans.
8. The installation contractor shall mark with indelible ink wall boxes and conduits that are to be used for data communications with the word "DATA".

C. JUNCTION BOXES

1. Only one junction box (J-Box) may be installed per conduit run at locations shown in drawings "SOLID/EXPOSED CEILING PLAN" (above), "SECTION B", and "SECTION C".



2. Junction boxes should be installed with cover plates attached.

D. CABLE TRAYS

1. Cable trays shall be provided as the primary cable route from just outside individual rooms to the closest communications room. Typically, cable trays are routed down hallways and serve the rooms on either side.
2. Cable trays must be from 18" to 24" wide.
3. Cable trays must have continuous rail sides.
4. Cable trays must provide for sleeved access through walls along the route.
5. Cable trays must be installed without discontinuities over the entire length. Vertical and horizontal transition pieces must be used to effect direction changes.
6. A minimum of 6" inches clearance must be provided above the top of the continuous rail.
7. Cable trays shall be installed above all other mechanical and electrical utilities whenever possible.
8. The method and location of cable tray entrance into each communications room must be coordinated with and approved by Telecommunications Services.

E. MOLDED RACEWAYS

1. Surface mounted, molded raceway systems must accommodate the installation of information outlets as specified above without modification.
2. Designs utilizing molded raceways must specify and provide all necessary faceplates, inserts, end plates, dust covers, blanks, bezels, adapters, etc. Installing contractor will provide only the information outlet specified.
3. Successful raceway implementations have been accomplished using Interlink/Wiremold 5500 and 5400 Series Raceways utilizing the Activate Series 2A-U2ATT & 3A-U2ATT inserts.
4. All raceway systems other than those specified above must be approved by Telecommunications Services prior to 50% review documents. A/E is required to provide detailed design information of any proposed alternatives. Examples of alternatives may be required prior to approval.
5. Raceway installers must provide Telecommunications Services with extra inserts totaling 10% of the installed number for future repair and maintenance.
6. All raceways systems must provide integral separation of power and communications cabling channels.

F. FURNITURE SYSTEMS

1. Project architects, engineers, and interior designers are responsible for specifying furniture systems which meet the criteria contained herein.
2. Furniture systems, wired tables, and custom-built millwork must accommodate the installation of the specified information outlets above without modification.
3. Designs utilizing furniture systems, wired tables, and/or custom-built millwork must specify and provide all necessary faceplates, inserts, end plates, dust covers, blanks, bezels, adapters, etc.

4. Successful furniture installations have been accomplished using CommScope M13C, M14C, and M26C modular furniture faceplates.
5. Successful retrofitting of tables and millwork have been accomplished using CommScope M30CC circular collars.
6. All information outlet mounting methods other than those specified must be approved by Telecommunications Services prior to 50% CD review documents. A/E is required to provide detailed design information of any proposed alternatives. Examples of alternatives may be required prior to approval.
7. Furniture installers must provide Network Services with extra modular furniture faceplates totaling 10% of the installed number for future repair and maintenance.
8. Designs utilizing furniture systems, wired tables, and/or custom-built millwork must provide continuous cable paths from each information outlet to the closest cable tray, trench, or chase having sufficient size for a 40% max. fill ratio for the cable specified.
9. Designs utilizing furniture systems, wired tables, and/or custom-built millwork must avoid flexible conduit for communications cable installation paths.

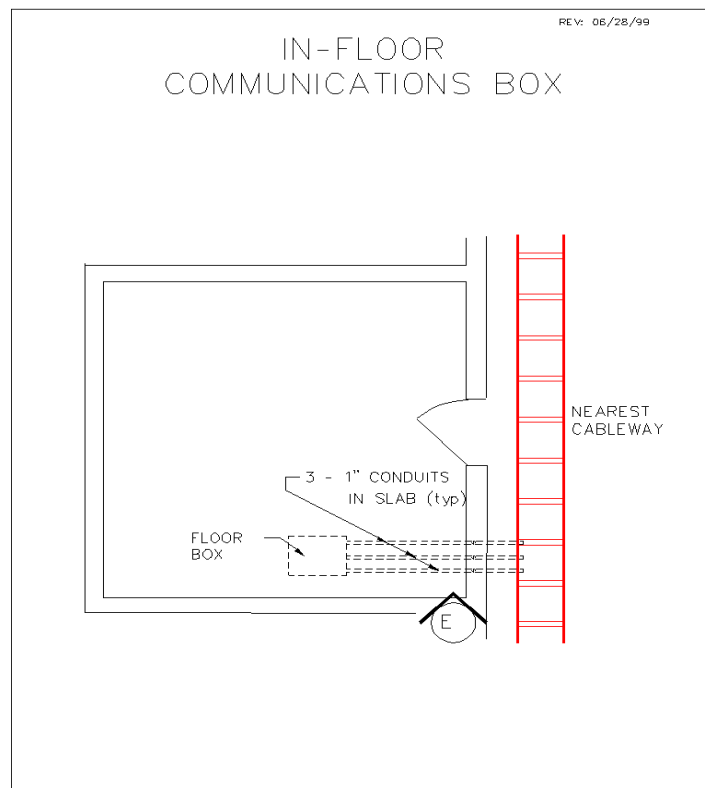
G. THROUGH-FLOOR FLUSH MOUNTED FIXTURES

1. Through-floor fixtures must accommodate the installation of information outlets as specified above without modification.
2. Successful through-floor fixture installations have been accomplished using Walker/Wiremold RC2001A with duplex receptacle and four CommScope Category 5 jack ports.
3. All through-floor fixtures other than those specified above must be approved by Telecommunications Services prior to 50% CD review documents. A/E is required to provide detailed design information of any proposed alternatives. Examples of alternatives may be required prior to approval.

H. IN-FLOOR COMMUNICATIONS & POWER BOXES

1. Surface mounted in-floor boxes are to be FSR #FL-540P-BLP-4, or Thomas & Betts Steel City AFM-8 provided with a duplex receptacle cover plate for every two information outlets required.
2. Installers must provide Telecommunications Services with extra duplex receptacle faceplates totaling 10% of the installed number for future repair and maintenance.
3. All in-floor boxes other than those specified above must be approved by Telecommunications Services prior to 50% CD review documents. A/E is required to provide detailed design information of any proposed alternatives. Examples of alternatives may be required prior to approval.
4. Conduit access
 - a. In slab installations will require three 1" conduits (in addition to any other power or phone conduits) installed to the closest cable tray, trench or communications room. The conduits will enter at a common end (short dimension) at the knockout locations provided. Power receptacles and associated conduit to be located at end opposite data communications conduit.

- b. Through-floor installations will require two 1 1/2" conduits straight through the deck to the ceiling space below. Conduits shall be installed at either end in the knockout locations provided. Power receptacles and associated conduit to be located in one corner.
 - c. All bends shall be long sweep with a 6" min. bend radius. All conduits will be installed with nylon pull string.
 - d. Separate conduits must be installed and not ganged together at junction boxes.
5. Refer to drawings "**IN-FLOOR COMMUNICATIONS BOX**" and applicable section drawings for conduit installation details.



I. CAT5E/CAT6 INSTALLATION AND ELECTRICAL SPECIFICS

1. The final number of outlets will be determined by the final construction plans.
2. Vendor must check with Telecommunications Services on how the distribution of network outlets will be split in areas previously wired (remodels, etc.).
3. Vendor should check for specifics with Telecommunications Services prior to the installation of wireless network outlets.
4. No more than 6 cables may be installed into 1 - 3/4" conduit for any Cat5e or Cat6 installation.
5. Areas with no direct wall access, such as reception desks and nurses stations, must have a one inch conduit and j-box installed for every leg space. Cabling will not be "daisy chained" from one outlet to another.
6. For public spaces each data outlet will have the necessary 20 amp electrical outlet (standard format), single-gang duplex, electrical within a four feet proximity of the data outlet, for each data outlet location; customer may request additional electrical.

7. Every power outlet in every data communications room will be a quad 20 amp electrical outlet (standard format) unless otherwise specified.
8. Every data outlet in public spaces will be in a single gang j-box, with no more than six cables, terminating in the outlet.

J. CAT5E/CAT6 TESTING AND CABLING REQUIREMENTS

1. **All cable runs will be certified to their respective standard (e.g., Cat5e or Cat6).**
Each cable run will contain a data report containing the following information:
 - a. Circuit ID (This would be the Port Designation, i.e.: 121-a1)
 - b. Building Location
 - c. Length of cable run
 - d. Communications Room number
 - e. Date of Test
 - f. Cable Type: (e.g., Cat5e UTP)
 - g. Type of Scanner Used
 - h. Overall Test Result of Cable: (e.g., PASS)
2. Wiring will be tested and reported as complying to the following individual tests:
 - a. **Wire Map:** Show the wiring is straight through, with no open, crossed, reversed or split pairs.
 - b. **Resistance:** Measured in ohms, limit, and pass/fail
 - c. **Length:** Measure the length of each cable pair.
 - d. **Propagation Delay:** Measured in nanoseconds – each pair.
 - e. **Impedance:** Determine if anomalies exist on cables longer than 5 meters (16 ft.). Measured for each pair. Range Limit set to (80-120 Ω)
 - f. **Return Loss:** Measures the difference between the power of a transmitted signal and the power of the signal reflections caused by variations in link and channel impedance.
 - g. **Attenuation:** Measure the loss of signal over the length of the cable. Attenuation for each pair in (dB), frequency for 100 MHz, and limit tested for each pair (dB).
 - h. **ACR:** Measures the difference between the signal attenuation and the near-end crosstalk, representing the strength of the attenuated signal in the presence of crosstalk.
 - i. **Next:** Measure the near-end crosstalk of a cable, and verify the cable has adequate immunity from the next pairs signal being transmitted back onto the receive pairs. Specify Next Loss, for each of the pairs, send and receive combinations.
 - j. **FEXT:** Measures the far-end crosstalk of a cable. Specify FEXT Loss, for each pair, send and receive combinations.
 - k. **PSNEXT:** Measures the NEXT induced on a pair from all adjacent pairs.
 - l. **PSELFEXT:** Measures the ELFEXT induced on a pair from all adjacent pairs.
3. At completion, provide Telecommunications Services with tested wire length of each cable run.
4. Deliver the test results to Telecommunications Services in an Excel spreadsheet or other text delimited file.
5. When adding data outlets to an existing Telecommunications Communications Rack, if available space for the new outlets is not available, vendor must provide and install UTP 24 port patch panels and wire management (Systimax 360-MOD-1U-24 and CPI 13070719) (NO SUBSTITUTIONS) at the highest available position within the racks. One T568B Cat5e modular jack is required at the patch panel - CommScope MPS100E-003 – Electrical Black (***Alternate Cat6:** CommScope MGS400-003 – Electrical Black) (NO SUBSTITUTIONS).
6. Provide two blue, non-booted Cat5e UTP patch cables, for each data outlet (***Alternate Cat6:** blue, non-booted Cat6 UTP patches cables). Telecommunications Services will provide the required patch cable lengths, not to exceed 14' each. Cables may be requested in lengths of 3, 4, 5, 6, 7, 10 and 14 feet. Cable Vendor must provide a cut sheet or sample of the patch cable, and get a breakdown of required cable lengths for all

patch cables, prior to the order. Deliver patch cables to Telecommunications Services where they will be checked for proper length and wiring.

2.4 CABLE LABELING

- A. UTP wiring will be labeled on both ends of the outlet, 3 inches back from punch down panel, and 3 inches back from the face plate punch down. Labels for all UTP wiring shall be white, self-laminating, adhesive labels.

The following examples are for the wire labeling. Labels should be marked, three inches back from both the wall plate termination point, and three inches back from the punch down termination point.

Example 1, if for a single wire on a single jack wall plate. Example 2, is for a wire on a multiple jack wallplate, which is part of a range on the punch down panel.

Example 1:

121-a1

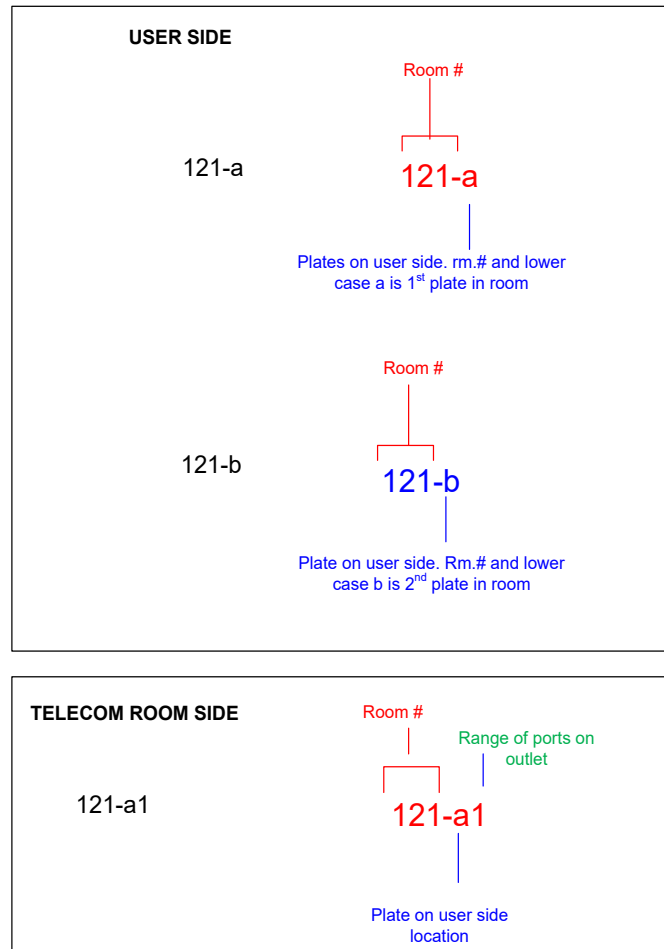
Example 2:

121-a2

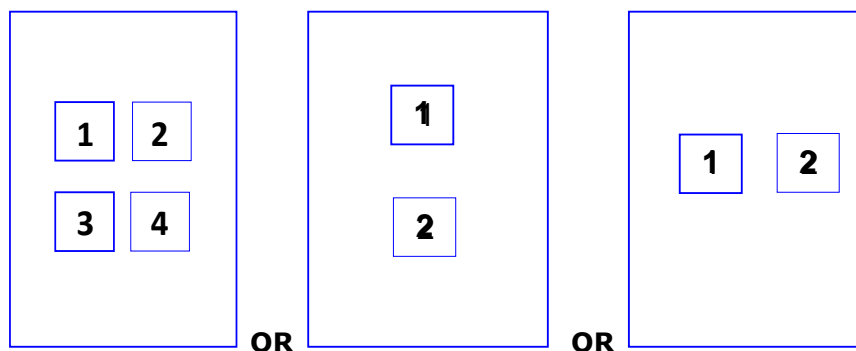
- B. Cable contractor identification tags shall be attached above conduit stub-up, and at each end of every UTP installation.
- C. Label large fiber cables or bundles on both ends of the fiber connections with (orange) self-laminating- adhesive labels, (Panduit part number PST-FO).
- D. As per TTU's OP's, cable runs shall be grouped together on main pathways going back to the punch down rack. The group of cables shall be tied together using cable tie wraps, and cable destinations will be marked every 50 ft. Markings shall be established in areas most visible for cable identification. Cable markings will use cable marker holders for all UTP wiring groups, with label (Panduit part number PSCB-12), and self-laminating / permanently marked printed labeling system.

2.5 FACE PLATE LABELING

- A. Face plates must be labeled with room designation. Room destination shall be labeled and centered, above the top port(s) on the face plate, with self-laminating or non-fading ink and stick on labels.
- B. Face plate (user side) labels and Communications Room labels will be labeled according to the following example:



- C. All face plates will be in numerical order from top to bottom, left to right.



- D. Punch down panel must be identical to room designation. For single & multiple port face plates, the range for the face plate designation and the port number will be used on the punch down panel.
1. Example, room designation of face plate reads: 121-a
 2. The first port of that face plate would be listed as 121-a1 on the punch down panel.
 3. In order to insure consistency with labeling scheme used at Texas Tech, the labeling scheme will be as shown below

Each faceplate is labeled in the form:

RRR-x

Where:

'RRR' is the room number and is comprised of '0'-'9'
& 'A'-'Z'

'-'

is a hyphen

'x'

is a lowercase

letter from 'a' - 'z'

Example:

1. The first faceplate located in Room 121 would be labeled **121-a**
2. The second faceplate located in Room 121 would be labeled **121-b**

Each outlet in a CommScope faceplate has a number (1 - 6), therefore, for testing and identification purposes each outlet is denoted by a combination of the faceplate label and the outlet number.

Each UTP cable is designated by the addition of a two letter building code to the front of the outlet designator. For examples, BA121-a1 would denote a cable in the Business Administration Building, Room 121, first faceplate, first outlet. Likewise BA121-b1 would denote a cable in the Business Administration Building, Room 121, second faceplate, first outlet.

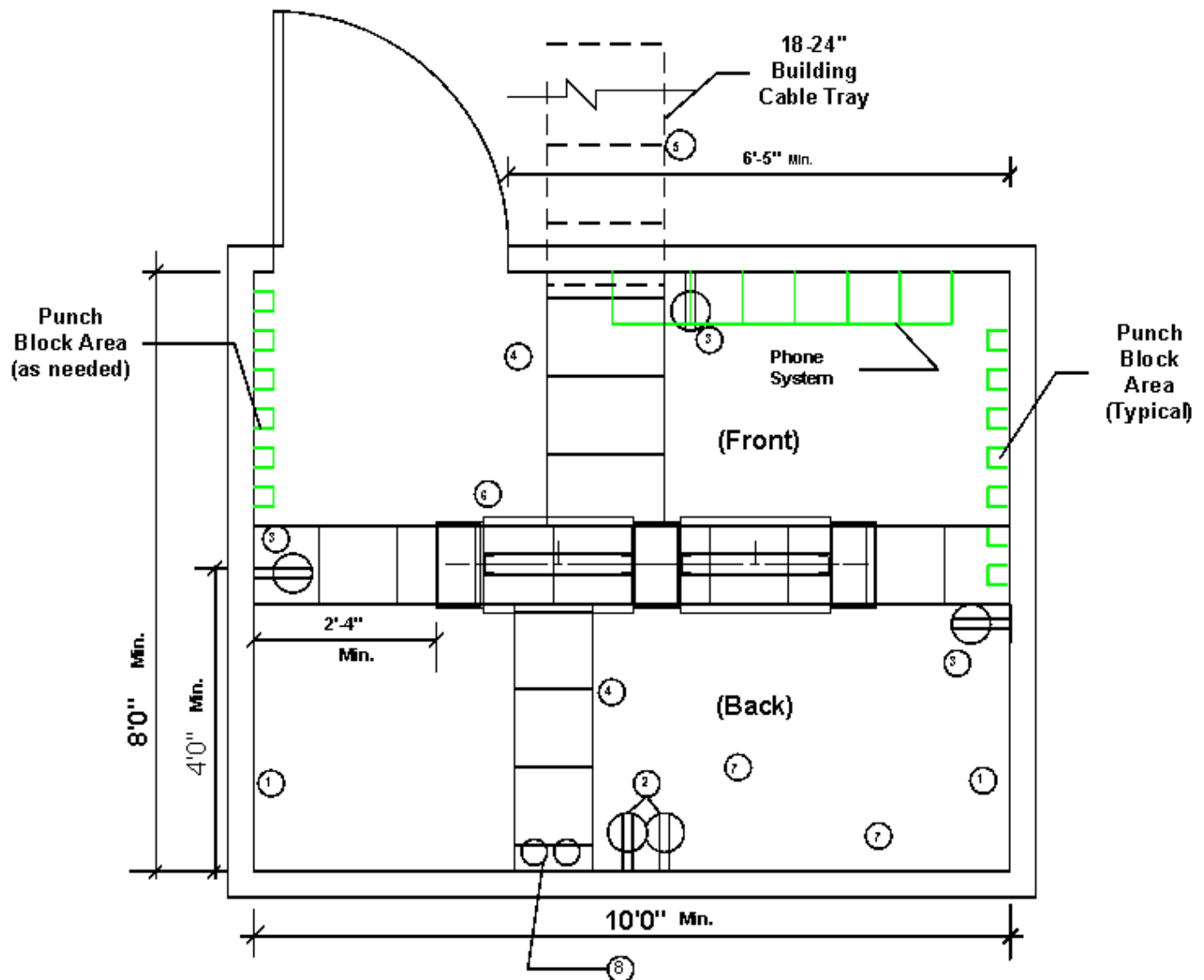
TTUnet Services Building Codes

BA Business Administration Building

Building Codes will be provided by Telecommunications Services.

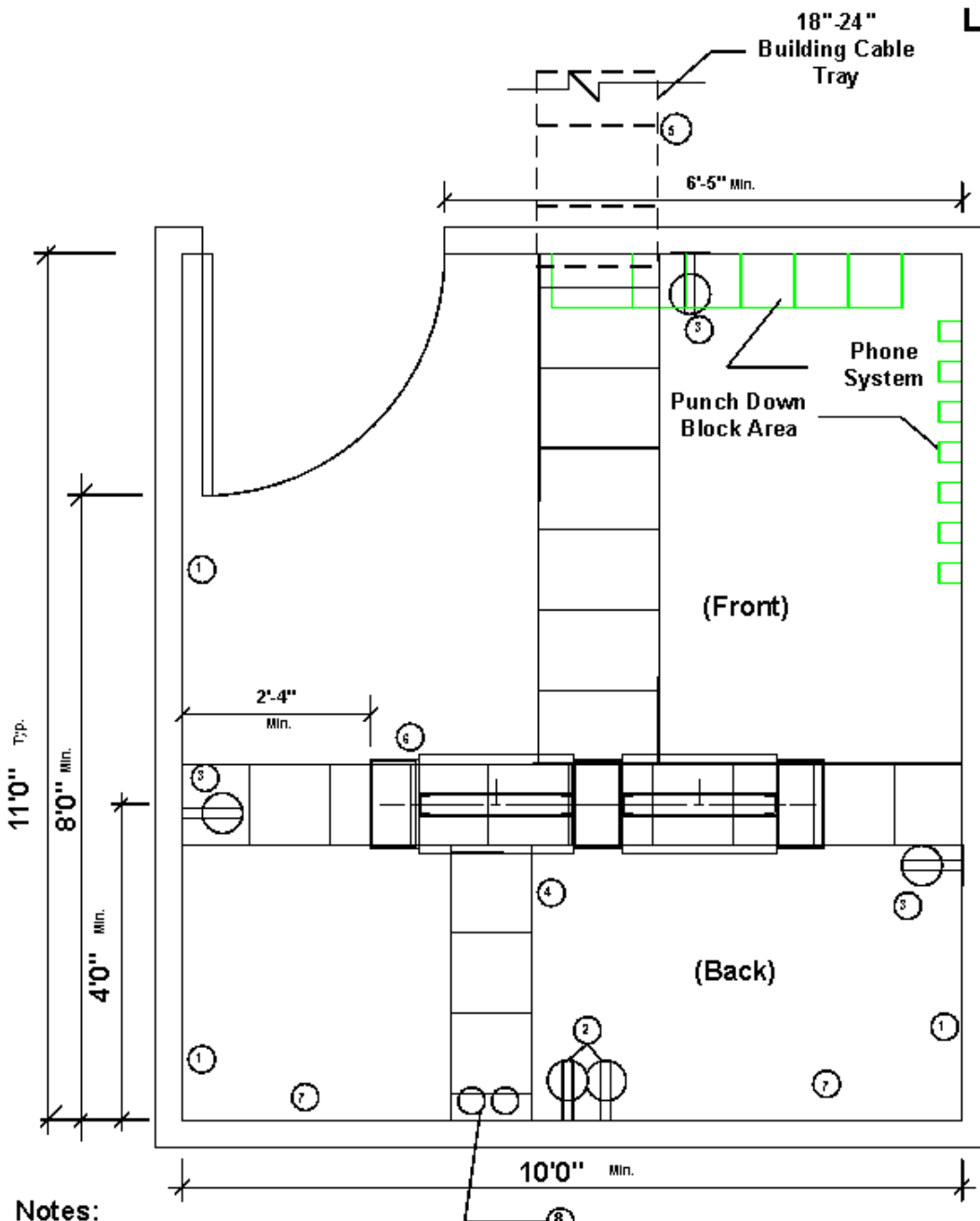
2.6 COMMUNICATION ROOMS

- A. Communications rooms must meet telecommunications' industry standards for size, cooling, heating, security and cleanliness.
- B. Use of communications rooms by others requires the written approval of the Managing Director of Telecommunications.
- C. Shown below are 4 typical layouts of communications rooms. Provisions for both cabling, electronics and maintenance are required with dimensions shown to be considered as minimum.

**Communication Room
Layout A****Notes:**

1. 3/4" painted (white or neutral) plywood from floor to ceiling on all walls.
2. 2-110VAC, 20A dedicated receptacles for data networking located as shown. 6'6" AFF.
3. 2-110VAC, 15A receptacles.
4. Cableway provided by Telecommunications Services.
5. Building cable tray entry into the Communications Room must be coordinated with Telecommunications in drawing design development.
6. Communications racks with vertical wire management provide by Telecommunications Services.
7. Walls on "Back Side" of room are reserved for Telecommunications Services and must remain clear for cable routes, future equipment and maintenance.
8. 2-4" Cored / Sleeved Holes for vertical access as needed.
9. Communications Rooms are for the exclusive use of data & phone services. All other uses must be approved in writing by the Director of Telecommunications.

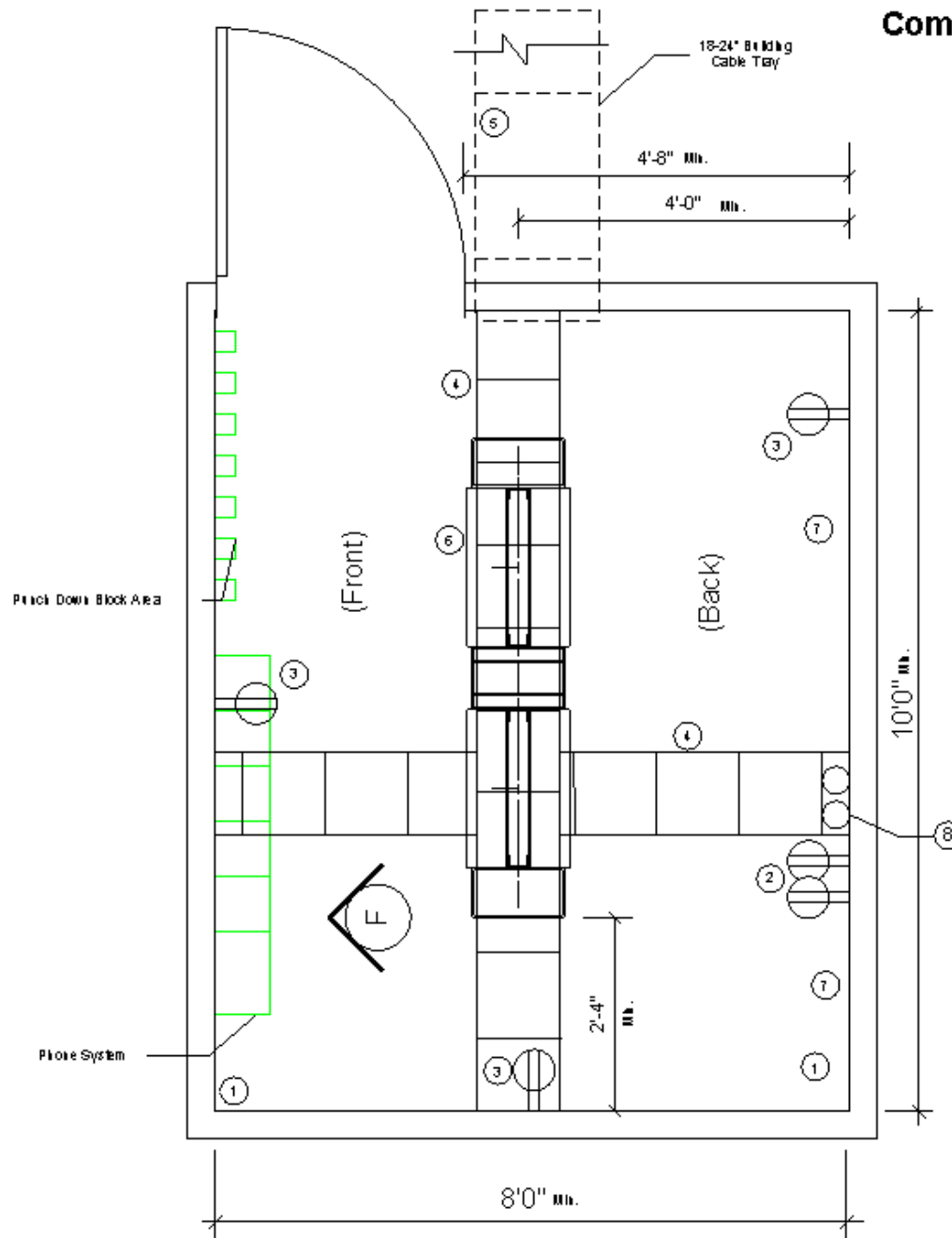
**Communication Room
Layout B**



Notes:

1. 3/4" painted (white or neutral) plywood from floor to ceiling on all walls.
2. 2-110VAC, 20A dedicated receptacles for data networking located as shown. 6'6" AFF.
3. 2-110VAC, 15A receptacles.
4. Cableway provided by Telecommunications Services.
5. Building cable tray entry into the Communications Room must be coordinated with Telecommunications in drawing design development.
6. Communications racks with vertical wire management provide by Telecommunications Services.
7. Walls on "Back Side" of room are reserved for Telecommunications Services and must remain clear for cable routes, future equipment and maintenance.
8. 2-4" Cored / Sleeved Holes for vertical access as needed.
9. Communications Rooms are for the exclusive use of data & phone services. All other uses must be approved in writing by the Director of Telecommunications.

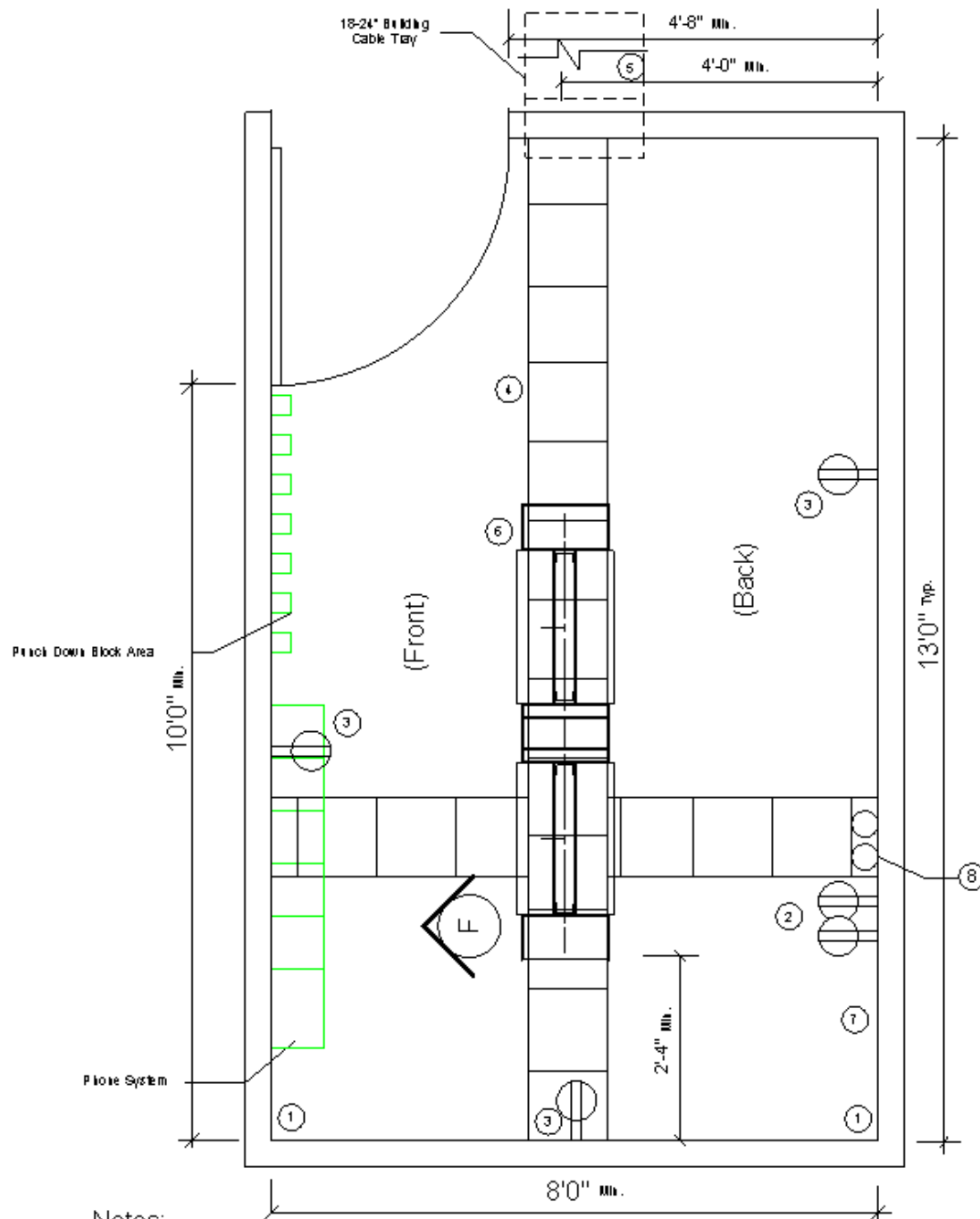
**Communication Room
Layout C**



Notes:

1. 3/4" painted (white or neutral) plywood from floor to ceiling on all walls.
2. 2-110VAC, 20A dedicated receptacles for data networking located as shown. 6'6" AFF.
3. 2-110VAC, 15A receptacles.
4. Cableway provided by Telecommunications Services.
5. Building cable tray entry into the Communications Room must be coordinated with Telecommunications in drawing design development.
6. Communications racks with vertical wire management provide by Telecommunications Services.
7. Walls on "Back Side" of room are reserved for Telecommunications Services and must remain clear for cable routes, future equipment and maintenance.
8. 2-4" Cored / Sleeved Holes for vertical access as needed.
9. Communications Rooms are for the exclusive use of data & phone services. All other uses must be approved in writing by the Director of Telecommunications.

**Communication
Room Layout D**



Notes:

1. 3/4" painted (white or neutral) plywood from floor to ceiling on all walls.
2. 2-110VAC, 20A dedicated receptacles for data networking located as shown. 6'6" AFF.
3. 2-110VAC, 15A receptacles.
4. Cableway provided by Telecommunications Services.
5. Building cable tray entry into the Communications Room must be coordinated with Telecommunications in drawing design development.
6. Communications racks with vertical wire management provide by Telecommunications Services.
7. Walls on "Back Side" of room are reserved for Telecommunications Services and must remain clear for cable routes, future equipment and maintenance.
8. 2-4" Cored / Sleeved Holes for vertical access as needed.
9. Communications Rooms are for the exclusive use of data & phone services. All other uses must be approved in writing by the Director of Telecommunications.

2.7 WORK COMPLETION SIGNOFF PROCESS

- A. When the cabling contractor determines the cabling work has been completed, and is in compliance with Telecommunications Services specifications, the contractor will notify Telecommunications Services to arrange a time for a representative to inspect the installation work.
- B. Cable testing results for both fiber and UTP terminations shall be delivered to Telecommunications Services personnel prior to inspection.
- C. A list of items to be corrected will be compiled during the inspection, and a copy will be sent to the contractor via email, so any corrections may be made. A re-inspection will be conducted to verify all items have been corrected.
- D. After any necessary corrections are completed and the terms of the cabling order have been completed, a representative from Telecommunications Services will sign a wiring completion form.

2.8 ADMINISTRATION

- A. Certification of cabling: Each Cable designation is to be tested for proper termination, with the results of these tests being delivered to Telecommunications Services in data form specified herein.
- B. Test Results shall be completed and given to Telecommunications Services for both fiber and copper terminations prior to Telecommunications Services approval of cabling.

END OF SECTION

(v2.1 2021-05-18)

TTU Telecom Review Process for Integrator Installed Systems

The following information and requirements apply to any work carried out at TTU locations that involves network cabling or digital communications as part of an integrator installed system:

Step-by-Step Process

1. Determine system category (see Categories and Requirements below).
2. Prepare system integrator's installation plan. To speed review, include connection diagram.
3. Submit TTU Telecom Network Service Request with details and integrator's installation plan.
4. Review system details with TTU Telecom.
5. Upon approval by TTU Telecom, system installation work may commence.

Definitions

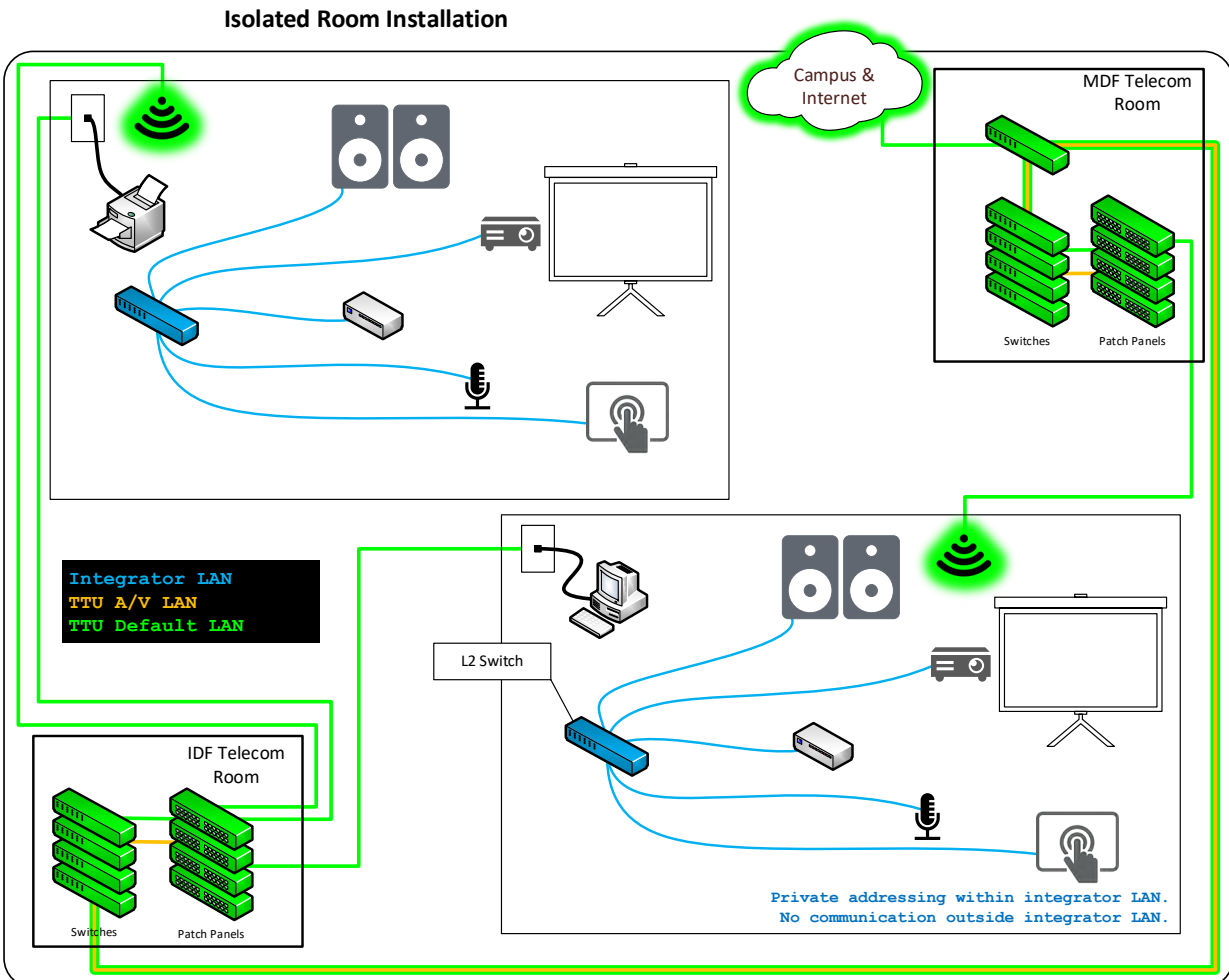
- **Cable, Cables, or Cabling:** Any UTP, STP or fiber-optic cabling used for digital networking (e.g., Ethernet, HDBaseT, AVB, Dante, Audio over Ethernet, etc.).
- **Facility Cable Plant:** The permanent building infrastructure for data communications. Includes main- and intermediate-distribution facilities (comm rooms), racks, patch panels, raceways, chases, faceplates, cables and any related equipment or mounts.
- **Integrator:** An organization which designs, installs, maintains, and supports a specialized multi-component system. Typically, these systems include environmental, security, audio/video, or media related applications.
- **Integrator System:** The system installed by an Integrator.
- **Integrator LAN:** Integrator-managed layer 2 Ethernet network containing only the Integrator System components.
- **Building LAN:** TTU-managed layer 2 Ethernet network within the building for communications within the building and TTU intranet. This LAN is generally the building's A/V LAN which is dedicated to A/V equipment and has access to communicate with other systems on campus. If granted exceptions by TTU Security, this LAN can also access Internet-based resources.
- **Isolated Room Installation:** Cabling within a single room, with network communications only within the Integrator LAN.
- **Building Cable Installation:** Cabling spans beyond a single room, with network communications only within the Integrator LAN. Facility Cable Plant is used to span rooms.
- **Building Network Installation:** Communications largely fit the definition of either an Isolated Room or Building Cable Installation, but some communication with the Building LAN is required for broader control, media transmission or system monitoring.
- **TTU Telecom Network Service Request:** Online submittal form for requesting the involvement of TTU Telecommunications in the review or installation of an Integrator System. Online form located at <https://www.net.ttu.edu/>.

Categories and Requirements

Integrator Systems fall into several generalized categories. Consider which of these categories fits your situation and include that category in any submitted information.

Isolated Room Installation

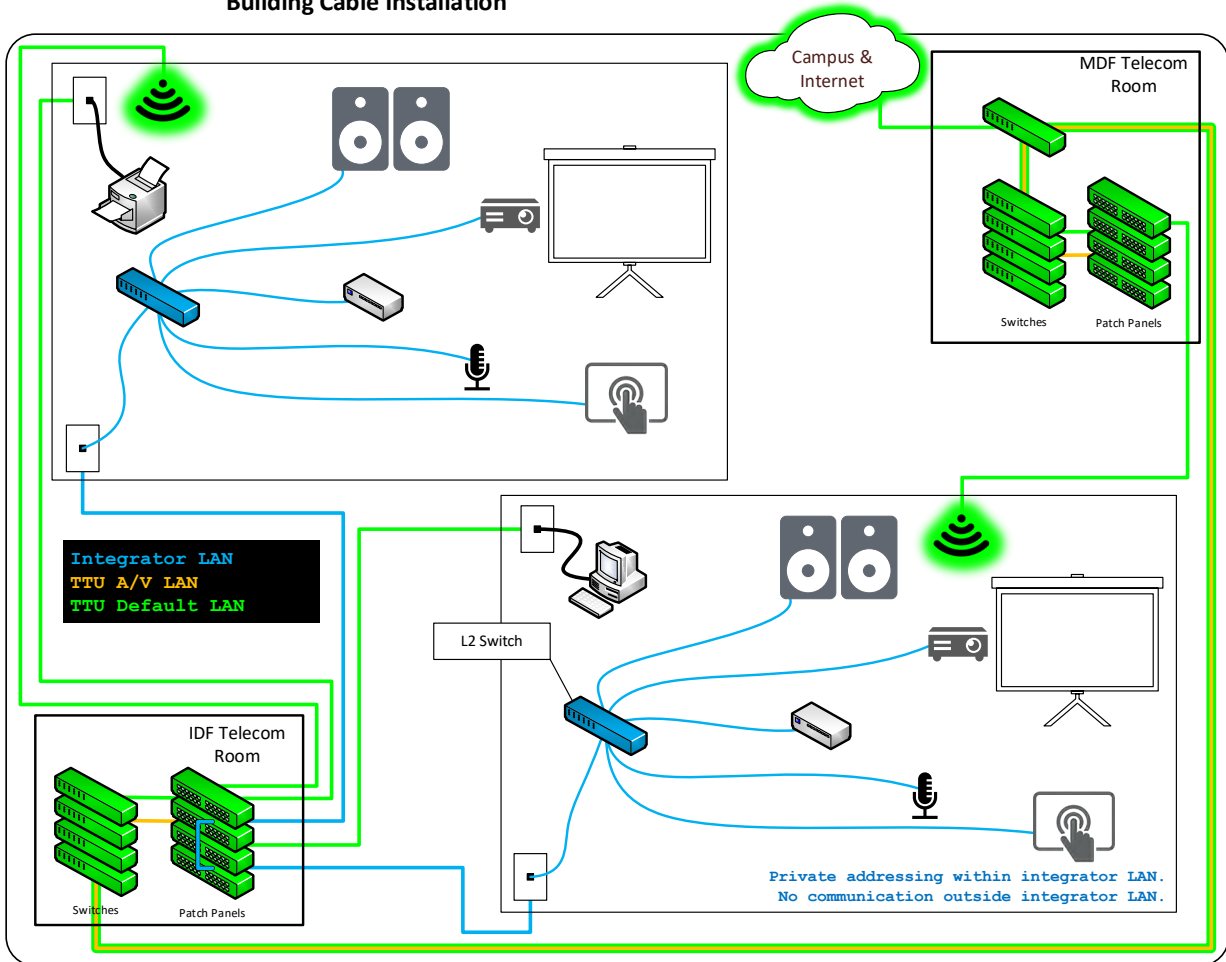
- Integrator System only connects and communicates between components in the Integrator LAN and those components do not communicate with other devices beyond the Integrator LAN (i.e., a closed system).
- No cable interconnections exist with the Facility Cable Plant infrastructure or the University-managed network equipment.
- Integrator LAN equipment must only include wired layer-2 switch equipment (no Wi-Fi equipment is permitted).
- IP addressing within the Integrator LAN is the responsibility of the system integrator.



Building Cable Installation

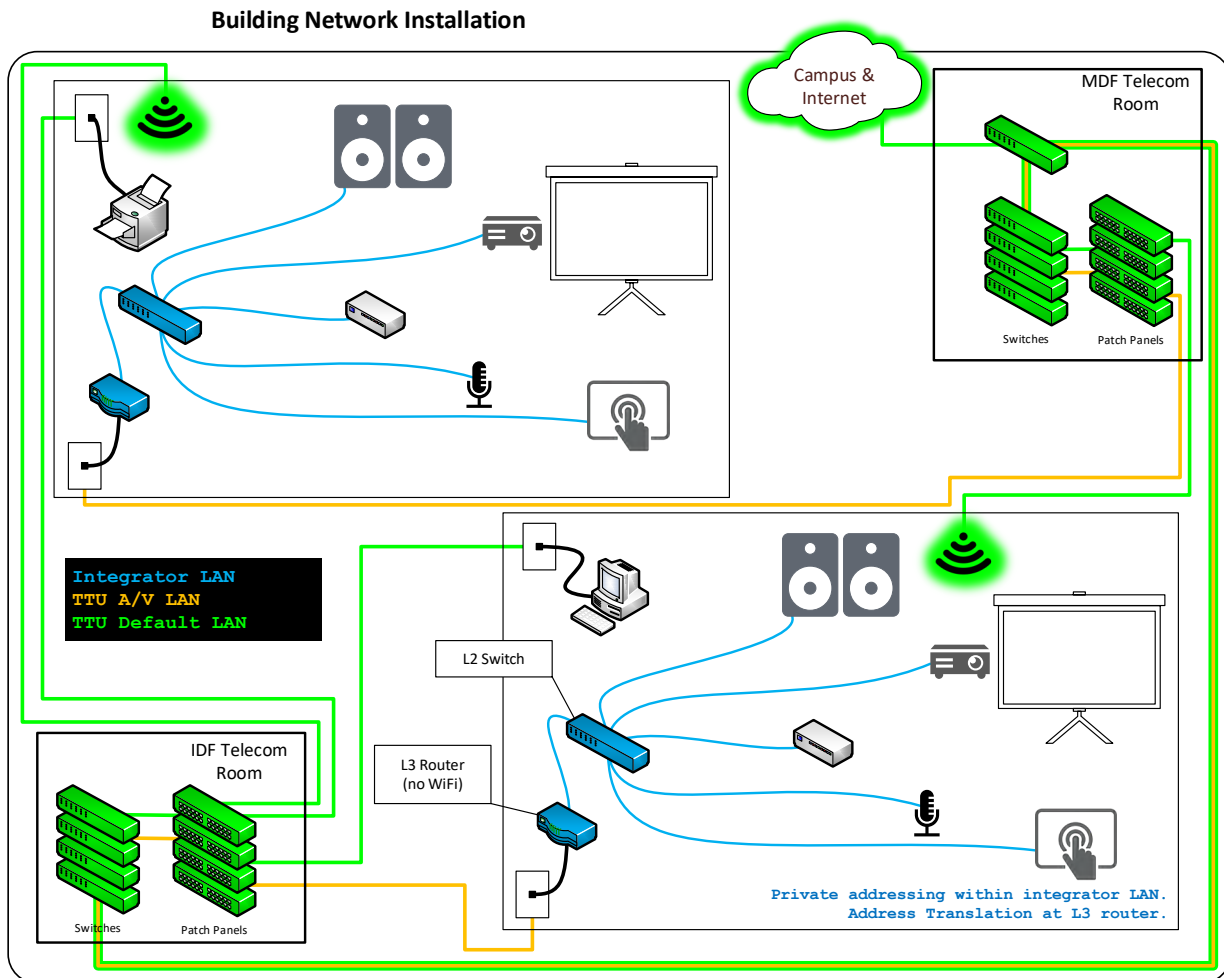
- Integrator System communicates between components within the Integrator LAN beyond a single room.
- Any cabling spanning rooms must make use of the Facility Cable Plant.
- Any cabling not spanning rooms must adhere to Isolated Room Installation requirements.
- Facility Cable Plant installation must be carried out by TTU Telecom in conjunction with a TTU Telecom Network Service Request.

Building Cable Installation



Building Network Installation

- Pertains to an Integrator System which communicates with the Building LAN.
- The Integrator System must provide layer 3 routing between the Integrator LAN and the Building LAN (i.e., the Integrator LAN may not bridge or switch to the Building LAN).
- The Integrator System must use port address translation (PAT) in order to communicate between the Integrator LAN and the TTU Building LAN.
- IP addressing within the Integrator LAN is the responsibility of the integrator.
- Building LAN must not be impacted by any Integrator LAN service (e.g., DHCP).
- IP addressing within the Building LAN is the responsibility of TTU and handled exclusively by DHCP (i.e., no manual IP configurations for integrator equipment in the Building LAN).
- Coordination of Building LAN communication must be carried out by TTU Telecommunications in conjunction with a TTU Telecom Network Service Request.



TTU Telecom Review Process for WiFi System Design & Installation

The following information and requirements apply to any WiFi design carried out for a Texas Tech University location:

Device Density & Capacity Planning

1. Design shall assume 2 WiFi devices per occupant.
2. Access point model shall be specified to provide best performance for the expected device density.
3. All classrooms shall be considered a high device density environment.

Coverage

1. All areas within the building shall be covered with WiFi service.
2. All outdoor areas with an expectation of stationary users (benches, tables, bus stops, artwork, etc.) shall be covered with WiFi service.
3. Mounting options for outdoor WiFi service shall be appropriate to the environment (e.g., bollards, poles, wall-mounts, etc.), and shall minimize signal attenuation due to landscaping.

Signal

1. 5GHz
2. -62 dB or greater in all areas
3. 2.4GHz will be available for backward compatibility but shall not be the basis of the design.
4. 20 MHz channel width (more channels are prioritized over more channel width).

Platform

1. Manufacturer: Aruba Networks
2. Access Point Series: Aruba Instant APs, 5xx Series or better
3. Management Model: Cloud managed
4. AP specification shall take device density and environmental application into consideration.
5. Indoor: Aruba Indoor IAP-5xx
6. Outdoor: Aruba Outdoor IAP-5xx

Deliverable

1. Documentation for the placement of access points meeting the above specified requirements, shown on architectural floor plans with clearly marked positions and orientation.
2. Documentation shall include all components required to accomplish the installation of the designed WiFi system.
3. Documentation shall provide colored heat maps specifying the expected signal strength.
4. Documentation shall specify which outdoor areas are designed with WiFi service coverage.
5. TTU Telecommunications will procure all WiFi system access points, mounts, and power injectors for contractor installation.

Review & Approval

1. Proposed WiFi design (deliverable) shall be provided to TTU Telecommunications prior to 100% DD for review and approval.
2. Upon any changes that affect AP placement, signal strength or other performance characteristics, the proposed design shall be updated and resubmitted to TTU Telecommunications for subsequent review and approval.
3. Any proposed deviations from these requirements shall be requested in writing to the Director of TTU Telecommunications Network Services for review and approval.

DATA COMMUNICATIONS CABLING INSPECTION PHOTO EXAMPLES

TEXAS TECH UNIVERSITY

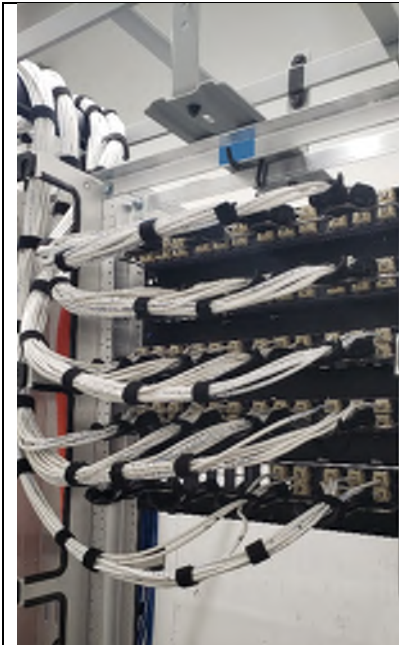
February 28, 2020

This document contains examples of photographs to be provided to TTU Telecommunications following service installation for the purpose of verifying proper installation and compliance with University policies and procedures.

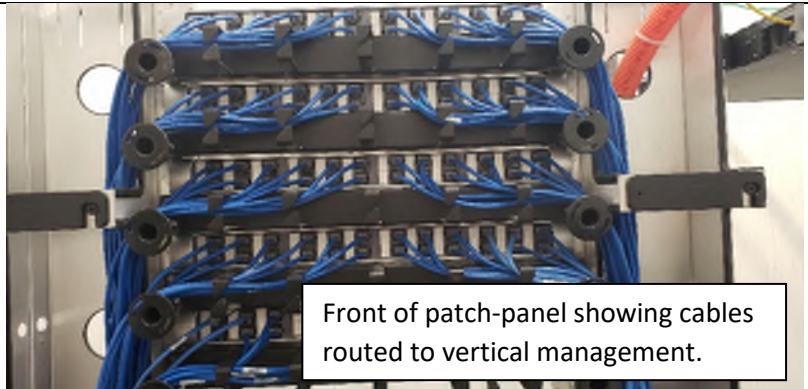
The intent of the photos is to convey the quality of your cable installation work to the satisfaction of TTU Telecommunications. The photos should include all portions of the cable path involved in your installation. Clear, well taken photos make it easy for TTU to quickly make that assessment.

Given the many variations of building type and installations, we understand that your photos will be limited by the available space, lighting, etc. But, please make every effort to provide the best quality photos capturing the components shown in these examples.

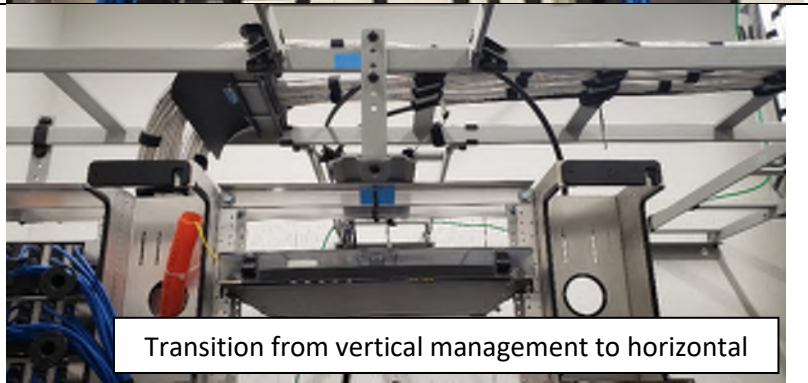
Communication Room Photos



Back of patch-panel showing cables routed to vertical management.



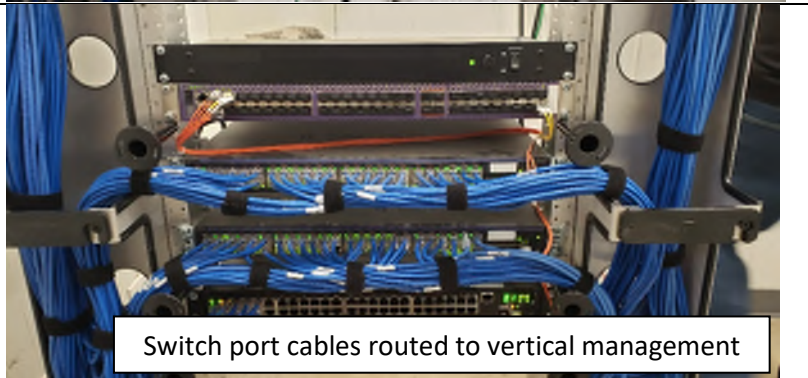
Front of patch-panel showing cables routed to vertical management.



Transition from vertical management to horizontal

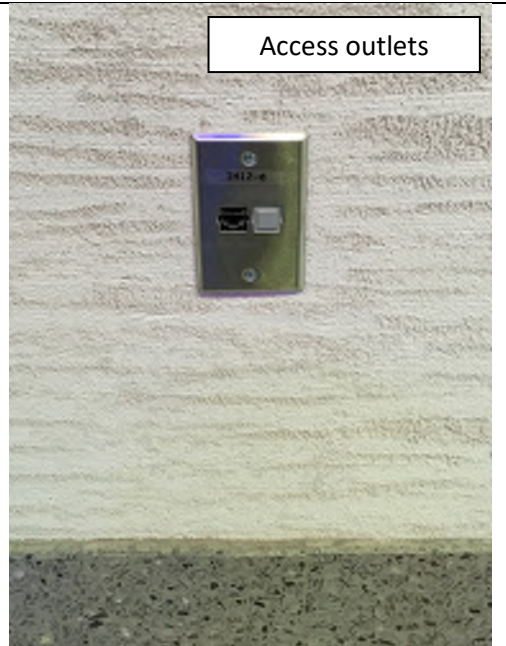


Full rack assembly

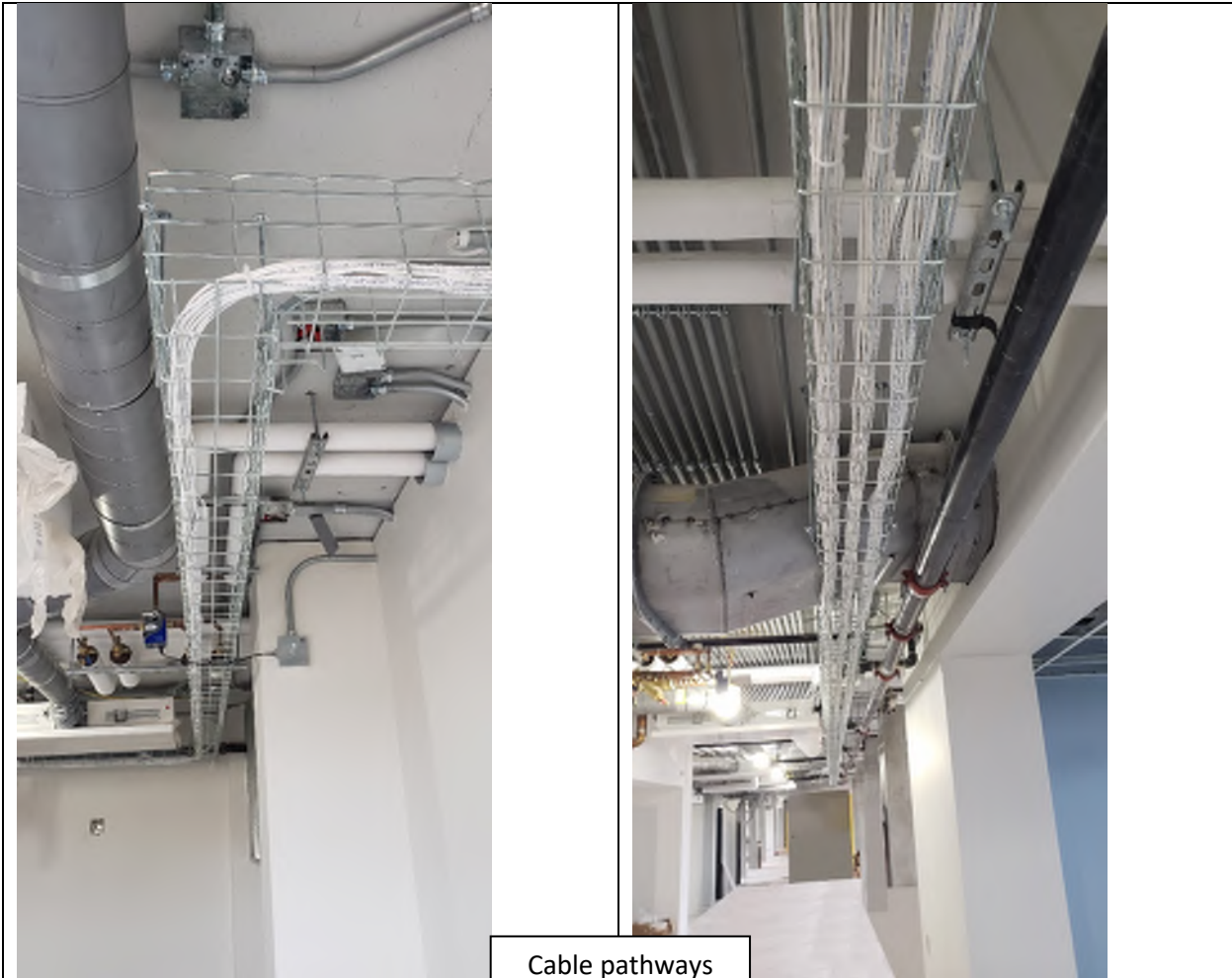


Switch port cables routed to vertical management

Penetrations & Access Outlets



Raceways, cable trays, J-hooks



Cable pathways

