Yale University

Yale IT Infrastructure Construction Standards
Revision 1.2
June 30, 2022

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IT INFRASTRUCTURE CONSTRUCTION STANDARDS

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1.2. Introduction and Purpose

This document provides the Yale IT design guidelines to ICT Design professionals for use in preparation of construction documents for new construction and renovation projects. The scope of this document includes requirements for IT project processes, structured cabling systems, security systems, audiovisual systems, and distributed antenna systems. This document is subject to change in form and technical content as

warranted by advancements in building construction techniques and IT systems technology. As such, Yale University specifically reserves the right to add to and revise, the information contained herein.

These design guidelines shall not be used as the final specification or bid document for any specific new or renovation project. Detailed and specific requirements for a project shall depend on the programmatic use of the space(s) and shall be confirmed during the project formulation and design phases of the project. The ICT Designer shall incorporate existing systems to ensure a seamless co-existence of newly provided infrastructure.

The project ICT Designer shall be a BICSI Registered Communications Distribution Consultant (RCDD) and/ or an AVIXA Certified Technology Specialist (CTS). The ICT Designer shall consult with the Yale Facilities Project Manager; Yale IT and project end users to ensure all IT requirements for the project are met.

Variances and exceptions are to be presented to Yale IT for approval in writing and shall include a written explanation and drawings describing the proposal. The ICT Designer or Contractor submitting the exception request is responsible to ensure that the performance of the system and the requirements of this specification are met within the proposed changes.

Work Not in Scope

Refer to Appendix B – Differential Scope of Work Matrix for complete scope of work descriptions. Items not in the ICT designer design and specification scope of work include:

- The Yale IT active electronic network equipment.

Governance and Compliance

The awareness of these standards and shared practices along with the adherence and adoption of these standards will be governed and administered through a variety of channels.

ITS-FTS/PS/FAC: The Information Technology Services (ITS) Foundational Technology Services (FTS) teams, Public Safety (PS) teams, as well as the Office of Facilities (FAC) Capital Program and Facilities Operations teams, are the collaborative governing body for IT infrastructure construction standards at Yale. Together ITS-FTS, PS and FAC will help to ensure visibility and adoption of these standards. Members of these teams will work with ICT designers and contractors to clarify standard requirements and permit exceptions when necessary.

TAC: The Technology Architecture Committee (TAC) will help to ensure that there is awareness and visibility of these standards for any future projects and initiatives that come through the ITS Gating Process. Additional information can be found on the confluence site: https://yaleits.atlassian.net/wiki/spaces/STAN/pages/803668001/TAC

PMO: The ITS Project Management Office (PMO) will have an active role in understanding what ITS projects need to comply with the IT Infrastructure Construction Standards. The PMO will support those projects through the ITS Gating process. .

ISO: Yale's ITS Information Security Office (ISO) will continue to be another mechanism to help ensure adherence to predefined standards through processes such as the SDR.

TAST: The Technology Architecture Standards Team (TAST) is a committee that has been initiated and formed under the current CIO to look across our technology landscape and to help in identifying areas for standards and shared practices. This document, along with many others, has been discussed and reviewed with this group. Additional information can be found on the confluence site: https://yaleits.atlassian.net/wiki/spaces/STAN/pages/803700826/TAST

Support

Support for the ICT Designer to request additional information or clarifications is available through the project specific Facilities project manager and Yale IT support personnel assigned to the project. Direct all inquiries to the Facilities project manager for distribution to the appropriate Yale IT personnel.

1.3. Codes and Standards

The IT systems design shall adhere to Industry Standards, applicable building codes, and specific user requirements for the building. Relevant codes and standards to be followed are listed below. For a complete list of IT standards, refer to the BICSI *TDMM 14th Edition Appendix A: Codes, Standards, Regulations, and Organizations.*

TIA:

- TIA-526-7-A, Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
- TIA-526-14-C, Optical Power Loss Measurement of Installed Multimode Fiber Cable Plant
- TIA-568.0-E, Generic Telecommunications Cabling for Customer Premises
- TIA-568.1-E, Commercial Building Telecommunications Cabling
- TIA-568.2-D, Balanced Twisted-Pair Telecommunications Cabling and Components
- TIA-568.3-D, Optical Fiber Cabling Components
- TIA-568.4-D, Broadband Coaxial Cabling and Components
- TIA-569-E, Telecommunications Pathways and Spaces
- TIA-606-D, Administration Standard for Telecommunications Infrastructure
- TIA-607-D, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
- TIA-758-B, Customer-Owned Outside Plant Telecommunications Cabling Standard
- TIA-862-B, Structured Cabling Infrastructure Standard for Intelligent Building Systems
- TIA-942-B, Telecommunications Infrastructure Standard for Data Centers
- ANSI/TIA-1152-A: Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
- ANSI/TIA-1179-A, Healthcare Facility Telecommunications Infrastructure Standard
- TIA-TSB-162-A, Telecommunications Cabling Guidelines for Wireless Access Points
- TIA TSB-184-A Guidelines for Supporting Power Delivery over Balanced Twisted-Pair Cabling

BICSI:

- BICSI Telecommunications Distribution Methods Manual (TDMM), 14th Edition
- BICSI Telecommunications Project Management Manual (TPMM), 1st Edition
- BICSI Information Technology Systems Installation Methods Manual (ITSIMM), 8th Edition
- BICSI Outside Plant Design Reference Manual (OSPDRM), 6th Edition
- ANSI/BICSI 001-2017, Information and Communication Technology Systems Design and Implementation Best Practices for Educational Institutions and Facilities
- ANSI/BICSI 002-2019, Data Center Design and Implementation Best Practices
- ANSI/BICSI 004-2018, Information Communication Technology Systems Design and Implementation Best Practices for Healthcare Institutions and Facilities
- ANSI/BICSI 005-2016, Electronic Safety and Security (ESS) System Design and Implementation Best Practices
- ANSI/BICSI 006-2020, Distributed Antenna Systems (DAS) Implementation Best Practices
- ANSI/BICSI 007-2020, Information Communication Technology Design and Implementation Practices for Intelligent Buildings and Premises

- ANSI/BICSI 008-2018, Wireless Local Area Network (WLAN) Systems Design and Implementation Best Practices
- ANSI/BICSI N1-2019, Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure
- ANSI/BICSI N2-17, Practices for the Installation of Telecommunications and ICT Cabling Intended to Support Remote Power Applications
- ANSI/BICSI N3-20, Planning and Installation Methods for the Bonding and Grounding of Telecommunication and ICT Systems and Infrastructure
- BICSI G1-17, ICT Outside Plant Construction and Installation: General Practices

AVIXA:

- A102.01:2017 Audio Coverage Uniformity in Listener Areas
- ANSI/AVIXA D401.01:201X Standard Guide for Audiovisual Systems Design and Coordination Processes
- V201.01:2022 Image System Contrast Ratio
- 10:2013 Audiovisual Systems Performance Verification
- RP-38-17 Recommended Practice for Lighting Performance for Small to Medium Sized Videoconferencing Rooms
- F502.02:201X Rack Design for Audiovisual Systems
- AVIXAF501.01:2015 Cable Labeling for Audiovisual Systems
- 202.01:2016 Display Image Size for 2D Content in Audiovisual Systems

Codes:

- National Fire Protection Association (NFPA) 70, National Electrical Code
  - Article 110: Requirements for Electrical Installations
  - Article 210.71 Meeting Rooms (2017 version), Article 210.65 Meeting Rooms (2020 version)
  - Chapter 3: Wiring Methods and Materials
  - Chapter 5: Special occupancies, including hazardous locations and health care facilities
  - Article 645: Information Technology Equipment
  - Article 770: Fiber Optics
  - Chapter 8: Communications Systems
- NFPA 72, National Fire Alarm and Signaling Code
- NFPA 75, Standard for the Fire Protection of Information Technology Equipment
- NFPA 1221, Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems
- Connecticut State Building Code
- International Fire Code, Section 510 Emergency Responder Radio Coverage in New Buildings
- ASME A17.1-2016, Safety Code for Elevators and Escalators
- Americans with Disabilities Act (ADA)

1.4. Terms and Abbreviations

For a complete list of relevant ICT industry acronyms, definitions, and abbreviations, refer to BICSI's *ICT Terminology Handbook, Version 3.0*. Yale IT specific acronyms, definitions, and abbreviations include, but are not limited to the following:

- **Core Network Room** – A dedicated room containing the Yale IT core network electronics - the public switched telephone network (PSTN) lines - health, life, and safety (HLS) electronics - and, central control equipment for alarms and notification systems, that provide data network and telecommunications services to campus buildings. The Core Network Room is the primary origination

point of first-level copper and fiber backbone cables; a cable infrastructure configured in a physical star, that terminates in campus buildings. For the required building services, the core electronics and equipment are interconnected with the campus backbone cable system via main distribution terminal (MDT) cross-connections and/or fiber distribution panels (FDP) patch cord patching.

- **IDT** – Intermediate Distribution Terminal: Located within a floor Telecom Room, the IDT is defined as a group of connectors (e.g., patch panels, punch-down blocks) that allow horizontal cross-connect (HC) of horizontal, backbone, and equipment cabling to be cross-connected with patch cords or jumpers. Also commonly referred to as an intermediate distribution frame (IDF).
- **MDT** – Main Distribution Terminal: Located within the building main Telecom Room, the MDT is defined as the intermediate cross-connect (IC) connection point between a backbone cable that extends from the campus main connect (MC) and the backbone cable from the horizontal cross-connect (HC). Also commonly referred to as a main distribution frame (MDF).

1.5. References

Office of Facilities Yale University: Refer to the Office of Facilities Yale University Design Standards for Capital Projects for additional project requirement including, but not limited to:

- General Guidelines
- Division 00: Procurement & Contracting Documents
- Division 01: General Requirements
- CAD Standards
- CAD Titleblocks
- Yale University Contractor Health & Safety Guidelines
- Link: https://facilities.yale.edu/contractor-consultant-resources/design-guidelines/yale-university-design-standards-capital-project

Yale New Haven Health System: YNHHS ITS Standards Network Infrastructure – Data Closets and Cabling 2018.

- Link: https://yale.box.com/s/c9dq5cyrpworlidnkaohx559vgm2ta57

Yale IT: Minimum Physical Security Standards for Critical IT Spaces

- Link: https://cybersecurity.yale.edu/protectingcriticalitspaces

1.6. Project Contractor Requirements and Qualifications

The ICT Designer shall include within the project specifications that the Structured Cabling Contractor shall meet the following requirements and qualifications:

- Contractor Resume: a resume of qualifications shall be submitted with the Contractor's proposal indicating the following:
  - A list of recently completed projects of similar type and size with contact names and telephone numbers for each.
  - A list of test equipment proposed for use in verifying the installed integrity of copper and fiber optic cable systems on the project.

  - A technical resume of experience for the Contractor's project manager and on-site installation supervisor assigned to the project.
  - A list of technical product training and manufacturer certifications attained by the Contractor's personnel installing the system.
  - A list of subcontractors who will assist the Contractor in performance of the work. Subcontractors shall meet the same training and certification requirements as the prime Contractor.
- The Contractor shall provide documentation indicating proper licensing by the State of Connecticut to install structured cabling systems.
- The Contractor shall be manufacturer certified, such that the structured cabling plant system will be warranted by the specified manufacturer for parts, labor, and application assurance for a period of no less than 25 years. The Contractor shall submit copies of the manufacturer certifications.

The project security system scope of work, including building access control, security cameras, intrusion detection, and intercom/emergency communications, shall be provided by a prequalified Security Contractor. Contact Yale IT to confirm the current list of prequalified Security Contractors approved to perform projects at Yale. Incorporate the prequalified Security Contractor list into the project bidding requirements.

1.7. Demolition and Temporary Protection of Yale IT Systems

Campus renovation projects may involve work effecting telecommunications infrastructure that is existing to remain. Temporary protection and selective demolition shall be provided by the project or through an associated enabling project. The following provisions shall be included in projects in coordination with project and construction managers:

- Existing Telecom Rooms and infrastructure effected by project demolition and renovation shall remain in operation until successful cutover to replacement Telecom Rooms and infrastructure, or until temporary service is established.
- Prior to demolition of existing Telecom Room walls, ceilings or flooring, construct temporary barriers fully enclosing the existing room equipment. The barriers shall provide physical protection from demolition debris and environmentally seal off the equipment to prevent ingress from dust and contaminates.
- Provide temporary cooling within the barrier spaces to maintain a temperature range between 50-85 degrees Fahrenheit and 10%-90% relative humidity noncondensing. Provide positive pressure within the barrier for dust control. Cooling equipment shall be served by the campus alternate power source if available in the building, or by a standby generator.
- Provide temporary power for the room equipment to maintain operation throughout the duration of construction. Temporary power shall be on alternate power source.
- Yale IT shall have access to all equipment throughout the course of construction. Provide a barrier entrance with sticky clean walk-off floor mats.
- Provide an IP based environmental monitoring system which shall alert the Contractor upon loss of power and when temperature and humidity is outside the acceptable ranges.
- The Contractor shall be held responsible for replacement of Yale IT equipment damaged or for voiding equipment warranties during construction per the general conditions of the contract.
- Temporary short duration planned outages of room equipment shall be preapproved by Yale IT.

- Provide sealed cabling egress ports for existing and new cabling routing through the barriers to the equipment racks. Where existing cabling bundles route through walls scheduled for demolition, provide protection for cabling and re-support cabling from structure. Permanent sleeves shall be provided around existing cabling to be built into new walls.
- Provide selective demolition of cabling back to the patch panels in the equipment racks. Re-terminate and re-label existing to remain cabling infrastructure on patch panels such that gaps do not exist where cabling was demolished. Organize the existing and new patch panel termination per the final permanent renovation layout.
- Relocation of IT active equipment within the room shall be performed by Yale IT.
- The Contractor is responsible to maintain continuity of branch wiring, controls cabling, etc. of existing systems that may extend outside of the scope of the demolition work of the project.
- Demolish abandoned cable as defined by NFPA 70 National Electrical Code: “installed communications cable that is not terminated at both ends at a connector or other equipment and not identified for future use with a tag."

1.8. Project Design and Construction Processes

Proper coordination of IT design and construction requirements are essential throughout the course of the project. Refer to Table 1 below for a summary of required tasks and deliverables organized by project phase. Note that some small projects of short duration shall have a combined Schematic Design and Design Development Phase, also referred to as an Enhanced Schematic Design (ESD).

Table 1 - Project Tasks and Deliverables

	Schematic Design	Design Development	Construction Documents	Bidding and Procurement	Construction	Close-Out
Project Design Kick-Off Meeting with Yale IT and Office of Facilities	X					
Site Survey with Yale IT Representative	X	X	X			
Forward Project Team Directory and Milestone Schedule to Yale IT representative	X					
Coordinate Project Telecom Rooms with Architect	X					
Coordinate with Utility Service Providers as Required	X		X			
Scope and Design Project Enabling Construction Packages	X	X	X			
Identify and issue written requests to Yale IT for variances from design requirements	X	X	X			
Provide Site OSP Plan, Building Riser, and Telecom Room Service Zone Diagrams	X	X	X			

	Schematic Design	Design Development	Construction Documents	Bidding and Procurement	Construction	Close-Out
Provide DAS Systems Site Assessment	X					
Determine DAS Systems Project Scope of Work	X					
DAS carrier coordination (AT&T, Verizon, T-Mobile) and signal source procurement		X	X	X	X	X
Provide ICT Basis of Design Project Narrative	X	X	X			
Provide Technology Project Drawings	X	X	X			
Provide Division 27/28 3-Part CSI Specification		X	X			
Yale IT develops network system design		X	X	X	X	
Provide Telecommunications Key Connection Schedule		X	X			
Provide project Wi-Fi Predictive Wireless Study Report using Ekahua Pro Software		X				
Conduct Page Turn Review Meeting with Yale IT	X	X	X			
Provide and Reconcile Yale IT Project Construction Budget	X	X	X			
Provide BIM Design and Coordination to LD300 Requirements			X			
Confirm Prequalified Security Contractor List			X			
Confirm Project Registration with Approved Cabling Plant Manufacturer				X		
Review Schedule of Unit Prices and Schedule of Values				X		
Descope Bidders and Review Contractor Certifications and Credentials				X		
Yale IT orders network equipment in coordination with Facilities project management				X	X	
Yale IT orders blue light emergency phone equipment in coordination with Facilities project management				X	X	

	Schematic Design	Design Development	Construction Documents	Bidding and Procurement	Construction	Close-Out
Contractor Shall Provide Project Schedule including Yale IT Milestone dates					X	
Contractor shall provide Yale IT with weekly construction progress reports					X	
Contractor shall document telecom room construction progress in Holo Builder Software					X	
Review and Approve Project Submittals (Copy and Discuss Approvals with Yale IT)					X	
Conduct Sitework and Underslab Site Field Report(s)					X	
Conduct Above Ceiling Pathways Field Report(s)					X	
Conduct Telecom Room and Structured Cabling Field Report(s)					X	
Sign-Off of Completed Turn Over and Acceptance Criteria					X	
Conduct Punch List(s) (Copy and Discuss Approvals with Yale IT)						X
Review and Approve Cabling Test Reports (Copy and Discuss Approvals with Yale IT)						X
Review and Approve Operations & Maintenance Manuals (Copy and Discuss Approvals with Yale IT)						X
Review and Approve Product Warranties (Copy and Discuss Approvals with Yale IT)						X
Review and Approve Record Drawings and BIM Model, Provided by the Contractor to LOD400 Level (Copy and Discuss Approvals with Yale IT)						X

1.9. Construction Drawings and Specifications

Provide a complete set of ICT construction documents detailing the project's scope of work. The organization and contents of the drawings shall follow the recommendations of the BICSI *Telecommunications Project Management Manual (TPMM)* and *ANSI/INFOCOMM 2M-2010 Standard Guide for Audiovisual Design and Coordination Processes*. Indicate ICT design work on T-series (Technology), SE-series (Security), or AV-series (Audiovisual) drawings as required for the project. Refer

to Appendix B – Differential Scope of Work Matrix for a system level breakdown of the work included in capital construction projects.

In addition, provide full CSI 3-Part Specifications including Division 27 – Communications and Division 28 – Electronic Safety and Security for each project. Typical Specifications Sections to be included, depending upon specific project requirements, are listed below. Refer to "Appendix G – CSI Outline Specifications" for abbreviated outline sections for reference only. The ICT Designer shall incorporate the content of the outline sections into full length specification sections for inclusion in the project construction documents.

DIVISION 27 – COMMUNICATIONS

270000	GENERAL COMMUNICATIONS PROVISIONS
270500	COMMON WORK RESULTS FOR COMMUNICATIONS
270526	GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS
270528	PATHWAYS FOR COMMUNICATIONS SYSTEMS
270529	HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS
270534	FLOOR BOXES FOR ELECTRICAL AND COMMUNICATION SYSTEMS
270536	CABLE TRAYS FOR COMMUNICATIONS SYSTEMS
270543	UNDERGROUND PATHWAYS AND STRUCTURES FOR COMMUNICATION SYSTEMS
270544	SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND CABLING
270553	IDENTIFICATION FOR COMMUNICATIONS SYSTEMS
271100	COMMUNICATIONS EQUIPMENT ROOM FITTINGS
271116	COMMUNICATIONS RACKS, FRAMES, AND ENCLOSURES
271313	COMMUNICATIONS COPPER BACKBONE CABLING
271513	COMMUNICATIONS COPPER HORIZONTAL CABLING
271523	COMMUNICATIONS OPTICAL FIBER HORIZONTAL CABLING
272000	TWO-WAY COMMUNICATION SYSTEMS
275119	SOUND MASKING SYSTEMS
275319	INTERNAL CELLULAR, PAGING, AND ANTENNA SYSTEMS

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

281300	ACCESS CONTROL
281600	INTRUSION DETECTION
282300	VIDEO SURVEILLANCE
285100	SECURITY INTERCOMMUNICATIONS SYSTEM

1.10. Project Budgeting and Schedules

Yale IT participates in the budget development and reconciliation process with the Facilities Project Manager during each project enabling, design, and bidding phase. To facilitate this process and properly plan for active systems deployment, the ICT designer shall proactively initiate coordination through the Facilities project manager. The ICT designer shall submit the following Coordination of Service Documentation (COSD) to Yale IT at each phase:

- "Appendix B – Differential Scope of Work Matrix"; Review and edit on a project specific basis. Each ICT system within the scope of work shall be identified.
- Project Summary: project name, project number, location, departments and occupancies, building space program with SF, and 8-1/2" x 11" plan diagrams
- Description of proposed site work and potential for interruption of existing infrastructure, including campus utility service providers
- Demolition and new work floor plans, indicating existing, relocated, and proposed Telecom Rooms
- Project schedule including enabling phases, departmental relocation move dates, certificate of occupancy dates, final occupancy dates

- ICT Basis of Design (BoD) narrative. The BoD shall include security systems device layout plan sketches and audiovisual systems types designations and quantities.
- ICT project drawings and specifications
- Telecommunications Key Connection Schedule: Coordinate and provide a Telecommunications Key Connection Schedule for each project in Microsoft Excel format. This schedule shall provide port take-off information for Yale IT to plan and deploy the network electronics and devices for the project. Refer to Table 2 below for a sample schedule:

Table 2 – Sample Telecommunications Key Connection Schedule

ROOM#	ROOM NAME	LOC.#	C6-V	C6-D	TV	FIB.	ACTIVE-Y/N	STA.ID	PHONE#	LEN
X	X	X	X#	X#	X#	X#				
X - FILLED IN BY THE ICT DESIGNER										
# - NUMBER OF VOICE/DATA/CATV/FIBER AT EACH LOCATION										
ACTIVE - CONNECT TO DATA HUB										

The ICT designer shall review the Construction Manager's project schedule for inclusion of the following milestones critical to Yale IT project deployments:

- Contractor bid review and descoping
- Bid award and Contractor notice to proceed
- ICT submittals review
- Selective demolition of existing ICT systems
- Communications site utility construction
- ICT systems rough-in
- ICT cabling installation
- Subcontractor network access requests
- Telecom Room turn over and acceptance
- Yale IT systems cutover
- Network Go Live
- Certificate of Occupancy Inspections
- End User Building Occupancy
- AV Installation and Commissioning

1.10. Telecom Room Turn Over and Acceptance Criteria

Prior to Yale IT acceptance of newly constructed or renovated Telecom Rooms, the project Contractors shall complete the following checklist and submit for ICT Designer/Yale IT approval. Incorporate the criteria below as contract requirements in project documentation:

- Provide construction schedule milestones for turnover of Telecom Rooms. Give a minimum of eight (8) weeks prior notice to permit network equipment orders such that the permanent equipment may be installed one time.
- The Structured Cabling Plant is installed in a neat and workmanlike manner, meeting the recommendations of the BICSI *Information Technology Systems Installation Methods Manual (ITSIMM)*. All cabling is bundled and managed using required cable management and runways.

- The punch list walkthrough has been performed
- All construction is complete inside the MDT/IDT Telecom Rooms
- Wall and ceiling surfaces are clean with final paint. Plywood backboards are properly installed
- Flooring is deeply cleaned (and waxed if applicable)
- Equipment racks, components, and trays are free of dust
- Packaging, supplies, debris, and wire clippings are removed from the TR interior and exterior vicinity
- Ductwork and vents serving the Telecom Room are cleaned
- Cabling service loops are properly supported
- The Structured Cabling Plant is labeled with machine printed labels and tested
- TR patch cords have been furnished, ready for installation by the Cabling Contractor
- Telecom Room penetrations and openings are sealed and firestopped with room positive air pressure
- Environmental systems are commissioned and operating normally with new air filters or temporary HEPA filters
- Power outlets are operational with correct device types. Prior notifications of planned power outages are provided
- Lighting and controls are installed with fixtures positioned correctly
- Grounding and bonding are provided per *TIA-607-D, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises*
- Permanent door is locked with limited key availability and the card reader is activated
- Door dust stopper is installed
- Dirt trapper/sticky mats are placed inside entrance door

1.11. Approved Products and Substitutions

Refer to Appendix A – Approved Components and Manufacturers, for a detailed list of equipment to be specified in capital construction projects. Yale IT primarily utilizes the listed approved products and has adapted language, practices, expectations, and a maintenance inventory based on their use. All ICT designs shall specify the features, quality, and performance of the products offered by these manufacturers. Where a specific manufacturer's product is specified, the Contract shall be based on that product only. Where several manufacturer's products are specified, Yale IT shall provide approval for the final products specified in the contract documents.

1.12. Cable Testing and Verification

Each copper horizontal permanent link shall be tested and verified per *ANSI/TIA-1152-A* and *ANSI/TIA-568.2-D* standards with Level III field test instruments for Category 6 (250 MHz) and Level IIIe field test instruments for Category 6A (500 MHz) cabling.

Each horizontal and backbone optical fiber permanent link shall be tested and verified per *ANSI/TIA 568.3-D*, *ANSI/TIA-526-7*, and *ANSI/TIA-526-14*. Test parameters shall include optical loss testing, magnified endface inspection, length measurement, and polarity testing. Outside plant interbuilding backbones shall also receive OTDR bidirectional testing at required multimode and Singlemode wavelengths.

Each 10 Gbps OM4 Fiber to the Desktop (FTTD) link shall be tested with a Bit Error Rate Test (BERT) test per the ITU-T standard G.821.

Copper multipair backbones shall be tested and verified for continuity, conductor shorts, polarity, effective ground test for shield, ground faults, power fault.

Air blown fiber tube cable testing: pressure and obstruction tests for all tubes and tube cables shall be conducted to manufacturer's recommended procedures. Test reports shall include tube cable ID, tube # (in), tube # (out), test pressure (P.S.I.), time held, and span length.

Test reports shall be generated and submitted to the ICT Designer, Yale IT and the cabling system manufacturer for review in electronic format with the appropriate reader software. All results shall include the cable identification numbers, test date and times, test operator, and the make/model of the testing equipment.

1.13. Record Documents

Upon completion and close out of the project, the ICT Designer shall review, approve, and forward a copy of the final project ICT record documents to Yale IT through the Facilities project manager. Yale IT will integrate the documentation into the cable plant and network system management databases. Electronic file naming shall follow Yale facilities standards requirements. Record documents provided shall consist of the following:

- Electronic drawing files in the following formats
  - Revit BIM Model, Level of Development 400 (LOD400)
  - CADD files in AutoCAD 2019 Format
  - PDF files
- Drawing files containing scale drawings of the complete ICT work set with all Yale IT disciplines. This will include site and building floor layouts depicting outlet locations, equipment plans, device locations, final labeling, telecom rooms, cable pathways, riser diagrams and all other information pertinent to the installation. In addition, include security system devices and equipment including card readers, cameras, panels, and all other devices on record drawings.
- Provide laminated hard copy, black and white, double sided, 11"x17" record drawing floorplans of areas served by each telecom room, and wall mount with hook and loop fasteners in the corresponding telecom room.
- Spreadsheet tables in Microsoft Excel format providing categorized workstation outlet room locations and labels as well as cross-connect field labeling diagrams for each patch panel and 110 block.
- Outside Plant Documentation – Submit the following for Yale IT to incorporate into the campus Langan GIS outside plant database:
  - Record photography of each telecom maintenance hole/handhole wall, as well as ductbank point of entrance close-ups
  - Record photography of OSP excavation indicating uncovered site utilities prior to trench backfilling
  - Butterfly maintenance hole diagrams in Microsoft Excel format listing each backbone and ABF tube cable name, type, size, and conduit routing.
  - Communication site civil utility drawings with ductbank routes and depth profiles
  - ABF system distribution diagrams
- Test reports for various systems as required herein in PDF format and original test data files with reader software.
- Operation and Maintenance manuals in PDF format for each system as required herein.
- Product and systems warranties documentation as required, registered with the Manufacturer.
- Audiovisual control systems source code files and configurations
- Security panel input/output sheets for each node. Print each sheet and place in panel with a PDF sent to Public Safety. Request template from Yale IT.
- Security panels shall be bar coded per naming convention standards provided by Yale IT.
- Wireless Access Point Installation Data including:
  - A floor plan identifying the exact location of each WAP
  - The identifier of the UTP permanent link supporting each WAP
  - The serial number and MAC address of each WAP in reference to its location

  - The mounting height above finished floor of each WAP
- User and system administrator training course materials and recordings

1.14. Interbuilding Backbone Pathways

Campus outside plant communications ductbanks and subbasement utility tunnels form the pathways for interbuilding backbone cabling serving each building. Yale IT must approve all pathways and building point of entrance designs in writing. Request existing outside plant record documentation from the Langan GIS system campus database for design reference. The recommendations of *ANSI-TIA-758-B-2012 - Customer Owner Outside Plant Telecommunications Infrastructure* and BICSI *Outside Plant Design Reference Manual, 6th Edition shall be followed for specific design and installation requirements*. In addition, observe the following design criteria:

- Interbuilding backbone pathways shall be provided in buried duct structures or building utility tunnels.
- Backbone pathways to each building point of entrance from the designated existing communications maintenance hole shall consist of four (4) 4" schedule 40 rigid nonmetallic conduit in concrete encased reinforced ductbank, unless directed otherwise by Yale IT. Confirm project specific requirements for redundant pathways for physical route diversity.
- Depth to top of ductbank shall be no less than 30" from grade. Follow NESC and NEC requirements for minimum utility line separations.
- Each duct conduit shall be mandrelled and have a pull rope with footage markers installed. Conduit ends shall be reamed and plugged to prevent ingress of water and debris. Ductbanks shall slope away from building point of entrances at 1/8" per foot minimum.
- Tracer wire caution tape shall be installed 12 in. above communications underground ductbanks.
- Ductbank lengths, routing, and bends shall comply with ABF tube cable system installation limits and requirements. In a campus environment, continuous straight ductbank lengths between maintenance holes shall be limited to 350 ft. Ducts shall have no more than 180 degrees of cumulative bends between maintenance holes/handholes. Curvatures shall be long and sweeping with a minimum bend radius of 15 ft.
- Joint Use Maintenance Holes (MHs) are not permitted for communications infrastructure.
- Communications maintenance holes (MH) may either be pre-cast or cast-in-place with at least 24,000 kPa (3500 psi) concrete, typically sized 7'L x 7'W x 6'H. Final size selection is project specific, to be governed by Yale IT.
- MH's shall have duct knockouts arranged for conduit entrances on all four walls. Conduits shall enter and exit the maintenance hole in a straight-line method. The remaining parallel walls are to remain free of conduit entrances for cable support and splicing operations unless otherwise permitted by Yale IT.
- MH appurtenances shall include ground rod, cable racks, pulling irons, 8" diameter sump hole, bolted entrance collar and frame, permanently installed ladder from top of collar to floor, and cover labeled "Telecommunications"
- MH covers shall be minimum 30" diameter round, cast iron, and centrally located on single-cover MH. Collar
- Handholes (HH's) may be used in backbone pathways serving small facilities where the communications infrastructure requirements are sparse. HH's shall be used as pull through points only and not splice points. HH's shall not be used in conduit runs that have more than three (3) 4" conduits. The maximum HH size shall not exceed 4'L x 4'W x 4'H.
- HH covers shall be 30" round minimum and centrally located for full access to the vault. Frames and covers used in roads or driveways shall be H-20 rated minimum to withstand vehicular traffic.

Utility Service Provider Coordination

Where the project scope of work involves moves, adds, changes, or disruption to existing utility service provider infrastructure, coordinate requirements through Yale IT. Existing campus service providers include:

- Frontier
- Comcast
- Crown Castle

Air Blown Fiber (ABF) Campus Distribution

The ABF system forms the optical fiber pathway infrastructure for distribution of air blown PEF (Polyethylene Extruded Foam) jacketed fiber bundles that contain 2 to 48 strands. The project may provide ABF tube cables through the campus ductbank system to buildings from a Core Network Room, an intermediate fiber distribution hub in another building, or from splices in nearby maintenance holes. Coordinate ABF system designs with Yale IT, beginning in the schematic design phase. The number of required tubes and fiber bundles shall be sized to accommodate the fiber configuration specified by Yale IT. The tube cable pathway may be segments of new tube cables, existing tube cables, or a combination of both. They shall be spliced together at various locations, to provide a continuous tube for air blown fiber bundles from the Core Network Room to the project building destination.

For each fiber span, indicate fiber types, strand counts, fiber distribution panels, tube cables, tube distribution units, and indoor and outdoor tube splices. Fibers may be OM4 50/125 um multimode (MM) and/or OS2 singlemode (SM) in bundles of 2 to 48 fiber. Confirm quantity and types of fiber strands required with Yale IT. Typically each building will be served with 48 strands OS2 singlemode and 48 strands OM4 50 micron multimode.

Provide for termination hardware of fiber bundles in building and core network rooms. Specify appropriately sized, high density, MM and SM, rack mounted, fiber distribution panels (FDP) with connector adapters as directed by Yale IT.

Tube cables include capacities of 2, 4, 7, and 19 tube cells. The cable tube capacity shall accommodate immediate fiber requirements plus future spares, as directed by Yale IT. The tube cable may be installed in conduit, exposed in tunnels or plenums, and routed through MH's. In all cases, the minimum bending radius of the tube cable, in conduit or not, shall be no less than 20 times the tube cable diameter.

Tube Distribution Units (TDU) are inside building enclosures used to transition or branch individual tube cells of tube cables. Tubes are joined together with manufacturer specified connector hardware, to provide the required, continuous, air blown pathways between building and core network rooms. At branch locations provide, unjacketed, black tubes to connect required tubes of one tube cable to another. At the network room locations, transition to unjacketed clear tubes for connection from the TDU to the rack mounted FDP's. Bending radius of tubes to be no less than 9" radius. All non-used tubes in the tube cables are to be sealed with tube end caps and stored in the TDU

Provide and locate, in the building and core network rooms, and any required intermediate building branch points, appropriately sized wall mounted tube distribution units (TDU) to terminate tube cables. Manage tube cables using Kellems Grips and bushings as recommended by the system manufacturer. Mount no more than three tube cables per TDU enclosure.

Tube cable splices not in TDU's may be required for long tube cable lengths (in-line) and/or branching in MH's. Provide appropriately sized, preformed, outdoor splice casings for maintenance hole or tunnel installation. Install tubes cables in conduit in such a manner that one (1) conduit is full prior to using the

next conduit. Conduit fill shall not exceed 40% of conduit cross sectional area. A maximum of two (2) 19-tube tube cables may be installed in one (1) 4 in. conduit without exceeding 40% conduit fill limitations. A maximum of five (5) 7-tube tube cables may be installed in one (1) 4" conduit without exceeding 40% conduit fill limitations.

The ABF system Contractor shall be certified by the ABF system Manufacturer to provide a 25-year extended warranty for the installation. The system shall be labeled including all fiber bundles, fiber termination units, terminations, tube cables, tube cells, tube splices, and tube distribution units. The system shall be fully tested, and reports provided as required. Documentation preparation shall include but is not limited to submittals, record drawings, system O&M documents, extended warranty, and manufacturer's certification of systems.

1.15. Interbuilding Backbone Cabling

Project requirements for interbuilding multipair copper and hard sheath optical fiber backbones shall be provided to the ICT Designer by Yale IT. OSP multipair copper cable shall be gel filled with transition to non-gel filled riser cable or lightning entrance protector stubs prior to termination at the lightning entrance protector. OSP rated cabling may be routed exposed from the building point of entrance for no more than 50' when not routed in IMC or rigid metal conduit. Provide lightning entrance protection for all OSP copper interbuilding backbone pairs, using 5-pin 240v solid state modules with PTC (positive temperature coefficient). Rack mounted lightning entrance protectors are typically provided within core network rooms with wall mounted units provided in building Telecom Room MDT's. Typically, a 25 pair copper backbone or 25 existing pairs in an existing trunk bundle shall be provided to serve each building (to be confirmed by Yale IT). Copper multipair outside plant splices shall consist of preformed line product stainless steel fillable splice cases with re-enterable encapsulant and 710 modules.

1.16. Telecom Room Requirements

Telecom Rooms (TR's) shall be designed as dedicated environmentally controlled rooms within buildings to serve as HC's (IDT's) or an IC (MDT) as well as contain active network electronics and building system head-end panels. Telecom room locations, sizes, and dimensions shall be designed in the schematic design phase and must be approved in writing by Yale IT.

Location and Adjacencies

- Telecom Rooms shall typically be located near the center of the area/floor served. The area served by the TR and the location of the TR shall be such that no permanent link exceeds 90 m (295 ft.) in total length.
- In a multi-story building, the TR's shall be located as to stack one directly above another in vertical congruence.
- Consideration shall be given such that the TR location selected may offer expansion into a larger room. Locations that are restricted by building components limiting future expansion shall be avoided (e.g., elevators, building structural elements, kitchens, outside walls, or other fixed building walls, etc.)
- TR's shall be accessible through common-use corridors that will allow the delivery of large cable reels and equipment, and access for repairs on a 24x7 basis.
- The main Telecom Room housing the building MDT shall be located as close as practical to the building entrance demarc point, and (if possible) to the electrical service room to reduce the length of OSP rated interbuilding backbones and bonding backbone grounding conductors.

- TR's may not be inside of or be part of a mechanical space, equipment room, washroom, storage area, or janitor closet.
- TR's shall be located in a dry area not subject to flooding. The TR shall not be located below water level unless preventive measures against water infiltration are employed. The room shall be free of water or drain lines not directly required in support of the equipment within the room. A floor drain shall be provided within the room if risk of water ingress exists.
- There shall be no obstructions in the room such as columns or building structure.
- Plumbing, piping, and fixtures are not permitted within a TR, except for a code required wet sprinkler line/head. The room shall not be located beneath toilets, showers, laboratories, kitchens, sinks, roof drain leaders, or other areas where water/liquid services are provided. No fire protection mains shall be routed through the room.
- The TR shall be located away from transformers, switchgear, motors, x-ray equipment, induction heaters, arc welders, radio and radar systems, or other sources of electromagnetic interference.
- Mechanical lines (e.g., ductwork, pneumatic tubing, electrical conduits), not related to the support of the TR, shall not be routed through it. In addition, the corridor plenum areas adjacent to the TR shall remain accessible and clear for cable pathways exiting the room.

Architectural Design Criteria

Room Sizes: Each building, regardless of size, shall have a minimum of one (1) full size MDT Telecom Room, unless otherwise approved by Yale IT. For renovations and adaptive reuse projects, a Shallow Telecom Room (STR) or Telecom Enclosure (TE) design may be submitted for final approval by Yale IT.

Telecom Room size shall be based on Table 3 below. Final sizes shall be reviewed on project specific basis. All dimensions indicated below are inside room dimensions.

Table 3 - Telecom Room Minimum Size Requirements

Building Area Served (GSF)	Room Size
Floor Area 25,000+	10'x14'
Floor Area 10,000-25,000	10'x11' *
Floor Area 5000-10000	10'x9' *
Floor Area 0-5000	10'x8' *
Building Smaller than 5000	4'x8'-6" (Shallow TR configuration)
Building Smaller than 1000	Telecom Enclosure (TE)

* *Where project programs require extensive audiovisual instruction and collaboration spaces, one or more TR's shall contain at least one additional equipment rack for network-based IP AV 1 Gbps and SDVoE 10 Gbps systems. To serve this capacity requirement, a 10'x14' TR room size will be required.*

Walls: All four (4) walls shall extend from the finished floor to the structural deck (e.g. the slab) and be fire rated if required by NFPA or the Connecticut State Building Code. This requirement is to provide environmental protection (dust) and climate control for electronic equipment. All four (4) walls shall be covered with ¾ in. void free grade A-C FRT plywood. Plywood shall be painted on all six sides with two coats of light gray fire-retardant paint, with FRT stamps left unpainted. Mount plywood 6" above finished floor to a height of 8'-6" on all walls. No windows or door sidelites shall be provided in the room.

Ceiling Height: No finished ceiling, open to building structure above, with minimum 10' clear above floor. Rooms shall not have a lay-in acoustical tile ceiling in order to not obstruct cable pathways. In such cases where fireproofing may be sprayed onto the exposed structural ceiling (deck), the fireproofing shall be treated to mitigate airborne dust.

Finishes: Floors, walls, and ceiling shall be treated to eliminate dust. Finishes shall be light in color to enhance room lighting in TR's. Floor covering shall be a vinyl anti-static or conductive rubber tile material. Color shall be determined on a case-by-case basis. The flooring shall be prepped, leveled, sealed, and cleaned prior to installation of flooring materials.

Doors/Access Control: Doors shall be a minimum of 36" wide and 80" high, without doorsill, hinged to open outward (code permitting) and rated as required. Doors for shallow TRs shall be double doors that open out 180 degrees to corridor. Shallow TR doors shall have top and bottom flushbolts that secure the inactive leaf. Door(s) shall be fitted with the University standard wall mounted HID multiCLASS card reader with integral keypad for two-factor authentication. The lock shall be electrified with key override keyed for a Yale IT key code. Door position switch, latch bolt monitoring, and a request to exit switch shall be provided. A campus IP security camera shall be provided in the Telecom Rooms to monitor the room entrance.

Floor Loading: The TR shall be located on floor areas designed with a minimum floor loading of 2.4 kPa (50 lb./ft2). The project structural engineer shall verify that concentrations of proposed equipment do not exceed the floor-loading limit.

Signage: The TR room shall be identified in accordance with the campus and building signage system.

Table 4 - Telecom Room and AV Projection Room Finish Schedule

TR Surface	Telecom Rooms/ AV Projection Rooms	Comments
Floor	24" x 24" Electrically Conductive Rubber Tile	Provide product equal to Staticworx Eclipse EC; Static Generation: <20 volts when tested according to ESD STM 97.2.*
Base	6-Inch High Rubber Wall Base	ASTM F1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous), Style B (cove)
Walls	¾ Inch Grade A-C FRT Plywood **	Install plywood 6 inches above finished floor to a height of 8'-6" on all walls. Paint plywood on all 6 sides with 2-coats of fire-retardant paint, (Light gray for Telecom Rooms, flat black for projection rooms). Do not paint over the Grade and FRT stamps.
Ceiling	Open to underside of deck above.	Where fire-resistive coatings are present on structural steel members, apply a compatible surface sealer to prevent dusting.***

* Prior to finish floor installation, confirm floor levelness meets the requirements for the function of the room. Provide floor leveling as required for room function and finishes. For projection rooms, the floor shall be level and not be sloped such as the audience area of the venue.

** Plywood backboard wall panels are installed on gypsum-board-clad steel stud or masonry walls.

*** Surface sealer shall be a UL classified surface sealer. Apply surface sealer at manufacturer's recommended spreading rate.

Electrical Design Criteria

Power: Each Telecom Room shall contain a 120/208V, 100A Main Circuit Breaker, 42-circuit subpanel dedicated to serve the equipment within the room. The subpanel shall be served from the campus normal and alternative (if available) power source Main Distribution Panel in the building. The subpanel shall be protected from voltage transients and power fluctuations by a Surge Protective Device, IEEE category B3 rated, installed in the subpanel.

UPS Power: Based upon the building use and project design criteria, a building-wide UPS system may be provided. This shall be a project specific decision confirmed by the project management team. If a building-wide UPS system is provided, the Telecom Room electrical subpanel riser shall be served by the UPS. If no building-wide UPS system is provided, local Telecom Room UPS's may be provided (project specific). Local Telecom Room UPS systems shall only be sized to maintain network systems operation during the outage time before the alternate power source is transferred online. Yale IT may typically size UPS's at 3KVA or 6KVA, depending upon the load requirement within the Telecom Room. If the building does not have the campus alternate power source available, local UPS units *shall not* be provided in Telecom Rooms. Note that UPS units, if provided, shall be registered under a multiyear maintenance service agreement (not included in the capital construction project scope).

Electrical circuiting and wiring devices: Provide circuits and receptacles from the TR electrical subpanel.

- Provide one (1) 120V/20A branch circuit with two NEMA 5-20R duplex receptacles in a 4"x4" outlet box mounted on the cable runway above and behind the center equipment rack.
- Based on project specific requirements, provide two (2) 208V/30A or 20A, 1Ø branch circuits each supplying one NEMA L6-30R or NEMA L6-20R twist-lock receptacle, respectively, in 4"x4" outlet box mounted on the cable runway above and on each side of abovementioned outlet box.
- Provide a minimum of two (2) 120V/20A branch circuits to serve security access control system panels and associated power supplies.
- Coordinate with design disciplines to determine locations of additional building systems panels located in the TR. Provide circuits as required for the systems (e.g. BAS, Fire Alarm, DAS, MNS, FAVE)
- Provide two (2) 120V/20A branch circuits serving a minimum of six (6) NEMA 5-20R duplex receptacles spaced evenly along the room perimeter at 18" above the floor, with box extensions through the plywood backboard. Shallow TR's shall be provided with three (3) NEMA 5-20R duplex receptacles.
- All junction boxes and receptacles shall have laser printed circuit identifiers affixed indicating the panel ID and circuit number.

PDU Units: Two redundant PDU units shall be provided and mounted in the TR equipment racks. The redundant power supplies within the network electronics equipment shall be connected to each PDU. One PDU Unit shall connect directly to the twistlock receptacle (L6-30R or L6-20R) located on the cable runway above the equipment rack, that is circuited to the Telecom Room subpanel (building power). The second PDU shall connect to the local UPS in the room if provided (project specific). The local UPS shall connect to second twist-lock receptacle (L6-30R or L6-20R) located on the cable runway above the equipment rack. If no UPS is provided for the project, both PDU's shall connect directly to the twistlock receptacles (L6-30R or L6-20R) located on the cable runway above the equipment rack served by the Telecom Room Subpanel.

Lighting: Lighting levels shall be a minimum of 50 foot-candles horizontal and 20 foot-candles vertical measured 3'-0" above the finished floor in equipment rack aisles. Fixtures shall be pendant mounted from structure approximately 8'-6" above the finished floor, suspended between and not from cable runway sections. Light fixtures shall be LED with universal-voltage electronic drivers and protective wire guards. A wall control switch with digital timer control shall be located at the room entrance. Dimmer switches and occupancy sensors shall not be used. Lighting fixtures shall be powered on a dedicated circuit from the TR subpanel, powered from the building alternate source to provide stand-by lighting within the room.

Bonding and Grounding: A telecommunications grounding system shall be provided complying with *TIA-607-D* . The main TR housing the MDT shall have a Primary Bonding Busbar (PBB) provided to which all Secondary Bonding Busbars (SBB's) located in STR's/TR's/AV Projection Rooms are connected through the Telecommunications Bonding Backbone (TBB). TR equipment, equipment racks, conduits, cable shields, entrance protectors, cable runways, sleeves, structural steel, local electrical panels, etc. shall be bonded to the room PBB or SBB. In addition, provide grounding for roof mounted antennas and equipment. The PBB shall be connected to the normal main electrical service ground of the building with a Telecommunications Bonding Conductor (TBC). Note that Yale buildings may have the alternate service

ground separated from the normal service ground, or the normal and alternate systems bonded together. Provide grounding system labeling and testing per standard recommendations.

Environmental Design Criteria

The rooms shall be protected from high temperature, contaminants, dust, moisture, and humidity that could affect operation and material integrity of active equipment within the TR.

HVAC Systems: HVAC shall be available on a 24 hours-per-day, 365 days-per-year basis. A stand-alone unit shall typically be provided for TR's when the building's HVAC system cannot ensure continuous operation. HVAC systems shall be powered by the campus alternate power source if available within the building. Provide a BMS system high temperature alarm point programmed to activate if the cooling setpoint temperature threshold is exceeded for more than 15 minutes.

Equipment Locations: HVAC equipment shall be wall mounted at a location that does not obstruct room cable pathways. Do not locate HVAC equipment above equipment racks or wall mounted systems panels. If this is unavoidable due to project circumstances, and a variance is granted by Yale IT, drip pans shall be located under the HVAC equipment. The pans shall be configured with drain lines and integral leak detection sensors that are configured as monitoring and alarm points in the building's BAS system. Equipment condensate drain lines shall immediately exit the room and not be routed along walls, cable runways, or over equipment racks. Condensate pumps shall not be provided within the TR unless approved by Yale IT.

Room Equipment Loads: Coordinate with Yale IT to develop load assumptions to be provided to the project HVAC Designer. The ICT Designer shall provide Yale IT with the required Coordination of Service Documentation including the Telecom Key Connection Schedule and Differential Scope of Work Matrix. This shall permit an estimate of network port counts and other system equipment to be created, confirming approximate heat rejection and cooling load requirements. Designers shall complete equipment specific load calculations and/or study equivalent TR's on campus to determine necessary cooling approach. Note that the addition of audiovisual network gear into the TR, if required, shall increase load requirements.

Operational Parameters: The TR HVAC system shall support equipment classes A1-A4 per ASHRAE TC9.9 with the following criteria:

- Heating setpoint: 64.4°F
- Cooling setpoint: 80.6°F
- Humidity Range, Non-Condensing 16°F DP to 59°F DP and 60% RH
- Local room thermostat control with BMS high temperature alarm. Thermostats shall be wall mounted and not battery powered.
- The BICSI TDMM provides a recommendation to "Maintain a positive pressure with a minimum of one air change per hour in the telecommunications space." In the mechanical system project Basis of Design, provide an evaluation including cost range and increase of system complexity to achieve this. Review with evaluation with facilities project management to determine whether this recommendation should be implemented in the project.

Vibration: Mechanical vibration coupled to equipment or the cabling infrastructure can lead to service failures over time. A common example of this type of failure would be loosened connections. If there is a potential for vibration within the building that will be conveyed to the TR via the building structure, the project structural engineer shall design safeguards mitigating excessive vibration.

Fire Protection: TR fire protection systems shall be provided as required by Code. Typical building TR's may be fitted with wet sprinklers utilizing wire guards over heads. In some cases, the TR may contain highly mission critical equipment or highly valuable assets that could mandate a dry pipe pre-action system. Campus Core Network Rooms shall require dry pipe pre-action or FM-200 clean agent fire suppression systems. Coordinate fire detection and extinguishing requirements with the Yale Fire Marshal.

Telecommunications Room Fit-Out Requirements

The TR's shall be fit out to meet the infrastructure requirements of Yale IT. Building end user equipment shall not be permitted in TR's. Fit-out components shall include:

- Wall plywood backboarding (refer to Architectural Design Criteria above)
- Overhead cable runway: Provide black color cable runway in 12", 18", and 24" widths around the TR perimeter and over each equipment rack line. Provide 6" of clearance from the wall to the edge of the cable tray for wall mounted electrical and systems panel clearances. Install the cable runway at 7'-9" above finished floor, leaving 9" clearance above equipment racks. Provide "waterfall" cable radius bend protection over each rack vertical cable manager. Ground each section of cable runway and bonding to the PBB/SBB.
- Sleeved penetrations: Provide a minimum of four (4) 4" re-enterable engineered firestop through penetration sleeves with integral intumescent material, installed through the wall into the corridor ceiling plenum above finished accessible ceiling. In addition, provide a minimum of four (4) 4" re-enterable engineered firestop through penetration sleeves in the floor below and deck above into corresponding stacked TR's. Final sleeve quantity required shall be based on cabling amounts, plus 50% spare capacity. Sleeve fill should not be less than the minimum, nor, more than the maximum, specified by the fire stopping material manufacturer. Provide additional vertical wall mounted cable runway sections to transition from floor and wall sleeves. All firestopped penetrations shall be labeled as required.
- Equipment rack line: Typically, provide three (3) two-post open 84"H equipment racks in a rack line, bolted to the floor, each bonded with a dedicated #6 AWG TEBC to the PBB/SBB.
    - Provide full height double-sided vertical cable management between each rack and at both ends of the rack line.
    - Upper transition trays shall be provided at the top of each rack, with horizontal cable managers required
    - Rack #1 (left) shall contain interbuilding backbone (MDT only) and riser cabling terminations at the top of rack. These shall consist of optical fiber termination cabinet(s) and 48 port RJ-45 Category 5e copper multipair voice riser cross-connect patch panel(s). Also, Yale IT provided active network electronics, gateways, and PDU's shall reside in the rack.
    - Rack #2 (center) moving left to right, shall contain horizontal cabling cross-connects consisting of angled 48 port RJ-45 Category 6A patch panels.
    - Rack #3 (right) shall contain systems including:
        - DAS system singlemode optical fiber system hub(s) and horizontal optical fiber cross-connect serving remote units
        - Fiber to the Desktop (FTTD) 50-micron laser optimized OM4 multimode horizontal optical fiber cross-connect termination cabinet(s), and corresponding fiber network switches, if required
        - Audiovisual systems network infrastructure, including IP AV 1 Gbps and SDVoE 10 Gbps architectures. Based upon the extent of these systems, additional dedicated equipment rack(s) (Rack #4, etc.) may be required in the rack line. SDVoE 10 Gbps systems operate on 50-micron laser optimized OM4 multimode optical fiber horizontal connections and additional fiber termination cross-connect cabinets shall be provided to support them.

    - IP sound masking and paging systems if required
    - Miscellaneous building systems
- Cable management: Cabling within the TR shall be expertly installed and managed in equipment racks and cable runways per the BICSI *ITSIMM*.
    - Category 6A cabling shall be organized in neat bundles of 24 cables, trained together from the rear patch panel terminations and routed into the rear section of the rack vertical managers and up to the overhead cable runway.
    - Strain relief bars shall be provided behind each patch panel where cabling will be supported and converge into a bundle.
    - Bundles shall neatly lay adjacent to and in parallel with one another within the cable runways.
    - Each bundle shall be secured with re-enterable hook and loop strap fasteners at the same 2' intervals. Aligned strap positioning shall be used to create air flow gaps between bundles.
    - Follow the recommendations of the NEC and *TIA TSB-184-A Guidelines for Supporting Power Delivery over Balanced Twisted-Pair Cabling* for design of cable bundles and pathways supporting the *IEEE 802.3bt* standard to source up to 90 watts at the PSE.
    - Machine printed cable labels shall be affixed within 2" of the cable termination at the patch panel.
    - Service loops shall be configured in figure 8 arrangements and fully supported on wall plywood backboard or empty cable runway.
    - Patch cords installed from patch panels into network switches shall utilize switch ports in sequential order. Do not skip or "jump around" to various ports on the network switch.
- Building Systems Headend Collocation: Yale IT shall permit the TR to be used by designers to collocate low voltage systems equipment panels and headends. This strategy permits shared use of the secure conditioned environment, cabling plant, building pathways (maintain separations), and IP networking. These low voltage systems shall include:
    - Security Systems
        - Access control panel headends shall be wall mounted in building TR's.
        - Network connectivity for access control panels, security cameras, intercom systems, and emergency phones shall be provided by the campus network. A dedicated security system IP network shall not be provided.
        - Category 6A cabling serving security devices shall be purple color. The cabling shall be fully integrated into the cable plant and not broken out into a separate patch panel.
        - Access control system composite cabling (non-IP) shall be physically separated from Category 6A cable bundles within pathways by no less than 6".
    - Audiovisual Systems
        - Each AV device in IP AV systems operating at 1 Gbps (such as the QSC Q-SYS Ecosystem) shall be served with Category 6A cabling plant from the TR with no physical layer distinctions in the cable plant.
        - Dedicated AV LAN network switches shall be provided in the TR by the Yale IT, and the IP AV devices shall be patched into the AV LAN network switches.
        - Optical fiber riser backbone strands shall uplink the AV LAN network switches.
        - IP AV system Core Processor(s) shall be provided in the MDT TR to serve the building-wide system.
        - Each AV device in SDVoE systems operating at 10 Gbps (such as the IDK 4K@60 AV over IP) shall be served with a dedicated 50-micron laser optimized OM4 multimode optical fiber horizontal cable plant.
        - 10 Gbps AV devices shall be connected to dedicated 10 Gbps per port, 100 Gbps or better AV LAN network switches that shall be provided in the TR by Yale IT and patched into the AV LAN network switches.
        - Optical fiber riser backbone strands shall uplink the 10 Gbps per port, 100 Gbps or better AV LAN network switches.
    - DAS Systems

        - DAS system secondary hubs in TR's shall provide 48V power (2C-14AWG) and communications (2 strand OS2 singlemode on LC duplex connectors) to remote units/antenna located throughout the building, using building pathways and open top J-hooks.
        - The DAS system primary hub shall be located in the building main TR MDT.
        - Singlemode OS2 backbone riser strands shall be designated for DAS and cross-connected into the hubs within TR's.
    - Building Automation Systems (BAS)
        - The ICT Designer shall coordinate with the project mechanical engineer for final locations of BAS system panels. The BAS systems shall utilize an independent dedicated control system network provided by the BAS system vendor. Campus network connections shall be provided at main BAS control panel locations, with no distinction in the physical layer cable plant.
    - Fire Alarm Voice Evacuation (FAVE) System
    - Mass Notification Systems (MNS)
    - Fiber to the Desktop (FTTD) Systems

1.17. Backbone Riser Cabling

Backbone riser cabling shall be provided for interconnections between the building MDT (IC) and IDT's (HC's) in a logical star topology. Backbone riser cabling requirements include the following (to be confirmed by Yale IT for each project).

- Optical Fiber Backbone Riser Cabling
    - Forty-eight (48) strand OS2 singlemode optical fiber, OFCP rated with interlocking armor and tightbuffered construction, terminated in rack mounted fiber termination cabinet with duplex LC splice on connectors. The fiber shall be ITU-T G.652.D compliant Full Spectrum.
        - Six (6) strands are reserved for DAS systems. Campus Zinwave deployments shall require APC angled physical contact style singlemode connectors.
        - Six (6) strands are reserved for AV LANs
    - Forty-eight (48) strand 50 Micron Laser Optimized OM4 multimode optical fiber, OFCP rated with interlocking armor and tightbuffered construction, terminated in rack mounted fiber termination cabinet with duplex LC splice on connectors.
        - OM4 termination hardware shall be Erika Violet color to distinguish from OM3 termination hardware, which is aqua color.
    - Provide splice on fiber connectors. Mechanical connectors are not permitted.
    - Provide 50% spare capacity in fiber termination cabinets
- Copper Multipair Voice Backbone Riser Cabling
    - One (1) 25 pair, CMP rated 100 Ohm multipair balanced twisted pair, 24 AWG solid conductor Category 3
    - In the MDT, terminate all risers on rack mounted 110 cross-connect blocks with C5 clips and cross-connect into the building entrance cable 110 block.
    - In the IDT's, terminate on a rack mounted 24 port Category 5e RJ-45 patch panel, with one pair terminated per RJ-45 port. The pair shall terminate on pins 4,5 in AT&T T568A connection.
    - Within the MDT, one (1) 25 pair shall be provided from the 110 rack cross-connect block, terminated wit C5 clips, to the rack. On the rack, terminate on a 24 port Category 5e RJ-45 patch panel, with one pair terminated per RJ-45 port. The pair shall terminate on pins 4,5 in AT&T T568A connection.
    - This topology shall permit an analog voice line to be cross-connected to any building workstation outlet using an RJ-45 patch cord.

1.18. Backbone Riser Pathways

- Backbone cabling pathways shall be clearly designated and designed to provide routing and protection for backbone riser cables, with 50% future capacity growth.
- Provide a minimum of four (4) 4" EMT from the main TR MDT to the IDT TR stack of rooms, or to each TR where they do not stack. In lieu of EMT conduit stubs, re-enterable engineered firestop through penetration sleeves shall be used where TR's directly stack.
- Backbone Pathways routed through the building shall be either cable tray or conduit. The installation of a physical separation for the protection of the backbone cables from horizontal cable installation is required. Backbone cables installed in cables trays shall be rated for appropriate use. Yale IT must approve use of cable tray as a backbone distribution system.
- Where backbone cables pass through stacked TR's, provide a cable runway vertically mounted from floor to ceiling for cable support.
- The conduit pathway shall extend to the roof to accommodate current or future cabling needs. Roof penetrations and seals shall be provided by the roofing contractor and not violate the roof warranty. Extend the building TBB to the roof to permit bonding of equipment.
- All pathway through penetrations shall be sealed or firestopped.

1.19. Horizontal Pathways

Horizontal cabling shall be supported from the TR's to the workstation outlets with an organized system of cable trays, J-hooks, and conduits. Pathways shall be sized to permit 50% spare capacity. According to the TIA Category 6A standard cabling distance limitation, the maximum run distance of horizontal pathways, including to floors above or below, shall be less than 295'. All pathway through penetrations shall be sealed or firestopped.

Typical outlet pathway installation shall consist of the following:

- J-hook open top cable supports above accessible ceilings to main cable tray runs
- Cable tray runs in corridors and densely populated areas, consolidating at the local TR
- One (1) 1.25" Conduit from 4-11/16"x4-11/16"x2-1/8" telecom outlet box with single gang trim ring stubbed above nearest accessible ceiling within the same room.
- Size horizontal distribution conduits for Category 6A cabling according to the minimum requirements in the table below:

Maximum Quantity of Cables at 40% Conduit Fill Based on Conduit Trade Size								
Cable Type	**Typical Cable Outside Diameter**	**1.25"C**	**1.5"C**	**2"C**	**2.5"C**	**3"C**	**3.5"C**	**4"C**
Category 6A	**0.295"**	**7**	**10**	**18**	**28**	**41**	**56**	**73**

Cable trays: Single tier overhead wire mesh basket style tray

- Provide 8" clear above tray for cable access
- Utilize ninety-degree sweeps when change in direction is required
- Bond to telecommunications grounding system
- Cable trays shall be continuous with no breaks or sharp cuts
- Methods of support: cantilever, trapeze brackets, or center hanging

J-hooks: J-hooks or equivalent open top cable supports are permitted for use above accessible finished ceilings.

- Supported from building structure
- Spacing shall be three to five ft. apart, with an average separation of four ft.
- Use is permitted from main cable tray runs to workstation outlet conduit stubbed out above accessible finished ceilings
- Provide 50% spare cabling capacity

Conduit: EMT conduit shall be provided for horizontal cable distribution where required. If the conduit route may be subjected to physical damage, provide RMC threaded conduit.

- Conduit runs shall have pull boxes every 80 ft. maximum and/or every two 90-degree bends
- Conduit bends shall sweep, LB fittings are not permitted
- Conduits shall be provided with pull strings
- Conduit shall be provided in the following areas:
  - Areas exposed without finished ceilings
  - Inaccessible ceilings
  - Tightly congested areas
  - Transition between floors
  - Serving floor mounted outlets

1.20. Horizontal Cabling

Horizontal network cabling for data, voice, and IP based video shall conform to the *ANSI/TIA-568-C.2, Balanced Twisted-Pair Telecommunications Cabling and Components for Category 6 and Category 6A Cable*. Cabling shall be NEC CMP plenum rated. Cable jacket color shall be blue per Yale IT standard unless otherwise noted. Terminate using T568B style terminations on rack mounted angled Category 6A RJ-45 48 port patch panels. Do not paint installed cabling as it will void the manufacturer warranty.

Optical fiber horizontal and FTTD cabling shall be of a fan-out type construction with a minimum 2.0mm outer jacket and high-strength reinforcing fibers protecting each fiber. The cables shall contain singlemode (OS2) fibers or 50-micron OM4 multimode fibers which meet or exceed the mechanical and transmission performance specifications in *ANSI/TIA-568-C.3*. The color of the cable's outer jacket shall be yellow for singlemode and Aqua for OM4 multimode. Cables shall be plenum rated OFNP. The fibers shall be terminated with splice-on LC connectors meeting *ANSI/TIA-568-C.3*. Adaptor modules shall be flush mount duplex LC. The color of the modules shall match the color of the mounting frame.

Wall mounted workstation outlets shall typically consist of a single gang four-port faceplate, color and material as selected by Architect. The faceplate shall be filled with the quantity of Category 6A jack modules required at each location with spare positions blanked off, with machine printed labels installed in label windows. Terminations shall be T568B style. Typically two (2) Category 6A cables shall be provided at workstation locations.

Additional outlet configurations include:

- Security Cameras: Provide one (1) Category 6A cable terminated with a field terminated plug connection.
- Elevator Travelling Cable: Include three (3) Category 6A cables to the elevator machine room for cab devices such as phones, security cameras, or wireless access points. Provide ethernet over coax extenders and include coaxial cabling in the travelling cable connecting the machine room and the cab.
- Building Equipment Panels: Provide two (2) Category 6A cables terminated in a biscuit style surface box at each building systems equipment panel including:
  - Main Building Automation System Panel

- Security Access Control Panel
- Fire Alarm Control Panel
- Elevator Control Panel
- Lighting Control Gateway Panel
- Power metering
- Irrigation Control Panels
- Timeclocks
- Electronic Key boxes
- Chair Lift Telephone

- Floor Boxes and Poke throughs: Provide decora style or 106 adapter plates as required to mount devices where full gang plates do not fit.
- Flat Panel Displays: Provide decora style or 106 adapter plates as required to mount devices in flat panel backbox located behind the display. Provide a minimum of two (2) Category 6A cables. Review with Yale IT whether locations should be provided with OM4 50 micron optical fiber to support SDVoE 10 Gbps connectivity.
- Audiovisual Control System Touch Panels: Provide one (1) Category 6A cable terminated with a field terminated plug connection.
- Surface Raceways: Provide decora style or 106 adapter plates as required to mount devices.
- Wall Mounted Telephones: Provide one single jack wall plate.
- Lab Casework: Coordinate actual needs on a per project basis. Historically, providing one (1) Category 6A cable per every two (2) lab bench seats has provided sufficient capacity.
- Elevator telephones: Generally provided under Division 14. Elevator phones are considered emergency telephones, battery operated automatic dialers are not acceptable. These circuits require dedicated conduit point to point. A ¾" conduit will be required for each elevator. This conduit shall be provided from the nearest TR to the box on the elevator controller cabinet where the elevator traveling cable's telephone pairs are terminated in the elevator machine room. Coordinate the installation and termination with Elevator Vendor and Yale IT.
- Emergency Telephones: The installation and location of emergency telephones must be coordinated with the Yale University Public Safety. Outdoor emergency telephones are hands-free weatherproof and require a 1" rigid conduit. A standard blue light that is illuminated 24 hours per day, 7 days per week shall identify each emergency telephone. Emergency telephones are to be cabled using cable for the intended use (indoor, buried service, aerial). The cable is to be terminated in the appropriate TR on a dedicated voice block as directed in the Telecommunications Key Connection Schedule. These circuits may require dedicated conduit point to point.
- Exterior pole mounted emergency phone requirements:
  - Concrete foundation no smaller than 24" diameter and 42" deep. Anchor bolts and template for same will be provided by Yale IT.
  - One (1) 1" minimum telecom conduit terminating in the TR of the building from where the voice circuit is provided. Provide a pull string, tied off at both ends. Telecom cabling shall be provided in liquid tight flexible steel conduit inside the pole. In addition, provide cabling to serve mass notification speakers where identified.
  - One (1) minimum size 1" power conduit to the building from where the voice circuit is provided and one 120VAC 15-amp branch circuit with emergency backup power
  - One 5/8" x 8' copper-clad steel ground rod with a #6 AWG copper wire to the base of the phone
  - The units shall be located adjacent to walkways, not in travel areas where they might interfere with pedestrians or service vehicles. Locate the code blue emergency phone so as to be wheelchair

accessible from the sidewalk. Install a concrete pad to extend to the sidewalk if necessary. Access to the phone shall not be impaired by landscaping or curbs. For ease of mowing in grass areas, the telephone shall be located on an 8” wide concrete mowing strip flush with the surrounding lawn.

1.21. Wireless Access Points

Wi-Fi shall be ubiquitous throughout the building. It is recommended that horizontal cabling serving wireless access points shall consist of two (2) Category 6A cables, in anticipation of the full future implementation of the IEEE 802.11ax standard supporting multi-Gigabit bandwidth rates. The outlets shall be mounted in a plenum rated biscuit style surface mount box with a 15’ service loop to permit final field location adjustments. The ICT Designer shall plan Wireless access point (WAP) locations on floor plans using the recommendations of *TIA-TSB-162-A* in the Schematic Design and Design Development Phases. WAP’s shall be a PoE PD. Yale IT shall provide Power-over-Ethernet IEEE *802.3at* Type 2 (PoE+) power sources.

In the Design Development phase, the ICT Designer shall conduct an RF predictive wireless study to confirm WAP locations. The study shall be performed by a certified wireless professional approved by Yale utilizing Ekahua Pro Software. Acceptable wireless certifications include but are not limited to ECSE, CWNA, CCNA Wireless, ACDA, or equivalent. The predictive study shall meet the following RF specifications as a minimum requirement for delivery of voice and video quality IEEE *802.11* services as defined by Cisco Systems:

- Radio shall be set on UNII2/3 frequencies at no more than 25mW power/14dBm
- Optimal Cell Boundary of the wireless access point shall be -67db measured by the client adapter in the 5Ghz band
- 20% cell overlap based on the optimal cell boundary to ensure smooth client roaming
- Latency shall be no less than 20 milliseconds
- Packet loss shall be no more than zero within the design coverage
- Packet jitter shall be less than 20ms

The ICT Designer shall review WAP mounting requirements with Yale IT to address various project conditions. A wireless access point enclosure may be recommended by Yale IT or the project Architect to provide physical protection or greater aesthetic appearance. In addition, high gain antennas, remote antennas, or high density WAP’s may be recommended by Yale IT to provide appropriate coverage from acceptable mounting positions. Outdoor site coverage shall be reviewed for each project, served with remote outdoor antenna locations, RF transparent site bollards, or emergency telephone stanchions.

Wireless access points shall be furnished by Yale and installed by the Cabling Contractor. Some locations shall require the wireless access point to be configured for vertical wall mounting. One (1) ceiling grommet shall be provided for each ceiling access point outlet location, installed in the ceiling tile with a patch cable provided from the jack to the wireless access point.

Provide a post-installation study to verify coverage requirements are met. This study shall include allowances for the addition of or re-positioning of WAP as needed.

1.22. Patch Cords

Patch cords shall be furnished for each Category 6A link, with one workstation end patch cord, and one telecom room end patch cord. The lengths and colors of patch cords within the TR shall be coordinated to match telecommunications equipment rack layouts and Yale IT standards. Excessive lengths are

unacceptable. Reduced diameter (or small diameter) 26 AWG and 28 AWG patch cords shall be provided in the TR. Final lengths and colors of patch cords furnished for workstations and devices shall be coordinated with Yale. In some instances where patch cords to devices such as telephones and wireless access points are exposed, the project Architect may wish to see a specific color patch cord (such as black) so as to not color clash with surrounding finishes and/or to match the device color. The typical color of patch cords to be provided at workstation locations is black.The Cabling Contractor shall install patch cords within the TR and patch in network devices. The Cabling Contractor shall furnish patch cords to Yale IT and project subcontractors for installation at floor workstation and device locations.

1.23. Labeling and Administration

The structured cabling plant shall be fully labeled and documented. The recommendations of *TIA-606-C, Administration Standard Telecommunications Infrastructure* shall be used as a guideline with specific requirements dictated by Yale IT.

- Only machine printed laminated labels that are mechanically fastened are acceptable for equipment, panel, cabling, and outlet labeling. Handwritten markings on the cable will not be accepted.
- Uniquely identify and label each permanent link as to reference its source termination patch panel port or wiring block position. The labels shall be durable, machine generated, self-adhering, at least 3/8" wide; the font shall be a minimum of 3/16" high and contrasting the background in color. Affix labels at the end of each cable within 12 inches of termination and to the front of the faceplate near the connector module. All identifiers shall be clearly recorded on the as-built drawings.
- Backbone cables shall be labeled at each end, within 6" from each termination. Additional labeling shall be provided on cables that pass-through locations such as conduit ends, splices, MH's, and pull boxes.
- Fiber distribution units shall be clearly labeled on the front cover. Racks, patch panels, and interconnect blocks shall be labeled. Label pathways and grounding busbars and wires
- TR's shall be labeled WWW01 (for MDT's), WWW02, WWW03, and so forth (for IDT's), where "WWW" represents the Yale Building Number. However, in cases where there is a switch in the building, the MDT is designated as WWW00 and all consecutive numbers thereafter are IDTs. An example of this would be Green Hall, where the MDT is labeled 277000, and the IDT's are 277001, 277002, 277003, etc.
- Each Category 6A telecom outlet shall be labeled XXX-YY DZ, where "XXX" is the room number, "YY" is the outlet in sequential order starting from the door and moving left, and "Z" is the sequential number of the jack in the faceplate. For room scheduling signage, the room number is the corridor with "D" being replaced by "RS". For FTTD applications, "D" is replaced with "F".
- Individual patch panels are not labeled. Cables and patch panel port labels shall match the faceplate label.
- Fiber interbuilding backbones are labeled FYWWWXX-VVVV, where "FY" is "FM" for multimode fiber, or "FS" for singlemode, "WWWXX" is the label of the terminating MDT, and "VVVV" is the label for the originating Core Network Room or MDT.
- Wireless Access Points shall be labeled WAP-XX, where "XX" is the sequential number of the WAP in the building.
- Equipment Racks in a rack line shall be labeled sequentially starting at 01, moving from left to right. Racks shall be labeled at the top center of the rack, using a 1" high label.
- TR patch cords, furnished and installed by the Cabling Contractor, shall be labeled per Yale IT requirements.
- Audio Visual device to device cabling shall be labeled on both ends SOURCE PORT : DESTINATION PORT. For example: "NV32-01 HDMI-OUT-1 : PROJECTOR HDMI-IN-1".

1.24. Area of Rescue Two-Way Communications Systems

The ICT Designer shall confirm whether projects require Area of Refuge and/or Area of Rescue two-way communications systems per Connecticut State Building Code. In addition, if not required by Code, the ICT Designer shall discuss with the Facilities Project Manager whether Yale wishes to implement the systems for improved building accessibility. Provide systems that meet code required functionality including call stations, signage, and a central command unit. The central command unit shall be programmed to dial out to the University's central station in the event there is no direct answer in the building fire command center, utilizing an analog POTS line.

1.25. Design Coordination for Joint Partnership Projects

Yale IT may deploy systems in facilities as a joint partnership with other entities where Yale IT does not directly control the infrastructure design. For these projects, the ICT Designer shall review the facility owner's standards and determine a methodology for adaptation to these standards. An example is joint projects with Yale New Haven Health System, where differing equipment manufacturers and healthcare standards are implemented.

1.26. Residential Colleges Requirements

The ICT Designer shall anticipate the following design requirements for projects at residential colleges.

- Wi-Fi shall be ubiquitous throughout the building and grounds. Pathways shall be planned for outdoor coverage. DAS coverage shall be provided for specific floors identified to have weak signal strength, in particular dining areas. Some vending and refrigerators utilize Wi-Fi and cellular communications for point of sale.
- Collaborate with the project Architect during end user interviews to uncover special case needs, activities, and events in the colleges that will rely on communications infrastructure.
- Various residential offices utilize service providers such as Comcast for cable television service, that is not billed through Yale IT. Anticipate service provider coordination required for moves, adds, changes to infrastructure in these cases.
- Cabling infrastructure shall be required for the following occupancies:
    - Suite Commons Rooms: two (2) Category 6A cables
    - Office spaces for Deans and Head of Colleges
    - Building common spaces used for guest speakers
    - Audiovisual Booths may require optical fiber connections
    - FAVE and MNS systems and speakers
    - Dining POS cashier stations – two (2) Category 6A cables
    - Laundry Rooms debit card system transaction panel – one (1) Category 6A cable
    - Public computer rooms – one (1) Category 6A cable and one (1) quad 120V/20A receptacle per workstation with two (2) Category 6A cables at multifunction printer stations for printer and card station. Students are now using Window Virtual Desktop more rather than going to the public computer rooms. These areas may be reprogrammed into E-Sports or Collaboration Rooms in the future. The ICT Designer shall assist Yale IT to develop the program for these spaces on a project specific basis.
    - Vending machines – one (1) Category 6A per machine
    - IP surveillance cameras, access control panels, intercom stations

- Chair lift telephone stations
- Dining services
  - kitchen timeclocks – one (1) Category 6A cable
  - kitchen wall mounted telephone – one (1) Category 6A cable
  - Employee kiosk– one (1) Category 6A cable
  - Manager's Office – three (3) Category 6A cables
  - Menu boards – two (2) Category 6A cables
  - Breakroom custodial timeclock - one (1) Category 6A cable
  - Digital signage flat panel displays – two (2) Category 6A cables

1.27. High Bandwidth Future Proof FTTD Deployments

A high bandwidth future proof FTTD system may be deployed where specifically requested by project stakeholders as part of the approved building program. Yale IT shall not provide determinations as which projects this system applies to. Utilizing singlemode OS2 fiber, the system shall support 40 Gbps 40GBASE-LR4 and 100 Gbps 100GBASE-LR4 per IEEE 802.3.ba and future higher speeds. This system shall extend singlemode fibers from the local IDT to specifically identified workstations using horizontal pathways and cabling infrastructure. In addition, consolidation point enclosures shall be provided within program areas to permit this singlemode infrastructure to be extended to specific workstations as required in the future. From an IDT rack mounted fiber enclosure, pre-terminated factory made MTP fiber trunks cables shall be provided to each consolidation point. The quantity of strands within each fiber trunk shall be sized based on the projected quantity of FTTD workstation outlets required. Yale IT shall provide fiber network switches in the IDT to support connectivity to the workstations.

2.1. Security Baseline Requirements Summary

The following represents a general listing of security requirements for physical and electronic security system installations that typically applies to all projects:

1. All exterior perimeter gates and doors must be fitted with card access systems, to include card readers, exit devices, and door management alarms. Where perimeter gates are two sections, each section will have its own means of electronic locking controlled by a card reader. All exterior perimeter doors designated for exit only shall be fitted with alarm monitoring equipment (door contact, a door management alarm, and a request-to-exit motion detector), and there shall be no exterior hardware or keyway. Where doors are set for emergency exit only (to control egress), these shall be fitted with delay-to-egress hardware tied into the Security and Fire Alarm systems, where permitted by the building code.
2. The following locations shall be fitted with full card access packages:
    a. All rooms/closet entries that house student, staff, employee or patient personal information
    b. All major mechanical/electrical/telecom/server room/utility tunnel entry
    c. All rooms, suites, closets that house high value or high risk equipment
    d. Any room/closet housing an electronic key management system
3. CCTV camera and electronic access control systems are intended for deterrence and forensic purposes only, and not to provide real-time monitoring.
4. All loading docks shall be fitted with access control at the vehicle and perimeter entries to the dock; and every effort shall be made to build access-control separations between the dock interior and the rest of the facility. All perimeter entries shall be fitted with card access, a means of communication (intercom or phone), and a CCTV system for the dock exterior, the dock interior and vehicle entries shall be installed. If there is a local dock receiving office, communication, CCTV and gate/door control shall be wired through there as well (for local system control).
5. CCTV cameras shall be added to all entry/exit door(s) and to areas where high risk material is stored. All cameras shall be wired or networked to Yale Security main server via a secure network circuit on the Yale Public Safety Network. **Other locations for CCTV would include all exit/entry points, cash handling areas (tellers, cashiers, convenience store counters, tec.), parking lots….**
6. Emergency Blue Phones with blue lights shall be installed at key building perimeter and walkway locations, as designated by Yale Security. On a case-by case, consideration shall be made for phones/poles to be fitted both with digitally managed CCTV cameras to allow for the monitoring and automatic call-up of emergency use of phones and with public address speakers for broadcasting evacuation notification.
7. The buildings shall be fitted with a DMP alarm communicator, which will serve to centrally transmit all fire alarm signals and intrusion, panic and equipment alarms.
8. Any legacy burglar alarm equipment in the space, including keypads, door contacts, motion detectors and alarm horns shall be removed. Requests for new or reactivated burglar alarm systems will be reviewed on a case-by-case basis.
9. Reception areas shall be fitted with a duress button interfaced to the DMP alarm panel.
10. Where appropriate to the use and security needs of the facility, provisions for a Central Security-Manned Reception Desk at the visitor entrance shall be included, which would be fitted out for local annunciation of building alarms, as well as for local CCTV monitoring.

11. All facility perimeter windows within 10 feet off grade shall either be inoperable or, if operable, fitted with security screens or limiters.

12. Perimeter lighting, courtyard lighting and lighting on exterior perimeter walkways shall be enhanced to ensure clear visibility for after-hour use.

12. The building fire alarm system shall be equipped with voice evacuation capabilities for building-wide emergency broadcasting, as follows:

    a. University owned or leased space where the University operates and maintains the building's fire alarm system:

        1. All renovations shall include the installation of additional wiring and raceways capable of supporting future speaker/strobes. Any NAC circuit being added to or modified is required to be completely modified (rewired). Wiring shall be installed to support future voice evacuation activation. Initially, horn/strobes shall be installed and set at slow-whoop. All additional voice evacuation wiring shall be clearly marked for future use.
        2. When 20% or more of a building is renovated at one time, the Fire Alarm node covering that portion of the building shall be converted to voice evacuation using Yale Fire Code Compliance Unit and Yale Public Safety approved methods and shall follow all applicable NFPA, State, and Local codes as well as Yale Fire Code Compliance Unit and Yale Public Safety specifications. Voice evacuation coverage shall be throughout renovated area of the building. Equipment/wiring/data shall also be included and installed to communicate on Yale's network with either the Siemens or FCI/Gamewell Mass Evacuation panels at 57 Lock Street and 101 Ashmun Street.

    b. Commercially-leased space where the University does not operate or maintain the building's fire alarm system (including YNHH space):

        1. All renovations shall include the installation of additional wiring and raceways capable of supporting future speaker/strobes. Any NAC circuit being added to or modified is required to be completely modified (rewired). Wiring shall be installed to support future voice evacuation activation. Initially, horn/strobes shall be installed and set at slow-whoop. All additional voice evacuation wiring shall be clearly marked for future use.
        2. In those buildings supported by a Siemens or FCI/Gamewell fire alarm system, where 20% or more of the building is renovated at one time, the building's fire alarm system shall be converted to voice evacuation using Yale Fire Code Compliance Unit and Yale Public Safety approved methods and shall follow all applicable NFPA, State, and Local codes as well as Yale Fire Code Compliance Unit and Yale Security specifications. Voice evacuation coverage shall be throughout the building. Equipment/wiring/data shall also be included and installed to communicate on Yale's network with either the Siemens or FCI/Gamewell Mass Evacuation panels at 57 Lock Street and 101 Ashmun Street.
        3. In those buildings not supported by a Siemens or FCI/Gamewell fire alarm system, an audio interface from the building fire panel to Siemens or FCI/Gamewell headend Mass Evacuation panels at 57 Lock Street and 101 Ashmun Street shall be implemented. If the building's fire alarm panel does not support this feature, no additional work is required.

13. Each facility shall be fitted with a Morse-Watchman electronic key management system for use by local Facilities Operations personnel. Additionally, Residential facilities shall be fitted with separate Morse-Watchman systems for use by local residents and residential management personnel.

14. A broadcast speaker shall be installed centrally within the courtyard to facilitate emergency broadcast via the fire alarm voice evacuation system.

15. Where appropriate to the use and security needs of the facility, provisions for a Central Security-Manned Reception Desk at the visitor entrance shall be included, which would be fitted out for local annunciation of building alarms, as well as for local CCTV monitoring.
16. All devices connected to the Yale Next Generation Network (NGN) shall be fully supported by the manufacturer.
17. Security equipment shall be served from the Yale Next Generation Network (NGN) and configured on the appropriate VLAN.
18. Security cameras shall use PoE power from the network switch. Confirm device power requirements and switch power budget available.
19. Yale Cultural properties may have additional and separate requirements. Coordinate with Yale IT to determine requirements.
20. West Campus properties may utilize a LENEL access control system. Coordinate access control design standards for these West Campus properties with Yale IT.

2.2. Security Requirements Summary for Student Residential Facilities

1. The following additional physical and electronic systems shall be installed to secure Student Residential Facilities and environs:

2. All courtyard perimeter primary entry doors to Entryways and shared facilities shall be fitted with card access system packages, including remotely managed/controlled Door Management Alarms.
3. Card access shall be installed at the following locations:
    a. All interior public/residential separations
    b. Entries to Library facilities
    c. Entries to Secure Storage Rooms
    d. Entries to Gallery Areas
    e. Entries to Computer and Media Facilities
    f. Administrative Office Suite
    g. Guest Suites
    h. Any designated room off a common area where privileges are limited to residents of the college (Weight Room, Theatre, etc.)
4. The entries to the Dining Services' public and staff areas shall be fitted with card access; and when approved by the Associate VP of HR&A delivery entrances/exits shall be fitted with CCTV cameras for Dining Services admitting and event recording.
5. All College entryway card access entry doors shall be fitted with electric strikes or electrified hardware with monitoring capabilities. Gate mag locks will include bonding sensors.
6. The following areas will be fitted with burglar alarm systems: the Head of College's houses; the Head of College's/Dean's administrative offices, and any gallery/exhibit spaces.
7. The Head of College's Offices shall be fitted with Morse-Watchmans networked electronic key cabinets to house the respective College's keys for distribution. A Morse Watchmans key system shall be installed as well in the Custodial Manager's area and the Dining Hall secure staff area. To the greatest extent possible, these Morse-Watchman systems will be shared.

8. All second-means-of-egress pass-through doors—suite-to-suite; bathroom-to-suite/bedroom; bedroom-to-bedroom shall be fitted with remotely managed/controlled Door Management Alarms. The bedroom-to-bedroom pass-through arrangement shall be prevented, if possible.
9. A broadcast speaker shall be installed centrally within the courtyard to facilitate emergency broadcast via the fire alarm voice evacuation system.
10. Intercom systems shall be established for the following areas:
    a. At key entry doors to the Head of College's living space, wired to locations within the house and to the administrative office suite
    b. At a key delivery entry gate to the administrative office suite
    c. At dining hall delivery entries to within the Dining hall receiving area

2.3. Security Requirements Summary for Clinical Space

The following ***additional*** physical and electronic systems shall be installed to secure Clinical Facilities and environs:

1. All electronic systems shall be Yale University Security's standard security and access control system components and control panels, with all alarm signals transmitted to the Yale University Central Alarm Station.
2. All perimeter entry doors off public corridors shall be fitted with prox card access. Those designated to be able to be left unlocked during certain periods of time shall be fitted with a dedicated "control" card reader with LED mounted on the interior of the door. Those designated for exit only shall be fitted with an alarm contact and a request-to-exit motion detector, with no hardware or keyway on the corridor side of the door.
3. The following clinical spaces shall be fitted with card access:
    a. Medical Records File room
    b. Narcotics closets/rooms
    c. Dedicated staff entry to private/clinical areas not off the main public corridor
4. Clinic entry doors from public waiting areas shall be located at a point visible to the receptionist. This door shall be lockable.
5. Duress buttons shall be installed at any area where large amounts of cash are taken or stored.
6. All perimeter glass to the public corridor shall be fitted with acoustic glass break detectors.
7. Any cash storage safe shall be immovable. A holdup button shall be placed near the cash safe shall large amounts of cash be stored. The safe itself shall be invisible to passers-by.
8. If the clinic will be used for after-hours patients as well, the corridor entry door shall be fitted with a doorbell, and chime speakers shall be distributed throughout the suite.

2.4. Security Requirements Summary for Research Facilities

The following ***additional*** physical and electronic systems shall be installed to secure Research Facilities and environs:

1. Windows fronting the exterior in areas with high-value equipment shall be fitted with glass break alarms.

2. High Risk Research and Storage Area entry doors within the facility shall be fitted with card access. When appropriate, CCTV cameras may be installed at key doors.
3. Where appropriate to the use and security needs of the facility, provisions for a Central Security-Manned Reception Desk at the visitor entrance shall be included, which would be fitted out for local annunciation of building alarms, as well as for local CCTV monitoring.
4. There shall be two points of electronic access-control separation between the exterior of a facility and interior lab/lab support areas (including wet bench, dry bench and computer lab areas). This may require card access on some combination of corridors, stairwells, elevators, and/or individual room doors.

2.5. Security Requirements Summary for Child Day Care Space

The following ***additional*** physical and electronic systems shall be installed to secure Child Daycare Facilities and environs:

1. There shall be at least **two** points of electronic access-controlled separation at the public entrance separating the building perimeter envelope from an interior waiting area and that waiting area from the interior Child Care areas. If there is an intermediary vestibule, both the exterior and interior vestibule doors shall be fitted with card access, and the exterior vestibule may remain unlocked during regularly scheduled parent drop-off and pick-up times. To facilitate authorized access, parents may be issued access cards that will allow them no farther than the waiting area.
2. There shall be local intercom communications at all the public entrance doors to several select intercom stations within and around the facility. This shall be interfaced with CCTV cameras, so that visitors can be seen as well as heard. There shall be no remote door release from interior intercom stations.
3. A receptionist area within the public waiting area shall be established, with a desk having the ability to communicate with and identify visitors seeking admittance, and with door release from there only. The desk will be fitted with limited CCTV monitoring capability, and it shall be staffed during drop-off and pick-up times.
4. The interior Child Care Areas shall be restricted to staff access only. Any non-staff person authorized on a temporary basis to be there must be escorted in and out. All perimeter doors to the interior space shall be fitted with alarms that sound locally and throughout the facility when used without authorization. These shall have card access to control entry and a card reader to either allow controlled egress on non-exit doors, delayed egress, or a reader to shunt the alarm upon egress on required exit doors. In sum, there shall be a very limited number of such entry doors to interior space.
5. CCTV cameras may be installed at interior perimeter points of entry and exit; at exterior play areas; and pick-up and drop-off parking areas. CCTV monitors with pan-tilt-zoom camera control may be provided at key interior staff monitoring areas.
6. The building's environmental system shall be established so that no windows need to be operable. Fixed windows shall be fitted with shock sensors. Any accessible windows that are operable shall be fitted with fixed security screens. Shall any be required to be set for egress, these shall be fitted with safety locks and alarm contacts that sound locally and at key areas of the building.
7. It is recommended that the building be fitted with an interior PA system, with communications in each room. Ideally, the alarm system shall be interfaced with this, so that the exact location of an alarm breach will be broadcasted to staff through the facility's speakers.

8. All interior activity, classroom and sleep area room entry doors shall be fitted with large vision panels so that staff can assess the interior from the exterior corridors.
9. Any exterior play area shall be physically and visually separated from public pathways with a wall of a minimum of 8'. These shall be as close to the building as possible, separated from driveways or public parking areas. Access into the play area shall be via a gate or opening on card access, with card access to control egress as well. The play area shall be fitted with an emergency telephone with its camera and fixed cameras to cover general play areas.
10. Emergency duress buttons shall be installed in interior and exterior childcare areas. These shall be installed with protective covers and out of general child reach.

2.6. Security Requirements Summary for YARC Space

The following ***additional*** physical and electronic systems shall be installed to secure YARC Facilities and environs:

1. There shall be at least **three** points of electronic access-controlled separation between the building perimeter envelope and YARC Animal Holding rooms. All animal facility use rooms shall be equipped with prox card readers. This includes, but may not be limited to, animal, procedure, wash center, offices, break rooms, locker rooms, surgical suites, storage and waste containment.
2. Any mechanical, electrical, security or telecom rooms that house support infrastructure for this facility shall be fitted with prox card access. These shall be designed to reside within the secure suite.
3. All electric locking hardware on card reader doors shall be fitted with latch bolt monitoring to detect latch taping, and all such locking hardware and catches shall be installed with tamper-proof screws. Pinned hinges shall be used for doors that have exposed hinges on the corridor side.
4. Any access controlled portal or adjacent wall with glass shall be fitted with acoustic glass break detectors.
5. Emergency communications telephones (area of refuge phones), with automatic ring-down to Security, shall be installed in key interior areas, cage wash areas, and other perceived remote areas within the space. Where practical, emergency communication telephones shall be placed at intervals that allow line of sight to at least one emergency communication telephone from all interior corridor location. Each emergency communication telephone will be equipped with a blue lamp.
6. Cellular service shall be provided in all animal facilities.
7. Any exterior windows within YARC space shall be filled in and covered. Where BL3 research is done, these walls-if not 2" thick, shall be fitted with vibration sensors.
8. CCTV cameras shall be installed at each entry point to the YARC facility, and where practical at intervals to allow video monitoring of all interior corridor locations. The video from these cameras will be recorded at a digital video recorder and managed by Yale Public Safety.
9. Biometrics shall be considered for high containment (e.g. BL3) facilities, and other specialized or sensitive areas.

2.7. Security Requirements Summary for Garage Facilities

The following ***additional*** physical and electronic systems shall be installed to secure Parking Garage Facilities and environs:

1. All exterior perimeter pedestrian gates and doors must be tied into Yale Public Safety's card access system only. All vehicle gates/barriers shall be wired primarily into the Yale Parking access system and secondarily into Yale Public Safety's access control system. All perimeter overhead or other vehicle gates must have alarm contacts wired to Yale Public Safety CAS for status.
2. Card access shall be installed on any Garage offices and Cashier's booths.
3. As much as is architecturally possible, all garage stairways and elevator backs shall be designed of heavy-duty glass or plexiglass to ensure clear interior visibility from the garage exterior. Doors into stairwells shall have large glass panels, and stairway landings shall be fitted with corner-mount mirrors for added security visibility.
4. The garage shall be designed to be fully enclosed/securable at all accessible points 12' from grade or below. Landscaping around the perimeter shall be arranged to reduce visual obstructions. Bushes or hedges, especially at entries and exits, shall be avoided.
5. In addition to key exterior perimeter pedestrian entries of the garage, Yale blue phone packages shall be installed at all elevator lobbies and stairwell entries on every floor, as well as on parking ramps and landings.
6. CCTV cameras may be installed at the following locations: at elevator lobbies and stairwells; at roof corners; at perimeter pedestrian entrances; at the interior and exterior of vehicle gates; at the Cashiers booth/office to monitor transactions; at blue phones. These cameras shall be wired back to the Yale Public Safety video servers. The garage office shall be fitted with a CCTV monitor and camera control for local viewing and assessment.
7. Garage Cashiers' booths and any office, in addition to card access, shall be fitted with glass break detection and emergency hold-up buttons.
8. Interior lighting must be widely distributed, and the lighting must compensate for any architectural obstructions, like closely spaced columns or beams.

2.8. Security Camera Installation Policies

This policy concerns the installation and use of equipment for video surveillance, monitoring, and recording on Yale University-owned, leased or controlled properties; this policy does not apply to the use of video applications for academic, research, or educational purposes of Yale University.

Security cameras are strategically placed throughout the Yale University community to meet the specific needs of departments and to assist the Yale University Department of Public Safety to deter crime, manage emergency response situations, and investigate suspected criminal behavior. No video surveillance cameras may be installed without authorization of the Department of Public Safety.

Video cameras to be used for safety, security or facilities management purposes may be installed in any location, on approval of the Video Review Committed (VRC), except for the following;

- Student dormitory rooms in the residence halls
- Living quarters of other residential facilities
- Bathrooms
- Locker rooms and other changing facilities

- Offices
- Classrooms not used as a lab

Storage and Retention of Recordings

All surveillance records shall be stored in a secure university centralized for a period of 45 days or, if required for specific purposes for certain locations, a set number of days. The video will then promptly be erased or written over, unless retained as part of a criminal investigation or court proceedings (criminal or civil), or other bona fide use as approved by the Director of Public Safety and Chief of Police or designee. Individual departments shall not store video surveillance recordings.

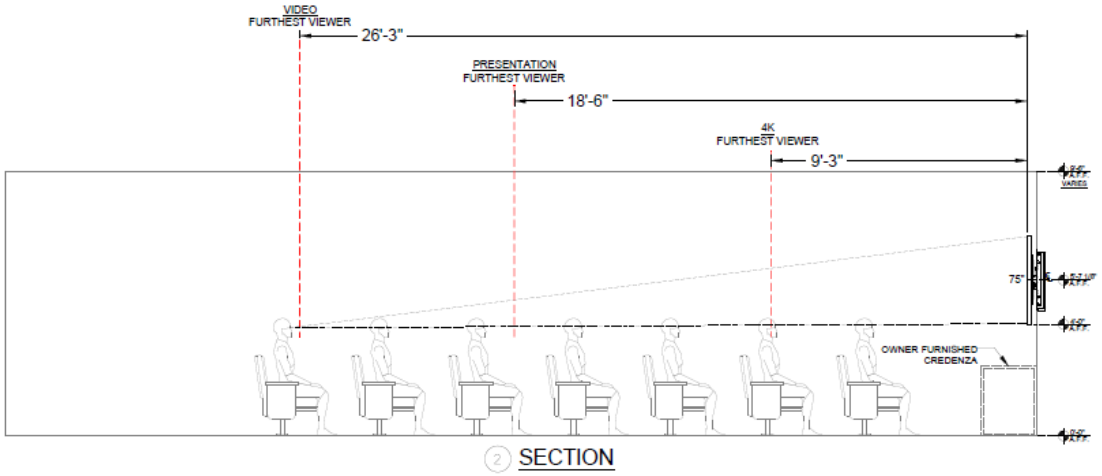
Exceptions

Uses of Public Safety Camera Systems beyond those described in this policy is prohibited. Persons having questions about the use of Public Safety Camera Systems not subject to this policy shall direct those questions to the VRC at VCR@yale.edu.

3.1. Audiovisual Guidelines and Best Practices

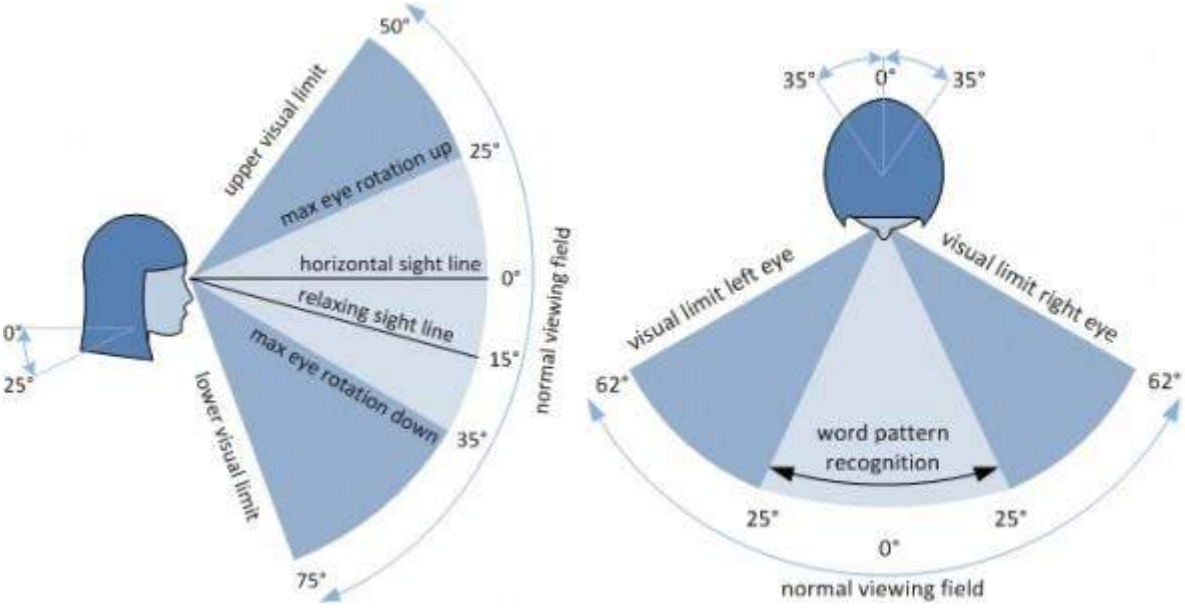
Recommended Display Size

Displays shall be sized to allow maximum viewability of content. Displays shall be 16:9 aspect ratio unless specified specifically for Cinema or non-traditional use. In a typical application displays shall be sized so that the Display Height (DH) multiplied by 6 is less than or equal to the Distance to the Farthest Viewer (DFV), DHx6≦DFV. In critical or fine detail viewing the DFV will be half or DHx3≦DFV. The maximum viewing angle cone shall be no more than 30 degrees from center. The closest viewer shall be no less than the height of the display away. In installations where recommended viewing distances and sizes cannot be met supplemental displays shall be included.



② SECTION

IMAGE DIAGONAL	MAXIMUM VIEWING DISTANCE		
	VIDEO	PRESENTATION	4K
75"	26'-3"	18'-6"	9'-3"

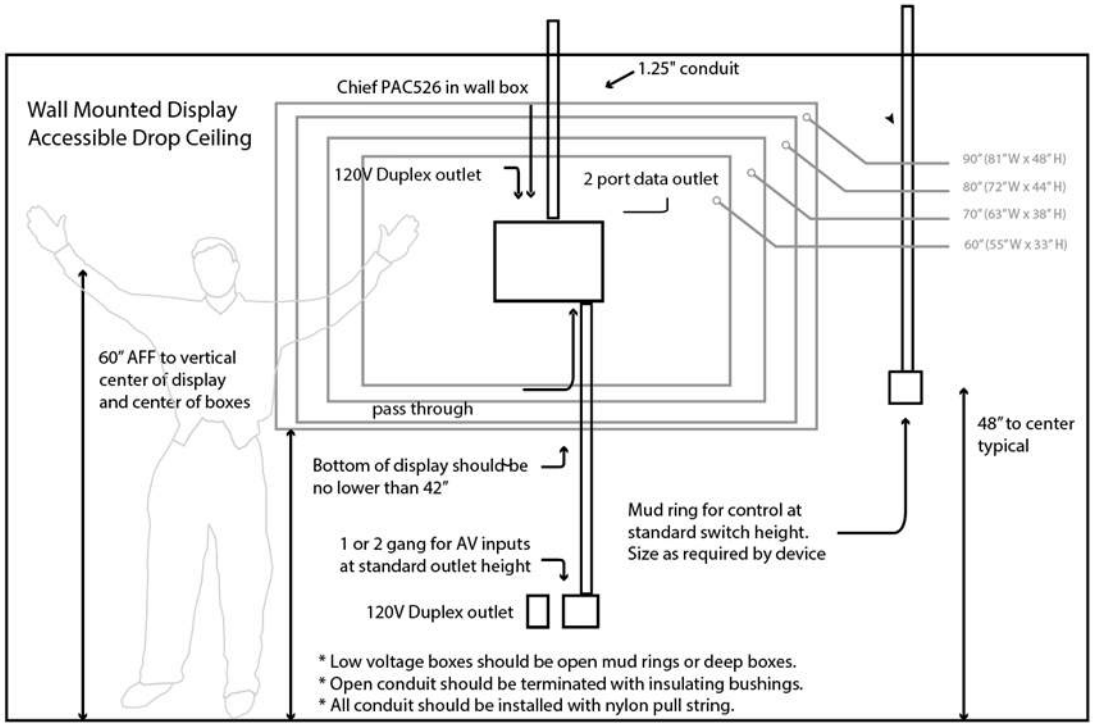


Recommended Display Type

Flat panel displays shall have 4K resolution. Projectors shall be LCD or LCOS based imaging and have a laser light source; 3-chip DLP projectors may be used in certain use cases. Projectors will be used in a 16:9 mode. Projection screens shall be tensioned and have a high contrast, 4K capable surface. Projection screen masking shall be provided as appropriate. Ambient light rejecting screen surfaces may be required in certain environments to provide adequate image brightness for the environment. Where architecturally appropriate the elimination of black drop on screens shall be considered. Projection screens shall be motorized with a physical up/down switch located in the room.

Display Installation

All displays must be installed in accordance with local codes and regulations. ADA clearances must be considered in all installations. It is recommended to install displays so the bottom of the image is no lower than 42” above finished floor (aff). Display height will depend on application. Displays shall be installed on articulating mounts to allow for easy access to the back of the display for service. For flat panel installation a Chief PAC526CF style back box is recommended with installed two (2) duplex power outlets and two (2) Category 6A RJ45 network connections, additional conduit may be required per system design. Review with Yale IT whether locations should be provided with OM4 50 micron optical fiber to support SDVoE 10 Gbps connectivity. Surface mount services should be avoided.



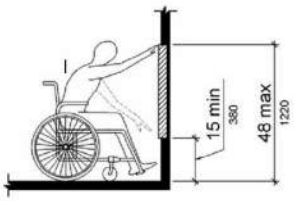


Figure 308.2.1
Unobstructed Forward Reach

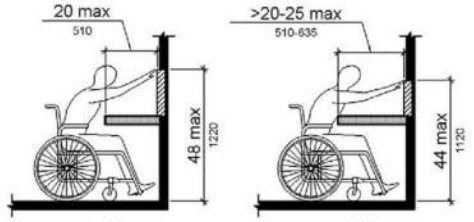


Figure 308.2.2
Obstructed High Forward Reach

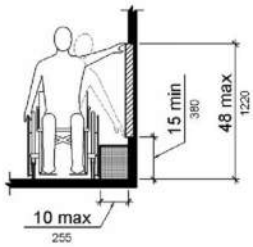


Figure 308.3.1
Unobstructed Side Reach

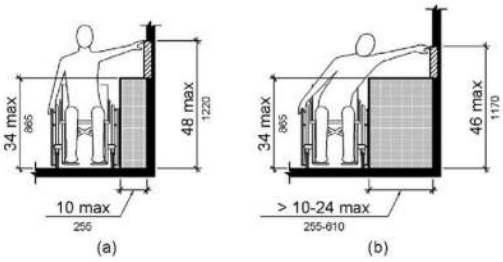


Figure 308.3.2
Obstructed High Side Reach

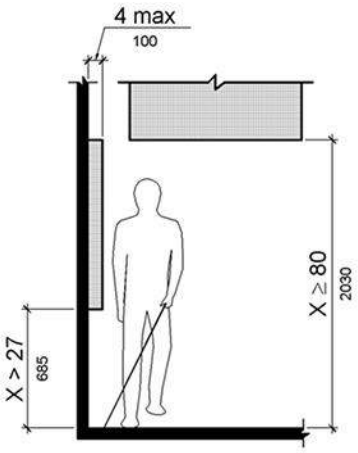


Figure 307.2
Limits of Protruding Objects

Audio Coverage and Uniformity

Program audio and music reinforcement shall reproduce a full range of frequencies while vocal reinforcement shall be tuned for speech intelligibility. Audio coverage shall vary by no more than 3dB across the listening area. Ambient Noise and Reverberation: Unoccupied classroom levels must not exceed 35 dBA; The signal-to-noise ratio (the difference between the teacher's voice and the background noise) shall be at least +15 dB at the listener's ears; Unoccupied classroom reverberation must not surpass 0.6 seconds in smaller classrooms or 0.7 seconds in larger rooms. Acoustic treatment, isolation or noise mitigation may be required to achieve an optimal environment. ADA hearing assist capabilities shall be included in all implementations.

Stereo program audio and music speakers are recommended for the front of the room while ceiling or pendant speakers configured for 70V operation provide speech audio. If one or the other is not possible all audio will be handled by a single speaker type. Line array or specialty speakers may be required by application.

Provide a fire alarm system relay bypass relay connection to amplifiers where required for fire alarm system audibility.

Control Systems

AV control system can serve different purposes depending on application. Typical functions include display power on/off, source selection, audio volume control and can include additional functions as required by the system design. AV control systems and monitoring shall be used in every AV installation.

QSC's Q-sys shall be used as the basis of design for AV control systems. YALE IT can provide graphical user interface (GUI) templates for use with control systems to provide consistency with other installations across the University. Use of touchscreen AV controls is recommended.

Infrastructure Requirements

AV systems now follow traditional IT infrastructure architecture. Almost all devices connect over Cat 6A cabling for audio, video, data and control, connect to network switches and need to be configured for specific applications and functions. An enterprise deployment of an AV system resembles a server farm or traditional network closet more than a traditional point to point system with AV devices transmitting information with traditional IP protocols and workflows, or AV over IP. As a rule of thumb each AV device requires a network connection. It is recommended centralized AV processing equipment reside in TR's as power and cooling requirements are the same for both systems. Additional AV infrastructure requirements include:

- AV equipment locations shall typically be served with a minimum 1-¼" conduit or as required by installation. Singular AV devices requiring only one (1) Category 6A cable, speaker wire, control cable, or microphone cable shall be served with a minimum ¾" conduit. Conduit shall terminate in an accessible location, AV equipment closet or TR. Conduit shall have nylon bushings installed on any exposed ends. Conduit shall be left with a nylon pull string for future use.
- Mounting heights for wall mounted control devices shall be mounted at ADA height.
- All physical device installation to be in compliance with local codes and industry best practices.
- Gang style boxes shall be open mud ring (old work) or deep boxes to accommodate AV connections.
- Cables and cords shall not be run across a floor without non-movable cord coverings.
- Large systems shall consider a Video over IP architecture which provides better value and control at scale than traditional systems.
- When utilizing flat panel backboxes, use designated backbox knockouts for mounting receptacles and network outlets. Do not wire into the backbox and mount biscuit style or gang boxes within the usable void of the backbox designated for audiovisual equipment.
- Prior to installation of sensitive audiovisual equipment and projection screens and surfaces within renovation areas, the project Contractors shall complete the following checklist and submit for ICT Designer/Yale IT approval. Incorporate the criteria below as contract requirements in project documentation:
    - All dust generating construction is complete inside the room and room is sealed from exterior construction areas.
    - Wall and ceiling surfaces are clean with final paint.
    - Room surfaces are free of dust
    - Ductwork and vents serving the Telecom Room are cleaned
    - Permanent door is locked with limited key availability
    - Door dust stopper is installed
    - Dirt trapper/sticky mats are placed inside entrance door where applicable
- Network cabling serving the audiovisual systems shall be provided by the project cabling contractor and terminated in the project telecom rooms as part of the building structured cabling system. No special designations shall be provided for cabling plant serving the audiovisual systems.
- At outlet height AV Input locations AC power must be installed adjacent to but electrically separated from the AV Input, for example on opposite sides of a stud bay. 120V duplex outlet typical.

Audiovisual Projection Rooms

Projection room infrastructure requirements shall conform to the architectural, electrical, and environmental design criteria in "Telecom Room Requirements" listed above. Power, cooling, and ventilation requirements demanded by large venue projection systems shall be carefully coordinated. The following design criteria shall be reviewed and coordinated for each project:

- Various sizes of projection rooms may be required for the following venues:
  - Single Projector Small Venue
  - Dual Projector Medium Venue
  - Multiple Projector Large Venue
- Based upon the room program and functional requirements, the ICT/AV Designer shall provide a Projection Room equipment layout plan and room section identifying the following:
  - Sight lines into the venue from operator workstations and projector light paths over the audience
  - Projection and view port glass windows and framing
  - Operator workstations
  - Equipment cart and trolley locations
  - Equipment racks and rack lines
  - Cable runways, room penetrations, and surface raceways
  - Grounding busbar
  - Lighting control panel
  - Electrical subpanel
  - Wall light switch(es), control panel(s), and AV panel(s) locations
  - Large venue projectors and infrastructure requirements
    - Mounts and structural tie points
    - Mirror systems for rear projection if used
    - Dedicated projection system ventilation or cooling apart from room HVAC system. Provide flexible ducts for final connections to equipment.
    - Power circuiting and device types
  - HVAC system loads, ductwork, and equipment locations
  - Room lighting
  - Wall sound transmission classes and room acoustical treatments
  - Door type and card reader access control
  - Rear projection screen installation details
  - Storage cabinet locations
  - Equipment working clearances and circulation paths
- The structured floor shall be 1” below finished floor within the projector room. Apply 1” self-leveling liquid flooring to ensure level floor across room with no more than 1/32” deviation from level. Coordinate final resilient flooring requirements with any trolley racks or rolling projector equipment sub-structure.
- Provide a dedicated electrical subpanel to serve the projection room.

3.2. AV Systems Types

Digital Signage

Digital Signage can range in size and type from a small table-top display up to a large video wall and can include interactivity or live triggering of content depending on programming. A typical digital signage deployment requires a display, duplex 120V power outlet, 2 Cat 6A RJ45 network connections and a content player. Physical installation and content must meet accessibility guidelines and comply with ADA requirements. Digital Signage software or service subscription costs shall be budgeted as a recurring cost and is typically not included in the cost of installation. In addition, recurring service and maintenance costs may apply. System requirements include:

- Display, size and type as needed for the application and design intent
- Media Player, mounted behind the display or integrated into the display
- Power: 120V/20A duplex receptacle behind display
- Network: two (2) Category 6A cables behind display
- Control (Power On/Off, Source Selection (if needed), Volume Control) via display or third-party control system
- Recommended: Chief PAC526CFW back box recessed in wall behind display containing the power and network outlets
- Optional enhancements:
  - Touch screen display
  - Supplemental audio reinforcement

Huddle Room

Huddle Rooms consist of small gathering spaces intended for less than 10 people and are intended as spaces for collaborative small group work. A typical huddle room requires a display, duplex 120V power outlet, two (2) Category 6A network connections, a laptop connection and optionally a dedicated source like a local computer. Wired HDMI input and wireless display video connection are highly recommended. Optional items include webcam/microphone. An interactive flat panel can be installed to provide additional use cases. Physical installation must meet accessibility guidelines and comply with ADA requirements. Service costs may include periodic maintenance or troubleshooting and are typically not included in the cost of installation. System requirements include:

- Display, typically 55” - 65”
- Power: 120V/20A duplex receptacle behind display
- Network: two (2) Category 6A cables behind display
- Wired HDMI input
- Wireless display video connectivity, recommended
- Control (Power On/Off, Source Selection (if needed), Volume Control) via third party control system. Touchscreen controller recommended.
- Webconferencing capabilities shall be required, Zoom Room integration optional
- Recommended: Chief PAC526CFW back recessed in wall behind display containing the power and network outlets
- Optional:
  - Touch screen display
  - Dedicated local computer with wireless keyboard/mouse
  - External room schedule and booking displays
  - Meeting Room Digital Signage display

Small Conference Room

A Small Conference Room will have a viewing distance of no more than 18 feet to the farthest viewer and typically utilizes display sizes of 75” or less. A typical small conference room requires a display, duplex 120V power outlet, 2 Cat 6A RJ45 network connections, a laptop connection and optionally a dedicated source like a local computer. Wired HDMI input and wireless display video connection are a minimum. Webcam/microphone are included but additional microphones may be required for audio coverage. An interactive flat panel can be installed to provide additional use cases. Physical installation must meet accessibility guidelines and comply with ADA requirements. Service costs may include periodic

maintenance or troubleshooting and are typically not included in the cost of installation. System requirements include:

- 65” - 75” display
- 120V duplex power at display
- 2 data at display
- Wired HDMI input
- Wireless display video connectivity
- Control (Power On/Off, Source Selection (if needed), Volume Control) via third party control system and touchscreen controller. Table top control typical.
- Webcam/microphone, Logitech series typical
- Recommended:
  - Zoom Room control and conferencing interface
  - Chief PAC526CFW back box installed behind display with duplex outlet and 2 data
- Optional:
  - Touch screen display
  - Additional table microphones may be required.
  - Dedicated local computer with wireless keyboard/mouse
  - External room schedule and booking displays
  - Meeting Room Digital Signage display

Large Conference Room

A Large Conference Room will have a viewing distance greater than 18 feet to the farthest viewer and typically utilizes display sizes of 86” or above. For displays above 100” diagonal a projector/screen shall be used. A typical large conference room requires a display, duplex 120V power outlet, 2 Cat 6A RJ45 network connections, a laptop connection and optionally a dedicated source like a local computer. Wired HDMI input and wireless display video connection are a minimum. Installed Pan-Tilt-Zoom (PTZ) camera and installed room microphones included. Interactive flat panels not typical to these installations due to room size. Physical installation must meet accessibility guidelines and comply with ADA requirements. Service costs may include periodic maintenance or troubleshooting and are typically not included in the cost of installation. System requirements include:

- 86” - above display, flat panel or screen/projector as required by application and intent
- 120V duplex power at display. Motorized screen will require power and low voltage relay connection with access that allows service of the power and low voltage connections.
- 2 data at display
- Wired HDMI input
- Wireless display video connectivity
- Control (Power On/Off, Source Selection (if needed), Volume Control) via third party control system and touchscreen controller. Table top control typical.
- PTZ camera and installed room microphones, QSC cameras and Shure microphones typical
- Recommended:
  - Chief PAC526CFW back box installed behind display with duplex outlet and 2 data
  - Zoom Room control and conferencing interface
- Optional:
  - Dedicated local computer with wireless keyboard/mouse
  - External room schedule and booking displays
  - Meeting Room Digital Signage display

Movable Display Cart

A Movable Display Cart is used in applications where a fixed installation is not possible or flexibility with display positioning is desired. A Movable Display Cart typically utilizes display sizes of 55" to 86". A typical movable display cart requires a display, nearby duplex 120V power outlet, 2 Cat 6A RJ45 network connections may be needed or the display may be able to operate on the wireless network, a laptop connection and optionally a dedicated source like a local computer mounted on a movable cart. Wired HDMI input and wireless display video connection are a minimum. Webcam/microphone are optional but recommended. An interactive flat panel can be installed to provide additional use cases. Physical installation must meet accessibility guidelines and comply with ADA requirements. Interactive displays require height adjustable carts. Service costs may include periodic maintenance or troubleshooting and are typically not included in the cost of installation. System requirements include:

- 55" - 75" Interactive Flat Panel with integrated Local PC and Wireless Display Gateway, wired HDMI input
  - Interactive Display, models considered with YALE IT consultation
  - Power and 2 Cat 6A to display by others
  - Yale network connection for each
- Wired HDMI input
- Wireless display video connectivity
- Control (Power On/Off, Source Selection (if needed), Volume Control) via the display onboard controls.
- Optional:
  - Touch screen display
  - Webcam/microphone
  - Zoom Room control and conferencing interface
  - Dedicated local computer with wireless keyboard/mouse
  - Soundbar
- Mobile display carts:
  - Current model includes Salamander Designs XL Electric Lift Mobile Stand (FPS1XL/EL/GG), Electric Lift Mobile Stand (FPS1/EL/GG) and Fixed Height Display Stand (FPS1/FH/GG)
  - *Height adjustable stand required for interactive displays
  - Accessories included for mounting of webcam or other accessories, power and data connections, storage cover and laptop shelf

Seminar - Interactive Flat Panel:

- Interactive Flat Panel with integrated Local PC and Wireless Display Gateway, wired HDMI input
  - Interactive Displays models considered with YALE IT consultation
  - Control directly via the Interactive display
  - Power and 2 Cat 6A to display by others required
  - Yale network connection for each
  - Microphone and ALS shall be required.

Seminar - Standard Flat Panel:

- Standard Flat Panel with integrated Local PC and Wireless Display Gateway, wired HDMI input
  - Network video encoder, local HDMI output to Primary Display
  - 8" wall or table mounted touch screen control
  - Current models include Samsung and LG Commercial displays

        - Display to be controlled by the AV control system
    - Power and 2 Cat 6A to display by others required
    - Typical Chief PAC526CF series back box installed behind display with standard power/data/conduit
    - Microphone and ALS shall be required.

Seminar - Projector and Screen:

- 16:9 aspect, 4K capable motorized screen
- 6000 lumen minimum laser projector
    - Current models include Epson (L610U) and Sony
- Local PC, Wireless Display Gateway, Wired HDMI input
        - Network video encoder, local HDMI to Preview Monitor
        - Network video decoder, local HDMI to Primary Display
        - 8” wall or table mounted touch screen control
        - Core processor, shared or standalone
    - Stereo presentation speakers installed at the display location. Standard models include QSC AD-S8T surface mount speaker. Speakers and amplifiers as required by system design and requirements.
    - ALS transmitter locations to be prewired. Single gang box with Cat 6A

Standard Presentation Classroom - Projector and Screen

Presentation Classroom: Fixed or flexible seating but primary use case is presentation of materials without recording capability. Traditional front of room teaching station with focus toward displays or large writing surfaces. Vocal reinforcement required. Room microphone required. System requirements include:

- 16:9 aspect, 4K capable motorized screen
- 6000 lumen minimum laser projector
    - Current models include Epson (L610U) and Sony
- Local PC, Wireless Display Gateway, Wired HDMI input, Blu-ray Player
        - Network video encoder for local sources
        - Network video decoder, local HDMI to Preview Monitor
        - Network video decoder, local HDMI to Primary Display
        - 8” wall or table mounted touch screen control
        - Core processor, shared or standalone
- AV Control located at teaching station
- Audio Inputs in addition to Source Audio to include:
    - 2, wireless microphones. Current models include Shure ULXD series.
- Audio Output in addition to ALS to include:
    - Stereo presentation speakers installed at the display location. Standard models include QSC AD-S8T surface mount speaker or as necessary for performance
    - Mono ceiling speakers recommended for vocal reinforcement. Standard models include QSC AD-C6T ceiling speaker
    - ALS transmitter preinstalled

Advanced Presentation Classroom - Projector and Screen

The advanced presentation classroom shall incorporate additional cameras and microphones for streaming and recording. System requirements include:

- 16:9 aspect, 4K capable motorized screen
- 6000 lumen minimum laser projector
  - Current models include Epson (L610U) and Sony
- Local PC, Wireless Display Gateway, Wired HDMI input, Blu-ray Player
    - Network video encoder for local sources
    - Network video decoder, local HDMI to Preview Monitor
    - Network video decoder, local HDMI to Primary Display. Additional display outputs may be incorporated.
    - 8” wall or table mounted touch screen control
    - Core processor, shared or standalone
  - Software Defined Video over Ethernet (SDVoE):
    - A SDVoE, or Video over IP, system shall be considered for all large and advanced systems designs.
    - Inputs and outputs as required by system use and design
- AV Control located at teaching station
- Audio Inputs in addition to Source Audio to include:
  - 2, wireless microphones for teaching station. Current models include Shure ULXD series
  - 8 additional wireless microphone channels. Current models include Shure ULXD series
- Audio Output in addition to ALS to include:
  - Stereo presentation speakers installed at the display location. Standard models include QSC AD-S8T surface mount speaker. Upgraded audio may include Coda Audio.
  - Mono ceiling speakers recommended for vocal reinforcement. Standard models include QSC AD-C6T ceiling speaker
  - Dedicated Broadcast audio output
- Included:
  - Camera and microphones for Lecture Capture or Streaming. Standard models include QSC Cameras and Shure MXA910 microphones. Selection will vary by venue and application
  - Dedicated Broadcast audio output located as the back of the room providing program and microphone audio
  - Dedicated Broadcast camera input designed to override or augment installed cameras
- Optional:
  - Lecture Capture recording system. The current standard is Panopto.

Auditorium - Projector and Screen

Auditorium: Primary use case is presentation of materials to large audiences. Traditional front of room teaching station with focus toward displays or large writing surfaces. AV Booth typical. AV Booth shall be equipped with AV sources and displays to allow production of technician-controlled events. Vocal reinforcement required. Cameras and lecture capture capabilities included. Advanced AV system control and integration. System requirements include:

- 16:9 aspect, 4K capable motorized screen
- 12,000 lumen minimum laser projector
  - Current models include Epson and Sony
- Local PC, Wireless Display Gateway, Wired HDMI input, Blu-ray Player

    - Network video encoder at teaching station
    - Network video decoder, local HDMI to Preview Monitor
    - Network video decoder, local HDMI to Primary Display
        - Network video encoder for local sources
        - Network video decoder, local HDMI to Preview Monitor
        - Network video decoder, local HDMI to Primary Display. Additional display outputs may be incorporated.
        - 11” wall or table mounted touch screen control
        - Core processor, shared or standalone
    - Software Defined Video over Ethernet (SDVoE):
        - A SDVoE, or Video over IP, system shall be considered for all large and advanced systems designs.
        - Inputs and outputs as required by system use and design
- AV Control located at teaching station and Booth
- Booth AV Sources including Blu-ray and wired HDMI input
    - Integrated into AV system for control from the Booth
    - Video production mixer such as Rolland V-600UHD with appropriate inputs/outputs. Recommended for produced events to enable seamless video preview and switching
- Audio Inputs in addition to Source Audio to include:
    - 2, wireless microphones for teaching station. Current models include Shure ULXD series
    - 8 additional wireless microphone channels. Current models include Shure ULXD series
    - Microphones required for audience capture where necessary
    - Additional microphones as required by system design or functionality
- Audio Output in addition to ALS to include:
    - Stereo presentation speakers installed at the display location. Audio system specified and sized for venue. Coda Audio systems preferred where applicable
    - Mono ceiling speakers recommended for vocal reinforcement. Standard models include QSC AD-C6T ceiling speaker
    - Dedicated Broadcast audio output
- Included Options:
    - Camera and microphones for Lecture Capture or Streaming. Standard models include QSC Cameras and Shure MXA910 microphones
    - Manual audio mixing console enabling full manual control of all audio sources. Must interface digitally with Q-Sys for switching between manual and auto modes.
    - Lecture Capture recording system. Current standard is Panopto.
    - Dedicated Broadcast camera input designed to override or augment installed cameras

Active Learning Classroom

Active Learning Classroom: Instructor led, media rich, group collaboration. Typically, multiple displays allowing individual group collaboration and instructor directed media to be displayed and controlled in an interactive and dynamic manner.

- Wolfvision Cynap vSolution Matrix active learning platform shall be installed in all Active Learning spaces
- Teaching/Touchdown station providing dedicated control and local input sources such as Local PC, Wireless Display Gateway, Wired HDMI input
- Audio Inputs in addition to Source Audio to include:

    - 2, wireless microphones for teaching station. Current models include Shure ULXD series
    - Additional microphones as required for system functionality and performance
- Audio Output in addition to ALS to include sound reinforcement necessary for system functionality and performance
- Note: Due to the custom and complex nature of Active Learning classrooms YALE IT shall be consulted on and approve of all designs and implementations.

3.3. Yale Classroom Minimum Standards

Video Sources

- Local PC with extended display capability to Preview Monitor
    - Yale provided classroom managed workstation
    - Yale network connection
- Wireless Display Gateway
    - Wolfvision Cynap Pure Wireless display network connection
- Wired HDMI input
    - Adapters provided for Mini DisplayPort and USB-C

Audio Sources

- Audio from input supporting allowable playback formats
- Microphone as needed for ALS such as room microphones
- Shure microphones, UXLD G50 or as needed by application to prevent interference. Frequency survey may be required.

Video Outputs

- Primary Display
    - Display shall be sized so that the height of display is equal to or less than the distance to the farthest viewer divided by 6
    - 16:9 aspect ratio
    - 4K capable projection surface or flat panel display
- Preview Monitor
    - Touch monitor with USB connection to Local PC. Current model includes Planar PCT2265 installed on an Ergotron LX mount. Note: In single display systems the Preview Monitor may be omitted.

Audio Outputs

- Stereo program audio speakers, speaker level wiring as required by system, ceiling speakers as necessary
- ALS audio transmitter as needed, infrastructure preinstalled, Cat 6A to ALS location
    - Listen Technologies IR Assisted Listening system or as required by venue
- Broadcast audio and video output as needed
- No more than 3dB difference in audio level across the listening space

Control

- Acceptable systems include Q-Sys as Basis of Design:
  - QSC Q-Sys Core, centralized audio, video and control processor
    - LAN A for AV, LAN B for Management
    - Located in MDF/IDF or locally as necessary
- Touch panel control in room of local AV system
  - Wall mounted, typical 1” conduit with 1, Cat 6A, POE+
  - Teaching station mounted in table top stand
- AV network connection
- Yale network connection allowing management, internet and remote access to the system. Coordinate with Yale AV for integration with current platforms and systems.

Video Distribution and Switching

- 4K infrastructure and compatibility must be provided
- Acceptable systems include:
  - Network based Video over IP
    - 1G Cat 6A network devices installed locally in the room and in AV/IT MDF/IDF closets
    - AV network connection to each
  - Software Defined Video over Ethernet (SDVoE):
    - A SDVoE, or Video over IP, system shall be considered for all large systems designs where a large number of inputs, outputs and signal routing flexibility is required. SDVoE systems support signal management and distribution in ways that make it a better value on large systems.
    - SDVoE systems are ideal for new construction and large renovations allowing enterprise management and scalability of deployments and full network integration of devices
    - 1G or 10G systems available, Cat6A or Fiber as required by the system, standard network infrastructure and topology, AV specific networking required. IDK is the preferred 10G solution.

Audio Distribution and Switching

- Core audio processing, as part of Control
  - Q-LAN, AES-67 and Dante audio over IP
  - Mic/Line/Speaker level wiring as needed, IP distribution preferred
  - AV network connection
- Assisted listening:
  - Listen Technologies IR ALS preferred. Connection or conversion as required by the system.
- Additional audio outputs shall be considered for Broadcast use in each system and must be provided in Standard Presentation room and above.

Network (Minimum Requirements)

- AV device locations typically require 2 network connections: Yale data network and Yale AV network

- Devices must be appropriately coordinated and configured with Yale ITS
- Display locations shall receive 2, Cat 6A
- AV Input locations shall receive 2, Cat 6A
- Equipment rack locations shall receive 2, Cat 6A. Additional network switching may be required.
- Touchscreen controllers receive 1, Cat 6A

Teaching Station

- ADA compliant teaching station, touchdown location or display cart. All devices must meet reach and usability standards.
  - Standard and custom furniture available
  - Custom millwork provided by Miller's Presentation Furniture
  - Power connection required
  - 2 Cat 6A required or per system design

Wall Mounted Display

- ADA compliant mounting
- Articulating mount preferred for accessibility to connections behind the display
- Typical display to have Chief PAC526 mounted behind the display location.
  - Duplex 15A/120V outlet installed in box by others
  - 2, Cat 6A installed by others
  - 1.25" conduit connected to lower wall boxes, floor boxes and/or extended to accessible ceiling
- Acceptable manufacturers include:
  - Samsung commercial
  - LG commercial
  - Planar
  - Others as approved by YALE IT

Movable Display Cart

- ADA compliant, motorized height adjustable stand
  - Salamander Designs display carts with power, network, storage and accessory mounting options. Custom branding available

Equipment Rack Design and Layout

- Provide blank panels over empty rack spaces
- System AV cabling shall be inaccessible to room users
- Wire management shall not be provided with zip ties
- ADA reachability must be implemented for any user controllable or configurable devices

Zoom Rooms

- Zoom is the primary desktop web conferencing platform for Yale

- Zoom Rooms are recommended for conference rooms and Administrative spaces to enable an integrated meeting room experience. Zoom Room consists of a controller, camera(s), microphone(s), speakers, Zoom Room appliance, and display
- Zoom Rooms shall use certified equipment and implementations

Room Schedule Panels

- Room schedule panels are currently regarded as optional
- Installation shall comply with ADA reachability guidelines
- Schedule panels shall integrate with existing calendaring platforms

4.1. Radio Communication In-Building Coverage Specifications

In building radio coverage systems generally consist of a neutral host DAS that provides cellular service reinforcement and a Public Safety DAS that provides code required Emergency Responder Radio Coverage. These two systems may be separated due to the enhanced infrastructure requirements of the Public Safety DAS as well as the different reinforcement needed based on its frequencies.

Neutral Host Cellular DAS

The neutral host cellular DAS shall meet the following requirements;

- Be neutral, meaning that it should be capable of supporting AT&T, Verizon, and T-Mobile signal sources.
- At a minimum accommodate WSP frequencies LTE700, AMPS850, PCS1900, AWS2100, WCS2300, BRS 2500/2600.
- Use infrastructure (cable, connectors, devices, antennas) that supports wireless systems operating on band widths from 600 MHz to 6 GHz.
- Allow for proactive remote management and end-to-end alarming of active electronics.

General Design Criteria: The DAS should be designed, constructed, and commissioned as a neutral-host system that will meets all subscribing carriers' frequency and technology requirements, as established by the appropriate RF engineers. Those may include, but not be limited to, C Band, 5G, mmWave, private LTE and CBRS.

- The DAS should be designed using iBwave.
- If the DAS is enabled for CBRS, it must be capable of supporting multiple carriers up to 150MHz.

Performance:

1. SINR Levels

The DAS should be designed using iBwave as the prediction tool, such that SINR levels achieve:

- 10 dB over 35%
- 4 dB over 85%
- 2 dB over 92%

Note: Once deployed, any DAS may be, and typically is, affected by a variety of external factors that can result in actual SINR levels being different than the iBwave modeling. However, those variances typically have no noticeable effect on users' experiences. Yale University and its DAS designer/installer should anticipate those conditions and work together in good faith to achieve the desired SINR levels, or levels as close to the iBwave models as possible.

2. RSRP and Dominance.

The DAS should be designed such that RSRP and dominance achieve -85 dBm or 8 dB dominance for 700MHz and 800MHz, and -90 dBm or 8 dB dominance for all other subscribing carriers' licensed frequencies over measured incoming external macro signal levels for 95% of the coverage area.

Note (1): A contractor's ability to meet these requirements requires cooperation from the carriers regarding the DAS' relationship to their macro sites operating in the area. Neither Yale University nor its designer/installer has control over carriers and their policies or practices. Consequently, there may be

differences between the carriers' requirements and the University's original expectations regarding coverage.
Note (2): Meeting desired dominance levels and coverage goals will require placing new equipment across the campus. The size and quantity of that equipment may be significant.

Management: The DAS should have the ability to be managed both on-site and remotely from a single location. The management system must include the following:

- The capability for firmware updates to be deployed quickly from a single control point.
- Creating module and remote inventory and system closeout packages must be automated.
- The system's administration must provide security/encryption layers for any remote administration elements.
- SNMP administration options for third-party NMS systems.
- The capacity to configure the system's operation for event-specific conditions.

Design and Construction Plans Review and Approvals: The University should require that the design be reviewed and approved by the subscribing carriers. The University also should reserve the right to review and approve the design and construction plans to ensure that agreed-upon performance and capacity goals will be met. Owners normally agree to carry out their review and provide feedback within 45 days. The University should receive a copy of the approved design and construction plans prior to the start of installation.

Post-Installation: The University should require confirmation that the carriers have accepted the system. The design and installation vendor(s) should deliver a copy of the as-built records within a reasonable time following the system's commissioning.

Public Safety Emergency Responder Radio Coverage System

Radio communication is the main mean of communications for Facilities Operations and Public Safety. Facilities Operations provides service and maintenance for the University and responds to emergencies that include building mechanical and structural failure. Facilities Operations may also be called upon to support other types of University events and emergences requiring support in areas of Physical Plant, Custodial, Grounds, and Fire Code Compliance, Power Plants, and Utilities. Additionally, when required, Facilities Operations can communicate with Yale Emergency Management, Yale Public Safety, Yale Hospitality, YARC, and host City/Town first responders.

Provide for inclusion of frequencies serving the municipalities' first responders in newly constructed buildings, additions to existing buildings, alterations to existing buildings where the geographic scope of work encompasses more than 50% of the building's gross area, including any additional floor area added and tie them into the fire system.

The ICT Designer shall consult with the Authority Having Jurisdiction (AHJ) of the municipality and Facilities Project Manager. The radio system(s) shall be designed to provide a minimum of 90 - 95% campus coverage and 99% coverage in vital areas. Subterranean spaces present radio signal deficiencies resulting from signal loss due to building penetration. Radio signal in subterranean spaces shall be enhanced

through a system design and engineering equipment which are linked to the radio systems through channel configuration (frequencies).

Public Safety System Code Requirements Summary: CT FLSC and IFC

- 2018 Connecticut State Building Code
- 2015 International Fire Code, Section 510

Systems and Equipment Summary

- DAS
- Multi-band Bi-Directional Amplifiers (BDA)
- Digital signal booster
- RF in-building antennas
- Riser rated coaxial cable
- Riser and Plenum rated fiber
- IP Address
- Emergency backup power
- Backup batteries (24 hours)
- Alarm points
- Equipment Enclosures housed in NEMA-4 compliant spaces.

Yale IT List of Approved Components and Manufacturers			
Equipment Type	**Basis of Design Manufacturer**	**Basis of Design Model**	**Notes**
Telecom Room Fit-Out Components			
Telecom Room Cable Runway	Chatsworth Universal Cable Runway , B-Line, Hubbell Premise Wiring, or approved equivalent		
Telecom Grounding Busbars (PBB/SBB/RBB)	Erico, Chatsworth, Hubbell Premise Wiring, Panduit, or approved equivalent		
Cabling Penetration Sleeves, Floor and Wall, with Firestopping	STI EZ-Path, Hilti SpeedSleeve, Wiremold Flamestopper		
Two Post Equipment Racks	Chatsworth, Siemon	55053-203, RS1-07-S	Black Color
Rack Upper Transition Tray, 3.5”D	Chatsworth	12183-X19	
Equipment Rack Double Sided Vertical Manager	Chatsworth, Siemon	Evolution G3 35571-703, VC1M-06D-1-45	
Equipment Rack Horizontal Manager, Single Sided, 2RU	Chatsworth, Siemon	30139-719, HCM-4-2U	
Fixed Wall Mounted 19” Equipment Rack; 41 Rack Units	Chatsworth	11962-X18	Coordinate final size requirements and accessories to specify unit
Wall Mounted Telecom Enclosure: 48”Hx30”D; solid door	Chatsworth	CUBE-iT 11996-X48	Coordinate final size requirements and accessories to specify unit
Telecom Riser Cabling Distribution			
Intrabuilding Multipair Category 3 Copper Backbone	General Cable, Mohawk, Superior Essex		
Category 5e Angled 24 Port Voice Crossconnect Patch Panel, 1 RU	Ortronics Siemon	Clarity OR-PHA5E6U24HD5-24A	
Category 5e Rack Mounted 100 Pair 110 Block	Siemon S110DA1-300RFT 300 Pair, S110DA1-200RFT 200 Pair, S110DA1-100RFT		Use for rack mounted applications
Category 5e Wall Mounted 100	Siemon S110AA2-300FT, Siemon S110AA2-200FT,		Use for wall mounted applications

Yale IT List of Approved Components and Manufacturers			
Equipment Type	**Basis of Design Manufacturer**	**Basis of Design Model**	**Notes**
Pair 110 Block	Siemon S110AA2-100FT		
Interbuilding Copper Voice Backbone	General Cable, Mohawk, Superior Essex		
Rack Mounted Telephone Entrance Protector	Circa	1880ENA1/NSC-200	
Wall Mounted Telephone Entrance Protector	Circa 110 Connector Series or approved equivalent		
Category 6 Entrance Protector	Circa 604-75110 or approved equivalent		
Telephone Entrance Protector 5-Pin Surge Protection Modules	Circa 4B1FS-240 or approved equivalent		
Intrabuilding Multimode Optical Fiber OM4 Backbone	Corning, Siemon	9BC5(X)(XXXX)-T512A, MIC Tight-Buffered, Interlocking Armored Cable, 50 µm OM4 Multimode	Provide cabling with OFCP Plenum or OFCR Riser rating as required by project conditions
Intrabuilding Singlemode Optical Fiber Backbone	Corning, Siemon	9BC8(X)(XXXX)-E205A, MIC Tight-Buffered, Interlocking Armored Cable, OS2 Singlemode	Provide cabling with OFCP Plenum or OFCR Riser rating as required by project conditions
Optical Fiber Rack Mounted Termination Cabinet	Corning, Siemon	RIC3-24-01, RIC3-48-01, RIC3-72-01/ CCH-02U, CCH-03U, CCH-04U with Duplex LC Adapter Panels, 24 F, OS2 SM and OM4 50 µm MM, RIC-F-LCU24-01C, RIC-F-LCQ24-01C	Size termination cabinet per specific project requirements with 50% spare capacity
Optical Fiber Wall Mounted Termination Cabinet	Corning, Legrand, Siemon	SWIC3-(X)-01, with Duplex LC Adapter Panels, 24 F, OS2 SM and OM4 50 µm MM, RIC-F-LCU24-01C, RIC-F-LCQ24-01C	Size termination cabinet per specific project requirements with 50% spare capacity
Optical Fiber SM Connector	Corning Siemon	FC-F-LCU-29BL FuseLite; OptiFuse Fusion Splice-On LC UPC Connector, Singlemode OS2	Zinwave DAS system fiber connections shall be APC in lieu of UPC, Siemon FC-F-LCA-29GR

Yale IT List of Approved Components and Manufacturers			
Equipment Type	**Basis of Design Manufacturer**	**Basis of Design Model**	**Notes**
Optical Fiber OM4 MM Connector	Corning Siemon	FC-F-LC5-29AQ OptiFuse Fusion FuseLite Splice-On LC Connector, 50 µm Multimode OM4	
Optical fiber indoor/outdoor rated	Corning	FREEDM One	Specify riser or plenum rating as required
Air Blown Fiber Tube Cabling, Plenum, riser, OSP rated	Sumitomo Electric Lightwave FutureFlex		
Air Blown Fiber, Fiber Bundles	Sumitomo Electric Lightwave FutureFlex		
Air Blown Fiber, Fiber Connectors	Sumitomo Electric Lightwave FutureFlex Lynx2 splice-on fiber optic connector		
Air Blown Fiber Tube Distribution Units	Sumitomo Electric Lightwave FutureFlex		
Air Blown Fiber Tube Distribution Splices	Sumitomo Electric Lightwave FutureFlex		
Outside Plant Innerduct	Endot, Dura-line, Maxcell, or approved equivalent		
Horizontal Distribution			
Wire Mesh Basket Cable Tray	Cablofil, Eaton B-Line Flextray, Nvent Caddy WBT, or approved equivalent		
Floor Boxes	Wiremold, Hubbell, FSR		
Pokethroughs	Wiremold, Hubbell, FSR		
Open Top J-Hooks for Cabling Supports	B-Line, Chatsworth, Mono-Systems, Nvent Caddy, Panduit, Thomas & Betts, Wiremold, or approved equivalent		
Category 6 Cabling Plenum CMP Rated	Mohawk, Belden, Siemon	AdvanceNet 4 PAIR #23 AWG UTP CATEGORY 6e+ PLENUM, Blue color, Part Number M57193, Siemon System 6 9C6P4-E3-06-RXA	Category 6 cabling plant shall be used in legacy applications with prior written Yale IT approval. Category 6A cabling is the Yale IT standard for structured cabling systems.
Category 6 Cabling Riser CMR	Mohawk,	AdvanceNet 4 PAIR #23 AWG UTP	Category 6 cabling plant shall be used in legacy

Yale IT List of Approved Components and Manufacturers			
Equipment Type	**Basis of Design Manufacturer**	**Basis of Design Model**	**Notes**
Rated	Belden, Siemon	CATEGORY 6e+ RISER, Blue color, Part Number M57202, Siemon System 6 9C6R4-E3-06-RXA	applications with prior written Yale IT approval. Category 6A cabling is the Yale IT standard for structured cabling systems.
Category 6 Cabling Indoor/Outdoor Riser Rated	Mohawk, Belden, Siemon	VersaLAN INDOOR/OUTDOOR 4 PAIR #23 AWG UTP CAT 6 CMR/CMX, Blue color, Part Number M59200	Category 6 cabling plant shall be used in legacy applications with prior written Yale IT approval. Category 6A cabling is the Yale IT standard for structured cabling systems.
Category 6A Cabling Plenum CMP rated	Mohawk, Belden, Siemon	GigaLAN 10 4 PAIR #23 AWG UTP CATEGORY 6A PLENUM, Blue color, Part Number M58646, Siemon 9C6P4-A5-06AR1A	Security system devices and cameras shall use Purple color cabling, Mohawk M57201 and Siemon 9C6P4-A5-08AR1A.
Category 6A Cabling Riser CMR rated	Mohawk, Belden, Siemon	GigaLAN 10 4 PAIR #23 AWG UTP CATEGORY 6A Riser, Blue color, Part Number M58646, Siemon 9C6R4-A5-06AR1A	Security system devices and cameras shall use Purple color cabling, Mohawk M57210, and Siemon 9C6R4-A5-08AR1A.
Category 6A Cabling Indoor/Outdoor Riser Rated	Mohawk, Belden Siemon	VersaLAN INDOOR/OUTDOOR 4 PAIR #23 AWG UTP CAT 6 CMR/CMX, Blue color, Part Number M59200, Siemon 9U6W4-A5-12-R1A	
Category 6 Angled 48 Port Patch Panel, 1RU or 2RU	Siemon, Ortronics	Clarity OR-PHA66U48, HD6-48A, or Z6-PNLA-U48K	Category 6 cabling plant shall be used in legacy applications with prior written Yale IT approval. Category 6A cabling is the Yale IT standard for structured cabling systems.
Category 6A Angled 48 Port Patch Panel, 1 or 2 RU	Siemon, Ortonics	Clarity OR-PHA6AU48, Z6A-PNLA-U48K	Category 6A Patch Panel for Wireless Access Point Cabling Termination
Category 6 Reduced Diameter Patch Cords	Ortronics 28 AWG stranded with 8-position modular plug, blue color unless otherwise required, Siemon SkinnyPatch 6 MC6-(XX)-(XX)		Category 6 cabling plant shall be used in legacy applications with prior written Yale IT approval. Category 6A cabling is the Yale IT standard for structured cabling systems. Provide reduced diameter patch cords for cross-connections within Telecom

Yale IT List of Approved Components and Manufacturers			
Equipment Type	**Basis of Design Manufacturer**	**Basis of Design Model**	**Notes**
			Rooms. Coordinate final lengths and colors required.
Category 6A Reduced Diameter Patch Cords	Ortronics 28 AWG stranded with 8-position modular plug, blue color unless otherwise required, Siemon SkinnyPatch 6A SP6A-(XX)-(XX)		Provide reduced diameter patch cords for cross-connections within Telecom Rooms. Coordinate final lengths and colors required. Provide cords for wireless access point cross-connections. Cords installed above ceilings shall be plenum rated as required.
Category 6 Patch Cords	28 AWG stranded with 8-position modular plug, blue color unless otherwise required, Siemon SkinnyPatch 6 MC6-(XX)-(XX)		Category 6 cabling plant shall be used in legacy applications with prior written Yale IT approval. Category 6A cabling is the Yale IT standard for structured cabling systems. Coordinate final lengths and colors required.
Category 6A Patch Cords	Blue color unless otherwise required: • Stranded Conductor CMG Rated: Siemon ZM6A-(XX)-(XX) • Solid Conductor CMR/CMP Rated: Siemon ZC6A-(XX)(X)-(X)(X)		Coordinate final lengths and colors required. Provide cords for wireless access point cross-connections. Cords installed above ceilings shall be plenum rated as required.
Category 6 Modular Jack	Ortronics Clarity 6 TracJack OR-TJ600, Siemon Max Jack MX6-F(XX)/ MX6-K(XX) or Zmax Z6A-(XX) Hybrid Flat/Angled with No Door		Provide fog white color unless otherwise directed by Yale IT
Category 6A Modular Jack	Ortronics Clarity 6a track jack OR-TJ6A, Siemon Z6A-(XX) Hybrid Flat/Angled with No Door		Provide fog white color unless otherwise directed by Yale IT
Category 6A UTP Modular Plug	Belden REVConnect 10GX Field Mount Plug RVAFPUBK-S1		Provide field mount plug termination for security camera locations.
Telephone Mounting Faceplate	Ortronics Siemon	TracJack OR-403STJ1WP, MC-WK-K(XX)-SS	
Four Port Modular Faceplate – Single Gang White	Ortronics Siemon	TracJack OR-40300546, MX-FP-S-04-02 or 10GMX-FPS04-02	Four Port Modular Faceplate – Single Gang White
Four Port Modular Faceplate – Single Gang Stainless Steel	Ortronics Siemon	TracJack OR-403STJ14, MX-FP-S-04-SS-L	Four Port Modular Faceplate – Single Gang Stainless Steel

Yale IT List of Approved Components and Manufacturers			
Equipment Type	**Basis of Design Manufacturer**	**Basis of Design Model**	**Notes**
Two Port Surface Mount Biscuit Box White	Ortronics Siemon	TracJack OR-404TJ2, MX-SM2-02	Boxes installed above finished ceilings shall be plenum rated as required
Systems Furniture Four Port Faceplate White	Ortronics Siemon	TracJack OR-40300633, MX-UMA-02	Coordinate systems furniture plate requirements with furniture provider
Four Port Decora Adapter Strap White	Ortronics Siemon	TracJack OR-41900018, MX-D4Z-02	
Four Port 106 Adapter Strap White	OrtronicsSiemon	TracJack OR-40800019 MX-E4F-02	
50 micron OM4 Laser Optimized Multimode Duplex LC Module	Ortronics, Siemon	TracJack OR-63700080, MX-F1-LCQ-(XX), use with CT4-FP-(XX) + CTE-MXA-(XX)-(XX) faceplates	
50 µm OM4 Laser Optimized Multimode Horizontal Cabling	Corning,Siemon	MICTight-Buffered Cable, Plenum 2 F, 50 µm multimode (OM4) 9BB5P002B-T512A	
Optical Fiber Patch Cords	Corning,Siemon LBP-LCULCUL-(XX), LBP-LCLC5V-(XX)AQ		Coordinate requirements with Yale IT
Cable Plant Labeling	Brady, Siemon, Panduit, or approved equivalent		
Cable Plant Tester and Reports	Fluke Networks Versiv test equipment with LinkWare Management Software or approved equivalent		
Wireless Access Point Enclosures	Oberon or approved equivalent		Coordinate requirements with Yale IT and the Architect
High Bandwidth Future Proof FTTD Deployment			
MDT/IDT Fiber Termination Cabinet: 1 RU, 2 RU, 4 RU.	Corning EDGE Housings: EDGE-01U, EDGE-02U, EDGE-04U; Siemon		
Consolidation Point Fiber Zone Box	Corning EDGE-FZB-04U; Siemon		
Fiber Module LC Duplex to MTP (pinned), 12 Fiber, OS2 Singlemode	Corning ECM-UM12-04-89G; Siemon		

Yale IT List of Approved Components and Manufacturers			
Equipment Type	**Basis of Design Manufacturer**	**Basis of Design Model**	**Notes**
Fiber Singlemode OS2 MTP Trunk: Single-mode Ultra (OS2), Non-pinned MTP® PRO Connector with Push-Pull Boot to Non-pinned MTP® PRO Connector with Push-Pull Boot, Non-armored, TIA-568 Standard Universal Type-B Polarity, Pulling grip on first end only	Corning 12F - G909012G(YY)DDU(XXX)F, 24F - G909024G(YY)DDU(XXX)F, 36F - G909036G(YY)DDU(XXX)F, 48F - G909048G(YY)DDU(XXX)F, 72F - G909072G(YY)DDU(XXX)F, 96F - G909096G(YY)DDU(XXX)F, 44F - G9090E4G(YY)DDU(XXX)F; Siemon		(YY) is cable type for Plenum, non-armored (PN) and Plenum BX armored (AD). (XXX) is the total footage of each pre-terminated factory-made cable.
Distributed Antenna Systems			
Head End Equipment	Zinwave or approved equivalent		Coordinate requirements with Facilities Project Management
Telecom Room Active Hubs	Zinwave or approved equivalent		Coordinate requirements with Facilities Project Management
Remote Units/Antennas	Zinwave or approved equivalent		Coordinate requirements with Facilities Project Management
Area of Rescue Two-way Communications System			
Area of Rescue Command Unit and Visual Indicator	Talkaphone AOR-XX or approved equivalent		
Area of Rescue Call Station	Talkaphone ETP-110 or approved equivalent		
System Building Signage	Custom Building Signage		Coordinate system requirements with project Architect for inclusion in the Building Signage Package
Fire Alarm Voice Evacuation (FAVE) System			
Building FAVE Panel	Siemens, Honeywell		Coordinate requirements with Yale IT
FAVE System Multimode Optical Fiber Patch Cords	Corning, Hubbell Premise Wiring, Ortronics		

Yale IT List of Approved Components and Manufacturers			
Equipment Type	**Basis of Design Manufacturer**	**Basis of Design Model**	**Notes**
Mass Notification System (MNS) System			
Building MNS Panel and Equipment			Coordinate requirements with Yale IT (Yale Emergency Management). The existing SysNova System is at End of Life, not well supported, and not functional. Replacement systems are under evaluation and may be implemented for the project.
Security Systems Infrastructure			
Door Hardware Power Supplies	Altronix or approved equivalent		
Outdoor Site Emergency Call Station Pole	U.S. Architectural Lighting	SNTA 4”	
Emergency Call Station 120V Blue Light	Dialight	RTO-0B07-001	
Security Access Control Composite Banana Cabling	Belden Inc.; Electronics Division Berk-Tek; a Nexans Company Mohawk/CDT; a division of Cable Design Technologies West Penn Wire/CDT		
Custom Entry Card Reader Bollards	Refer to photographs of campus installations in Appendix D		Coordinate custom design requirements with project Architect
Security Systems Equipment			
Access Control Panel	AMAG Technology	<u>Licensing</u> • AMAG ENT-LIC-008-V9 - Symmetry Enterprise 8 Reader License Add-on • AMAG ENT-LIC-064-V9 -Symmetry Enterprise 64 Reader License Add-on <u>Reader Boards</u> • AMAG M2150-4DBC-DL-HSE - Symmetry M2150 4DBC HSE 4 Reader	Provide minimum 20% spare I/O point and card reader capacity at each access control headend location in the building.

Yale IT List of Approved Components and Manufacturers			
Equipment Type	**Basis of Design Manufacturer**	**Basis of Design Model**	**Notes**
		Panel BOARD ONLY - DL, 20K. • AMAG M2150-8DBC-DL-HSE - Symmetry M2150 8DBC HSE 8 Reader Panel BOARD ONLY - 20K. • AMAG M2150-8DC-DL-HSE - Symmetry M2150 8DC HSE 8 Reader Panel BOARD ONLY - DL <u>Elevator Panels</u> • AMAG M2150-ELEV-HSE - Symmetry M2150 HSE Elevator Node with Enclosure - 20K cards. • AMAG M2150-ELEV-EXT-HSE - Symmetry M2150 HSE Elevator Extender with Enclosure - Requires M2150-ELEV & 18VAC trans <u>Input and Output Modules</u> • AMAG M2150-AC8/4 • AMAG M2150-OC4/8 <u>Input and Output Controllers</u> • AMAG M2150-AC24/4 Board only • AMAG M2150-OC4/24 Board only <u>Network Module</u> • AMAG MN-NIC-4 - Symmetry M2150 NIC Module <u>Panel Enclosures</u> • AMAG FPO150-B100C8D8E4A LifeSafety Power Enclosure • AMAG FPO150/250-2C82D8E8A LifeSafety Power Enclosure	
Security Power Supply	Altronix or approved equivalent		Specify fire alarm system interface where required.
Integrated Card Reader	Sargent	SN Series SN200 Weigand Signo Reader	For building telecom room access control doors,

Yale IT List of Approved Components and Manufacturers			
Equipment Type	**Basis of Design Manufacturer**	**Basis of Design Model**	**Notes**
			provide model with integrated keypad for dual authentication. Coordinate with Yale IT for latest model number. Reader support for Bluetooth shall be provided. Ensure system firmware lights the reader LED red when the door is locked, green when the door is unlocked, and flashing green during momentary unlocking of a door in a normally locked state.
Wall Mounted Card Reader	HID	Signo Reader 40	Coordinate with Yale IT for latest model number. Reader support for Bluetooth shall be provided. Ensure system firmware lights the reader LED red when the door is locked, green when the door is unlocked, and flashing green during momentary unlocking of a door in a normally locked state.
Mullion Mounted Card Reader	HID	Signo Reader 20	Coordinate with Yale IT for latest model number. Reader support for Bluetooth shall be provided. Ensure system firmware lights the reader LED red when the door is locked, green when the door is unlocked, and flashing green during momentary unlocking of a door in a normally locked state.
Keypad Card Reader	HID	Signo Reader 40K	Coordinate with Yale IT for latest model number. Reader support for Bluetooth shall be provided. Ensure system firmware lights the reader LED red when the door is locked, green when the door is unlocked, and flashing green during momentary unlocking of a door in a normally locked state.
Request to Exist Sensor	Bosch	DS160	
Overhead Door Contact Position Switch	Sentrol 2505A, GRI, Magnasphere, or approved equivalent		
Recessed Door Position Switch	Sentrol SR-1078W, GRI, Magnasphere, or approved equivalent		

Yale IT List of Approved Components and Manufacturers			
Equipment Type	**Basis of Design Manufacturer**	**Basis of Design Model**	**Notes**
Door Management Alarm	Designed Security, Inc (DSI)	ES4200-K3-T1	
Security Camera - Exterior, Fixed, Vandal Resistance, Weatherproof	Axis Communications or approved equivalent	P3267-LVE or approved equivalent with SD Card edge storage enabled and Axis 64 GB SD card provided.	**Coordinate camera specification and final camera submittal approval with Yale IT.** Final selection for camera model numbers shall be confirmed in the submittal review process of the project Construction Administration phase.
Security Camera - Exterior, Fixed, Vandal Resistance, Weatherproof, PTZ Camera	Axis Communications or approved equivalent	Q6155-E or approved equivalent with SD Card edge storage enabled and Axis 64 GB SD card provided.	**Coordinate camera specification and final camera submittal approval with Yale IT.** Final selection for camera model numbers shall be confirmed in the submittal review process of the project Construction Administration phase.
Security Camera - Exterior, Vandal Resistant, Weatherproof, Wide Dynamic Range (Canopy)	Axis Communications or approved equivalent	P3267-LVE or approved equivalent with SD Card edge storage enabled and Axis 64 GB SD card provided.	**Coordinate camera specification and final camera submittal approval with Yale IT.** Final selection for camera model numbers shall be confirmed in the submittal review process of the project Construction Administration phase.
Security Camera - Interior, Fixed Camera	Axis Communications or approved equivalent	P3265-LV or approved equivalent with SD Card edge storage enabled and Axis 64 GB SD card provided.	**Coordinate camera specification and final camera submittal approval with Yale IT.** Final selection for camera model numbers shall be confirmed in the submittal review process of the project Construction Administration phase.
Security Camera - Interior, Wide Dynamic Range, (facing Exterior Door)	Axis Communications or approved equivalent	P3265-LV or approved equivalent with SD Card edge storage enabled and Axis 64 GB SD card provided.	**Coordinate camera specification and final camera submittal approval with Yale IT.** Final selection for camera model numbers shall be confirmed in the submittal review process of the project Construction Administration phase.
Security Camera - Interior, Fixed	Axis	P3265-LV or approved equivalent with SD	**Coordinate camera specification and final camera**

Yale IT List of Approved Components and Manufacturers			
Equipment Type	**Basis of Design Manufacturer**	**Basis of Design Model**	**Notes**
Camera, Corridors	Communications or approved equivalent	Card edge storage enabled and Axis 64 GB SD card provided.	**submittal approval with Yale IT.** Final selection for camera model numbers shall be confirmed in the submittal review process of the project Construction Administration phase.
Security Camera - Interior, Fixed Camera, Elevators	Axis Communications or approved equivalent	P9106v Brushed Steel with Axis T8645 PoE+ Over Coax Compact Kit or approved equivalent with SD Card edge storage enabled and Axis 64 GB SD card provided.	**Coordinate camera specification and final camera submittal approval with Yale IT.** Final selection for camera model numbers shall be confirmed in the submittal review process of the project Construction Administration phase.
Security Camera - Interior, Fixed, 180-degree multi-imager, Wide Dynamic Range	Axis Communications or approved equivalent	P3807-PVE or approved equivalen with SD Card edge storage enabled and Axis 64 GB SD card provided.	**Coordinate camera specification and final camera submittal approval with Yale IT.** Final selection for camera model numbers shall be confirmed in the submittal review process of the project Construction Administration phase.
Security Camera - Exterior, Fixed, Wide Dynamic Range: 180 Degree Camera	Axis Communications or approved equivalent	P3807-PVE or approved equivalent with SD Card edge storage enabled and Axis 64 GB SD card provided.	**Coordinate camera specification and final camera submittal approval with Yale IT.** Final selection for camera model numbers shall be confirmed in the submittal review process of the project Construction Administration phase.
Security Camera - Interior, Fixed, Single Imager Panoramic Fisheye	Axis Communications or approved equivalent	M3068-P or approved equivalent with SD Card edge storage enabled and Axis 64 GB SD card provided.	**Coordinate camera specification and final camera submittal approval with Yale IT.** Final selection for camera model numbers shall be confirmed in the submittal review process of the project Construction Administration phase.
Security Camera - Exterior, Fixed, Wide Dynamic Range: 360 Degree Camera	Axis Communications or approved equivalent	P3727-PLE or approved equivalent with SD Card edge storage enabled and Axis 64 GB SD card provided.	**Coordinate camera specification and final camera submittal approval with Yale IT.** Final selection for camera model numbers shall be confirmed in the submittal review process of the project Construction Administration phase.
Security Camera - Interior, Fixed,	Axis	P3727-PLE or approved equivalent with	**Coordinate camera specification and final camera**

Yale IT List of Approved Components and Manufacturers			
Equipment Type	**Basis of Design Manufacturer**	**Basis of Design Model**	**Notes**
Wide Dynamic Range: 360 Degree Camera	Communications or approved equivalent	SD Card edge storage enabled and Axis 64 GB SD card provided.	**submittal approval with Yale IT.** Final selection for camera model numbers shall be confirmed in the submittal review process of the project Construction Administration phase.
Security Camera - Exterior, Fixed, Wide Dynamic Range: 360 Degree/PTZ Camera, Network Camera with pole mounted gooseneck/pendant mount	Axis Communications or approved equivalent	Q61000-E/Q6128-LE PTZ or approved equivalent with SD Card edge storage enabled and Axis 64 GB SD card provided.	**Coordinate camera specification and final camera submittal approval with Yale IT.** Final selection for camera model numbers shall be confirmed in the submittal review process of the project Construction Administration phase.
Covert Duress Button	United Security US-HUB2SA, DMP, Honeywell, Interlogix		Coordinate specification and final submittal approval with Yale IT. Final selection shall be confirmed in the submittal review process of the project Construction Administration phase.
Intrusion Dual Technology Motion Detector	DMP, Bosch, Honeywell, Interlogix, Optex		
Wireless Intrusion Sensors, Receivers, Repeaters	DMP 1100XH, DMP 1100R, Interlogix		
Glass Break Detector	Interlogix ShatterPro Acoustic Glassbreak Sensor, Honeywell		
Laser Scan Detector	Optex RLS 2020I or approved equivalent		
Shock Sensor	GRI Shockgard SG-1 or approved equivalent		
Plunger Switch	GRI PB2020T or approved equivalent		
Video Intercom System, IP SIP based	Aiphone, Axis, Viking		
Emergency Call Station	Gai-tronics	293AL-003 in Blue Color	Call Station shall not be specified with a keypad dial
Building Alarm Panel to Central Station	DMP	550	
Alarm System Keypad	DMP	7000 Series Thinline LCD Keypad	

Yale IT List of Approved Components and Manufacturers			
Equipment Type	**Basis of Design Manufacturer**	**Basis of Design Model**	**Notes**
Building Alarm Panel Digital Cellular Communicator	DMP	263/381-2	
Video Management Systems	Milestone	Xprotect 5 year care plus and 5 year care premium with every camera.	Include 5-year license for each camera connected. Provide Pro Support for each camera provided.
Electronic Keybox	Morse Watchmans	KeyWatcher Touch	
Audiovisual Systems			
In-Wall Recessed Flat Panel Backboxes	Chief PAC526FCW or Fire Rated FSR PWB-FR-450-XXX		
Motorized Projection Screens	Dalite, Stewart Filmscreen, Screen Innovations		All screen surfaces must be high contrast and, where appropriate, ambient light rejecting. 16:9 aspect ratio format
AV Network Switches and Configuration	Cisco Next Generation Network Switches		Coordinate with Yale IT to determine whether Cisco style switches should be provided that may permit integration with the Yale Next Generation Network at a future date.
Ceiling speakers (with back boxes, transformers, and grilles)	QSC	AcousticDesign Series	
Video Cameras	QSC	PTZ-IP 20x60	
Audio Visual consoles and Audio Visual Equipment Cabinets	Millers Presentation Furniture, Middle Atlantic		
Lecterns	Miller's Presentation Furniture		Refer to standard details for additional information on Lectern types.
Data / Video projector and ceiling mounting brackets	Chief Manufacturing or approved equivalent		
Wall and ceiling mounted flat	Samsung,	Commercial grade minimum models	Displays shall have IP control

Yale IT List of Approved Components and Manufacturers			
Equipment Type	**Basis of Design Manufacturer**	**Basis of Design Model**	**Notes**
screen video displays	LG, Sony, Planar		
Microphones	Shure	MXA-xxx series, ULX-D G50	
Point to Point Audiovisual Systems	QSC	Q-Sys	
1 Gigabit AV over IP Systems	QSC	Q-Sys	
10 Gigabit SDVoE Systems	IDK	IP NINJAR Series	
Control Interfaces - Touchscreens and physical controls	QSC	Q-SYS TSC-XXX-G3	
Room Schedule Panels	Crestron	TSS-7	Coordinate room availability indicators, size, and mounting conditions with Architect
Audio DSP Programming	QSC	Q-Sys Core Processors	

APPENDIX B1 - SAMPLE PROJECT SPECIFIC SOW MATRIX TEMPLATE

Item Description	Design/Specified by					Furnished by								Installed by								
	Yale	Owner Vendor	Architect	Electrical Engineer	ICT Designer	Yale	General Contractor	Electrical Contractor	Cabling Contractor	Security Contractor	AV Contractor	DAS Contractor	Fire Alarm Contractor	Yale	General Contractor	Electrical Contractor	Cabling Contractor	Security Contractor	AV Contractor	DAS Contractor	Fire Alarm Contractor	Questions / Comments
Telecom Room Fit-Out Components																						
Cable Runway in Telecom Rooms																						
Telecom Grounding Busbars																						
Telecom Grounding Backbones																						
Telecom Bonding																						
Wall Plywood Backboarding																						
Cabling Penetration Sleeves, Floor and Wall, w/ Firestopping																						
Cabling Plant Equipment Racks and Vertical Mangers																						
Category 6/6A Patch Panels, Horizontal Managers, and Cable Terminations																						
Optical Fiber Patch Cords																						
Telecom Riser Cabling Distribution																						
Building Riser Conduits																						
Riser Cabling - Copper Backbone																						
Copper Voice Termination Patch Panel																						
Riser Cabling - Optical Fiber, Singlemode and OM4 Multimode																						
Optical Fiber Termination Cabinets																						
Outside Plant Interbuilding Air Blown Fiber/Copper Backbones																						
Air Blown Fiber Tube Distribution Units, Tube Cables, Tube Splices																						
Outside Plant Communications Ductbank																						
Horizontal Distribution																						
Corridor Cable Trays																						
Outlet Conduit and Device Backboxes																						
Floor Boxes and Poke Throughs																						
Open Top J-Hooks for Cabling Supports																						
Category 6/6A Horizontal Cabling																						
Workstation Outlets/Faceplates/Jack																						
Workstation Horizontal Category 6/6A and OM4 Fiber Patch Cords																						
Cable Plant Labeling																						
Cable Plant Testing																						
Network Electronics Equipment																						

APPENDIX B1 - SAMPLE PROJECT SPECIFIC SOW MATRIX TEMPLATE

Item Description	Design/Specified by					Furnished by								Installed by								
	Yale	Owner Vendor	Architect	Electrical Engineer	ICT Designer	Yale	General Contractor	Electrical Contractor	Cabling Contractor	Security Contractor	AV Contractor	DAS Contractor	Fire Alarm Contractor	Yale	General Contractor	Electrical Contractor	Cabling Contractor	Security Contractor	AV Contractor	DAS Contractor	Fire Alarm Contractor	Questions / Comments
Network Equipment Racks																						
Rack Mounted PDU's																						
Rack Mounted UPS's																						
Telecom Room Network Switches																						
Telecom Room Voice Gateways																						
Core Network Room Core Switching Equipment Upgrades																						
Wireless Access Points (Wi-Fi 802.11ac/ax)																						
Wireless Access Points RF Predictive Study																						
Wireless Access Points RF Post Installation Study																						
Wireless Access Point Enclosures																						
Telephone Handsets (Analog and VoIP)																						
Building User PC Workstations																						
Distributed Antenna Systems																						
Site Assessment																						
RF Predictive Study																						
Head End Equipment																						
Telecom Room Active Hubs																						
Remote Units/Antennas																						
Optical Fiber/Low Voltage Power Cabling																						
Wireless Coverage and Signal Strength Testing																						
Two-Way Communication System for Area of Rescue																						
Conduit Rough-in and Device Backboxes																						
Area of Rescue Command Unit and Visual Indicator																						
Area of Rescue Call Station																						
System Cabling																						
Command Unit Analog Telephone Line																						
System Building Signage																						
Fire Alarm Voice Evacuation (FAVE) System																						
Building FAVE Panel																						
FAVE System Multimode Optical Fiber Patch Cords																						
Mass Notification System																						
Building MNS Panel																						
MNS System Cabling																						

APPENDIX B1 - SAMPLE PROJECT SPECIFIC SOW MATRIX TEMPLATE

Item Description	Design/Specified by					Furnished by								Installed by								
	Yale	Owner Vendor	Architect	Electrical Engineer	ICT Designer	Yale	General Contractor	Electrical Contractor	Cabling Contractor	Security Contractor	AV Contractor	DAS Contractor	Fire Alarm Contractor	Yale	General Contractor	Electrical Contractor	Cabling Contractor	Security Contractor	AV Contractor	DAS Contractor	Fire Alarm Contractor	Questions / Comments
MNS System Site Speakers																						
MNS Central Station and Site Speaker Testing																						
Security System Infrastructure																						
Security Systems Conduit Rough-in and Device Backboxes																						
Electrified Door Hardware (hardware Installation)																						
Electrified Door Hardware (terminations)																						
Door Hardware Power Supplies																						
Security System Pathways (Non-IP Network Based)																						
Security System Cabling (Non-IP Network Based)																						
Security System Device Terminations																						
Category 6 Network Cabling and Terminations																						
Fire Alarm System Interfaces, Relays, and Programming																						
Outdoor Site Emergency Telephone Concrete Base and Pole																						
Emergency Telephone 120V Blue Light																						
Custom Entry Card Reader Bollards																						
Security System Equipment																						
Access Control Panels and Wallfield Elevations																						
Card Readers																						
Request to Exist Sensor																						
Door Position Switches																						
Door Management Alarms																						
Security Cameras and Mounts																						
Intrusion Detection Systems Devices																						
Video Intercom System																						
Emergency Call Stations																						
Building Alarm Panel to Central Station																						
Building Alarm Panel Cellular Modem																						
Network Video Recording (NVR) Systems																						
Electronic Keyboxes																						
Security System Programming																						
System Testing and Training																						
Audiovisual Infrastructure and Equipment																						
Conduit, junction boxes, floor boxes, wireways and other electrical (construction related) rough-in work pertaining to the installation of the AV systems																						

APPENDIX B1 - SAMPLE PROJECT SPECIFIC SOW MATRIX TEMPLATE

Item Description	Design/Specified by					Furnished by								Installed by								
	Yale	Owner Vendor	Architect	Electrical Engineer	ICT Designer	Yale	General Contractor	Electrical Contractor	Cabling Contractor	Security Contractor	AV Contractor	DAS Contractor	Fire Alarm Contractor	Yale	General Contractor	Electrical Contractor	Cabling Contractor	Security Contractor	AV Contractor	DAS Contractor	Fire Alarm Contractor	Questions / Comments
Power receptacles and related electrical requirements																						
Network Connections																						
AV Network Switches and Configuration																						
Yale Network Integration																						
Low Voltage Audiovisual Cabling																						
Audiovisual Cable Terminations																						
Ceiling speakers (with back boxes, transformers, and grilles)																						
Video Cameras																						
Audio Visual consoles and Audio Visual Equipment Cabinets																						
Lectern																						
Data / Video projector and ceiling mounting brackets																						
Wall and ceiling mounted flat screen video displays																						
Wall mounted fixed projection screens																						
Ceiling mounted electric screens (recessed and surface mount)																						
Digital Signage Hardware																						
Digital Signage Software																						
Microphones																						
Control Systems - Hardware and Programming																						
Control Interfaces - Touchscreens and physical controls																						
Audio DSP Programming																						
AV System Documentation																						
Video System Test Reporting																						
Audio System Test Reporting																						
Control System Test Reporting																						
Final Commissioning Report																						
AV System User Acceptance Training																						
Project Close																						
Maintenance of AV System																						
AV System Troubleshooting																						
Research / Testing Computer Displays / Monitors																						

Yale IT Systems Differential Scope of Work Matrix				
System	**Designed By**	**Furnished By**	**Installed By**	**Notes**
Telecom Room Fit-Out Components				
Cable Runway in Telecom Rooms	ICT Designer	Project CM/GC (Recommend assigning to Cabling Contractor)	Project CM/GC (Recommend assigning to Cabling Contractor)	
Telecom Grounding Busbars	ICT Designer	Project CM/GC (Recommend assigning to Cabling Contractor)	Project CM/GC (Recommend assigning to Electrical Contractor)	
Telecom Grounding Backbones	ICT Designer	Project CM/GC (Recommend assigning to Electrical Contractor)	Project CM/GC (Recommend assigning to Electrical Contractor)	
Telecom Bonding	ICT Designer	Project CM/GC (Recommend assigning to Cabling Contractor)	Project CM/GC (Recommend assigning to Cabling Contractor)	
Wall Plywood Backboarding	ICT Designer	Project CM/GC (Recommend assigning to Cabling Contractor)	Project CM/GC (Recommend assigning to Cabling Contractor)	
Cabling Penetration Sleeves, Floor and Wall, with Firestopping	ICT Designer	Project CM/GC (Recommend assigning to Cabling Contractor)	Project CM/GC (Recommend assigning to Cabling Contractor)	
Cabling Plant Equipment Racks and Vertical Managers	ICT Designer	Project CM/GC (Recommend assigning to Cabling Contractor)	Project CM/GC (Recommend assigning to Cabling Contractor)	
Category 6/6A Patch Panels, Horizontal Managers, and Cable Terminations	ICT Designer	Project CM/GC (Recommend assigning to Cabling Contractor)	Project CM/GC (Recommend assigning to Cabling Contractor)	
Category 6/6A Patch Cords	ICT Designer	Project CM/GC (Recommend assigning to Cabling Contractor)	Project CM/GC (Recommend assigning to Cabling Contractor)	
Optical Fiber Patch Cords	ICT Designer	Yale IT	Yale IT	
Telecom Riser Cabling Distribution				

Yale IT Systems Differential Scope of Work Matrix				
System	**Designed By**	**Furnished By**	**Installed By**	**Notes**
Building Riser Conduits	ICT Designer	Project CM/GC (Recommend assigning to Electrical Contractor)	Project CM/GC (Recommend assigning to Electrical Contractor)	
Riser Cabling - Copper Backbone	ICT Designer	Project CM/GC (Recommend assigning to Cabling Contractor)	Project CM/GC (Recommend assigning to Cabling Contractor)	
Copper Voice Termination Patch Panel	ICT Designer	Project CM/GC (Recommend assigning to Cabling Contractor)	Project CM/GC (Recommend assigning to Cabling Contractor)	
Riser Cabling - Optical Fiber, Singlemode and OM4 Multimode	ICT Designer	Project CM/GC (Recommend assigning to Cabling Contractor)	Project CM/GC (Recommend assigning to Cabling Contractor)	
Optical Fiber Termination Cabinets	ICT Designer	Project CM/GC (Recommend assigning to Cabling Contractor)	Project CM/GC (Recommend assigning to Cabling Contractor)	
Outside Plant Interbuilding Air Blown Fiber/Copper Backbones	ICT Designer	Project CM/GC (Recommend assigning to Cabling Contractor)	Project CM/GC (Recommend assigning to Cabling Contractor)	Contractor shall be Manufacturer Certified to provide the Air Blown Fiber distribution system.
Air Blown Fiber Tube Distribution Units, Tube Cables, Tube Splices	ICT Designer	Project CM/GC (Recommend assigning to Cabling Contractor)	Project CM/GC (Recommend assigning to Cabling Contractor)	Contractor shall be Manufacturer Certified to provide the Air Blown Fiber distribution system.
Outside Plant Communications Ductbank	ICT Designer/Site Civil Engineer	Project CM/GC (Recommend assigning to Electrical Contractor)	Project CM/GC (Recommend assigning to Electrical Contractor)	
Horizontal Distribution				
Corridor Cable Trays	ICT Designer	Project CM/GC (Recommend assigning to Electrical Contractor)	Project CM/GC (Recommend assigning to Electrical Contractor)	
Outlet Conduit and Device Backboxes	ICT Designer	Project CM/GC (Recommend assigning to Electrical Contractor)	Project CM/GC (Recommend assigning to Electrical Contractor)	

Yale IT Systems Differential Scope of Work Matrix				
System	**Designed By**	**Furnished By**	**Installed By**	**Notes**
Floor Boxes and Poke Throughs	ICT Designer	Project CM/GC (Recommend assigning to Electrical Contractor)	Project CM/GC (Recommend assigning to Electrical Contractor)	
Open Top J-Hooks for Cabling Supports	ICT Designer	Project CM/GC (Recommend assigning to Cabling Contractor)	Project CM/GC (Recommend assigning to Cabling Contractor)	
Category 6/6A Horizontal Cabling	ICT Designer	Project CM/GC (Recommend assigning to Cabling Contractor)	Project CM/GC (Recommend assigning to Cabling Contractor)	
Workstation Outlets/Faceplates/Jacks	ICT Designer	Project CM/GC (Recommend assigning to Cabling Contractor)	Project CM/GC (Recommend assigning to Cabling Contractor)	
Workstation Horizontal Category 6/6A and OM4 Fiber Patch Cords	ICT Designer	Project CM/GC (Recommend assigning to Cabling Contractor)	Project CM/GC (Recommend assigning to Cabling Contractor)	
Cable Plant Labeling	ICT Designer	Project CM/GC (Recommend assigning to Cabling Contractor)	Project CM/GC (Recommend assigning to Cabling Contractor)	
Cable Plant Testing	ICT Designer	Project CM/GC (Recommend assigning to Cabling Contractor)	Project CM/GC (Recommend assigning to Cabling Contractor)	
Network Electronics Equipment				
Network Equipment Racks	ICT Designer	Project CM/GC (Recommend assigning to Cabling Contractor)	Project CM/GC (Recommend assigning to Cabling Contractor)	
Rack Mounted PDU’s	ICT Designer	Yale IT	Yale IT	Funded through Project
Rack Mounted UPS's	Yale IT	Yale IT	Yale IT	Funded through Project
Telecom Room Network Switches	Yale IT	Yale IT	Yale IT	Does not include specialty systems switches such as IP Audiovisual or Sound Masking.
Telecom Room Voice Gateways	Yale IT	Yale IT	Yale IT	

Yale IT Systems Differential Scope of Work Matrix				
System	**Designed By**	**Furnished By**	**Installed By**	**Notes**
Core Network Room Core Switching Equipment Upgrades	Yale IT	Yale IT	Yale IT	
Wireless Access Points (Wi-Fi 802.11ac/ax)	Yale IT	Yale IT	Project CM/GC (Recommend assigning to Cabling Contractor)	
Wireless Access Points RF Predictive Study	ICT Designer or Yale IT	NA	NA	
Wireless Access Point Enclosures	ICT Designer/Architect	Project CM/GC (Recommend assigning to Cabling Contractor)	Project CM/GC (Recommend assigning to Cabling Contractor)	Coordinate final enclosure selections with Yale IT for WAP compatibility and mounting requirements.
Telephone Handsets (Analog and VoIP)	Yale IT	Yale IT	Yale IT	
Building User PC Workstations	Yale IT	Yale IT	Yale IT	Does not include building systems operations workstations included in the project specifications.
Distributed Antenna Systems				
Site Assessment	RF ICT Designer	NA	NA	Coordinate requirements with Facilities Project Manager, not Yale IT.
RF Predictive Study	RF ICT Designer	NA	NA	Coordinate requirements with Facilities Project Manager, not Yale IT.
Head End Equipment	RF ICT Designer	Project CM/GC (Recommend assigning to DAS Contractor)	Project CM/GC (Recommend assigning to DAS Contractor)	Coordinate requirements with Facilities Project Manager, not Yale IT.
Carrier Coordination and Sources	RF ICT Designer	Project CM/GC (Recommend assigning to DAS Contractor)	Project CM/GC (Recommend assigning to DAS Contractor)	Coordinate requirements with Facilities Project Manager, not Yale IT.
Telecom Room Active Hubs	RF ICT Designer	Project CM/GC (Recommend assigning to DAS Contractor)	Project CM/GC (Recommend assigning to DAS Contractor)	Coordinate requirements with Facilities Project Manager, not Yale IT.

Yale IT Systems Differential Scope of Work Matrix				
System	**Designed By**	**Furnished By**	**Installed By**	**Notes**
Remote Units/Antennas	RF ICT Designer/Architect	Project CM/GC (Recommend assigning to DAS Contractor)	Project CM/GC (Recommend assigning to DAS Contractor)	Coordinate locations and mounting conditions with the project Architect.
Optical Fiber/Low Voltage Power Cabling	RF ICT Designer	Project CM/GC (Recommend assigning to Cabling Contractor)	Project CM/GC (Recommend assigning to Cabling Contractor)	Coordinate requirements with Facilities Project Manager, not Yale IT.
Wireless Coverage and Signal Strength Testing	RF ICT Designer	Project CM/GC (Recommend assigning to DAS Contractor)	Project CM/GC (Recommend assigning to DAS Contractor)	Coordinate requirements with Facilities Project Manager, not Yale IT.
Two-Way Communication System for Area of Rescue				
Conduit Rough-in and Device Backboxes	ICT Designer	Project CM/GC (Recommend assigning to Electrical Contractor)	Project CM/GC (Recommend assigning to Electrical Contractor)	
Area of Rescue Command Unit and Visual Indicator	ICT Designer	Project CM/GC (Recommend assigning to Electrical Contractor)	Project CM/GC (Recommend assigning to Electrical Contractor)	
Area of Rescue Call Station	ICT Designer	Project CM/GC (Recommend assigning to Electrical Contractor)	Project CM/GC (Recommend assigning to Electrical Contractor)	
System Cabling	ICT Designer	Project CM/GC (Recommend assigning to Electrical Contractor)	Project CM/GC (Recommend assigning to Electrical Contractor)	
Command Unit Analog Telephone Line	ICT Designer	Project CM/GC (Recommend assigning to Cabling Contractor)	Project CM/GC (Recommend assigning to Cabling Contractor)	
System Building Signage	Architect	Building Signage Provider	General Contractor	
Fire Alarm Voice Evacuation (FAVE) System				
Building FAVE Panel	ICT Designer	Project CM/GC (Recommend assigning to Approved FAVE System Vendor)	Project CM/GC (Recommend assigning to Approved FAVE System Vendor)	

Yale IT Systems Differential Scope of Work Matrix				
System	**Designed By**	**Furnished By**	**Installed By**	**Notes**
FAVE System Multimode Optical Fiber Patch Cords	ICT Designer	Project CM/GC (Recommend assigning to Approved FAVE System Vendor)	Project CM/GC (Recommend assigning to Approved FAVE System Vendor	
Mass Notification System (MNS) System				
Building MNS Panel	ICT Designer	Project CM/GC (Recommend Assigning to Approved MNS System Vendor)	Project CM/GC (Recommend Assigning to Approved MNS System Vendor)	
MNS System Cabling	ICT Designer	Project CM/GC (Recommend Assigning to Approved MNS System Vendor)	Project CM/GC (Recommend Assigning to Approved MNS System Vendor)	
MNS System Site Speakers	ICT Designer	Project CM/GC (Recommend Assigning to Approved MNS System Vendor)	Project CM/GC (Recommend Assigning to Approved MNS System Vendor)	
MNS Central Station and Site Speaker Testing	ICT Designer	Project CM/GC (Recommend Assigning to Approved MNS System Vendor)	Project CM/GC (Recommend Assigning to Approved MNS System Vendor)	
Security Systems Infrastructure				
Security Systems Conduit Rough-in and Device Backboxes	ICT Designer	Project CM/GC (Recommend assigning to Electrical Contractor)	Project CM/GC (Recommend assigning to Electrical Contractor)	
Electrified Door Hardware	Architect/Door Hardware Consultant/ICT Designer	General Contractor/Door Hardware Supplier	Installed by General Contractor/ Recommend terminations assigned to Security Contractor	Electrified locks and exit devices with integrated card reader, door position switch, and request to exit switch shall be furnished and installed by the manufacturer certified Security Contractor.

Yale IT Systems Differential Scope of Work Matrix				
System	**Designed By**	**Furnished By**	**Installed By**	**Notes**
Door Hardware Power Supplies	Door Hardware Consultant/ICT Designer	Project CM/GC (Recommend assigning to Security Contractor)	Project CM/GC (Recommend assigning to Security Contractor)	Where electrified door hardware is served by manufacturer specific power supplies, the power supplies shall be furnished by the General Contractor and documented in the project door hardware schedules.
Security System Pathways (Non-IP Network Based)	ICT Designer	Project CM/GC (Recommend assigning to Electrical Contractor)	Project CM/GC (Recommend assigning to Electrical Contractor)	Composite cables for access control doors shall be routed in segregated pathways away from Category 6/6A network cabling.
Security System Cabling (Non-IP Network Based)	ICT Designer	Project CM/GC (Recommend assigning to Security Contractor)	Project CM/GC (Recommend assigning to Security Contractor)	
Security System Device Terminations	ICT Designer	Project CM/GC (Recommend assigning to Security Contractor)	Project CM/GC (Recommend assigning to Security Contractor)	
Category 6 Network Cabling and Terminations	Security/ICT Designer	Project CM/GC (Recommend assigning to Cabling Contractor)	Project CM/GC (Recommend assigning to Cabling Contractor)	IP-based network connections and analog phone lines shall be provided for equipment and devices including but not limited to access control panels, IP security cameras, IP intercom stations, electronic keyboxes, and emergency call stations.
Fire Alarm System Interfaces, Relays, and Programming	Security/Electrical Consultant	Project CM/GC (Recommend assigning to Fire Alarm Contractor)	Project CM/GC (Recommend assigning to Fire Alarm Contractor)	
Outdoor Site Emergency Telephone Concrete Base and Pole	Security/Site Civil Consultant	Project CM/GC (Recommend assigning to Electrical Contractor)	Project CM/GC (Recommend assigning to Electrical Contractor)	

Yale IT Systems Differential Scope of Work Matrix				
System	**Designed By**	**Furnished By**	**Installed By**	**Notes**
Emergency Telephone 120V Blue Light	ICT Designer	Yale Public Safety	Project CM/GC (Recommend assigning to Electrical Contractor)	
Custom Entry Card Reader Bollards	Architect/ICT Designer	General Contractor	Project CM/GC (Recommend assigning to Electrical Contractor)	
Security Systems Equipment				
Access Control Panels and Wallfield Elevations	ICT Designer	Project CM/GC (Recommend assigning to Security Contractor)	Project CM/GC (Recommend assigning to Security Contractor)	Locations shall be coordinated within Telecom Rooms
Card Readers	ICT Designer	Project CM/GC (Recommend assigning to Security Contractor)	Project CM/GC (Recommend assigning to Security Contractor)	
Request to Exist Sensor	ICT Designer	Project CM/GC (Recommend assigning to Security Contractor)	Project CM/GC (Recommend assigning to Security Contractor)	
Door Position Switches	ICT Designer	Project CM/GC (Recommend assigning to Security Contractor)	Project CM/GC (Recommend assigning to Security Contractor)	
Door Management Alarms	ICT Designer	Project CM/GC (Recommend assigning to Security Contractor)	Project CM/GC (Recommend assigning to Security Contractor)	
Security Cameras and Mounts	ICT Designer/ Architect	Project CM/GC (Recommend assigning to Security Contractor)	Project CM/GC (Recommend assigning to Electrical Contractor)	Security camera locations shall be coordinated with the project Architect and reviewed by Yale Public Safety during project design phases.
Intrusion Detection Systems Devices	ICT Designer	Project CM/GC (Recommend assigning to Security Contractor)	Project CM/GC (Recommend assigning to Security Contractor)	
Video Intercom System	ICT Designer	Project CM/GC (Recommend assigning to Security Contractor)	Project CM/GC (Recommend assigning to Security Contractor)	

Yale IT Systems Differential Scope of Work Matrix				
System	**Designed By**	**Furnished By**	**Installed By**	**Notes**
Emergency Call Stations	ICT Designer	Yale Public Safety	Project CM/GC (Recommend assigning to Security Contractor)	Emergency call station locations shall be coordinated with the project Architect and reviewed by Yale Public Safety during project design phases.
Building Alarm Panel to Central Station	ICT Designer	Project CM/GC (Recommend assigning to Security Contractor)	Project CM/GC (Recommend assigning to Security Contractor)	DMP Panel shall be provided at the Fire Alarm Main Panel or Fire Command Center with Cellular modem connection to Central Station
Building Alarm Panel Cellular Modem	ICT Designer	Project CM/GC (Recommend assigning to Security Contractor)	Project CM/GC (Recommend assigning to Security Contractor)	
Network Video Recording (NVR) Systems	ICT Designer	Project CM/GC (Recommend assigning to Security Contractor)	Project CM/GC (Recommend assigning to Security Contractor)	Coordinate storage capacity and requirements with Yale Public Safety during project design phases.
Electronic Keyboxes (Morse Watchman) and Timeclock devices	Architect/ ICT Designer	Yale Facilities	General Contractor	Coordinate quantity and locations with Yale and Architect. Design wall blocking, ADA clearances, power, network, and card reader connections with design team during project design phases.
Security System Programming	Project CM/GC (Recommend assigning to Security Contractor)	Project CM/GC (Recommend assigning to Security Contractor)	Project CM/GC (Recommend assigning to Security Contractor)	
System Testing and Training	Project CM/GC (Recommend assigning to Security Contractor)	Project CM/GC (Recommend assigning to Security Contractor)	Project CM/GC (Recommend assigning to Security Contractor)	

Yale IT Systems Differential Scope of Work Matrix				
System	**Designed By**	**Furnished By**	**Installed By**	**Notes**
Audiovisual Infrastructure and Equipment				
Conduit, junction boxes, floor boxes, wireways and other electrical (construction related) rough-in work pertaining to the installation of the AV systems	AV ICT Designer	Project CM/GC (Recommend assigning to Electrical Contractor)	Project CM/GC (Recommend assigning to Electrical Contractor)	AV Contractor will provide necessary plans and documentation to be integrated into the appropriate construction sets for coordination and implementation by other trades as necessary.
Power receptacles and related electrical requirements	Electrical Engineer	Project CM/GC (Recommend assigning to Electrical Contractor)	Project CM/GC (Recommend assigning to Electrical Contractor)	
Network Connections	ICT Designer/AV Contractor/AV ICT Designer	Project CM/GC (Recommend assigning to Cabling Contractor)	Project CM/GC (Recommend assigning to Cabling Contractor)	AV Contractor to submit a Network Request spreadsheet of all network attached devices by location including Manufacturer, Model, Serial Numbers, MAC Addresses, Usernames, Passwords via the project to AVSD and Network Engineering.
AV Network Switches and Configuration	Yale IT	Yale IT	Yale IT	Port List and Switch Configuration summary shall be provided to Yale IT. Laminated copy of switch port, VLAN and attached device should be kept with all network switches.

Yale IT Systems Differential Scope of Work Matrix				
System	**Designed By**	**Furnished By**	**Installed By**	**Notes**
Yale Network Integration	Yale Data Network Operations	Yale Data Network Operations	Yale Data Network Operations	If not established, create and document AV VLANs for Control, Audio and Video as separate subnets. Provide IP and Subnet and other related network information to AVSD and AV Contractor. Configuration and connections necessary for Yale Data integration into AV systems.
Low Voltage Audiovisual Cabling	AV ICT Designer	Project CM/GC (Recommend assigning to AV Contractor)	Project CM/GC (Recommend assigning to AV Contractor)	
Audiovisual Cable Terminations	AV ICT Designer	Project CM/GC (Recommend assigning to AV Contractor)	Project CM/GC (Recommend assigning to AV Contractor)	
Ceiling speakers (with back boxes, transformers, and grilles)	AV ICT Designer	Project CM/GC (Recommend assigning to AV Contractor)	Project CM/GC (Recommend assigning to AV Contractor)	
Video Cameras	AV ICT Designer	Project CM/GC (Recommend assigning to AV Contractor)	Project CM/GC (Recommend assigning to AV Contractor)	
Audio Visual consoles and Audio Visual Equipment Cabinets	AV ICT Designer	Project CM/GC (Recommend assigning to AV Contractor)	Project CM/GC (Recommend assigning to AV Contractor)	
Lectern	AV ICT Designer	Project CM/GC (Recommend assigning to AV Contractor)	Project CM/GC (Recommend assigning to AV Contractor)	
Data / Video projector and ceiling mounting brackets	AV ICT Designer	Project CM/GC (Recommend assigning to AV Contractor)	Project CM/GC (Recommend assigning to AV Contractor)	
Wall and ceiling mounted flat screen video displays	AV ICT Designer	Project CM/GC (Recommend assigning to AV Contractor)	Project CM/GC (Recommend assigning to AV Contractor)	

Yale IT Systems Differential Scope of Work Matrix				
System	**Designed By**	**Furnished By**	**Installed By**	**Notes**
Wall mounted fixed projection screens	AV ICT Designer	Project CM/GC (Recommend assigning to AV Contractor)	Project CM/GC (Recommend assigning to AV Contractor)	
Ceiling mounted electric screens (recessed and surface mount)	AV ICT Designer	Project CM/GC (Recommend assigning to AV Contractor)	Project CM/GC (Recommend assigning to AV Contractor Access hatches as required – GC Power Connection – EC Low Voltage Screen Control – AV Contractor	
Microphones	AV ICT Designer	Project CM/GC (Recommend assigning to AV Contractor)	Project CM/GC (Recommend assigning to AV Contractor)	
Control Systems - Hardware and Programming	AV ICT Designer	Project CM/GC (Recommend assigning to AV Contractor)	Project CM/GC (Recommend assigning to AV Contractor)	A description of each function of the control system shall be provided describing operation and system performance expectations. Integrate with existing monitoring or server platforms as necessary.
Control Interfaces - Touchscreens and physical controls	AV ICT Designer	Project CM/GC (Recommend assigning to AV Contractor)	Project CM/GC (Recommend assigning to AV Contractor)	All touch screen graphic user interfaces and physical controls must follow AVSD standards for design and functionality. The programmer will submit a functionality and usage narrative accompanied by screenshots of all User Interface elements.
Audio DSP Programming	Project CM/GC (Recommend assigning to AV Contractor)	Project CM/GC (Recommend assigning to AV Contractor)	Project CM/GC (Recommend assigning to AV Contractor)	

Yale IT Systems Differential Scope of Work Matrix				
System	**Designed By**	**Furnished By**	**Installed By**	**Notes**
AV System Documentation	AV ICT Designer	Project CM/GC (Recommend assigning to AV Contractor)	Project CM/GC (Recommend assigning to AV Contractor)	To include final versions of all previously submitted documentation
Video System Test Reporting	AV ICT Designer	Project CM/GC (Recommend assigning to AV Contractor)	Project CM/GC (Recommend assigning to AV Contractor)	A report of video devices tested and devices used to perform the test. All routes tested and validated.
Audio System Test Reporting	AV ICT Designer	Project CM/GC (Recommend assigning to AV Contractor)	Project CM/GC (Recommend assigning to AV Contractor)	A report of audio inputs and outputs tested and devices used to perform the test. All routes tested and validated.
Control System Test Reporting	AV ICT Designer	Project CM/GC (Recommend assigning to AV Contractor)	Project CM/GC (Recommend assigning to AV Contractor)	A report of controls and behaviors tested. All common and detailed activity tested and validated.
Final Commissioning Report	AV ICT Designer	Project CM/GC (Recommend assigning to AV Contractor)	Project CM/GC (Recommend assigning to AV Contractor)	A report of each location and system certifying the systems, performance and practices meet design intentions, functionality requirements and note any exceptions. Distribute accordingly.
AV System User Acceptance Training	AV ICT Designer	Project CM/GC (Recommend assigning to AV Contractor)	Project CM/GC (Recommend assigning to AV Contractor)	
Project Close	AV ICT Designer	Project CM/GC (Recommend assigning to AV Contractor)	Project CM/GC (Recommend assigning to AV Contractor)	Attach all project documentation
Maintenance of AV System	NA	NA	Project CM/GC (Recommend assigning to AV Contractor)	Proactive maintenance, firmware updates, and other regular service of equipment through a Service Level Agreement

Yale IT Systems Differential Scope of Work Matrix				
System	**Designed By**	**Furnished By**	**Installed By**	**Notes**
AV System Troubleshooting	Owner		Service Now Ticket	Owner will work with AV Contractor or AVSD to resolve AV System functionality issues. This does not include operational assistance.

Designer Note: The ICT Designer shall provide designs that fully document and incorporate Yale IT Standards and best practices into projects. This Appendix contains photographic documentation, for reference only, that is indicative of final approved installations. It shall be incumbent upon the ICT Designer to provide designs and construction administration to achieve final approved installations as documented in this Appendix. Some photographs are labeled "Incorrect Installation" which depict bad practice to be avoided. Coordinate with Yale IT to confirm the existence of updates and revisions not yet incorporated into this documentation.

APPENDIX C – IT PHOTOGRAPHIC DOCUMENTATION

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Telecom Outlet Photo 4 – Two (2) Category 6/Two (2) Strand 50 Micron OM4 with LC Duplex Connector for Fiber to the Desktop (FTTD) outlet

Firestopping Photo 5 – Grounded and Firestopped Conduit Penetration Sleeves

Telecom Room Photo 6 - Telecom Room Plywood Backboard, Exposed Fire Retardant Treated Label

Telecom Room Photo 7 – Electrical Subpanel

Telecom Room Photo 8 – Electrical Subpanel (2)

DINTO
ELECTRICAL CONTRACTORS

Panel Location:
Surface IDF G112
Date Typed:
1/9/2020

Voltage: 208/120V

Fed From: Panel EPP/GT

PANEL: EPP/GT2

CKT#	Poles	Amps	Description	CKT#	Poles	Amps	Description
1	1	20	SECURITY PNLS-IDF G112	2	1	20	CONV. RCPT-IDF G112
3	1	20	SECURITY PNLS-IDF G112	4	1	20	EQUIP RCPT-IDF G112
5	1	20	SECURITY PNLS-IDF G112	6	1	20	EQUIP RCPT-IDF G112
7	2	20	VOIP RCPT-IDF G112	8	1	20	EQUIP RCPT-IDF G112
9				10	1	20	EQUIP RCPT-IDF G112
11	2	20	VOIP RCPT-IDF G112	12	1	20	EQUIP RCPT-IDF G112
13				14	1	20	EQUIP RCPT-IDF G112
15	2	30	L6-30R - IDF G112	16	1	20	SPARE
17				18	1	20	RECPT ROOM G114A
19	2	30	L6-30R - IDF G112	20	1	20	SPARE
21				22	1	20	SPARE
23	1	20	SPARE	24	1	20	SPARE
25	1		SPACE	26	1		SPACE
27	1		SPACE	28	1		SPACE
29	1		SPACE	30	1		SPACE
31	1		SPACE	32	1		SPACE
33	1		SPACE	34	1		SPACE
35	1		SPACE	36	1		SPACE
37	1		SPACE	38	1		SPACE
39	1		SPACE	40	1		SPACE
41	1		SPACE	42	1		SPACE

121 Turnpike Drive | Middlebury, CT 06762 | Tel: 203-575-9473
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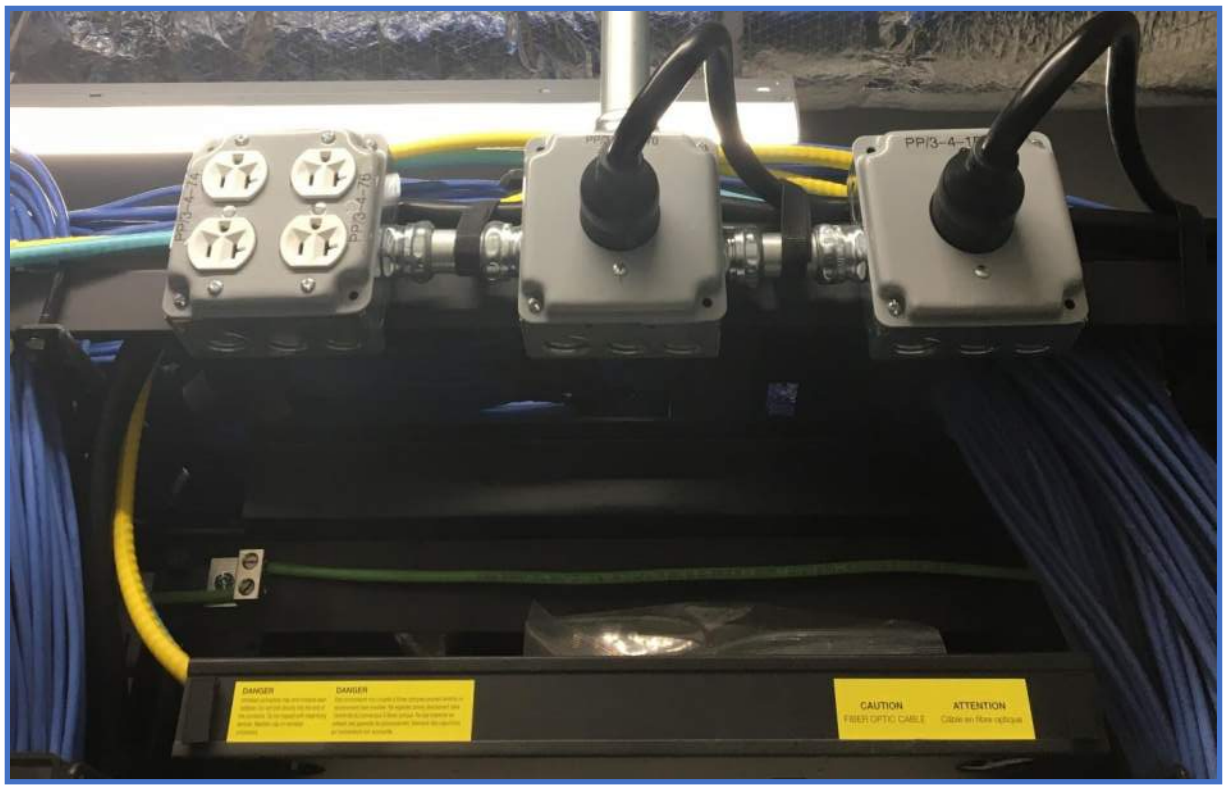
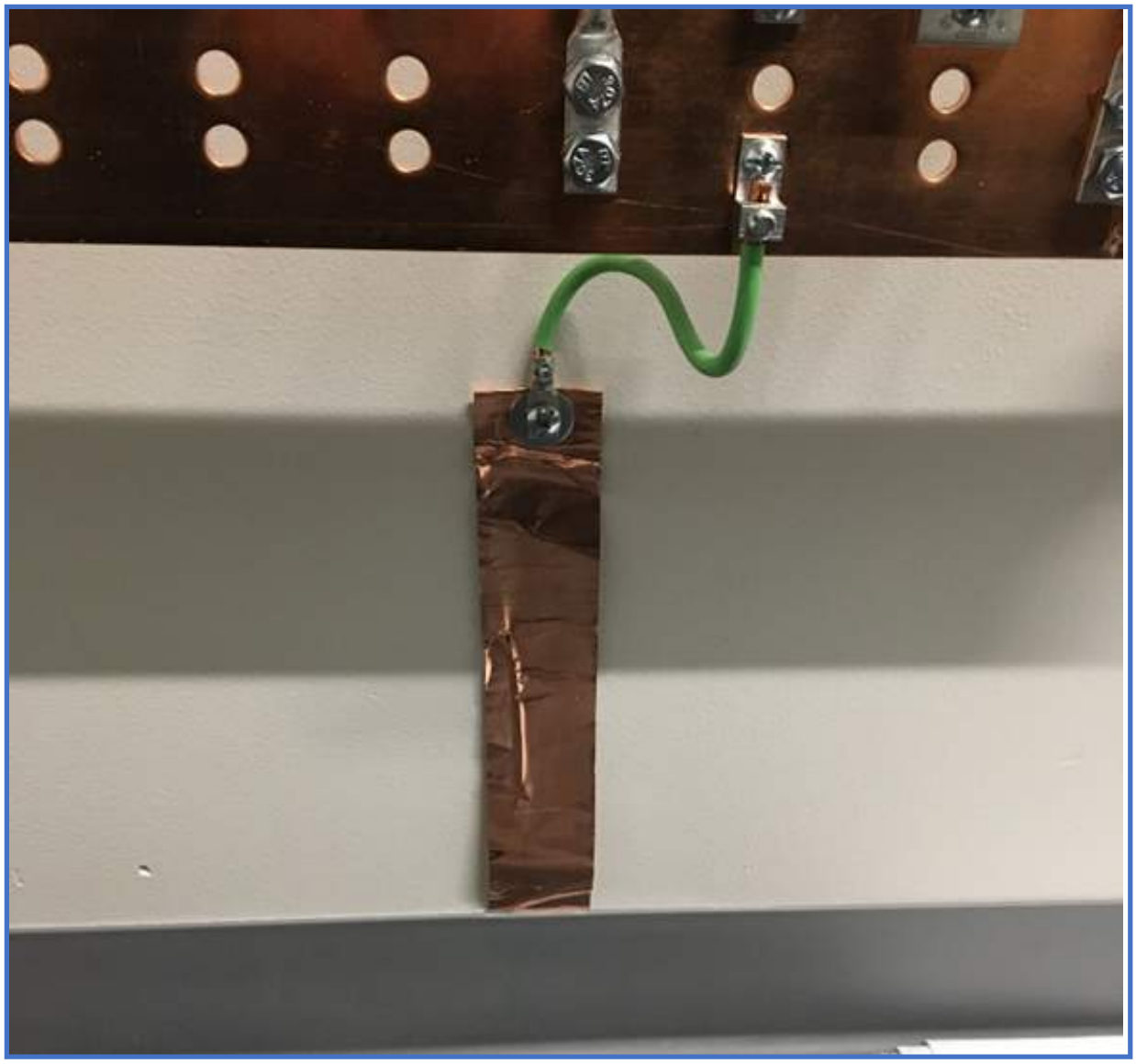
NOTICE

Telecom Room Photo 9 - Electrical Subpanel Schedule

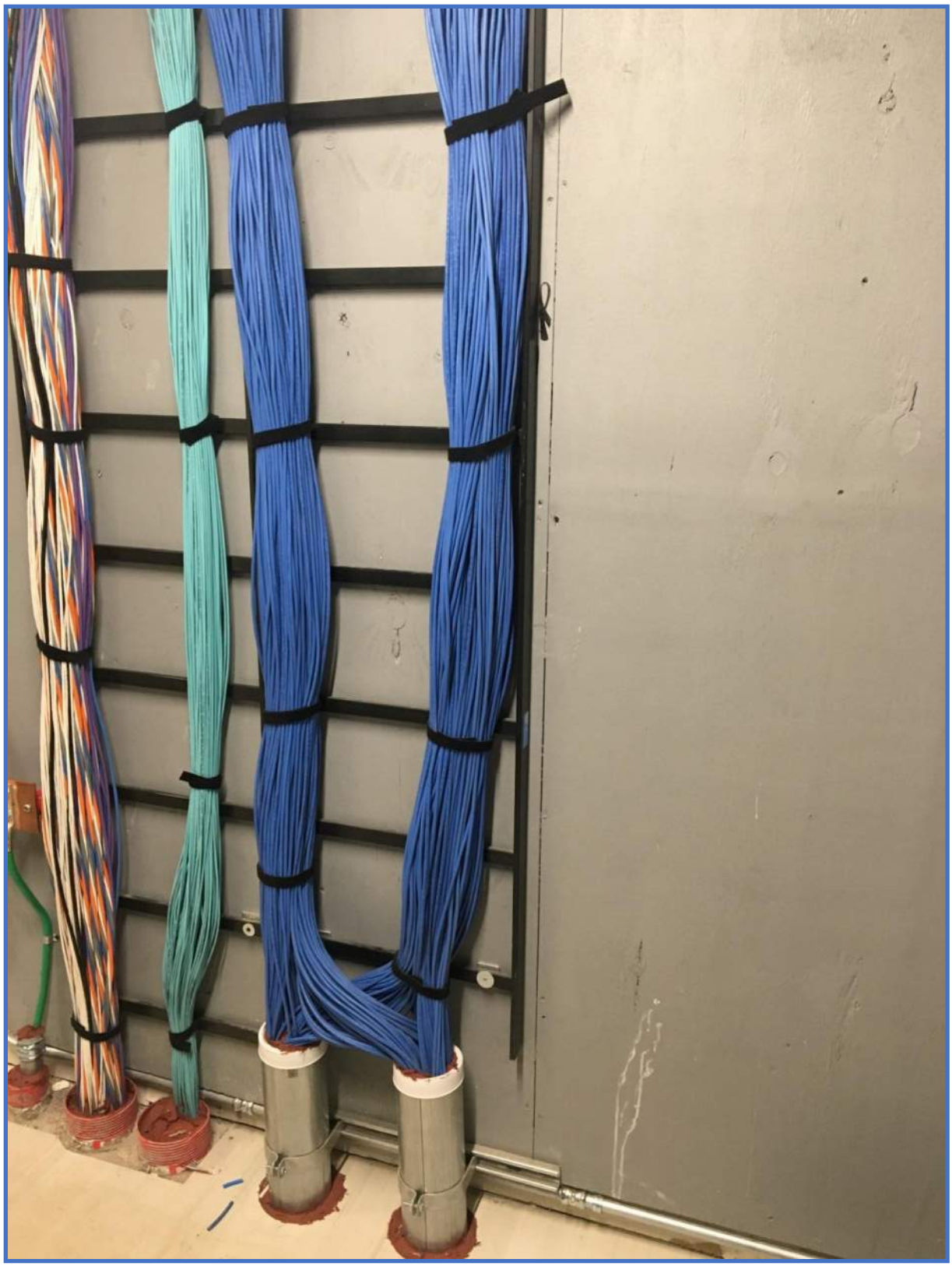


Telecom Room Photo 10 - Electrical Receptacle Devices Mounted to Cable Runway Above Equipment Racks

Telecom Room Photo 11 – Telecom Room Wall Mounted Evaporator Unit



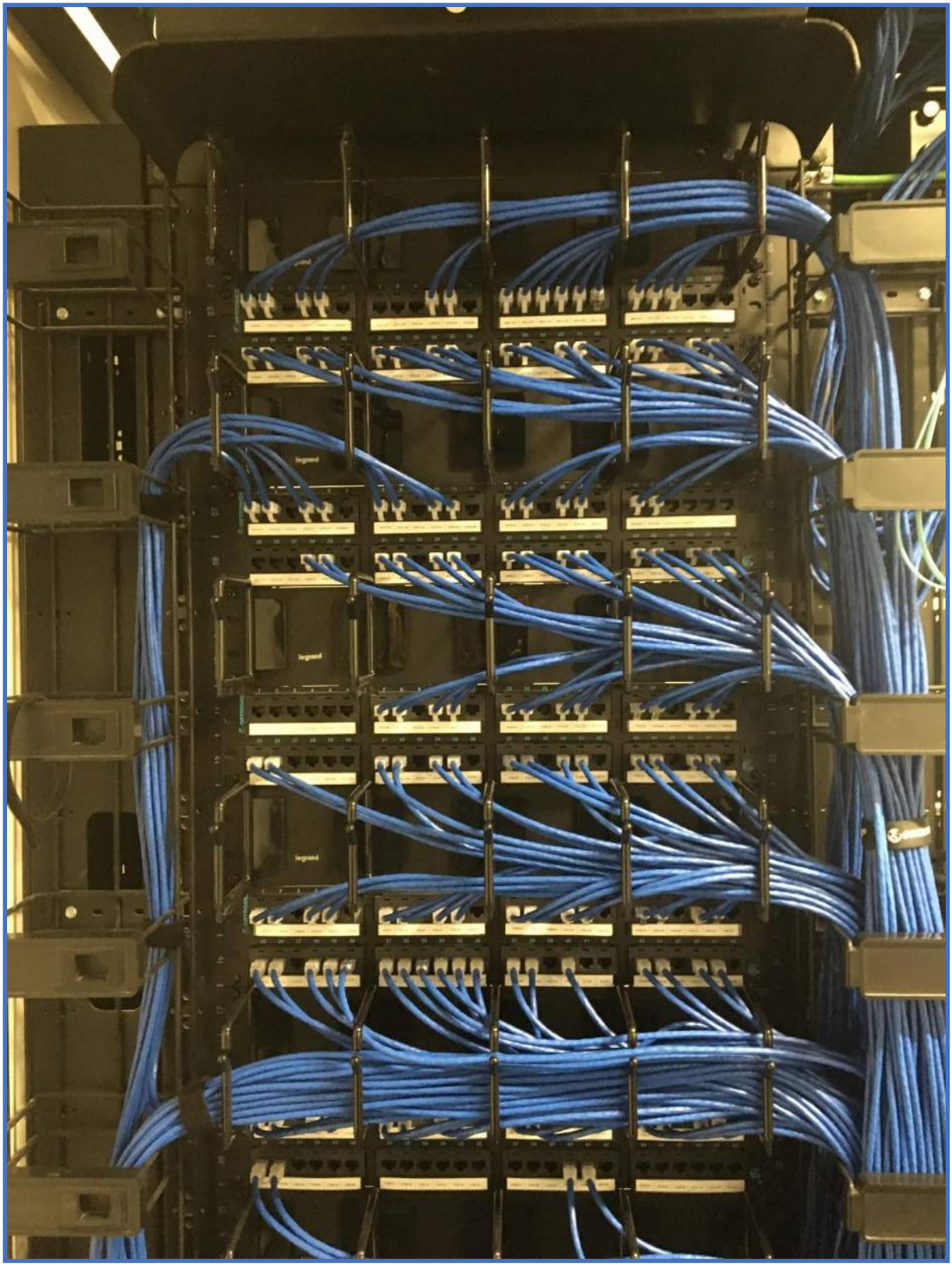
Telecom Room Photo 12 - Static Dissipative Flooring Bonded to PBB or SBB



Telecom Room Cable Runway Photo 13 – Wall Mounted Vertical Cable Runway

Telecom Room Cable Runway Photo 14 – Waterfall Cable Drop Out

Cabling Equipment Rack Photo 15 – Back of Rack Cable Management

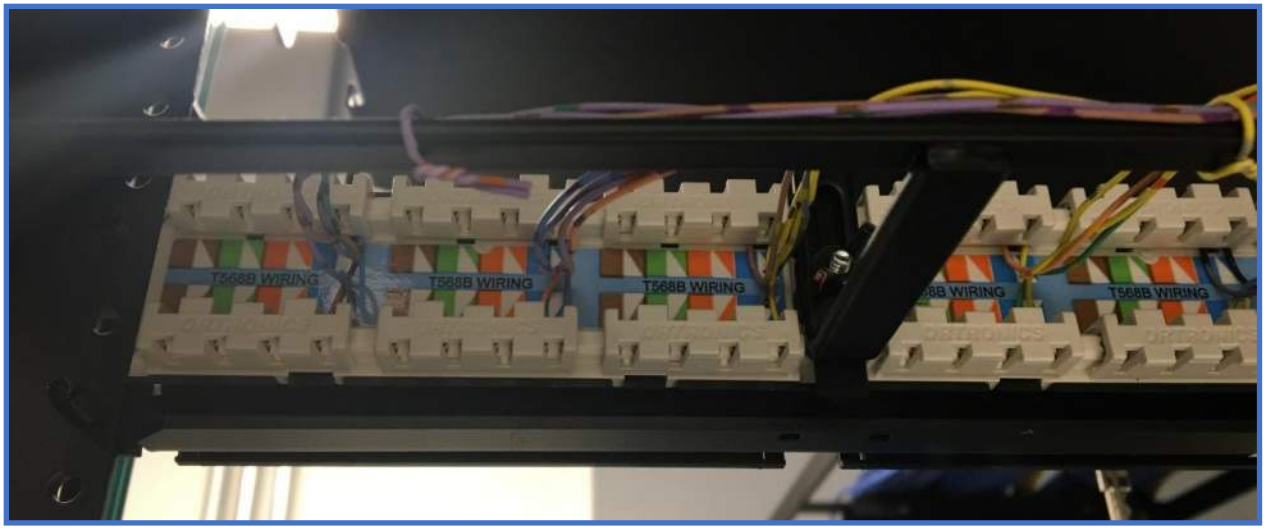


Cabling Equipment Rack Photo 16 – Front of Rack Cable Management (Flat Patch Panels)

Cabling Equipment Rack Photo 17 – Equipment Rack Base Bolted to Floor

Cabling Equipment Rack Photo 18 – Patch Panel Cabling Termination, Labeling, Hook and Loop Fasteners, and Rear Cable Management Bars (Flat Patch Panels)

Optical Fiber Terminations Photo 19 – Riser Cabling Duplex LC Singlemode and OM4 Multimode Connector Adapter Panels in Optical Fiber Termination Cabinet



Riser Cabling Terminations Photo 20 – Voice Copper Backbone RJ-45 Patch Panel Terminations, Pins 4+5 Blue Pair T568B

Network Electronics Photo 21 – Rack Mounted Redundant Power Distribution Units (PDU's)

Network Electronics Photo 22 – Rack Mounted Redundant Power Distribution Units (PDU's)

Network Electronics Photo 23 – Rack Mounted Redundant Power Distribution Units (PDU's)

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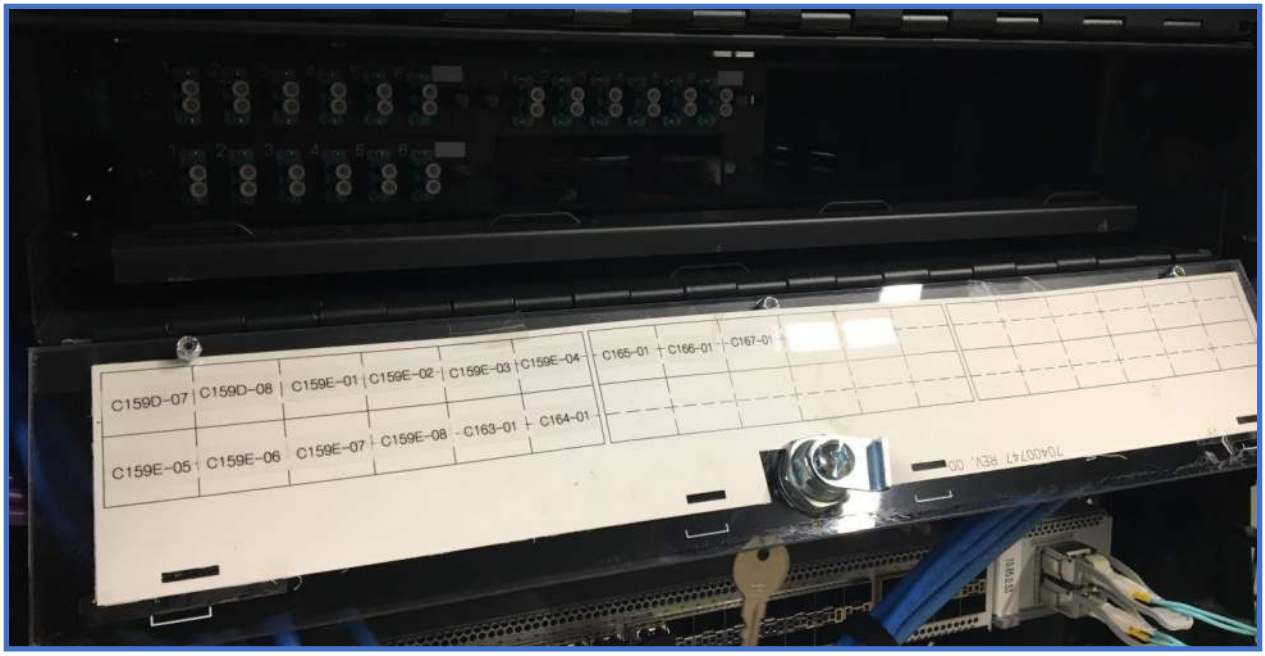
Air Blown Fiber (ABF) Photo 27 – Tube Distribution Unit Wall Field (2)

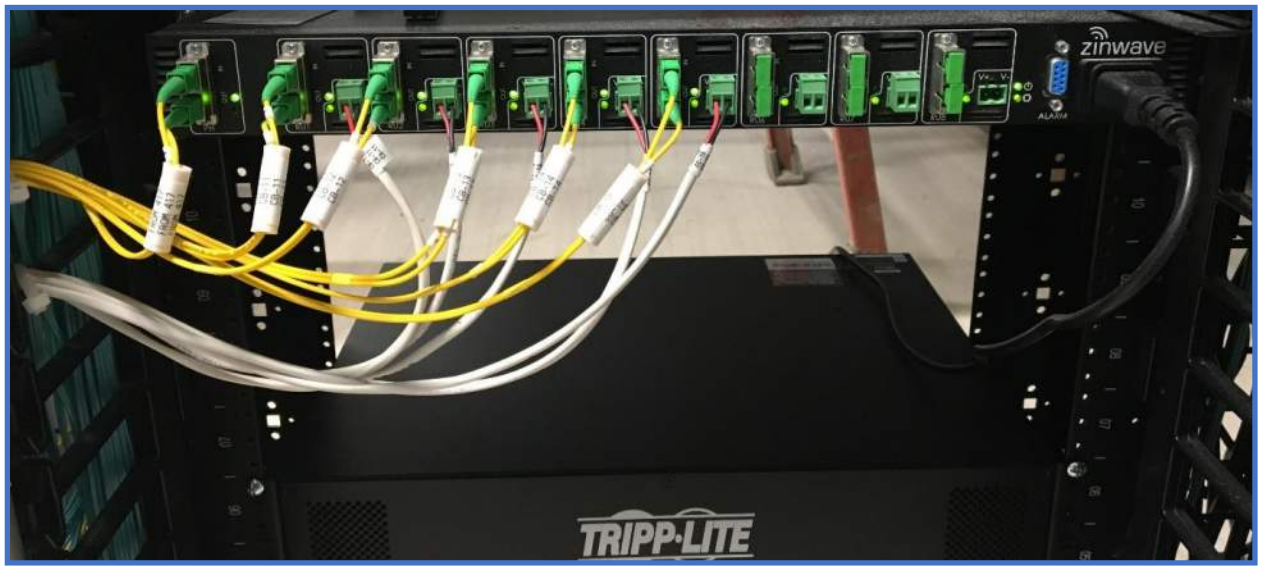
Science Network Photo 28 – OM4 50 Micron Multimode Science Network Optical Fiber Termination Cabinet



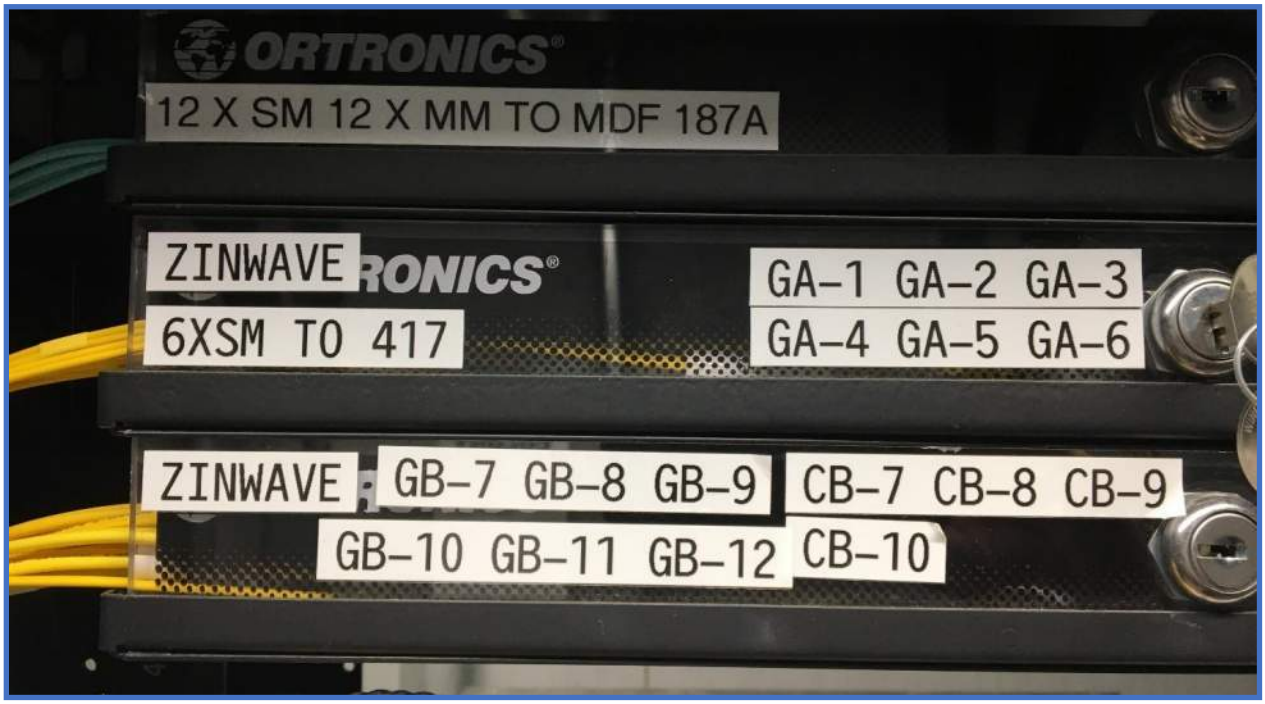
Science Network Photo 29 – OM4 50 Micron Multimode Science Network Optical Fiber Termination Cabinet Labeling (1)

Science Network Photo 30 – OM4 50 Micron Multimode Science Network Optical Fiber Termination Cabinet Labeling (2)

Distributed Antenna System Photo 31 – Singlemode Optical Fiber Termination Cabinet and Labeling

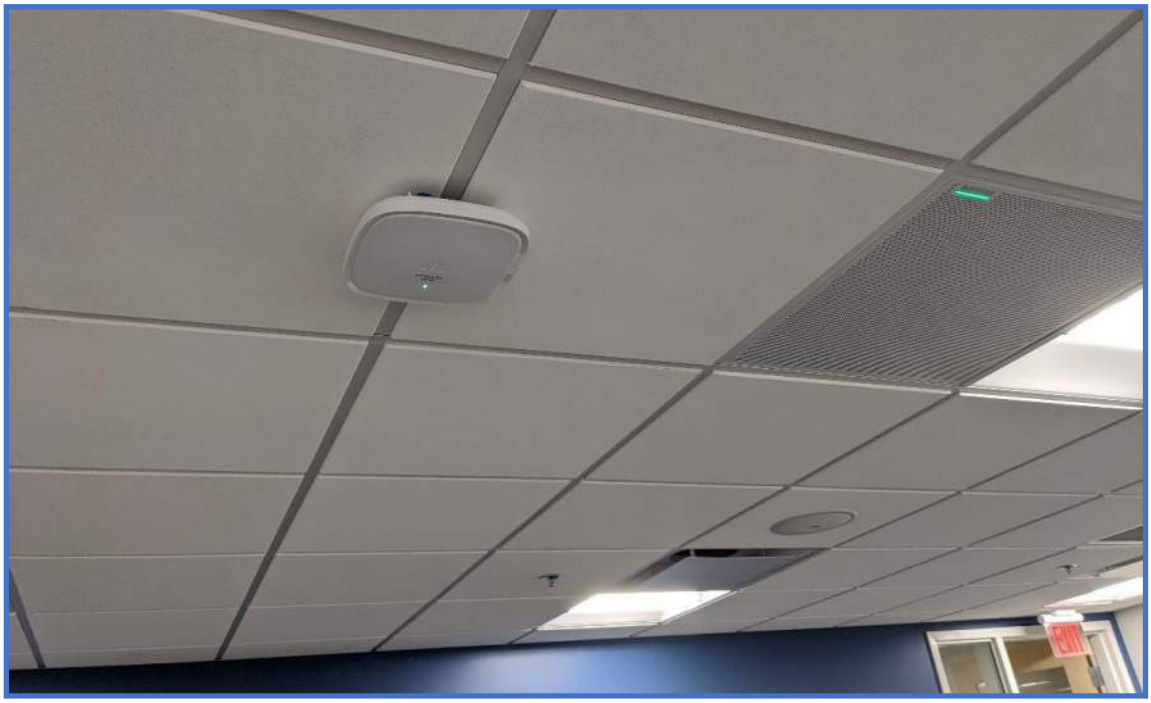


Distributed Antenna System Photo 32 – Optical Fiber and Low Voltage Hub Serving DAS Remote Units



Distributed Antenna System Photo 33 – Singlemode Optical Fiber Termination Cabinet Labeling

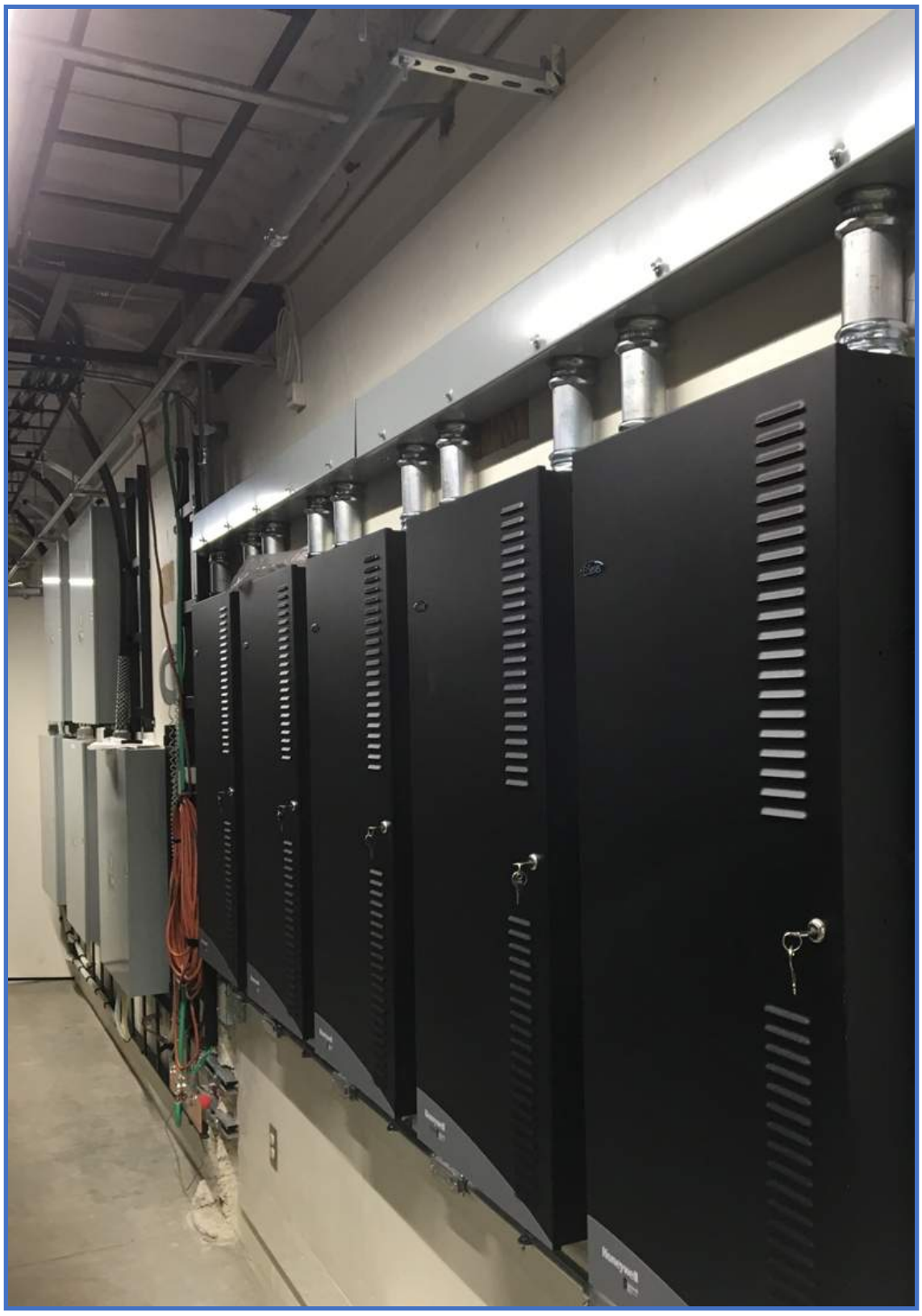
Distributed Antenna System Photo 34 – Ceiling Antenna



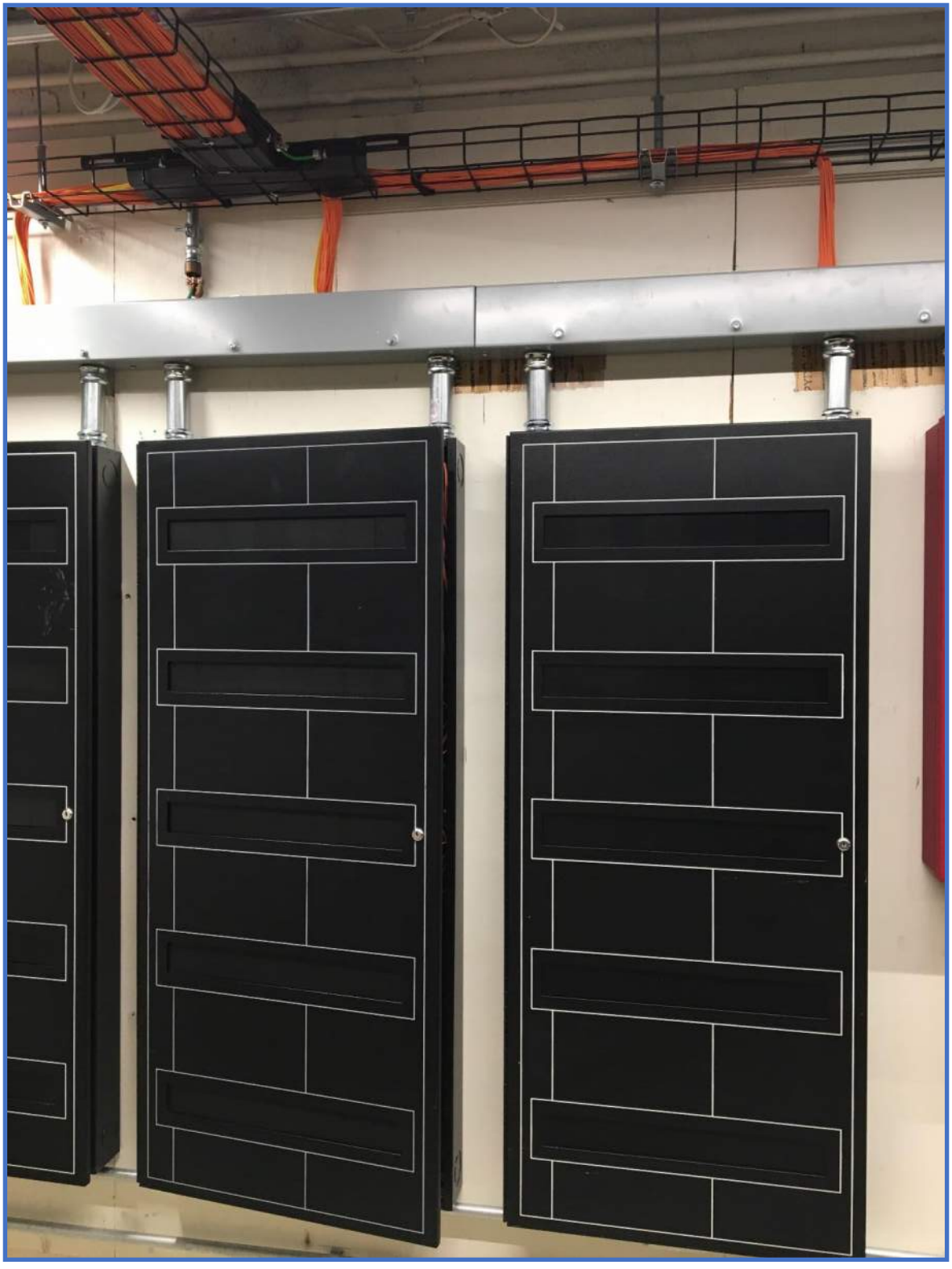
Wi-Fi Photo 35 – Ceiling Mounted Wireless Access Point

Wi-Fi Photo 36 – Ceiling Mounted Wireless Access Point

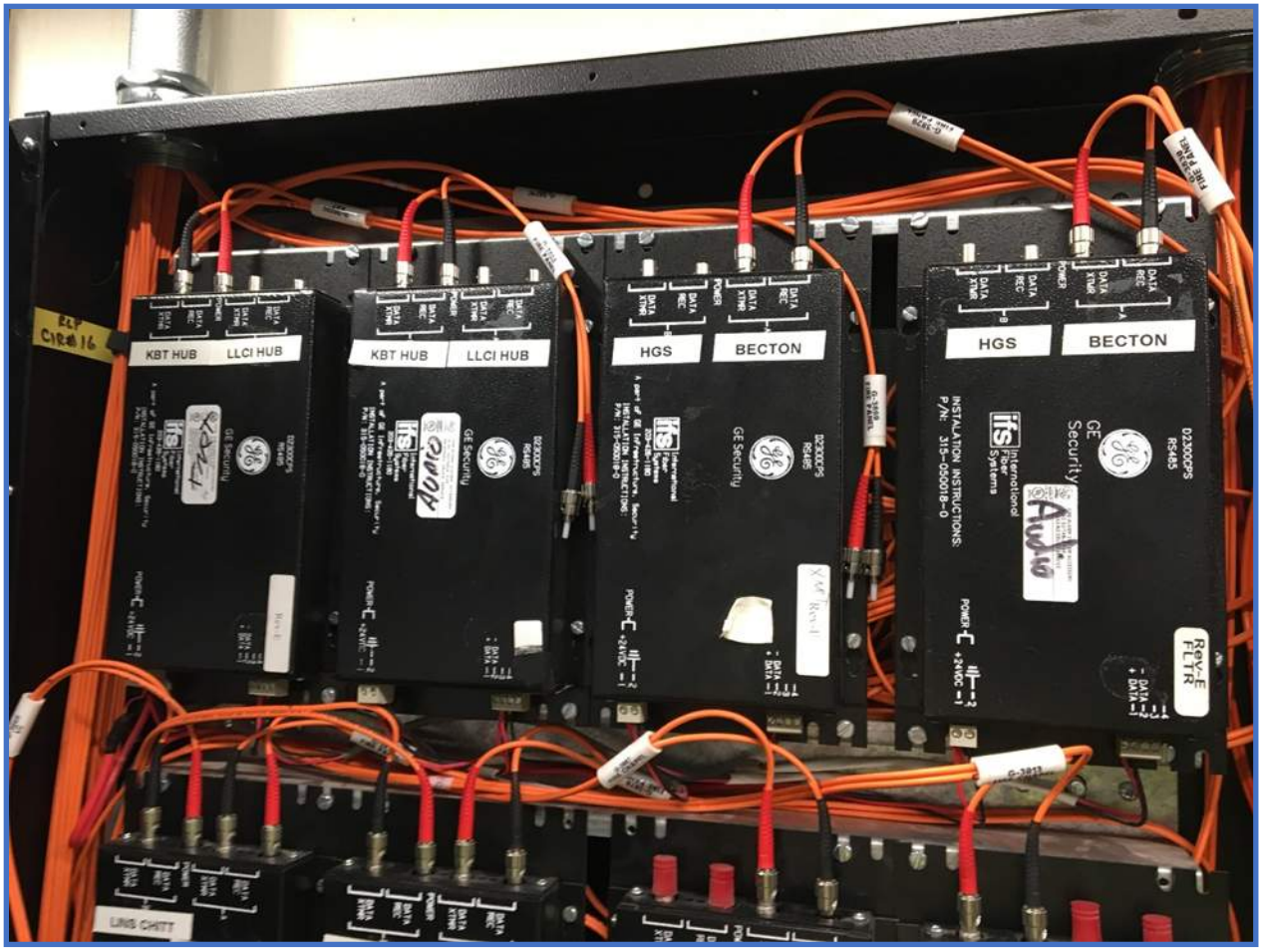
Wi-Fi Photo 37 – Wireless Access Point Biscuit Style Telecom Outlet Supported From Building Structure



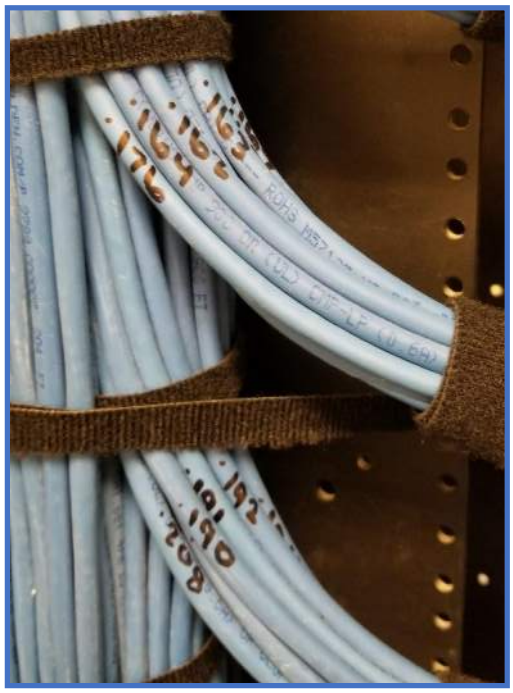
Fire Alarm Voice Evacuation (FAVE) System Photo 37 – FAVE Wallfield



Fire Alarm Voice Evacuation (FAVE) System Photo 38 – Siemens FAVE Wallfield



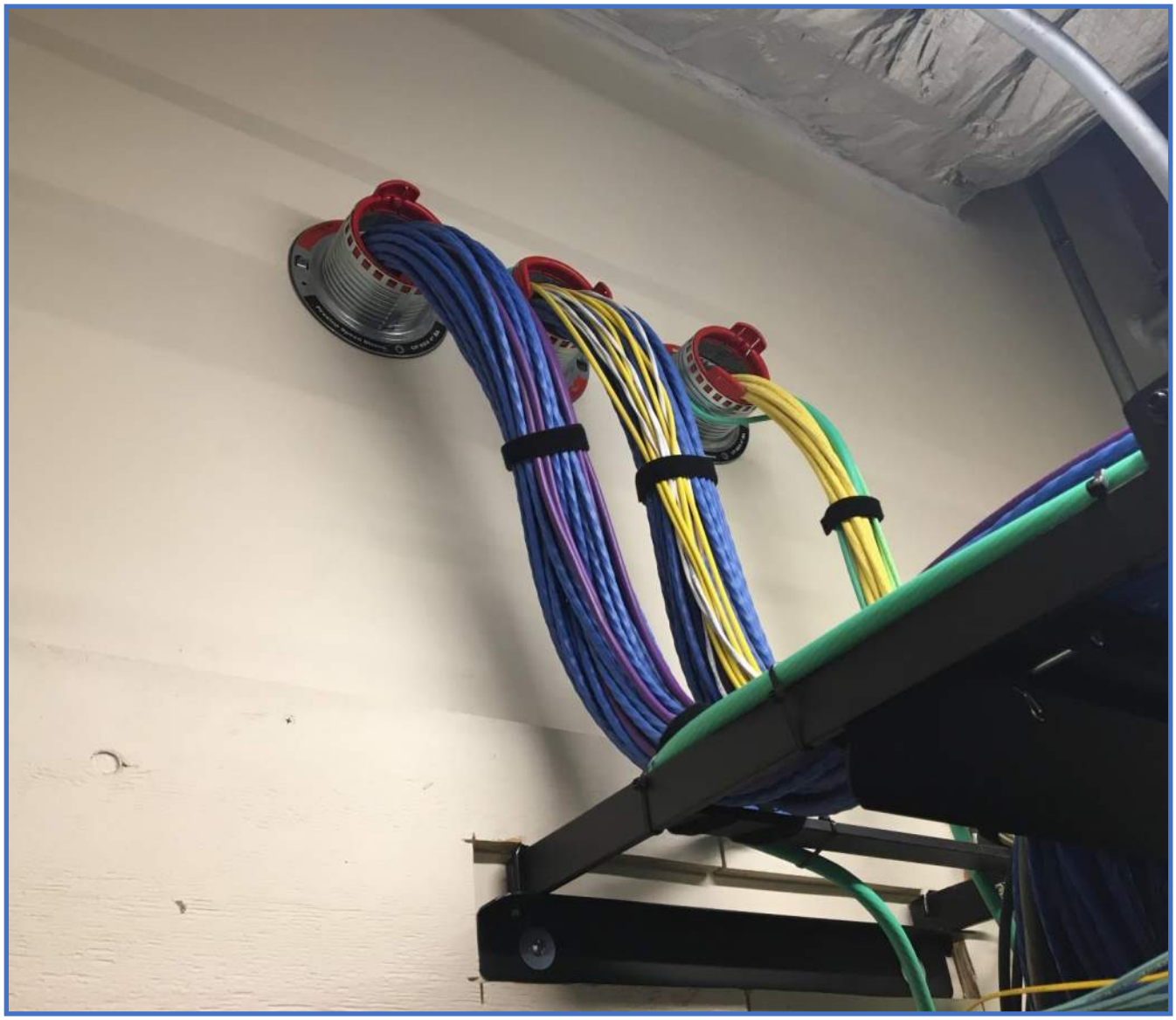
Fire Alarm Voice Evacuation System (FAVE) Photo 39 – Siemens System Optical Fiber Transmitters Serving Campus Buildings



Incorrect Installation Photo 40 – Handwritten Labels Are Not Permitted

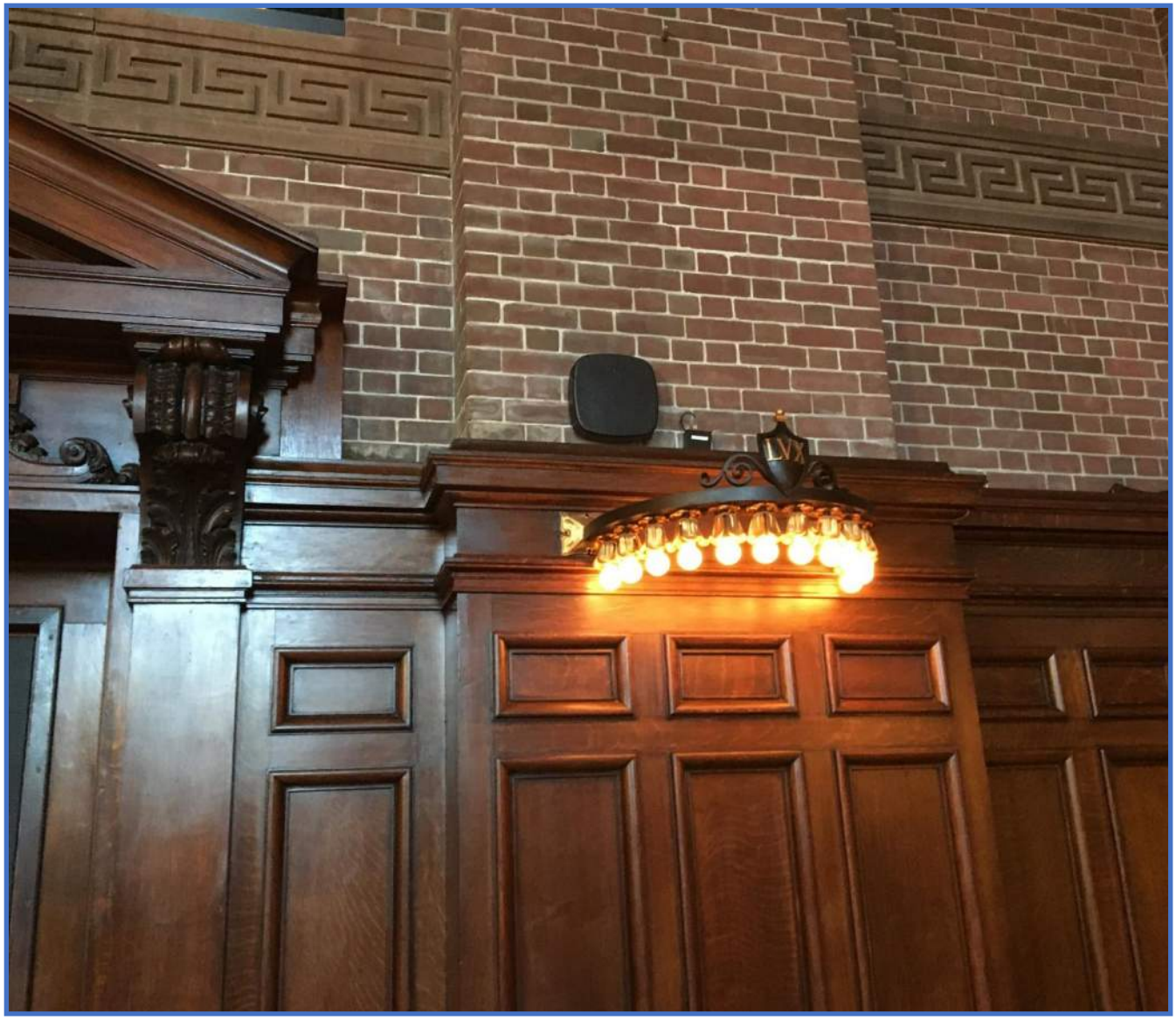
Incorrect Installation Photo 41 – RJ-45 Ports Shall Not Be Skipped in Patch Panel

Incorrect Installation Photo 42 – Utility Routes Shall be Coordinated Unlike Depicted in this Photo



Re-enterable Fire Rated Sleeves Photo 43 – Telecom Room Sleeved Cabling Penetrations

BAS Controls Headend Photo 44 – Building Controls System Headend Colocated in a Telecom Room



Wireless Access Point Photo 455 – Device and Cabling Color Coordination with Interior Finishes

Designer Note: The ICT Designer shall provide designs that fully document and incorporate Yale IT Standards and best practices into projects. This Appendix contains photographic documentation, for reference only, that is indicative of final approved installations. It shall be incumbent upon the ICT Designer to provide designs and construction administration to achieve final approved installations as documented in this Appendix. Some photographs are labeled "Incorrect Installation" which depict bad practice to be avoided. Coordinate with Yale IT to confirm the existence of updates and revisions not yet incorporated into this documentation.

APPENDIX D – SECURITY SYSTEMS PHOTOGRAPHIC DOCUMENTATION

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Security Systems Photo 2 – Access Controlled Single Door with Integrated Reader 4
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Security Systems Photo 4 – Integrated Card Reader, Right Hand Reverse Leaf of Double Door 6
Security Systems Photo 5 – Access Controlled Vivarium Door 7
Security Systems Photo 6 – Access Control Panel Wallfield on Backboard in Telecom Room 8
Security System Photo 7 – Access Control System Panel Terminations 9
Security System Photo 8 – Access Control System Power Supply 10
Security System Photo 9 – Access Control Panel Labeling 11
Security System Photo 10 – Access Control Composite Door Cabling Separated from Network Cabling within Telecom Room Cable Runways 12
Security System Photo 11 – Alarm Panel (DMP) and Keypad Located at the Building Main Fire Alarm Panel for Central Station Communications 13
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Security System Photo 13 – Door Management Alarm Panel with Key Override 15
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Security System Photo 29 – Device Mounting Integration at Existing Entry 31

Security Systems Photo 1 – Labeled Integrated Mortise Card Reader with Door Position Switch and Request to Exit Switch

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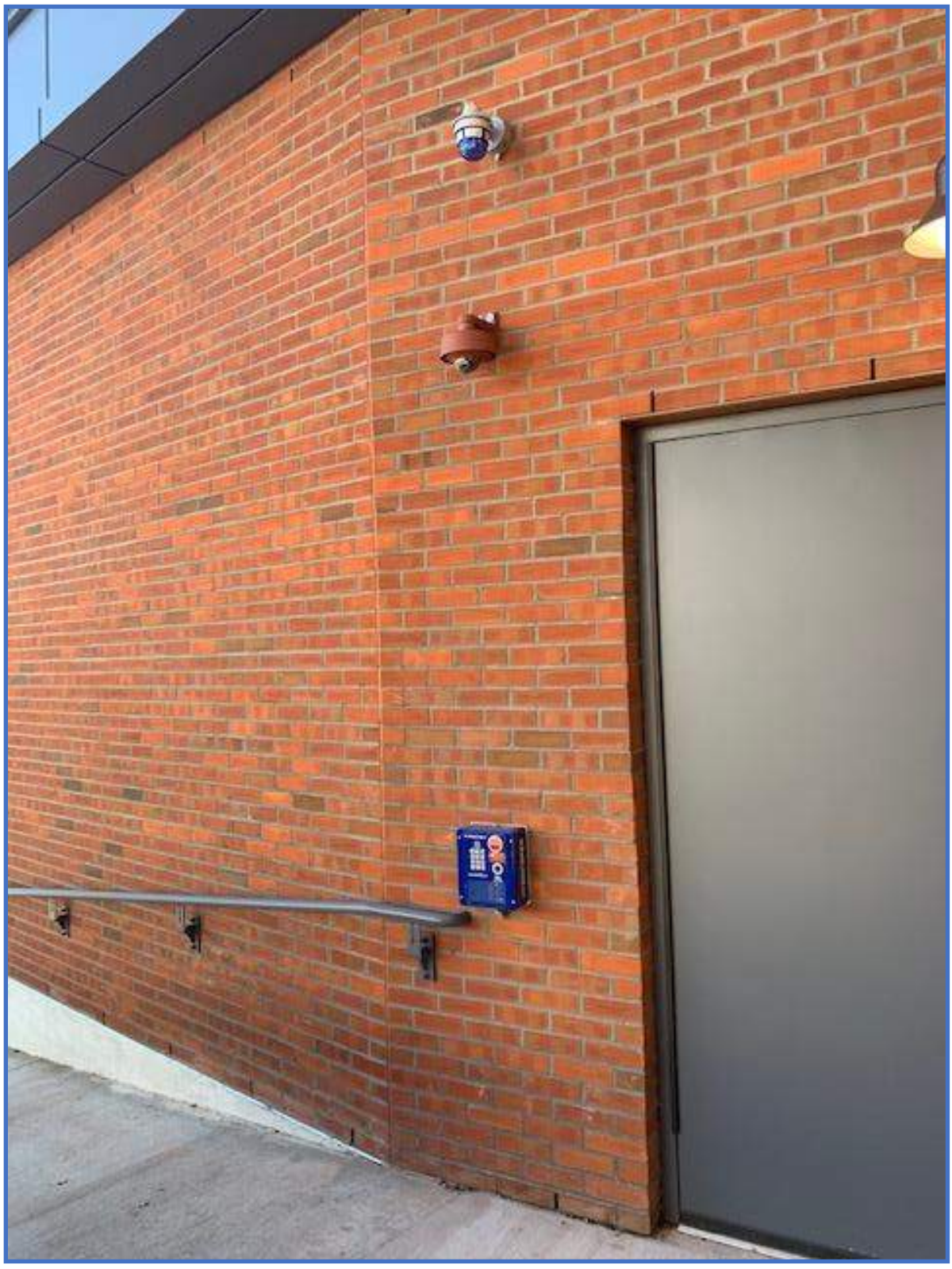
Security System Photo 17 – Video Intercom Substation at Exterior Entry Door

Security System Photo 18 – Interior Emergency Telephone Call Station

Security System Photo 19 – Exterior Emergency Telephone Call Station



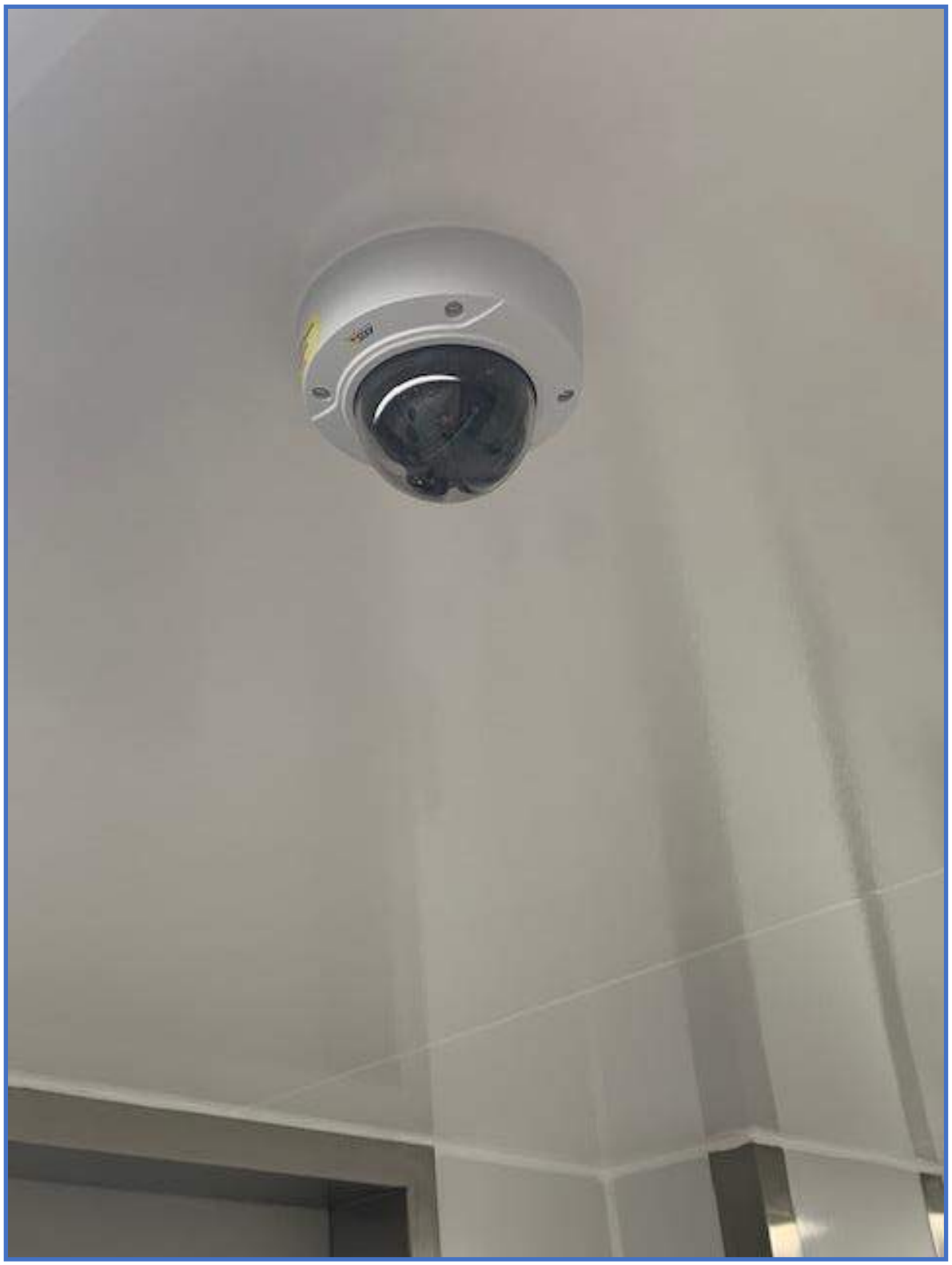
Security System Photo 20 – Exterior Emergency Telephone Call Station with Blue Light Strobe and Security Camera

Security System Photo 21 – Exterior Pole Mounted Emergency Telephone

Access Control Photo 22 – Exterior Pole with Emergency Telephone, Blue Light Strobe, and Multi-Imager Security Camera

Security System Photo 23 – Exterior Pole with Emergency Telephone, Blue Light Strobe, and 360 Degree PTZ Security Camera

Security System Photo 24 – Exterior Wall Mounted 180 Degree Security Camera with Custom Painted Casing



Security System Photo 25 – Ceiling Mounted Security Camera

Security System Photo 26 – Morse Watchman Electronic Key Box

Security System Photo 27 – Milestone NVR Equipment Rack

Security System Photo 28 - Milestone NVR Equipment Rack

Security System Photo 29 – Device Mounting Integration at Existing Entry

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APPENDIX E – AUDIOVISUAL SYSTEMS PHOTOGRAPHIC DOCUMENTATION

Audiovisual Cabinet Photo 1 - SDVoE 10 Gbps Audiovisual Cabinet Equipment Rack....3
Audiovisual SDVoE Headend Photo 2 - SDVoE 10 Gbps IP High Definition 4K Signal Extenders Via OM4 50 Micron Multimode Optical Fiber....4
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Conference Room Photo 5 – Wall Mounted Interactive Touch Flat Panel with UC Conferencing Wide Angle Camera/Beam Forming Microphone (Logitech Meetup)....7
Room Scheduling Signage Photo 6 – 7" Room Scheduling Sign with Glass Mount....8
Ceiling Array Microphone Photo 7 – Ceiling Array Microphone with Custom Pendant Mount (Shure MXA910 Series)....9
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Ceiling Projector Photo 10 – Pendant Mounted Projector in Finished Accessible Ceiling....11
Assistive Listening System (ALS) Transmitter Photo 11 – Wall Mounted Infrared ALS Transmitter (Listen Technologies LT-84)....11
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Conference Room Credenza Rack Photo 13 – Touchpanel Controlled QSC Q-Sysy 1 Gbps AV over IP System with Local Room PC, Amplifier, IP Encoder/Decoder, Remote Controlled IP PDU....13
Audiovisual Cabinet Photo 14 – Wall Mounted Rotating Wall Cabinet Installation....14
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Telecom Room Audiovisual Equipment Photo 16 – Rack Mounted Audiovisual Equipment Headend for 1 Gbps AV over IP QSC Q-Sys System with Remote Redundant Core Processors and Remote Controlled IP PDU....16
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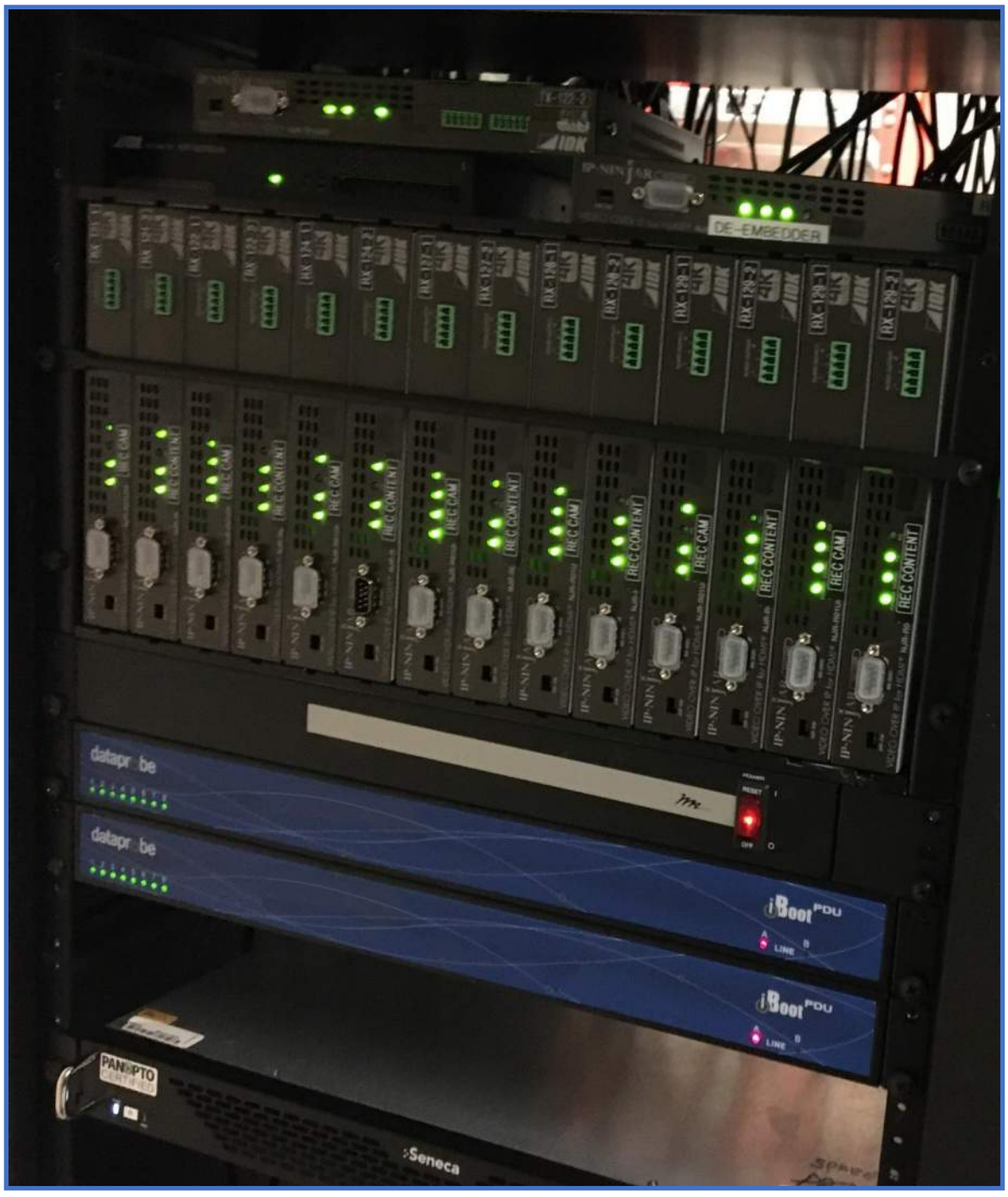
Audiovisual Lectern Photo 18 – Custom Millwork Audiovisual Equipment Lectern (Miller's Presentation Furniture)....18

Audiovisual Cabinet Photo 1 - SDVoE 10 Gbps Audiovisual Cabinet Equipment Rack



Audiovisual SDVoE Headend Photo 2 - SDVoE 10 Gbps IP High Definition 4K Signal Extenders Via OM4 50 Micron Multimode Optical Fiber

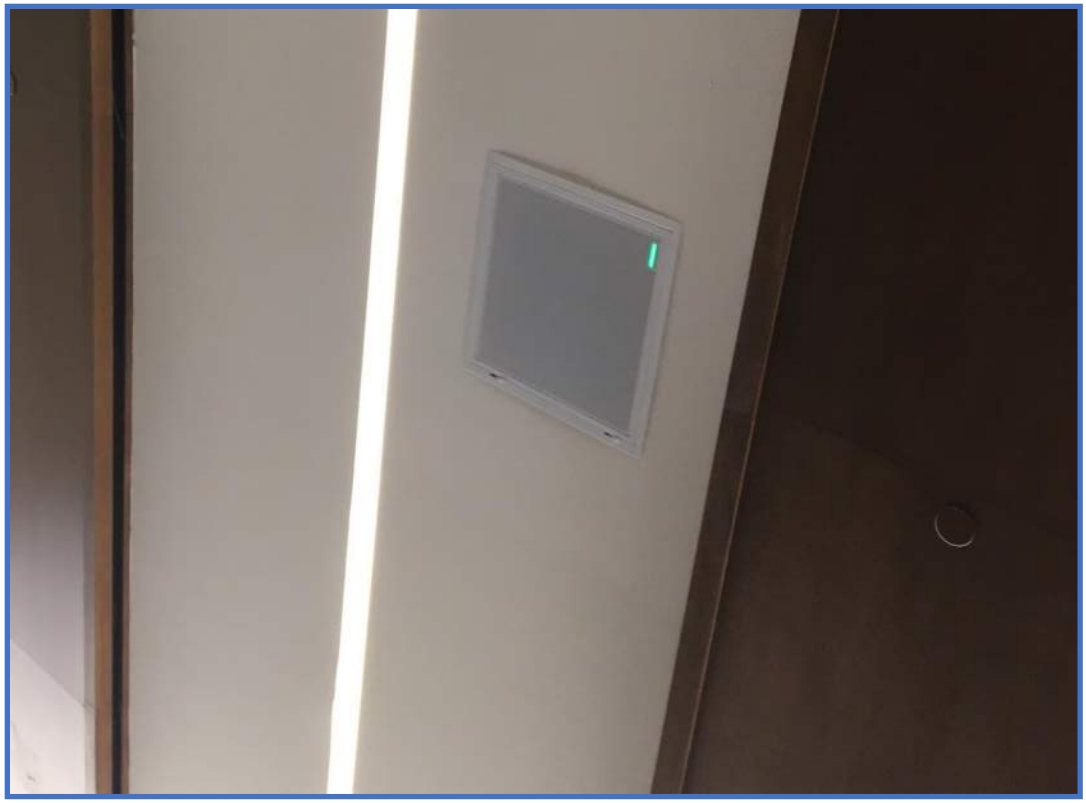
Audiovisual SDVoE Headend Photo 3 – Panopto-Certified Video Capture Appliances (by Seneca)

Audiovisual SDVoE Headend Photo 4 – Core Processor, Remote Classroom PC, Remote Wireless Presentation Device, SDVoE 10 Gbps OM4 Optical Fiber Extenders

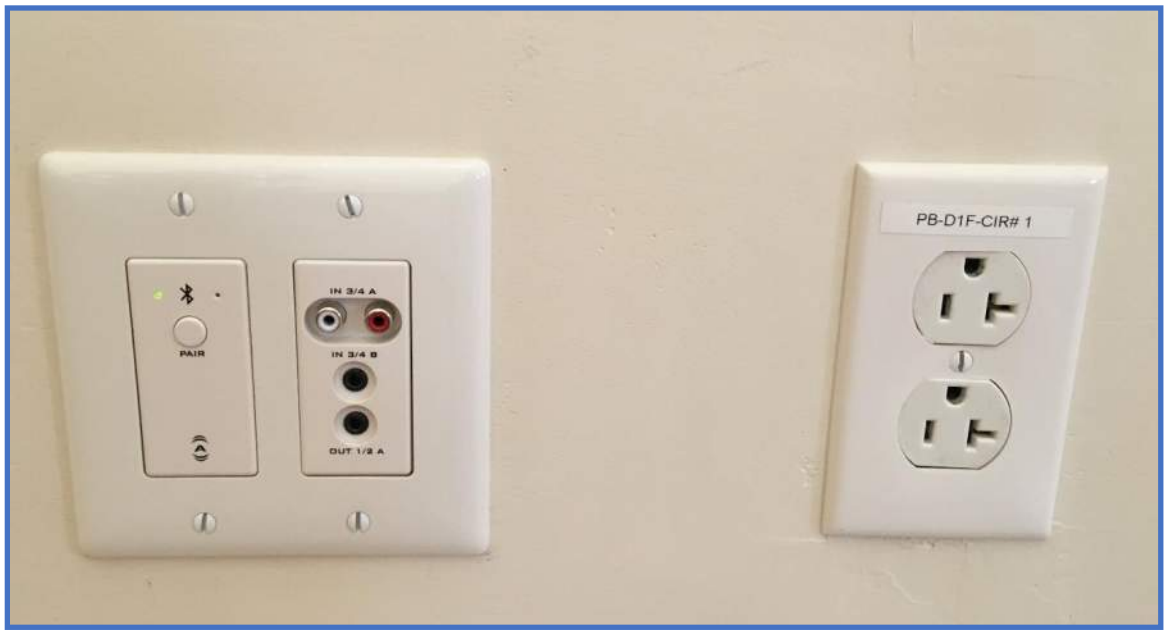
Conference Room Photo 5 – Wall Mounted Interactive Touch Flat Panel with UC Conferencing Wide Angle Camera/Beam Forming Microphone (Logitech Meetup)

Room Scheduling Signage Photo 6 – 7" Room Scheduling Sign with Glass Mount

Ceiling Array Microphone Photo 7 – Ceiling Array Microphone with Custom Pendant Mount (Shure MXA910 Series)



Ceiling Array Microphone Photo 8 – Ceiling Array Microphone in Finished Hard Ceiling (Shure MXA910 Series)



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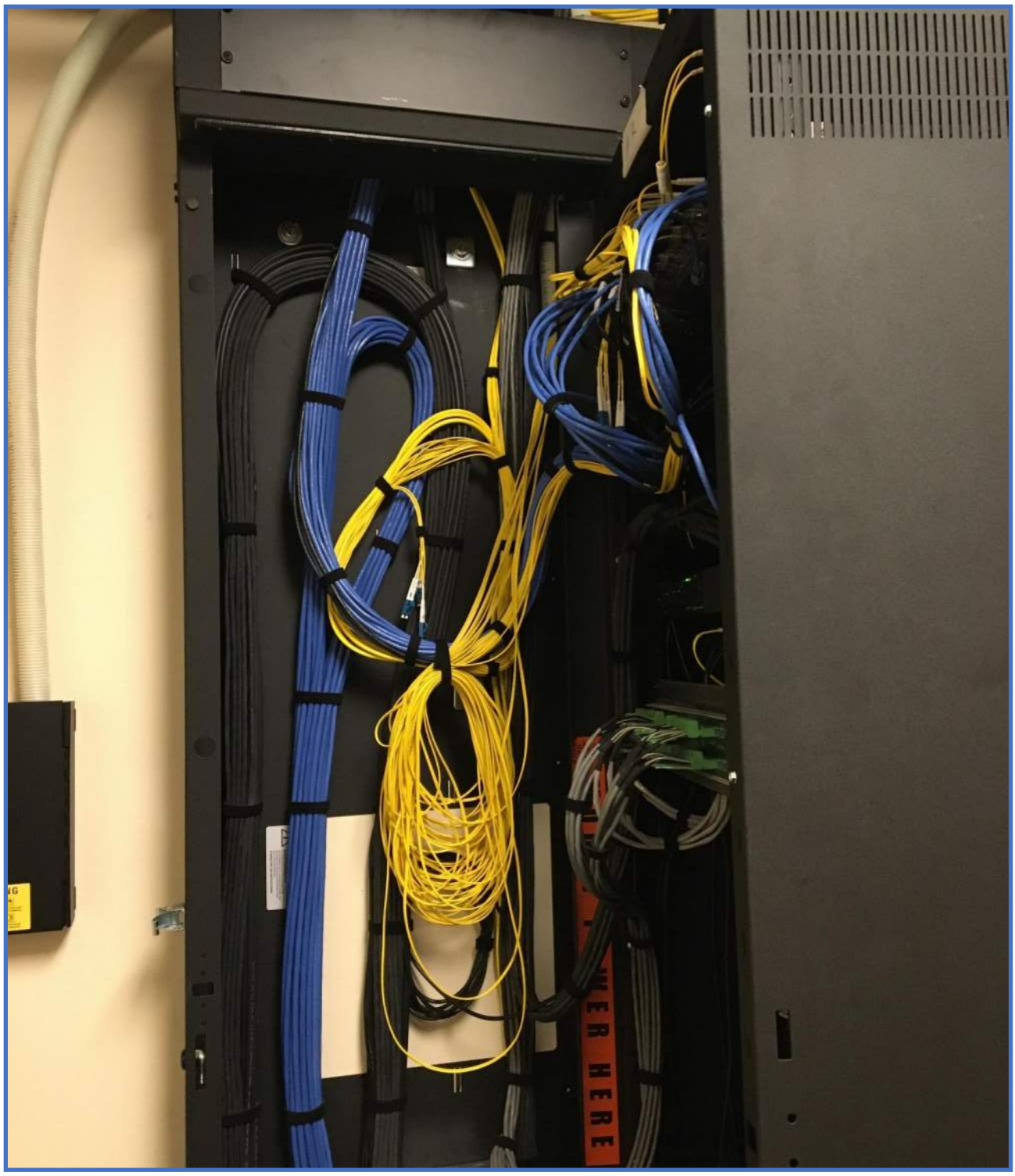
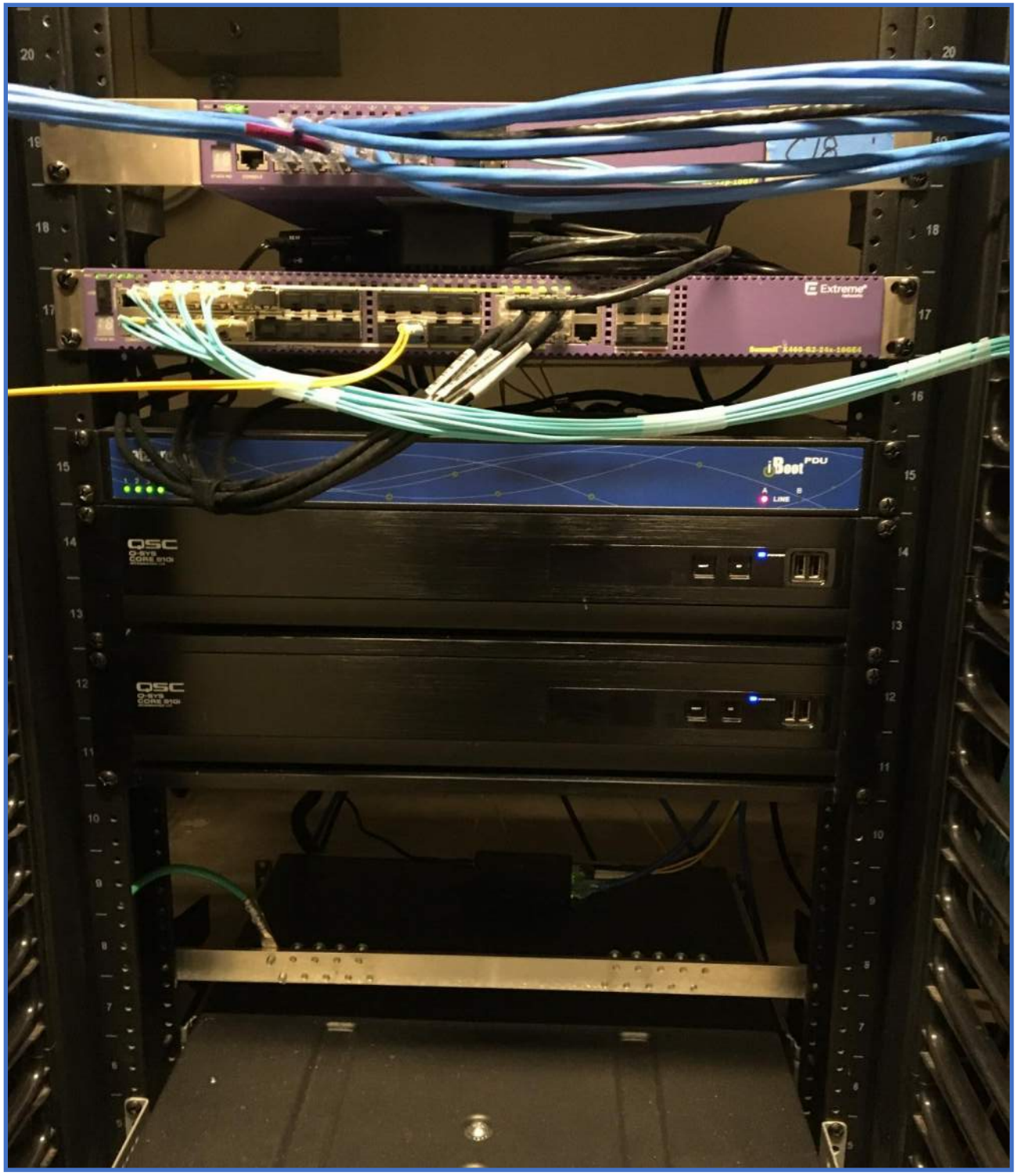
Conference Room Credenza Rack Photo 13 – Touchpanel Controlled QSC Q-Sysy 1 Gbps AV over IP System with Local Room PC, Amplifier, IP Encoder/Decoder, Remote Controlled IP PDU

Audiovisual Cabinet Photo 14 – Wall Mounted Rotating Wall Cabinet Installation



Audiovisual Cabinet Photo 15 – Wall Mounted Rotating Wall Cabinet Installation Showing Service Loop Cable Management



Telecom Room Audiovisual Equipment Photo 16 – Rack Mounted Audiovisual Equipment Headend for 1 Gbps AV over IP QSC Q-Sys System with Remote Redundant Core Processors and Remote Controlled IP PDU

Audiovisual Lectern Photo 17 – Custom Millwork Audiovisual Equipment Lectern (Miller's Presentation Furniture)

Audiovisual Lectern Photo 18 – Custom Millwork Audiovisual Equipment Lectern (Miller's Presentation Furniture)

TYPICAL CONSTRUCTION DETAILS

Designer Note: The ICT Designer shall provide construction details for projects that fully document Yale IT Standards and best practices. This Appendix contains sample construction details indicative of the minimum level of documentation expected for typical projects designs. The ICT Designer shall enhance the information shown in the construction details to fully document the specific design requirements of each project.

YALE IT STRUCTURED CABLING SYSTEMS DETAIL LIST

DETAIL NUMBER	DETAIL NAME
GENERAL DETAILS GROUP	
T001	DRAWING SYMBOL SCHEDULE
T002	DRAWING ABBREVIATIONS
STRUCTURED CABLING INFRASTRUCTURE DETAILS GROUP	
T003	OPEN TOP CABLE SUPPORT DETAIL
T004	TELECOMMUNICATIONS OUTLET CONDUIT AND BACKBOX DETAIL
T005	TELECOMMUNICATIONS SURFACE RACEWAY FEED IN DETAIL
T006	ENGINEERED THROUGH PENETRATION SLEEVE DETAIL
T007	PRIMARY BONDING BUSBAR (PBB) DETAIL
T008	SECONDARY BONDING BUSBAR (SBB) DETAIL
T009	MULTISERVICE LARGE FLOOR BOX DETAIL
T010	MULTISERVICE LARGE POKETHROUGH DETAIL
T011	FLOOR BOX DETAIL
T012	POKETHROUGH DETAIL
T013	WIREMESH CABLE TRAY SPLICE DETAIL
T014	WIREMESH CABLE TRAY SUPPORT DETAIL
T015	WIREMESH CABLE TRAY SECTION DETAIL
STRUCTURED CABLING DETAILS GROUP	
T016	WALL MOUNTED TELECOM OUTLET FACEPLATE ELEVATIONS
T017	SURFACE RACEWAY TELECOM OUTLET DETAIL
T018	SYSTEMS FURNITURE TELECOM OUTLET DETAIL
T019	WIRELESS ACCESS SPOINT TELECOM OUTLET DETAIL
T020	IP SECURITY CAMERA TELECOM OUTLET DETAIL
T021	EQUIPMENT PANEL TELECOM OUTLET DETAIL
T022	TELECOMMUNICATIONS OUTLET SCHEDULE
T023	TELECOMMUNICATIONS OUTLET SCHEDULE
T024	FACEPLATE LABELING DETAIL
T025	PATCH PANEL LABELING DETAIL
T026	VOICE PATCH PANEL CROSSCONNECT DETAIL
TELECOM ROOM DETAILS GROUP	
T027	10’X14’ TR ENLARGED PLAN

T028	10'X14' TR WALL ELEVATIONS
T029	10'X11' TR ENLARGED PLAN
T030	10'X9' TR ENLARGED PLAN
T031	10'X8' TR ENLARGED PLAN
T032	4'X8'-6" STR ENLARGED PLAN
T033	TELECOM ENCLOSURE CABINET DETAIL
T034	MDT ROOM TELECOM RACK LINE ELEVATION
T035	IDT ROOM TELECOM RACK LINE ELEVATION
COMMUNICATIONS RISER DIAGRAMS	
T036	TELECOMMUNICATIONS RISER DIAGRAM
T037	TELECOMMUNICATIONS GROUNDING RISER DIAGRAM
T038	AREA OF RESCUE COMMUNICATIONS RISER DIAGRAM
COMMUNICATIONS OUTSIDE PLANT DETAILS GROUP	
T039	TELECOM MAINTENANCE HOLE DETAILS
T040	TELECOM HANDHOLE DETAILS
T041	TELECOM DUCTBANK DETAIL - TWO (2) 4" CONDUITS
T042	TELECOM DUCTBANK DETAIL - THREE (3) 4" CONDUITS
T043	TELECOM DUCTBANK DETAIL - FOUR (4) 4" CONDUITS
T044	CONDUIT BUILDING POINT OF ENTRANCE DETAIL

SECURITY SYSTEMS DETAIL LIST

DETAIL NUMBER	**DETAIL NAME**
GENERAL DETAILS GROUP	
T045a	SECURITY DRAWINGS SYMBOL SCHEDULE
T045b	SECURITY DRAWINGS SYMBOL SCHEDULE
T046	SECURITY DRAWINGS ABBREVIATIONS
SECURITY RISER DIAGRAMS	
T047	ACCESS CONTROL RISER DIAGRAM
T048	SECURITY CAMERA RISER DIAGRAM
T049	ELEVATOR CAB SECURITY RISER DIAGRAM
T050	VIDEO INTERCOM SYSTEM RISER DIAGRAM
SECURITY ACCESS CONTROL DOOR DIAGRAMS	
T051	DOOR TYPE C1 - INTEGRATED CARD READER, SINGLE DOOR
T052	DOOR TYPE C1I - INTEGRATED CARD READER, SINGLE DOOR, VIDEO INTERCOM
T053	DOORY TYPE C1K - WALL CARD READER WITH KEYPAD
T054	DOOR TYPE C2 - INTEGRATED CARD READER, DOUBLE DOOR, EXIT DEVICE
T055	DOOR TYPE C2 - INTEGRATED CARD READER, DOUBLE DOOR, FIXED LEAF
T056	DOOR TYPE C2AO - CARD READER WITH AUTO OPENER, DOUBLE DOOR

T057	DOOR TYPE EEO - EMERGENCY EXIT ONLY
T058	DOOR TYPE EO - EXIT ONLY
T059	DOOR TYPE S1R - CARD READER, STAIRWELL RE-ENTRY, SINGLE DOOR
T060	DOOR TYPE CSL - SLIDING AUTO OPERATOR DOOR
T061	DOOR TYPE M1 - MONITORED SINGLE DOOR
T062	DOOR TYPE M2 - MONITORED DOUBLE DOOR
T063	DOOR TYPE DE1 - DELAYED EGRESS, SINGLE DOOR
T064	DOOR TYPE DE2 - DELAYED EGRESS, DOUBLE DOOR

AUDIOVISUAL SYSTEMS DETAIL LIST

DETAIL NUMBER	DETAIL NAME
GENERAL DETAILS GROUP	
T065	DRAWING SYMBOL SCHEDULE
T066	SURFACE MOUNTED FLAT PANEL BACKING DIAGRAM
T067	COMPACT TEACHING STATION
T068	CREDENZA WITH RACK
T069	FULL SIZE TEACHING STATION
T070	HEIGHT ADJUSTABLE TABLE

COMMUNICATIONS

XY
ZZ

TELECOMMUNICATIONS OUTLET DEFINED AS

X - QUANTITY OF CABLES/JACKS AT OUTLET
Y - APPLICATION OF CABLE TYPE WHERE:
- N - NETWORK
- W - WIRELESS ACCESS POINT
- V - TELEVISION SERVICE OUTLET
- SC - SECURITY CAMERA
- TC - TIME CLOCK
- FA - FIRE ALARM PANEL
- BS - BUILDING SYSTEM
- T - TELEPHONE
- MM - MULTIMODE OPTICAL FIBER FTTD
- SM - SINGLEMODE OPTICAL FTTD

ZZ - MOUNTING CONDITION
- ___ - BLANK, WALL MOUNTED +18" OR AS OTHERWISE NOTED
- SF - MOUNTED IN SYSTEMS FURNITURE
- CLG - MOUNTED FLUSH ON CEILING
- AFC - MOUNTED ABOVE FINISHED CEILING
- SR - MOUNTED IN SURFACE RACEWAY
- TV - MOUNTED TO SERVE FLAT PANEL
- WT - MOUNTED TO SERVE WALL MOUNTED TELEPHONE
- SM - SURFACE MOUNTED CONDITION
- CP - MOUNTED TO SERVE CEILING PROJECTOR
- FB - MOUNTED IN FLOORBOX/POKE THROUGH
- DA - DIRECT ATTACHMENT PLUG CONNECTION
- EP - MOUNTED IN EQIUPMENT PANEL

TELECOMMUNICATIONS OUTLET MOUNTED ABOVE COUNTER HEIGHT

TELECOMMUNICATIONS BACKBOX WITH GROMMET FACEPLATE

TELECOMMUNICATIONS BACKBOX WITH BLANK FACEPLATE

SEALED CONDUIT SLEEVE

F ENGINEERED FIRESTOP PENETRATION SLEEVE

N ENGINEERED PENETRATION SMOKE AND ACOUSTICAL SLEEVE

SURFACE MOUNTED RACEWAY SECTION

CTSB-"XX-YY" SOLID BOTTOM CABLE TRAY, "XX" INDICATES WIDTH IN INCHES, "YY" INDICATED DEPTH IN INCHES

CTWM-"XX-YY" WIRE MESH CABLE TRAY, "XX" INDICATES WIDTH IN INCHES, "YY" INDICATED DEPTH IN INCHES

CTRW-"XX-YY" CABLE RUNWAY CABLE TRAY, "XX" INDICATES WIDTH IN INCHES, "YY" INDICATED DEPTH IN INCHES

Y / X FLUSH POKE THROUGH, WITH POWER, DATA, AND AV CONNECTIONS. "X" INDICATES TELECOM OUTLET TYPE IN POKE THROUGH AND "Y" INDICATES POKE THROUGH TYPE - REFER TO SPECIFICATIONS

Y / X FLUSH POKE THROUGH, WITH POWER AND DATA CONNECTIONS. "X" INDICATES TELECOM OUTLET TYPE IN POKE THROUGH AND "Y" INDICATES POKE THROUGH TYPE - REFER TO SPECIFICATIONS

Y FLUSH POKE THROUGH, WITH POWER CONNECTIONS. SEE ELECTRICAL POWER DRAWINGS FOR DETAILS. "Y" INDICATES POKE THROUGH TYPE - REFER TO SPECIFICATIONS

Y / X FLUSH FLOOR BOX, WITH POWER, DATA, AND AV CONNECTIONS. "X" INDICATES TELECOM OUTLET TYPE IN FLOOR BOX AND "Y" INDICATES FLOOR BOX TYPE - REFER TO SPECIFICATIONS

Y / X FLUSH FLOOR BOX, WITH POWER AND DATA CONNECTIONS. "X" INDICATES TELECOM OUTLET TYPE IN FLOOR BOX AND "Y" INDICATES FLOOR BOX TYPE - REFER TO SPECIFICATIONS

Y FLUSH FLOOR BOX, WITH POWER CONNECTIONS. SEE ELECTRICAL POWER DRAWINGS FOR DETAILS. "Y" INDICATES FLOOR BOX TYPE - REFER TO SPECIFICATIONS

TDU TUBE DISTRIBUTION UNIT

BEP BUILDING ENTRANCE PROTECTOR

110 110-STYLE CROSSCONNECT BLOCK

66 66-STYLE CROSSCONNECT BLOCK

HHCT-XX-YYHHH CENTER SPLINE CABLE TRAY ("XX" INDICATES WIDTH IN INCHES, "YY" INDICATED DEPTH IN INCHES) ABOVE FINISHED ACCESIBLE CEILING

LLLCT-XX-YYLLL WALL MOUNTED CABLE TRAY ("XX" INDICATES WIDTH IN INCHES, "YY" INDICATED DEPTH IN INCHES) ABOVE FINISHED ACCESSIBLE CEILING

CONDUIT ROUTED UNDERNEATH FLOOR SLAB

TELECOM ROOM SERVING ZONE BOUNDARY

J-HOOK (OPEN TOP CABLE SUPPORT) RUN

J JUNCTION BOX

PBB TELECOMMUNICATIONS PRIMARY BONDING BUSBAR

SBB TELECOMMUNICATIONS SECONDARY BONDING BUSBAR

3/4" FIRE RETARDANT GRADE AC PLYWOOD BACKBOARD WALL MOUNTED

TELECOMMUNICATIONS TWO POST EQUIPMENT RACK WITH VERTICAL MANAGERS

SERVER CABINET

TP TELECOM POLE CEILING FEED

<Pick location in Project Information>

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Notes

Client/Project
YALE UNIVERSITY

ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0
Date 07/31/2020

Title
DRAWING SYMBOLS SCHEDULE

Detail Number
T001

ABBREVIATIONS

1/C	SINGLE CONDUCTOR
A	AMPS
A/C	AIR CONDITIONING UNIT
AC	ALTERNATING CURRENT
ACT	ABOVE CEILING TILE
ADA	AMERICANS w/ DISABILITIES ACT
ADD'L	ADDITIONAL
ADJ	ADJUSTABLE
AFC	ABOVE FINISHED CEILING
AFCI	ARC FAULT CIRCUIT INTERRUPTER
AFF	ABOVE FINISHED FLOOR
AFG	ABOVE FINISHED GRADE
AHU	AIR HANDLING UNIT
AL	ALUMINUM
ALD	ASSISTED LISTENING DEVICE
ALT	ALTERNATE
ARCH	ARCHITECTURAL
ATS	AUTOMATIC TRANSFER SWITCH
AUTO	AUTOMATIC
AVG	AVERAGE
BC	BONDING CONDUCTOR
BFC	BELOW FINISHED CEILING
BFG	BELOW FINISH GRADE
BKR	BREAKER
BLDG	BUILDING
BOF	BOTTOM OF FIXTURE
BTM	BOTTOM
C	CONDUIT
CAP	CAPACITY
CATV	COMMUNITY ACCESS TELEVISION
CFM	CUBIC FEET/MINUTE
CIRC	CIRCULATING
CKT	CIRCUIT
CL	CENTERLINE
CLG	CEILING MOUNTED
CMU	CONCRETE MASONRY UNIT
CO	COMPANY
CONC	CONCRETE
CONN	CONNECTION
CONST	CONSTRUCTION
CONT	CONTINUOUS
CONTR	CONTRACTOR
CPU	CENTRAL PROCESSING UNIT
CT	CURRENT TRANSFORMER
CTR	CENTER
CU	COPPER
DED	DEDICATED
DET	DETAIL
DF	DRINKING FOUNTAIN
DIAM	DIAMETER
DIM	DIMENSION
DISC	DISCONNECT
DIV.	DIVISION
DN	DOWN
DPR	DAMPER
DWG	DRAWING
DWH	DOMESTIC WATER HEATER
EA	EACH
EC	ELECTRICAL CONTRACTOR
ELEC	ELECTRICAL
ELEV	ELEVATOR
EM	EMERGENCY ONLY
EM GEN	EMERGENCY GENERATOR
EMT	ELECTRICAL METALLIC TUBING
ENCL	ENCLOSURE
EP	ELECTRIC-PNEUMATIC
EQUIP	EQUIPMENT
ETR	EXISTING TO REMAIN
EWC	ELECTRIC WATER COOLER
EXH	EXHAUST
EXIST	EXISTING
EXTER	EXTERIOR
F&I	FURNISH AND INSTALL
FAB	FABRICATE
FACP	FIRE ALARM CONTROL PANEL
F.A.ZONE	FIRE ALARM ZONE
FBO	FURNISHED BY OTHERS
FDGP	FIRE ALARM DATA GATHERING PANEL
FIN	FINISH
FIXT	FIXTURE
FLR	FLOOR
FLUOR	FLUORESCENT
FP	FIRE PROTECTION
FPC	FIRE PROTECTION CONTRACTOR
FU	FUSE
GA	GAUGE
GAL	GALLONS
GC	GENERAL CONTRACTOR
GFI	GROUND FAULT INTERRUPTER
GRC	GALVANIZED RIGID CONDUIT
GRD	GROUND
HC	HORIZONTAL CROSSCONNECT
HGT	HEIGHT
HORIZ	HORIZONTAL
HP	HORSEPOWER
HTG	HEATING
HTGHV	HEATING HIGH VOLTAGE
HV	HIGH VOLTAGE
HW	HOT WATER
HZ	HERTZ
IC	INTERMEDIATE CROSSCONNECT
IDF	INTERMEDIATE DISTRIBUTION FRAME
IDT	INTERMEDIATE DISTRIBUTION TERMINAL
IMC	INTERMEDIATE METAL CONDUIT
INCL	INCLUDE
INFO	INFORMATION
INST	INSTANTANEOUS
INSUL	INSULATION
JAN	JANITOR
JB	JUNCTION BOX
JT	JOINT
LTG	LIGHTING
LTS	LIGHTS
LV	LOW VOLTAGE
LVR	LOUVER
MAX	MAXIMUM
MC	MECHANICAL CONTRACTOR
MCB	MAIN CIRCUIT BREAKER
MCC	MOTOR CONTROL CENTER
MCT	MAIN CROSSCONNECT
MDF	MAIN DISTRIBUTION FRAME
MDT	MAIN DISTRIBUTION TERMINAL
MER	MECHANICAL EQUIPMENT ROOM
MECH	MECHANICAL
MFR.	MANUFACTURER
MH	MANHOLE
MIN	MINIMUM
MISC	MISCELLANEOUS
MLO	MAIN LUG ONLY
MM	MULTIMODE FIBER OPTIC STRAND
MOA	MULTI-OUTLET ASSEMBLY
MTD	MOUNTED
MTG	MOUNTING
MTS	MAIN TERMINAL SPACE
NIC	NOT IN CONTRACT
NO	NUMBER
NOM	NOMINAL
NTS	NOT TO SCALE
OC	ON CENTER
OD	OUTSIDE DIAMETER
OFE	OWNER FURNISHED EQUIPMENT
OH	OVERHEAD
OPNG	OPENING
OS	OCCUPANCY SENSOR
OSP	OUTSIDE PLANT
PBB	PRIMARY BONDING BUSBAR
PC	PHOTO CELL
PD	PUNCH DOWN
PE	PNEUMATIC TUBING
PEND	PENDANT
PH	PENTHOUSE
PLBG	PLUMBING
PNL	PANEL
POE	POINT OF ENTRANCE
POS	POINT OF SERVICE
PR	PAIR
PRESS SW	PRESSURE SWITCH
PS	PULL SWITCH
PT	POTENTIAL TRANSFORMER
PTZ	PAN/TILT/ZOOM
RA	RETURN AIR
REC	RECESSED
RECEPT	RECEPTACLE
REQD	REQUIRED
RM	ROOM
SBB	SECONDARY BONDING BUSBAR
SEC	SECURITY
SECT	SECTION
SIM	SIMILAR
SM	SINGLE MODE FIBER OPTIC STRAND
SMR	SURFACE MOUNTED RACEWAY
SPD	SURGE PROTECTED DEVICE
SQ FT	SQUARE FOOT
STD	STANDARD
STL	STEEL
STOR	STORAGE
STRUCT	STRUCTURAL
SURF	SURFACE
SUSP	SUSPENDED
SUSP CLG	SUSPENDED CEILING
SW	SWITCH
T-STAT	THERMOSTAT
TBB	TELECOMMUNICATIONS BONDING BACKBONE
TE	TELECOMMUNICATIONS ENCLOSURE
TELE	TELEPHONE
TELECOM	TELECOMMUNICATIONS
TEMP	TEMPERATURE
TERM	TERMINAL
TGB	TELECOMMUNICATIONS GROUNDING BUSBAR
TMGB	TELECOMMUNICATIONS MAIN GROUNDING BUSBAR
THK	THICK
TOF	TOP OF FIXTURE
TR	TELECOMMUNICATIONS ROOM
TV	TELEVISION
TYP	TYPICAL
UG	UNDERGROUND
UH	UNIT HEATER
UNO	UNLESS NOTED OTHERWISE
UON	UNLESS OTHERWISE NOTED
UTP	UNSHIELDED TWISTED PAIR
UV	UNIT VENTILATOR
VDT	VISUAL DISPLAY TERMINAL
VERT	VERTICAL
VFD	VARIABLE FREQUENCY DRIVE
VGA	VIDEO GRAPHICS ARRAY
VOL	VOLUME
VS	VACANCY SENSOR
VT	VAPOR TIGHT
WAP	WIRELESS ACCESS POINT
WP	WEATHERPROOF
WT	WEIGHT
XFMR	TRANSFORMER

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Notes

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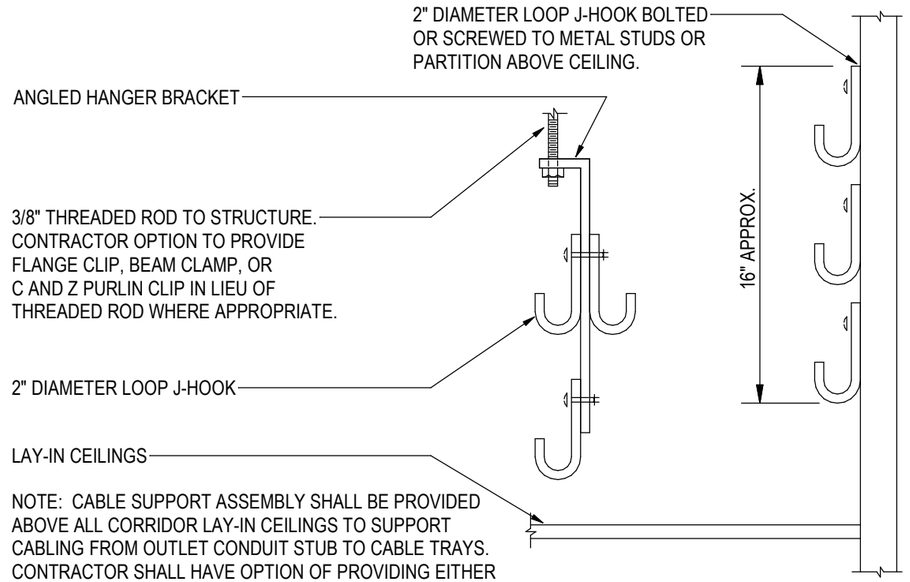
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0

Date 07/31/2020

Title
DRAWING
ABBREVIATIONS

Detail Number
T002



NOTE: CABLE SUPPORT ASSEMBLY SHALL BE PROVIDED ABOVE ALL CORRIDOR LAY-IN CEILINGS TO SUPPORT CABLING FROM OUTLET CONDUIT STUB TO CABLE TRAYS. CONTRACTOR SHALL HAVE OPTION OF PROVIDING EITHER OF THE ABOVE ASSEMBLIES WHERE REQUIRED. TOTAL NUMBER OF J-HOOKS (OPEN TOP CABLE SUPPORTS) SHALL BE EQUAL QUANTITY AS RECOMMENDED BY MANUFACTURER BASED ON NUMBER OF CABLES INSTALLED PLUS 50% SPARE CAPACITY. DIFFERENT CABLE TYPES SHALL BE SUPPORTED BY SEPARATE J-HOOKS. J-HOOKS SPACING SHALL BE 3'-4' INTERVALS.

OPEN TOP CABLE SUPPORT DETAIL

Not to Scale

<Pick location in Project Information>

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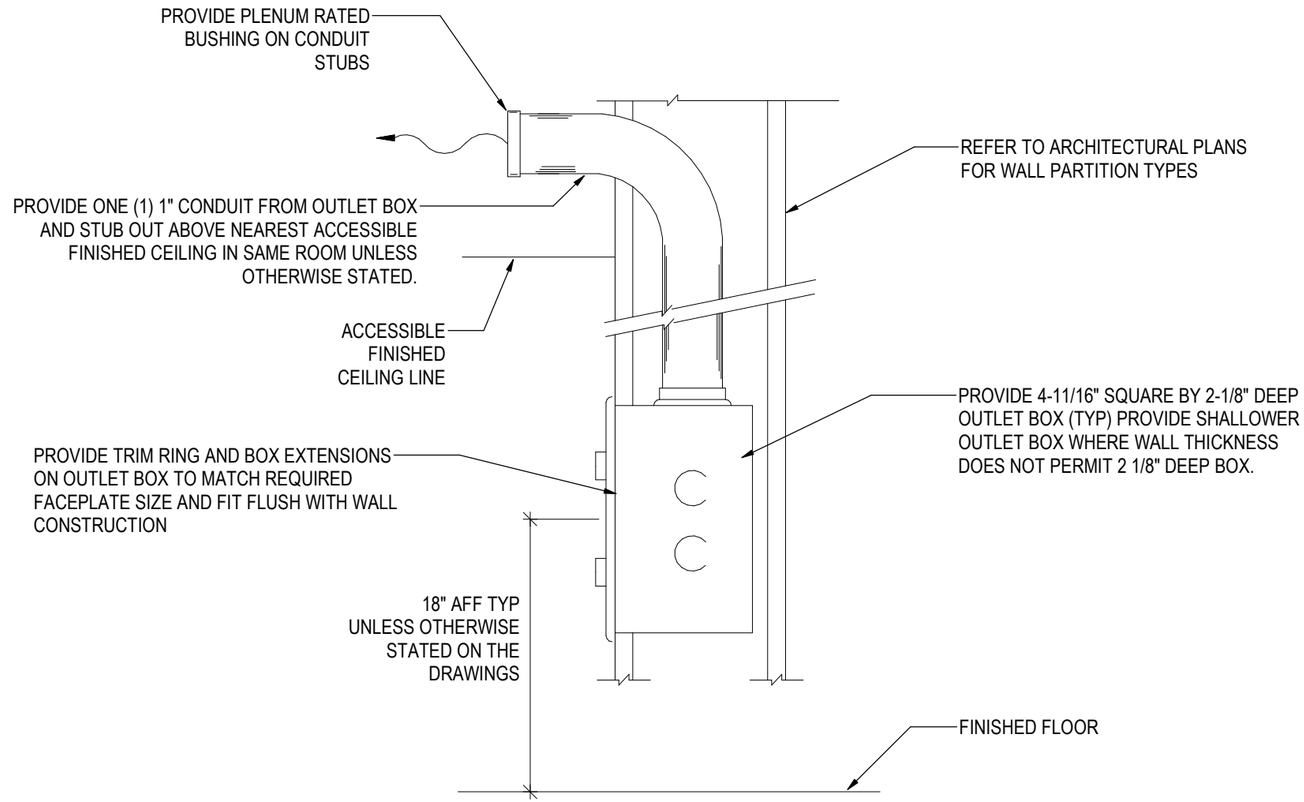
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0

Date 07/31/2020

Title
OPEN TOP CABLE SUPPORT DETAIL

Detail Number
T003



TELECOMMUNICATIONS OUTLET CONDUIT AND BACKBOX DETAIL

Not to Scale

<Pick location in Project Information>
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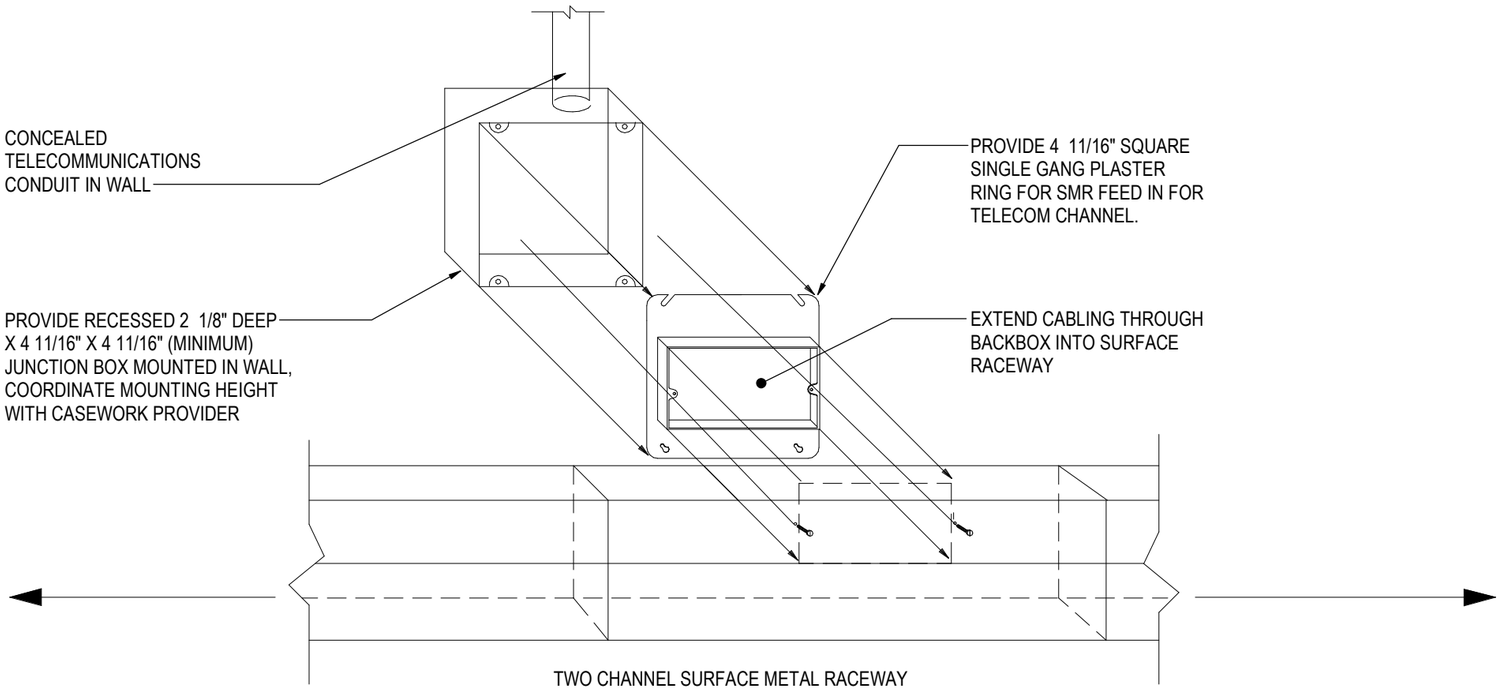
Revision No. 1.0

Date 07/31/2020

Title
TELECOMMUNICATIONS OUTLET CONDUIT AND BACKBOX DETAIL

Detail Number
T004



PROVIDE FEED-IN TO RACEWAY EVERY 8 FT ALONG LENGTH OF RACEWAY
DETAIL IS FOR GENERAL INFORMATION AND DOES NOT INCORPORATE ALL ACCESSORIES REQUIRED FOR A COMPLETE INSTALLATION.

TYPICAL TELECOMMUNICATIONS OUTLET SMR FEED-IN

Not to Scale

<Pick location in Project Information>
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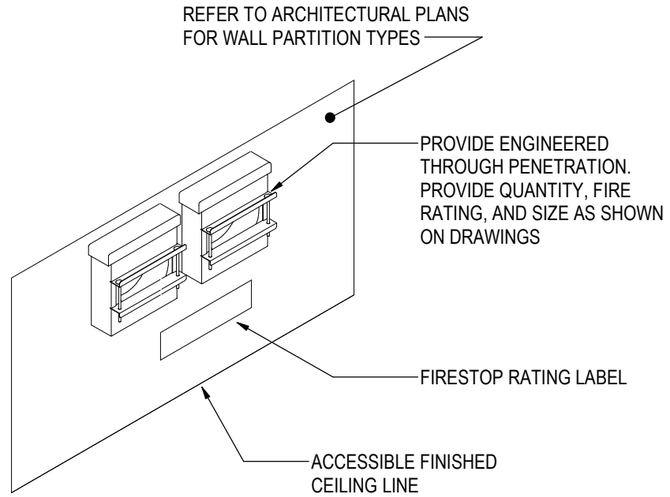
Revision No. 1.0
Date 07/31/2020

Title
TELECOMMUNICATIONS SURFACE RACEWAY FEED IN DETAIL

Detail Number
T005



ENGINEERED THROUGH PENETRATION SLEEVES DETAIL

Not to Scale

<Pick location in Project Information>
6/6/2022 4:03:48 PM

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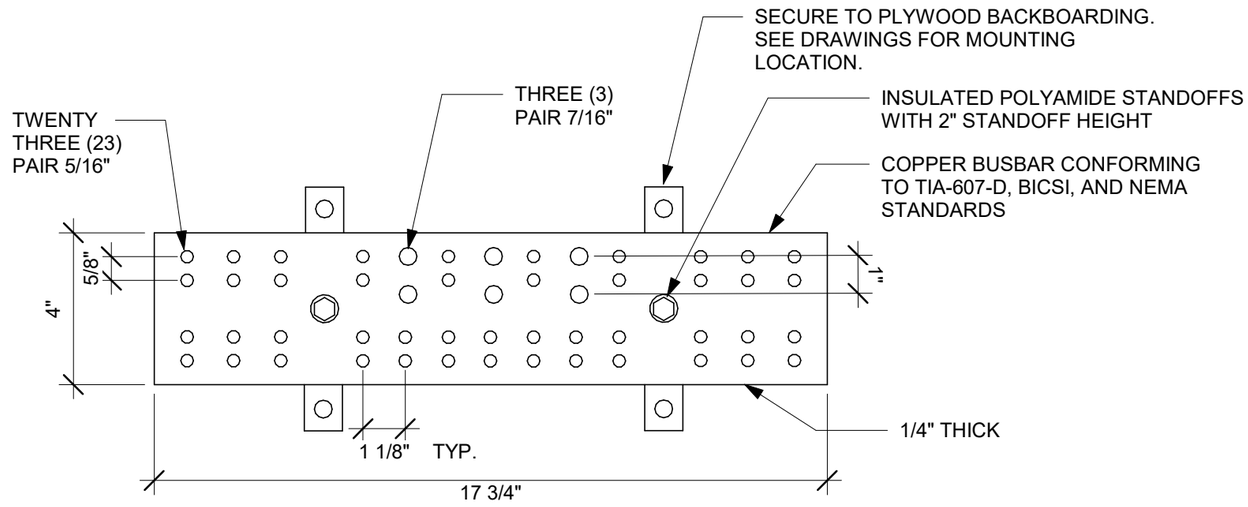
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0

Date 07/31/2020

Title
ENGINEERED THROUGH PENETRATION SLEEVE DETAIL

Detail Number
T006



PBB (PRIMARY BONDING BUSBAR) DETAIL

Not to Scale

<Pick location in Project Information>

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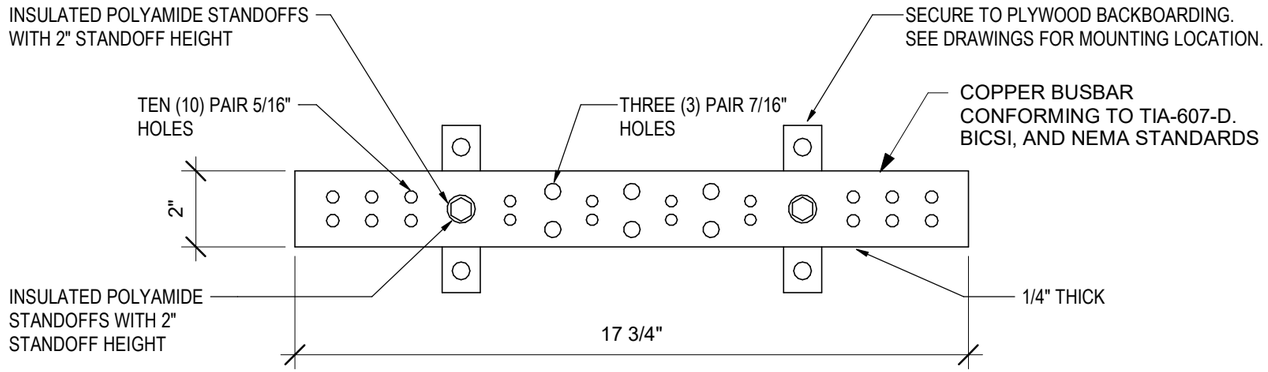
Date 07/31/2020

Title
PRIMARY BONDING BUSBAR (PBB) DETAIL

Detail Number
T007



SECONDARY BONDING BUSBAR (SBB) DETAIL

Not to Scale

<Pick location in Project Information>

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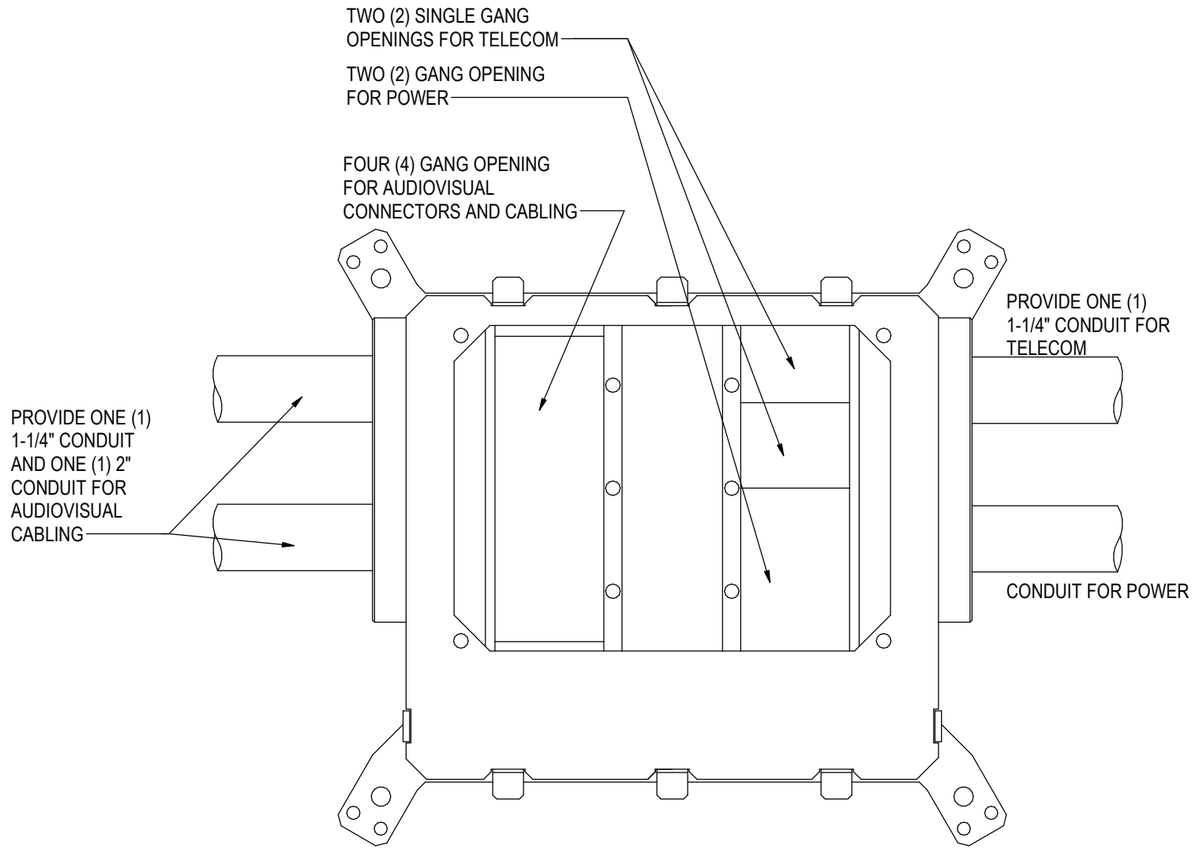
Revision No. 1.0

Date 07/31/2020

Title
SECONDARY BONDING BUSBAR (SBB) DETAIL

Detail Number
T008



NOTE:
ROUTE CONDUITS AND STUB OUT ABOVE FINISHED CEILING IN SAME ROOM SERVED BY FLOOR BOX.

MULTISERVICE LARGE FLOOR BOX DETAIL

Not to Scale

<Pick location in Project Information>
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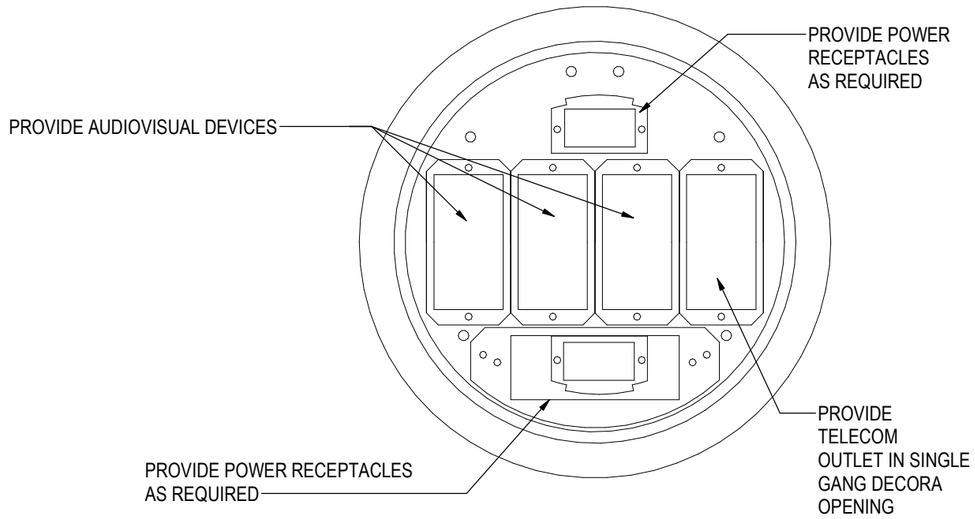
Revision No. 1.0

Date 07/31/2020

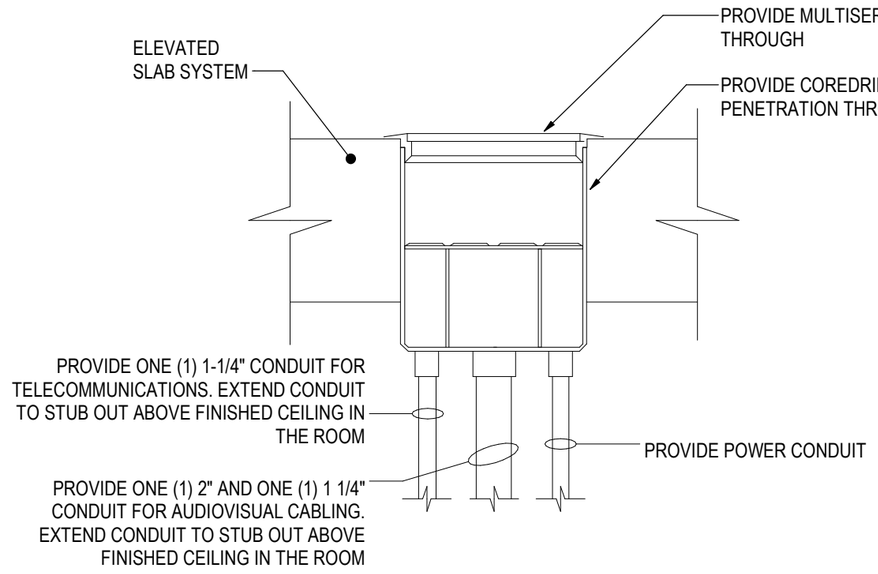
Title
MULTISERVICE LARGE FLOOR BOX DETAIL

Detail Number
T009



MULTISERVICE LARGE POKETHROUGH DETAIL

Not to Scale



MULTISERVICE LARGE POKETHROUGH SECTION

Not to Scale

<Pick location in Project Information>
6/6/2022 4:03:50 PM

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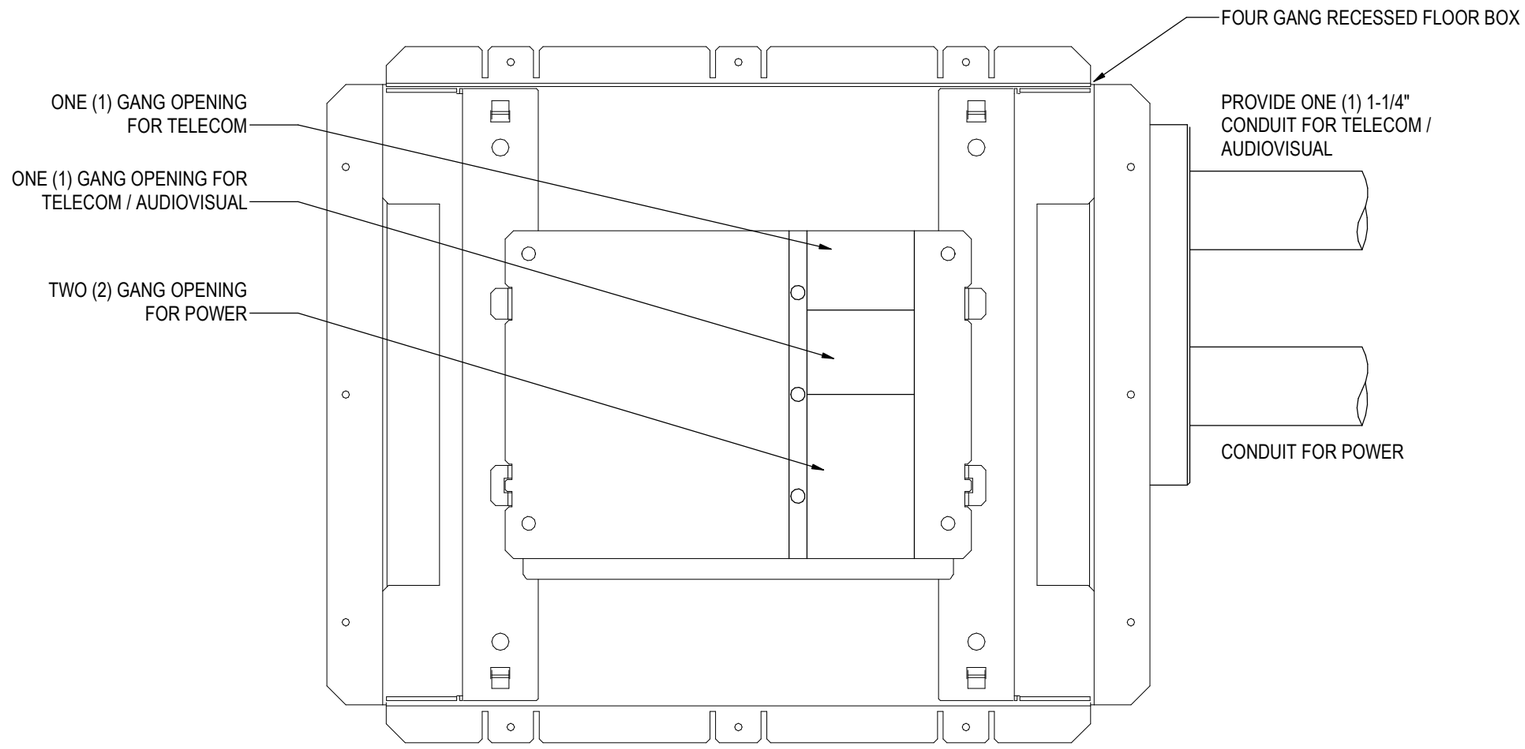
Revision No. 1.0

Date 07/31/2020

Title
MULTISERVICE LARGE POKETHROUGH DETAIL

Detail Number
T010



NOTE:
ROUTE CONDUITS AND STUB OUT ABOVE FINISHED CEILING IN SAME ROOM SERVED BY FLOOR BOX.

FOUR GANG FLOORBOX DETAIL

Not to Scale

<Pick location in Project Information>
6/6/2022 4:03:50 PM

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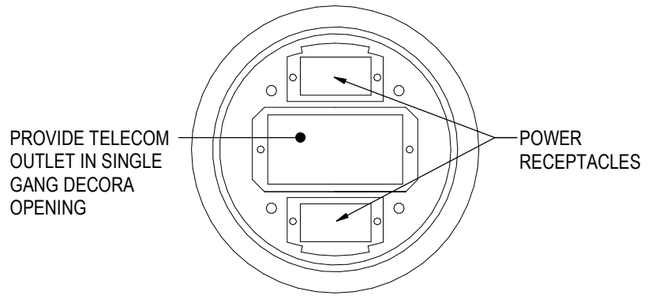
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0
Date 07/31/2020

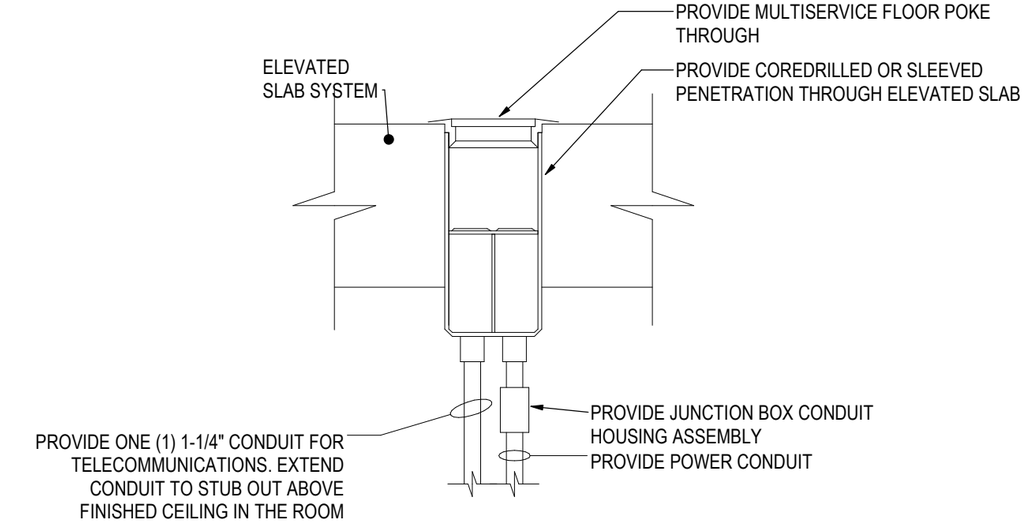
Title
FLOOR BOX DETAIL

Detail Number
T011



POKETHROUGH DETAIL

Not to Scale



POKETHROUGH SECTION

Not to Scale

<Pick location in Project Information>

6/6/2022 4:03:50 PM

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ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0

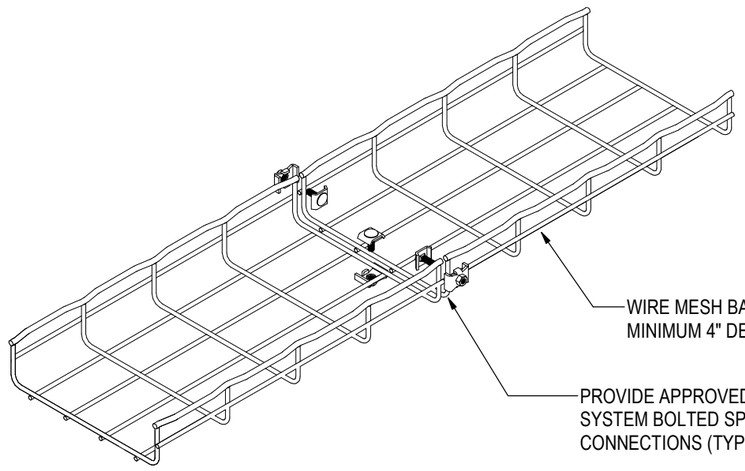
Date 07/31/2020

Title

POKETHROUGH DETAIL

Detail Number

T012



WIRE MESH CABLE TRAY SPLICE DETAIL

Not to Scale

<Pick location in Project Information>
6/6/2022 4:03:51 PM

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Notes

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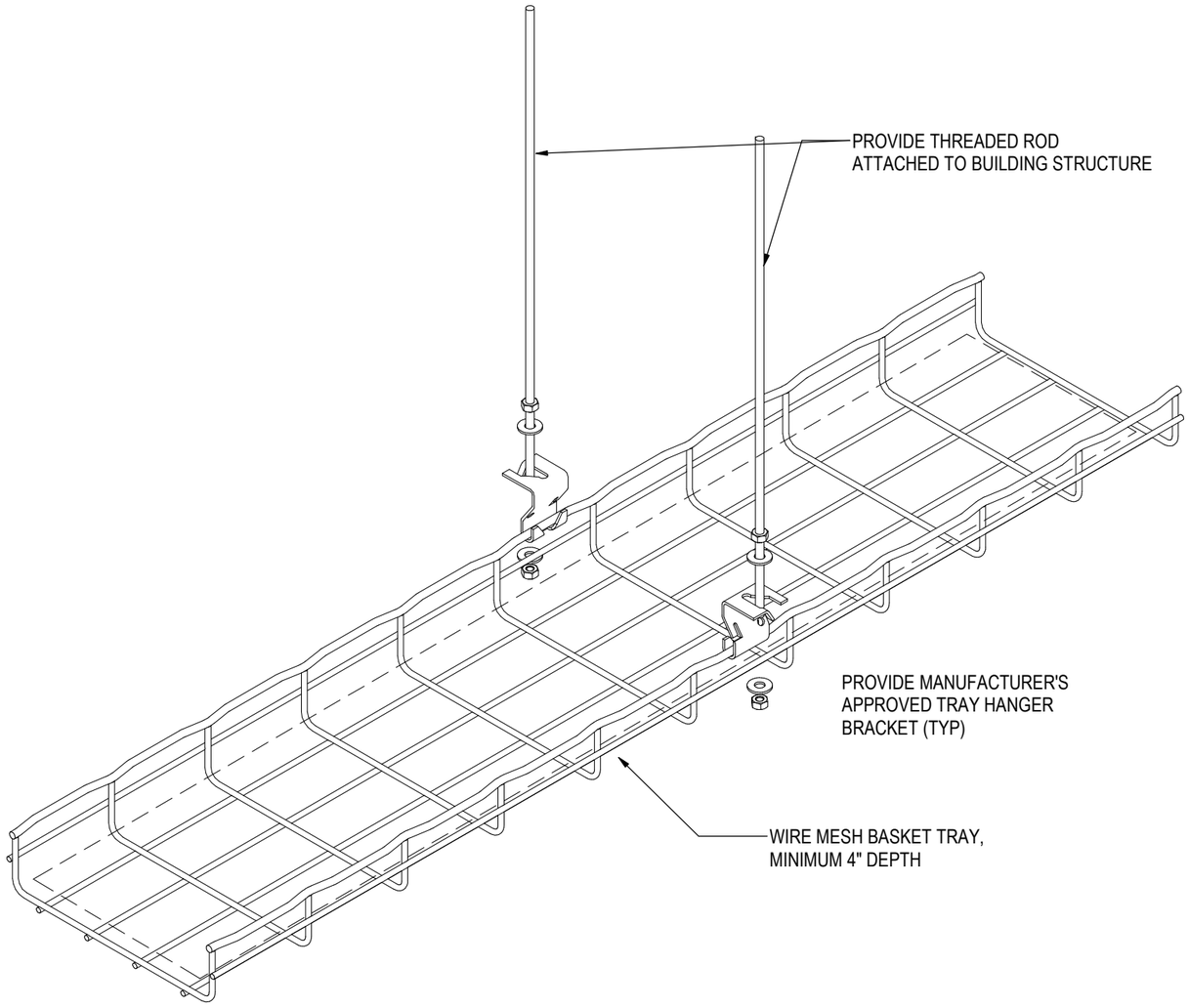
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0

Date 07/31/2020

Title
WIREMESH CABLE TRAY SPLICE DETAIL

Detail Number
T013



WIRE MESH CABLE TRAY SUPPORT DETAIL

Not to Scale

<Pick location in Project Information>

6/6/2022 4:03:52 PM

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Notes

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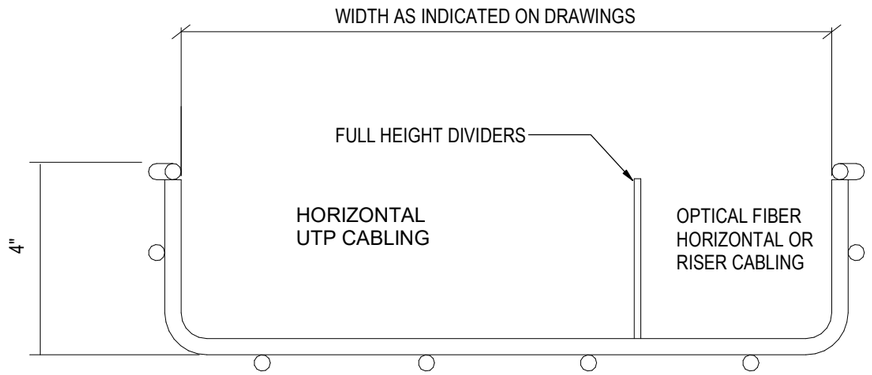
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0

Date 07/31/2020

Title
WIREMESH CABLE TRAY SUPPORT DETAIL

Detail Number
T014



NOTE: PROVIDE LONG RADIUSED HORIZONTAL BEND AT ALL 90 DEGREE BENDS.

WIRE MESH CABLE TRAY SECTION DETAIL

Not to Scale

<Pick location in Project Information>

6/6/2022 4:03:52 PM

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Notes

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ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

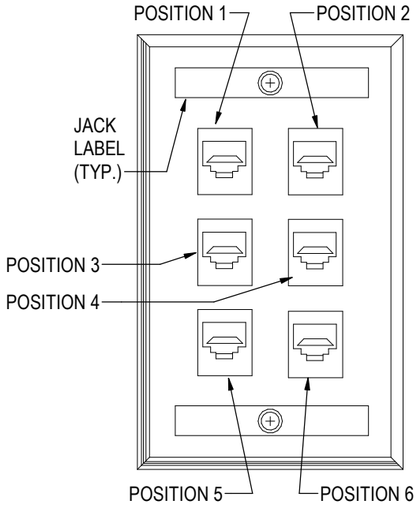
Revision No. 1.0

Date 07/31/2020

Title
WIREMESH CABLE TRAY SECTION DETAIL

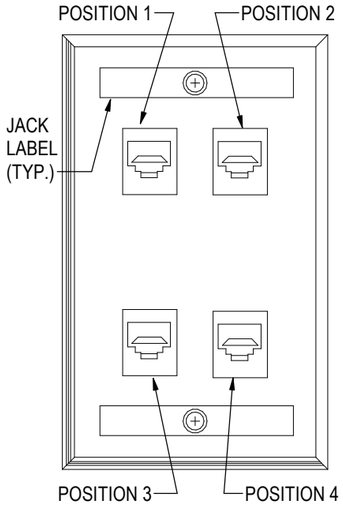
Detail Number
T015

TYPE "6N"
TELECOMMUNICATIONS OUTLET



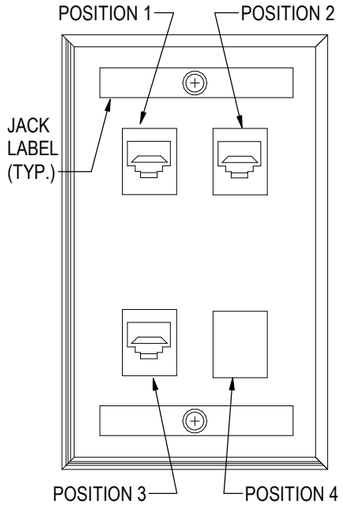
SINGLEGANG WHITE
SIX PORT FLUSH FACEPLATE
WITH UNIVERSAL JACK OPENINGS

TYPE "4N"
TELECOMMUNICATIONS OUTLET



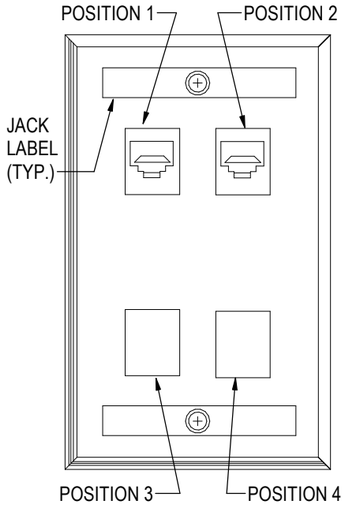
SINGLEGANG WHITE
FOUR PORT FLUSH FACEPLATE
WITH UNIVERSAL JACK OPENINGS

TYPE "3N AND 2N/1T"
TELECOMMUNICATIONS OUTLET



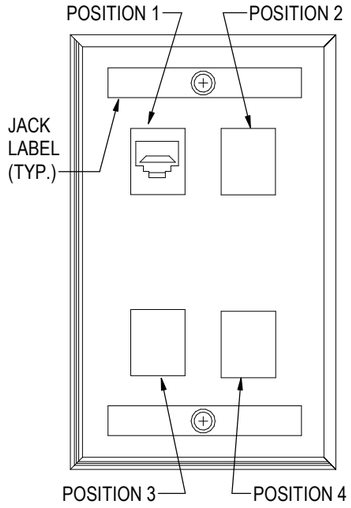
SINGLEGANG WHITE
FOUR PORT FLUSH FACEPLATE
WITH UNIVERSAL JACK OPENINGS

TYPE "2N AND 1N/1T"
TELECOMMUNICATIONS OUTLET



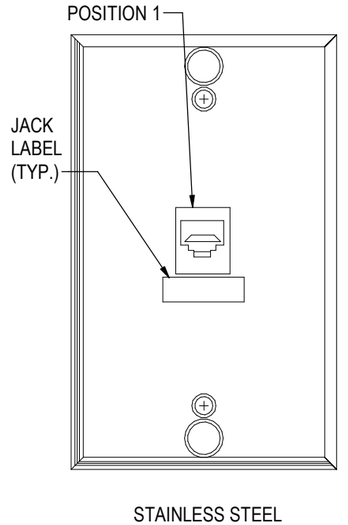
SINGLEGANG WHITE
FOUR PORT FLUSH FACEPLATE
WITH UNIVERSAL JACK OPENINGS

TYPE "1N"
TELECOMMUNICATIONS OUTLET



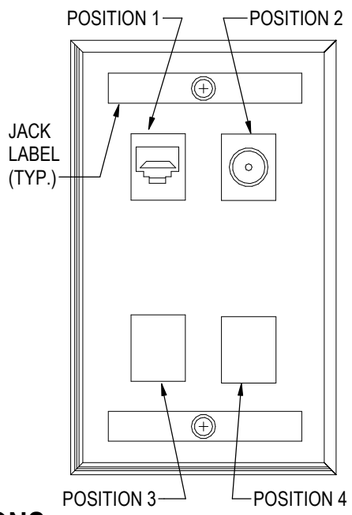
SINGLEGANG WHITE
FOUR PORT FLUSH FACEPLATE
WITH UNIVERSAL JACK OPENINGS

TYPE "1T-WT"
TELECOMMUNICATIONS OUTLET



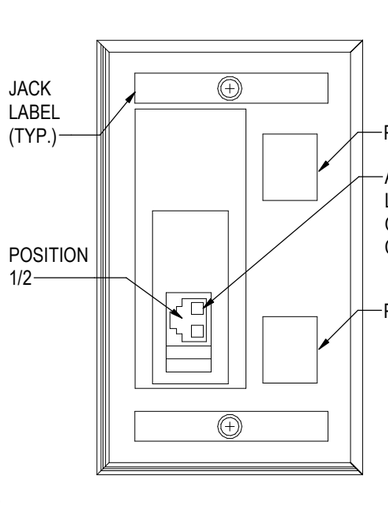
STAINLESS STEEL
TELEPHONE MOUNTING PLATE
WITH KNOBS AND FLUSH FITTING
JACK MODULE

TYPE "1N/1V"
TELECOMMUNICATIONS OUTLET



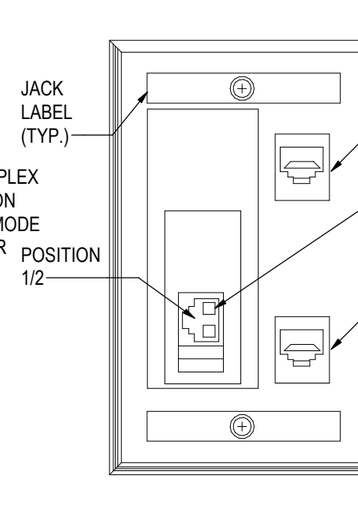
SINGLEGANG WHITE
FOUR PORT FLUSH FACEPLATE
WITH UNIVERSAL JACK OPENINGS

TYPE "2MM"
TELECOMMUNICATIONS OUTLET



SINGLEGANG WHITE
TWO PORT FLUSH FACEPLATE
WITH UNIVERSAL JACK OPENINGS

TYPE "2N/2MM"
TELECOMMUNICATIONS OUTLET



SINGLEGANG WHITE
TWO PORT FLUSH FACEPLATE
WITH UNIVERSAL JACK OPENINGS

WALL MOUNTED TELECOMMUNICATIONS OUTLET FACEPLATE ELEVATIONS

Not to Scale

<Pick location in Project Information>

6/6/2022 4:03:52 PM

Yale

Notes

Client/Project
YALE UNIVERSITY

ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

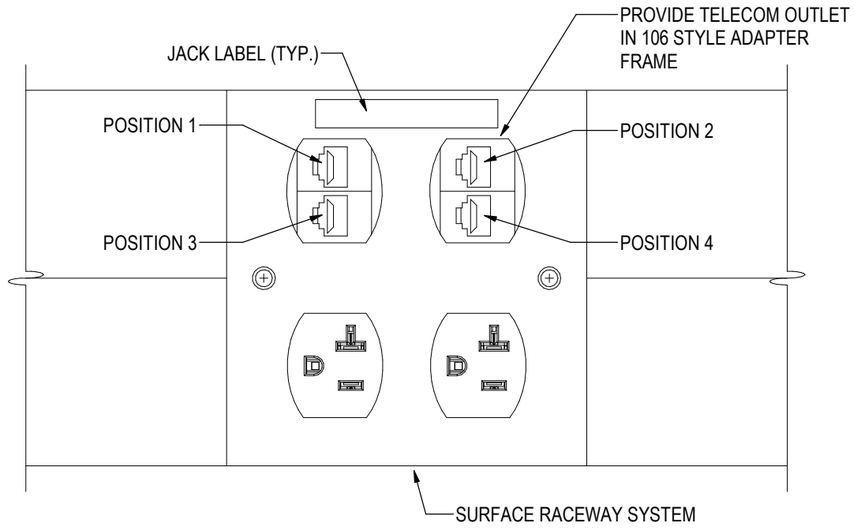
Revision No. 1.0

Date 07/31/2020

Title
WALL MOUNTED
TELECOM OUTLET
FACEPLACE ELEVATIONS

Detail Number
T016

TYPE "_N" SR MOUNTING CONDITION



SURFACE RACEWAY (SR MOUNTING CONDITIONS) TELECOM OUTLET DETAIL

Not to Scale

<Pick location in Project Information>

6/6/2022 4:03:53 PM

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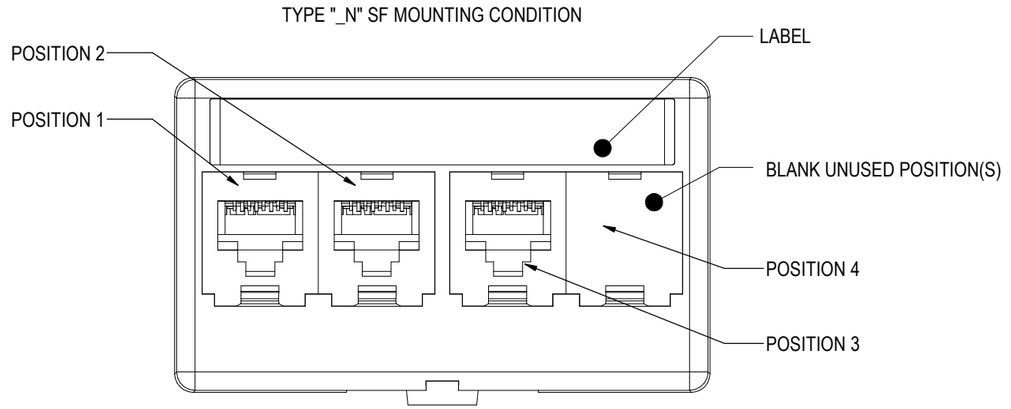
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0

Date 07/31/2020

Title
SURFACE RACEWAY TELECOM OUTLET

Detail Number
T017



SYSTEMS FURNITURE TELECOM OUTLET DETAIL (SF MOUNTING CONDITION)

Not to Scale

6/6/2022 4:03:53 PM <Pick location in Project Information>

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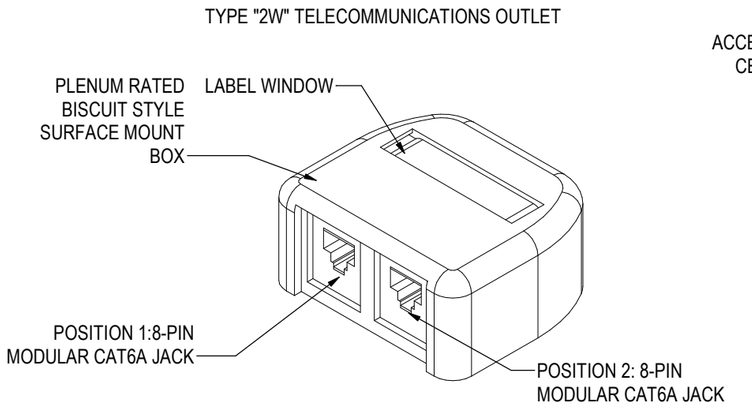
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0

Date 07/31/2020

Title
SYSTEMS FURNITURE TELECOM OUTLET DETAIL

Detail Number
T018

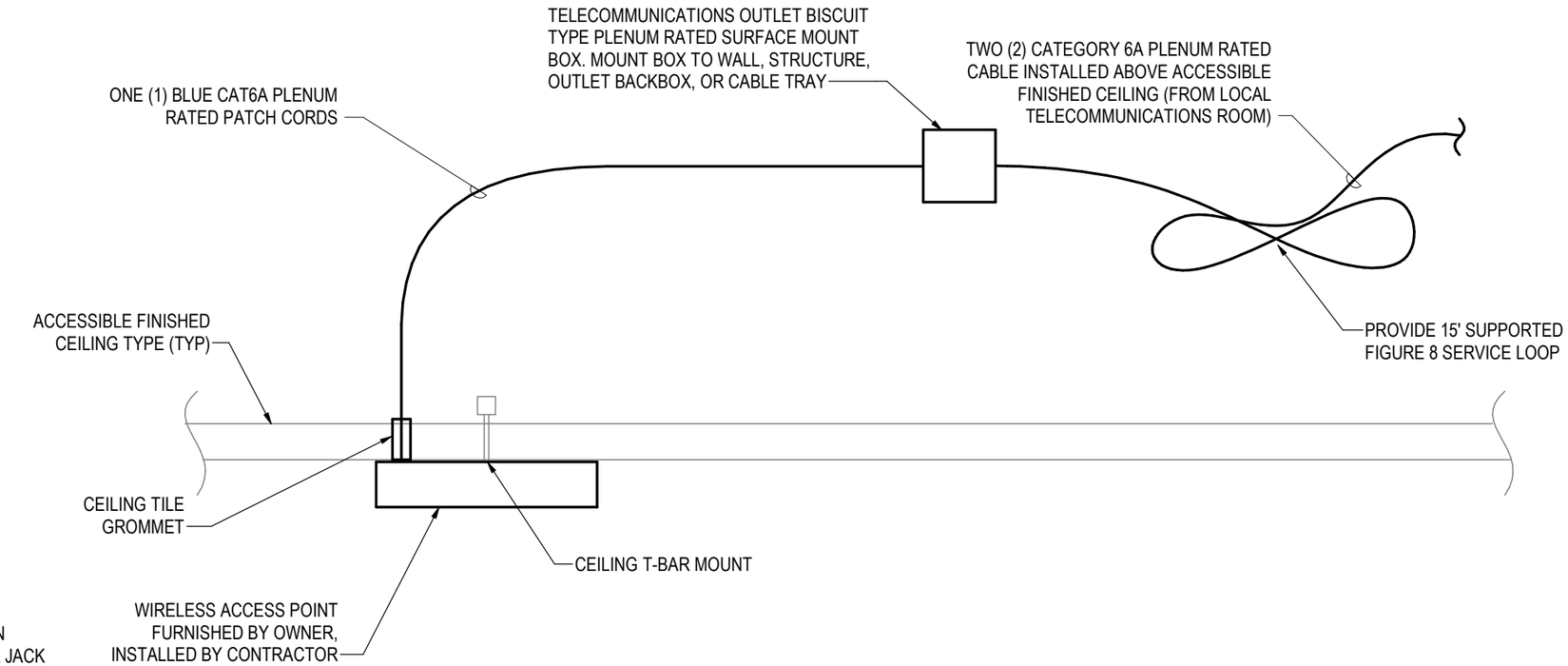


WIRELESS ACCESS POINT TELECOM OUTLET DETAIL

Not to Scale

NOTES:

1. PROVIDE TWO (2) 4-PAIR CATEGORY 6A UTP PLENUM-RATED CABLE TERMINATED ON AN 8-PIN MODULAR CATEGORY 6A JACK.
2. TERMINATE CABLE WITH TIA/EIA T568B PINNING.
3. TERMINATE CABLE ON DEDICATED WIRELESS ACCESS POINT CATEGORY 6A PATCH PANEL.
4. PROVIDE COMPUTER GENERATED LABELS WITH 1/4" HIGH BLACK TEXT. HANDWRITTEN LABELS ARE UNACCEPTABLE.
5. PROVIDE TEMPORARY, REMOVABLE LABEL ON CEILING TILE/GRID TO IDENTIFY OUTLET LOCATION WHEN LOCATED ABOVE FINISHED ACCESSIBLE CEILING.



WIRELESS ACCESS POINT ACCESSIBLE CEILING INSTALLATION DETAIL

Not to Scale

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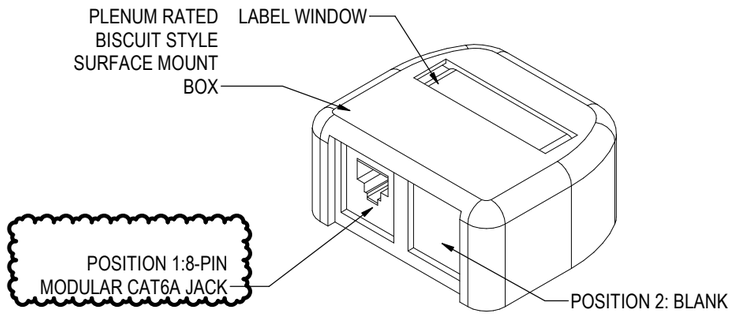
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0
Date 07/31/2020

Title
WIRELESS ACCESS POINT TELECOM OUTLET DETAIL

Detail Number
T019

TYPE "1SC" TELECOMMUNICATIONS OUTLET



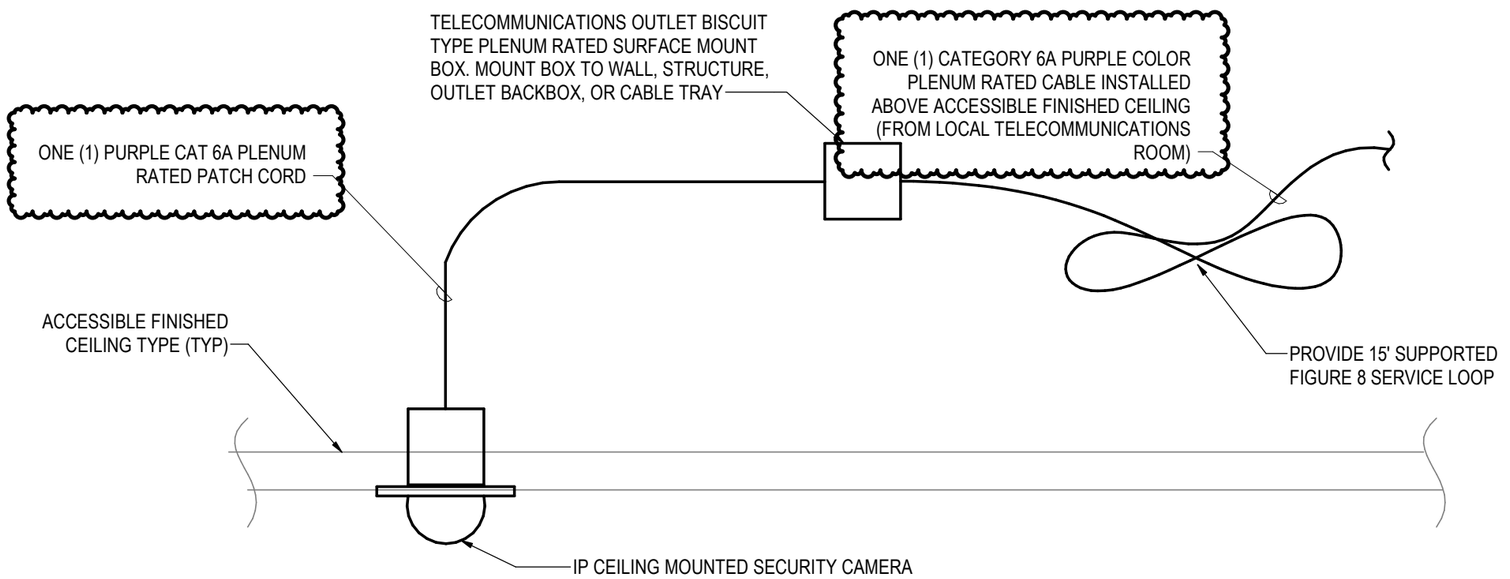
MOUNT ABOVE FINISHED CEILING

NOTES:

1. PROVIDE ONE (1) PURPLE COLOR 4-PAIR CATEGORY 6A UTP PLENUM-RATED CABLE TERMINATED ON AN 8-PIN MODULAR CATEGORY 6A JACK.
2. TERMINATE CABLE WITH TIA/EIA T568B PINNING.
3. PROVIDE COMPUTER GENERATED LABELS WITH 1/4" HIGH BLACK TEXT. HANDWRITTEN LABELS ARE UNACCEPTABLE.

SECURITY CAMERA TELECOM OUTLET DETAIL

Not to Scale



SECURITY CAMERA ACCESSIBLE CEILING INSTALLATION DETAIL

Not to Scale

<Pick location in Project Information>
6/6/2022 4:03:54 PM

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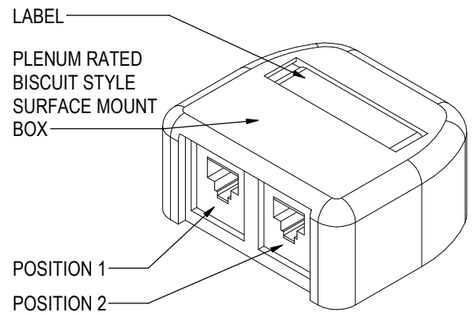
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.2 Date 06/30/2022

Title
IP SECURITY CAMERA TELECOM OUTLET DETAIL

Detail Number
T020

TYPE "1BS" AND "2BS" TELECOMMUNICATIONS OUTLET



BUILDING SYSTEMS TELECOM OUTLET DETAIL (EP EQUIPMENT PANEL MOUNTING CONDITION)

Not to Scale

<Pick location in Project Information>

6/6/2022 4:03:54 PM

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ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0

Date 07/31/2020

Title
EQUIPMENT PANEL
TELECOM OUTLET DETAIL

Detail Number
T021

TELECOMMUNICATIONS OUTLET TYPE AND SYMBOL		TYPE "6N" OUTLET 6N	TYPE "4N" OUTLET 4N	TYPE "3N" OUTLET 3N	TYPE "2N" OUTLET 2N	TYPE "1N" OUTLET 1N	TYPE "2W" OUTLET 2W	TYPE "1SC" OUTLET 1SC	TYPE "1N/1V" OUTLET 1N 1V
POSITION 1	CABLE TYPE	4 PAIR SOLID CONDUCTOR 23 AWG, 100 OHM UTP, CMP CATEGORY 6A	4 PAIR SOLID CONDUCTOR 23 AWG, 100 OHM UTP, CMP CATEGORY 6A	4 PAIR SOLID CONDUCTOR 24 AWG, 100 OHM UTP, CMP CATEGORY 6A	4 PAIR SOLID CONDUCTOR 23 AWG, 100 OHM UTP, CMP CATEGORY 6A	4 PAIR SOLID CONDUCTOR 23 AWG, 100 OHM UTP, CMP CATEGORY 6A	4 PAIR SOLID CONDUCTOR, 100 OHM UTP, CMP CATEGORY 6A	4 PAIR SOLID CONDUCTOR 23 AWG, 100 OHM UTP, CMP CATEGORY 6A	4 PAIR SOLID CONDUCTOR 23 AWG, 100 OHM UTP, CMP CATEGORY 6A
	TERMINATION	CATEGORY 6A RJ-45 8 POSITION, 8 WIRE T568B TERMINATION MODULE	CATEGORY 6A RJ-45 8 POSITION, 8 WIRE T568B TERMINATION MODULE	CATEGORY 6A RJ-45 8 POSITION, 8 WIRE T568B TERMINATION MODULE	CATEGORY 6A RJ-45 8 POSITION, 8 WIRE T568B TERMINATION MODULE	CATEGORY 6A RJ-45 8 POSITION, 8 WIRE T568B TERMINATION MODULE	CATEGORY 6A RJ-45 8 POSITION, 8 WIRE T568B TERMINATION MODULE	CATEGORY 6A RJ-45 8 POSITION, 8 WIRE T568B TERMINATION MODULE	CATEGORY 6A RJ-45 8 POSITION, 8 WIRE T568B TERMINATION MODULE
	EXTERIOR CABLE JACKET COLOR	BLUE	BLUE	BLUE	BLUE	BLUE	BLUE	PURPLE	BLUE
	JACK MODULE COLOR	WHITE	WHITE	WHITE	WHITE	WHITE	WHITE	WHITE	WHITE
POSITION 2	CABLE TYPE	4 PAIR SOLID CONDUCTOR 23 AWG, 100 OHM UTP, CMP CATEGORY 6A	4 PAIR SOLID CONDUCTOR 23 AWG, 100 OHM UTP, CMP CATEGORY 6A	4 PAIR SOLID CONDUCTOR 24 AWG, 100 OHM UTP, CMP CATEGORY 6A	4 PAIR SOLID CONDUCTOR 23 AWG, 100 OHM UTP, CMP CATEGORY 6A	NONE	4 PAIR SOLID CONDUCTOR, 100 OHM UTP, CMP CATEGORY 6A		18 AWG COPPER COVERED STEEL CENTER CONDUCTOR COAX CATVP RG-6
	TERMINATION	CATEGORY 6A RJ-45 8 POSITION, 8 WIRE T568B TERMINATION MODULE	CATEGORY 6A RJ-45 8 POSITION, 8 WIRE T568B TERMINATION MODULE	CATEGORY 6A RJ-45 8 POSITION, 8 WIRE T568B TERMINATION MODULE	CATEGORY 6A RJ-45 8 POSITION, 8 WIRE T568B TERMINATION MODULE	SPACE WITH BLANK MODULE	CATEGORY 6A RJ-45 8 POSITION, 8 WIRE T568B TERMINATION MODULE		F-TYPE COMPRESSION CABLE CONNECTOR WITH FEMALE SPLICE BARREL
	EXTERIOR CABLE JACKET COLOR	BLUE	BLUE	BLUE	BLUE	NA	BLUE		BLUE
	JACK MODULE COLOR	WHITE	WHITE	WHITE	WHITE	WHITE	WHITE		WHITE
POSITION 3	CABLE TYPE	4 PAIR SOLID CONDUCTOR 23 AWG, 100 OHM UTP, CMP CATEGORY 6A	4 PAIR SOLID CONDUCTOR 23 AWG, 100 OHM UTP, CMP CATEGORY 6A	4 PAIR SOLID CONDUCTOR 24 AWG, 100 OHM UTP, CMP CATEGORY 6A	NONE	NONE			NONE
	TERMINATION	CATEGORY 6A RJ-45 8 POSITION, 8 WIRE T568B TERMINATION MODULE	CATEGORY 6A RJ-45 8 POSITION, 8 WIRE T568B TERMINATION MODULE	CATEGORY 6A RJ-45 8 POSITION, 8 WIRE T568B TERMINATION MODULE	SPACE WITH BLANK MODULE	SPACE WITH BLANK MODULE			SPACE WITH BLANK MODULE
	EXTERIOR CABLE JACKET COLOR	BLUE	BLUE	BLUE	NA	NA			NA
	JACK MODULE COLOR	WHITE	WHITE	WHITE	WHITE	WHITE			WHITE
POSITION 4	CABLE TYPE	4 PAIR SOLID CONDUCTOR 23 AWG, 100 OHM UTP, CMP CATEGORY 6A	4 PAIR SOLID CONDUCTOR 23 AWG, 100 OHM UTP, CMP CATEGORY 6A	NONE	NONE	NONE			NONE
	TERMINATION	CATEGORY 6A RJ-45 8 POSITION, 8 WIRE T568B TERMINATION MODULE	CATEGORY 6A RJ-45 8 POSITION, 8 WIRE T568B TERMINATION MODULE	SPACE WITH BLANK MODULE	SPACE WITH BLANK MODULE	SPACE WITH BLANK MODULE			SPACE WITH BLANK MODULE
	EXTERIOR CABLE JACKET COLOR	BLUE	BLUE	NA	NA	NA			NA
	JACK MODULE COLOR	WHITE	WHITE	WHITE	WHITE	WHITE			WHITE
POSITION 5	CABLE TYPE	4 PAIR SOLID CONDUCTOR 23 AWG, 100 OHM UTP, CMP CATEGORY 6A							
	TERMINATION	CATEGORY 6A RJ-45 8 POSITION, 8 WIRE T568B TERMINATION MODULE							
	EXTERIOR CABLE JACKET COLOR	BLUE							
	JACK MODULE COLOR	WHITE							
POSITION 6	CABLE TYPE	4 PAIR SOLID CONDUCTOR 23 AWG, 100 OHM UTP, CMP CATEGORY 6A							
	TERMINATION	CATEGORY 6A RJ-45 8 POSITION, 8 WIRE T568B TERMINATION MODULE							
	EXTERIOR CABLE JACKET COLOR	BLUE							
	JACK MODULE COLOR	WHITE							

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ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.2

Date 06/30/2022

Title
TELECOMMUNICATIONS OUTLET SCHEDULE

Detail Number
T022

TELECOMMUNICATIONS OUTLET TYPE AND SYMBOL		TYPE "1N/1T" OUTLET (1N 1T)	TYPE "1BS" OUTLET (1BS)	TYPE "2BS" OUTLET (2BS)	TYPE "1T" OUTLET (1T)	TYPE "1TC" OUTLET (1TC)	TYPE "2MM" OUTLET (2MM)	TYPE "2N/2MM" OUTLET (2N/2MM)
POSITION 1	CABLE TYPE	4 PAIR SOLID CONDUCTOR 23 AWG, 100 OHM UTP, CMP CATEGORY 6A	4 PAIR SOLID CONDUCTOR 23 AWG, 100 OHM UTP, CMP CATEGORY 6A	4 PAIR SOLID CONDUCTOR 23 AWG, 100 OHM UTP, CMP CATEGORY 6A	4 PAIR SOLID CONDUCTOR 23 AWG, 100 OHM UTP, CMP CATEGORY 6A	4 PAIR SOLID CONDUCTOR 23 AWG, 100 OHM UTP, CMP CATEGORY 6A	TWO STRAND 50 MICRON LASER OPTIMIZED OM4 MULTIMODE FTTD	TWO STRAND 50 MICRON LASER OPTIMIZED OM4 MULTIMODE FTTD
	TERMINATION	CATEGORY 6A RJ-45 8 POSITION, 8 WIRE T568B TERMINATION MODULE	CATEGORY 6A RJ-45 8 POSITION, 8 WIRE T568B TERMINATION MODULE	CATEGORY 6A RJ-45 8 POSITION, 8 WIRE T568B TERMINATION MODULE	CATEGORY 6A RJ-45 8 POSITION, 8 WIRE T568B TERMINATION MODULE	CATEGORY 6A RJ-45 8 POSITION, 8 WIRE T568B TERMINATION MODULE	SPLICE ON DUPLEX LC 50 MICRON MM CONNECTOR	SPLICE ON DUPLEX LC 50 MICRON MM CONNECTOR
	EXTERIOR CABLE JACKET COLOR	BLUE	BLUE	BLUE	BLUE	BLUE	AQUA	AQUA
	JACK MODULE COLOR	WHITE	WHITE	WHITE	WHITE	WHITE	AQUA	AQUA
POSITION 2	CABLE TYPE	4 PAIR SOLID CONDUCTOR 23 AWG, 100 OHM UTP, CMP CATEGORY 6A	NONE	4 PAIR SOLID CONDUCTOR 23 AWG, 100 OHM UTP, CMP CATEGORY 6A			NA	NA
	TERMINATION	CATEGORY 6A RJ-45 8 POSITION, 8 WIRE T568B TERMINATION MODULE	SPACE WITH BLANK MODULE	CATEGORY 6A RJ-45 8 POSITION, 8 WIRE T568B TERMINATION MODULE			NA	NA
	EXTERIOR CABLE JACKET COLOR	BLUE	NA	BLUE			NA	NA
	JACK MODULE COLOR	WHITE	NA	WHITE			NA	NA
POSITION 3	CABLE TYPE	NONE	NONE	NONE			NONE	4 PAIR SOLID CONDUCTOR 23 AWG, 100 OHM UTP, CMP CATEGORY 6A
	TERMINATION	SPACE WITH BLANK MODULE	SPACE WITH BLANK MODULE	SPACE WITH BLANK MODULE			SPACE WITH BLANK MODULE	CATEGORY 6A RJ-45 8 POSITION, 8 WIRE T568B TERMINATION MODULE
	EXTERIOR CABLE JACKET COLOR	NA	NA	NA			NA	BLUE
	JACK MODULE COLOR	WHITE	WHITE	WHITE			WHITE	WHITE
POSITION 4	CABLE TYPE	NONE	NONE	NONE			NONE	4 PAIR SOLID CONDUCTOR 23 AWG, 100 OHM UTP, CMP CATEGORY 6A
	TERMINATION	SPACE WITH BLANK MODULE	SPACE WITH BLANK MODULE	SPACE WITH BLANK MODULE			SPACE WITH BLANK MODULE	CATEGORY 6A RJ-45 8 POSITION, 8 WIRE T568B TERMINATION MODULE
	EXTERIOR CABLE JACKET COLOR	NA	NA	NA			NA	BLUE
	JACK MODULE COLOR	WHITE	WHITE	WHITE			WHITE	WHITE
POSITION 5	CABLE TYPE							
	TERMINATION							
	EXTERIOR CABLE JACKET COLOR							
	JACK MODULE COLOR							
POSITION 6	CABLE TYPE							
	TERMINATION							
	EXTERIOR CABLE JACKET COLOR							
	JACK MODULE COLOR							

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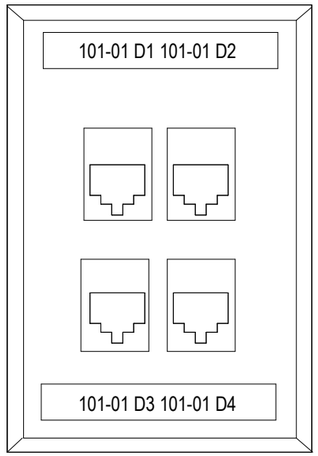
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.2

Date 06/30/2022

Title
TELECOMMUNICATIONS OUTLET SCHEDULE

Detail Number
T023



EXAMPLE LABEL FOR FIRST OUTLET IN ROOM 101

XXX - YY DZ

XXX - ROOM NUMBER
YY - OUTLET NUMBER IN SEQUENTIAL ORDER AT DOOR
AND MOVING TO THE LEFT
D - MEDIA DESIGNATION
D - DATA
F - OPTICAL FIBER
RS - ROOM SCHEDULING PANEL OUTLET
Z - SEQUENTIAL NUMBER OF JACK IN FACEPLATE

FACEPLATE LABELING DETAIL

Not to Scale

<Pick location in Project Information>

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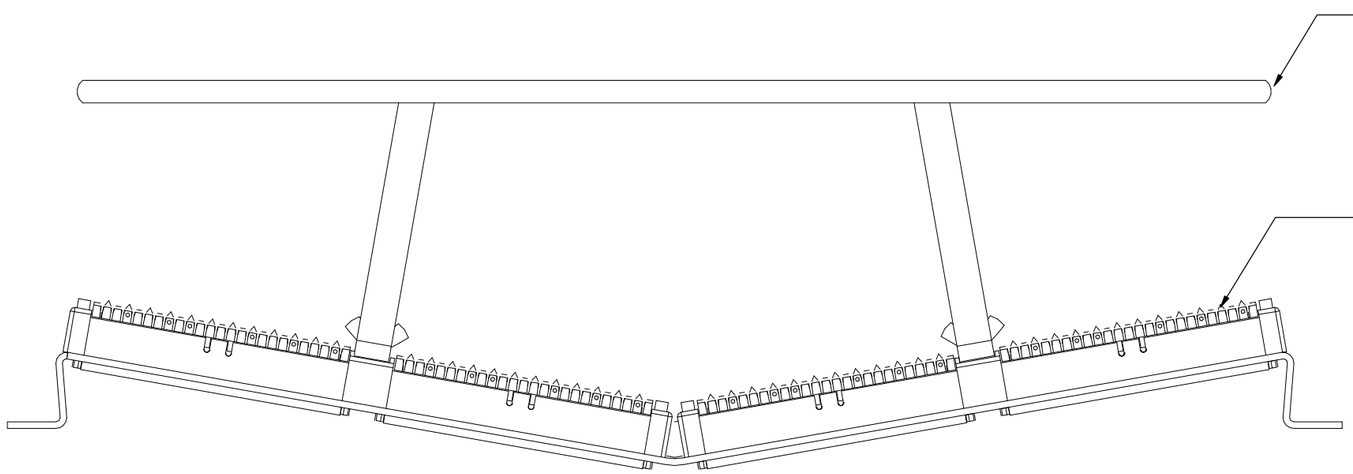
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0
Date 07/31/2020

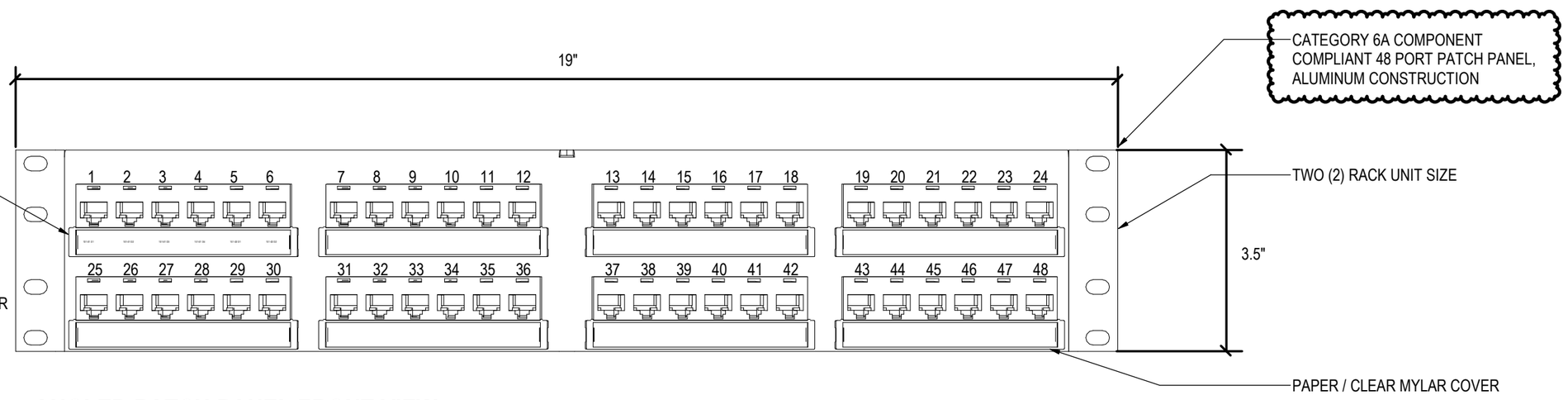
Title
FACEPLATE LABELING DETAIL

Detail Number
T024



ANGLED PATCH PANEL TOP VIEW

Not to Scale



EXAMPLE LABEL FOR FIRST AND SECOND OUTLET IN ROOM 101

XXX - YY DZ

XXX - ROOM NUMBER
YY - OUTLET NUMBER IN SEQUENTIAL ORDER AT DOOR AND MOVING TO THE LEFT
D - MEDIA DESIGNATION
- D - DATA
- F - OPTICAL FIBER
- RS - ROOM SCHEDULING PANEL OUTLET

Z - SEQUENTIAL NUMBER OF JACK IN FACEPLATE

ANGLED PATCH PANEL FRONT VIEW

Not to Scale

<Pick location in Project Information>
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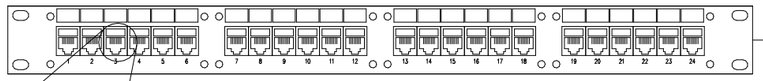
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.2
Date 06/30/2022

Title
PATCH PANEL LABELING DETAIL

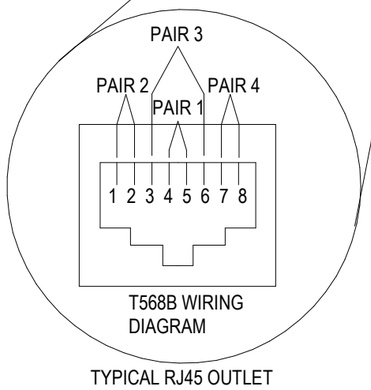
Detail Number
T025

RACK MOUNTED VOICE CATEGORY 5e PATCH PANEL



TO MDT ROOM XXX RACK MOUNTED MAIN CROSS CONNECT AND VOICE GATEWAY

PROVIDE
25 PAIR
CATEGORY 3 MULTIPAIR
COPPER INTRABUILDING RISER



T568B WIRING DIAGRAM

TYPICAL RJ45 OUTLET

TERMINATE ONE (1) PAIR OF CATEGORY 3 MULTIPAIR COPPER TRUNK TIE TO EACH RJ-45 PATCH PANEL PORT TO PAIR 1, PINS 4,5.

VOICE BACKBONE PATCH PANEL DETAIL

Not to Scale

<Pick location in Project Information>

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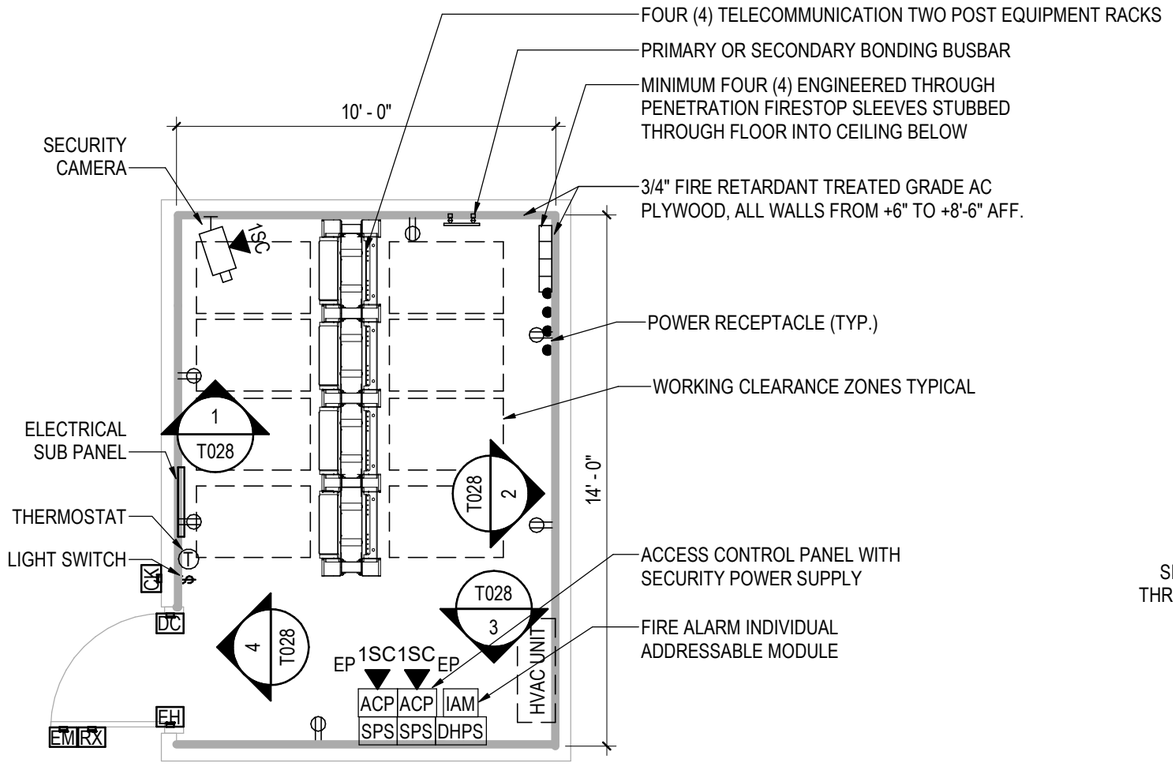
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0

Date 07/31/2020

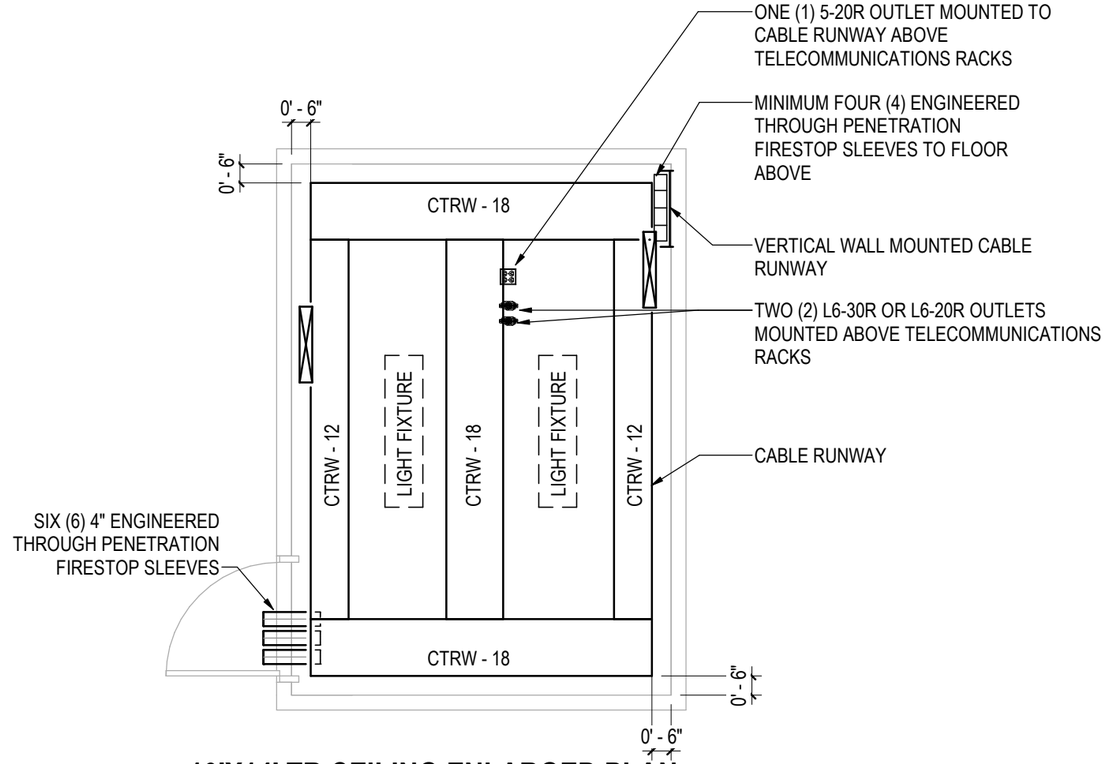
Title
VOICE PATCH PANEL CROSSCONNECT DETAIL

Detail Number
T026



10'X14' TR ENLARGED PLAN

1/4" = 1'-0"



10'X14' TR CEILING ENLARGED PLAN

1/4" = 1'-0"

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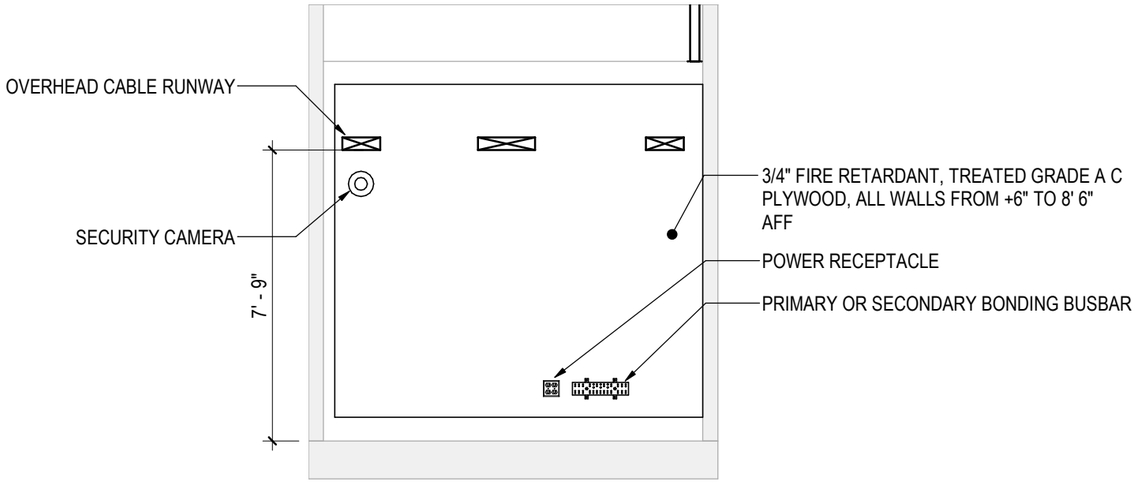
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0
Date 07/31/2020

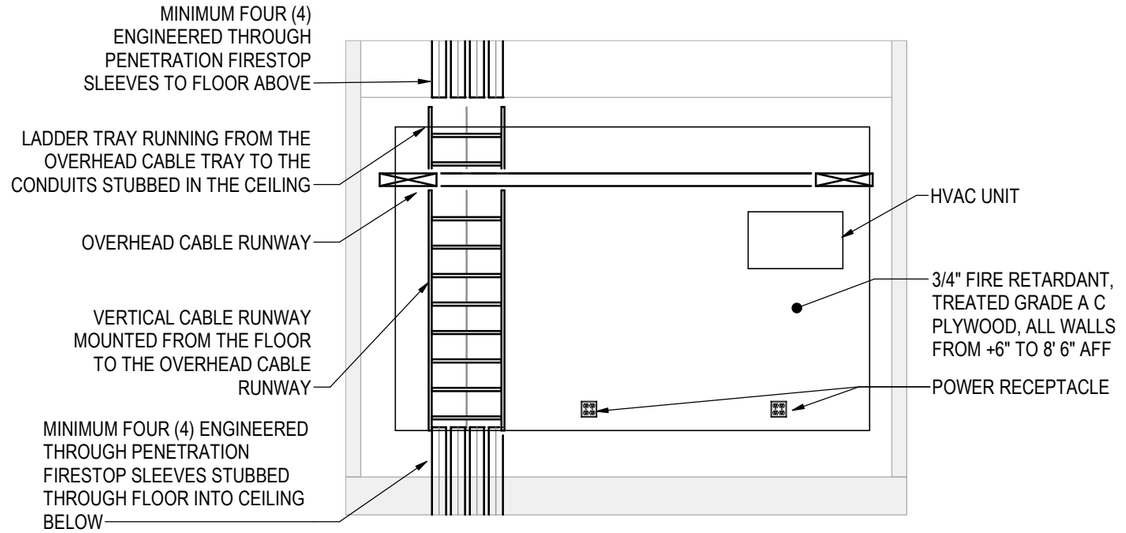
Title
10'X14' TR ENLARGED PLAN

Detail Number
T027



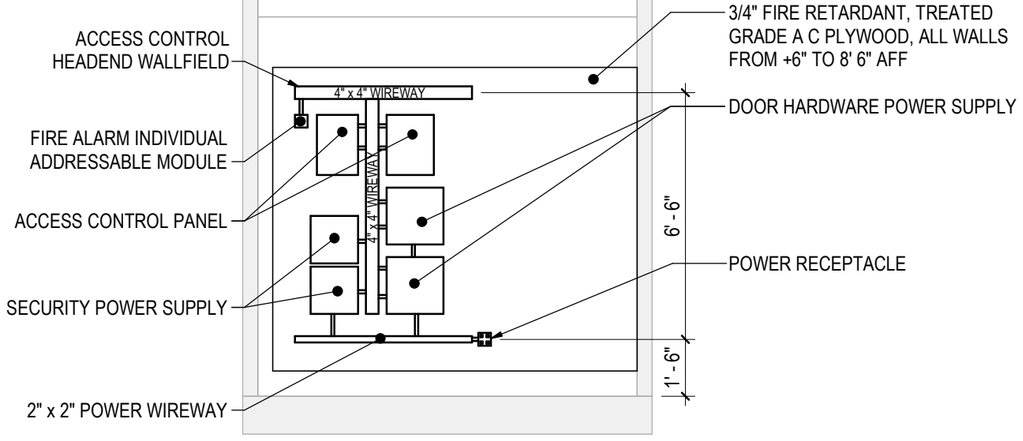
1 T028 10'X14' TR NORTH WALL ELEVATION

1/4" = 1'-0"



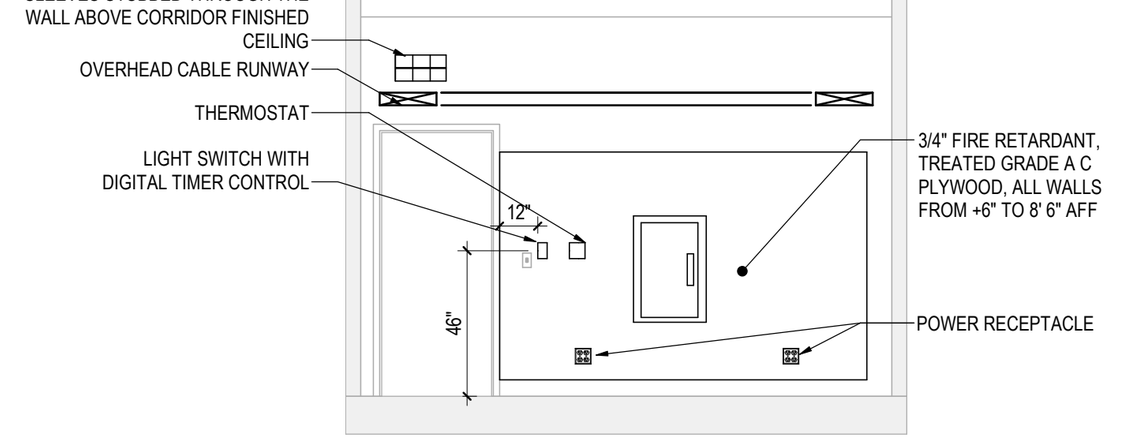
2 T028 10'X14' EAST WALL ELEVATION

1/4" = 1'-0"



3 T028 10'X14' TR SOUTH WALL ELEVATION

1/4" = 1'-0"



4 T028 10'X14' TR WEST WALL ELEVATION

1/4" = 1'-0"

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Notes

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ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0

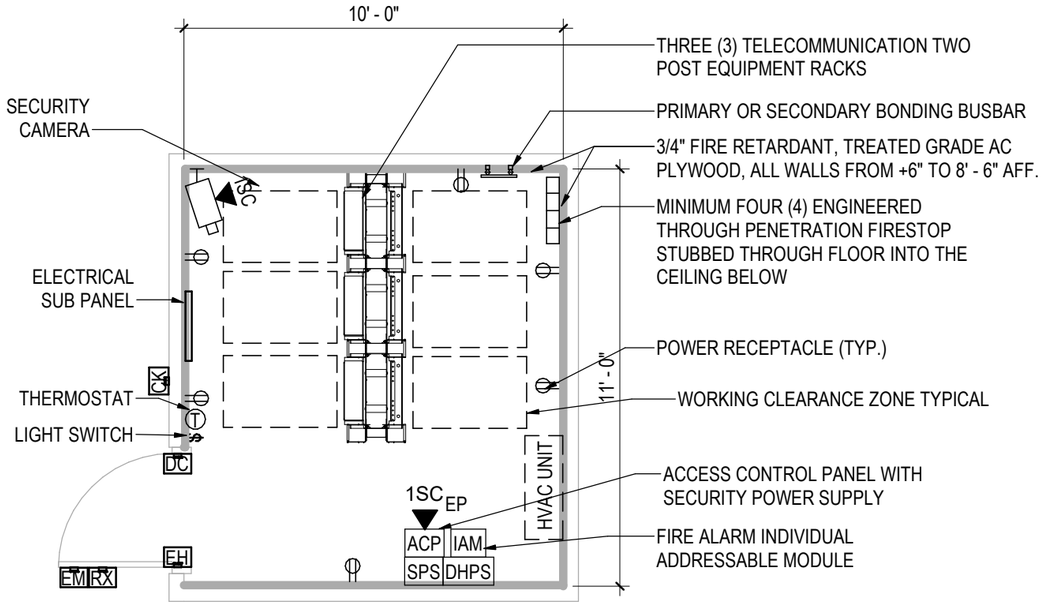
Date 07/31/2020

Title
10'X14' TR WALL ELEVATIONS

Detail Number
T028

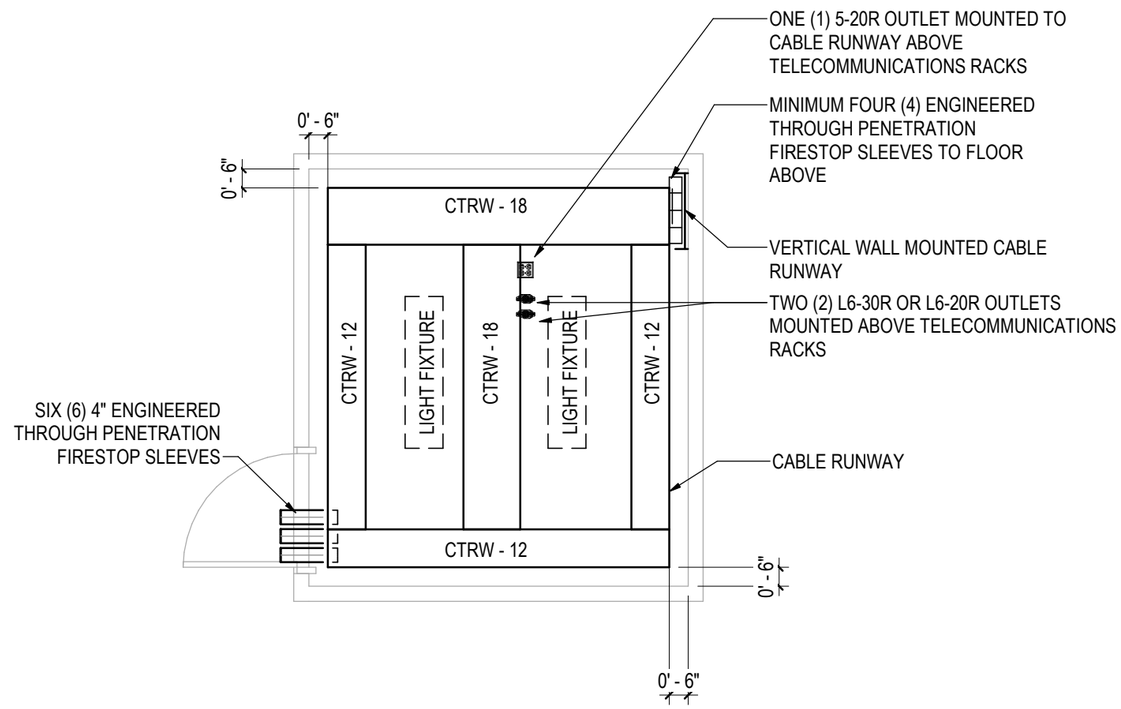
<Pick location in Project Information>

6/6/2022 4:03:58 PM



10'X11' TR ENLARGED PLAN

1/4" = 1'-0"



10'X11' TR CEILING ENLARGED PLAN

1/4" = 1'-0"

<Pick location in Project Information>
6/6/2022 4:03:59 PM

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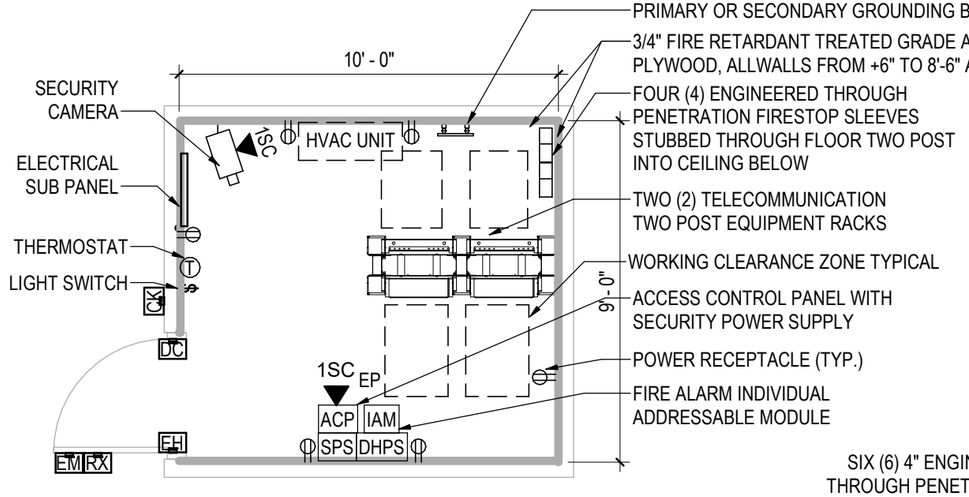
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No.	Date
1.0	07/31/2020

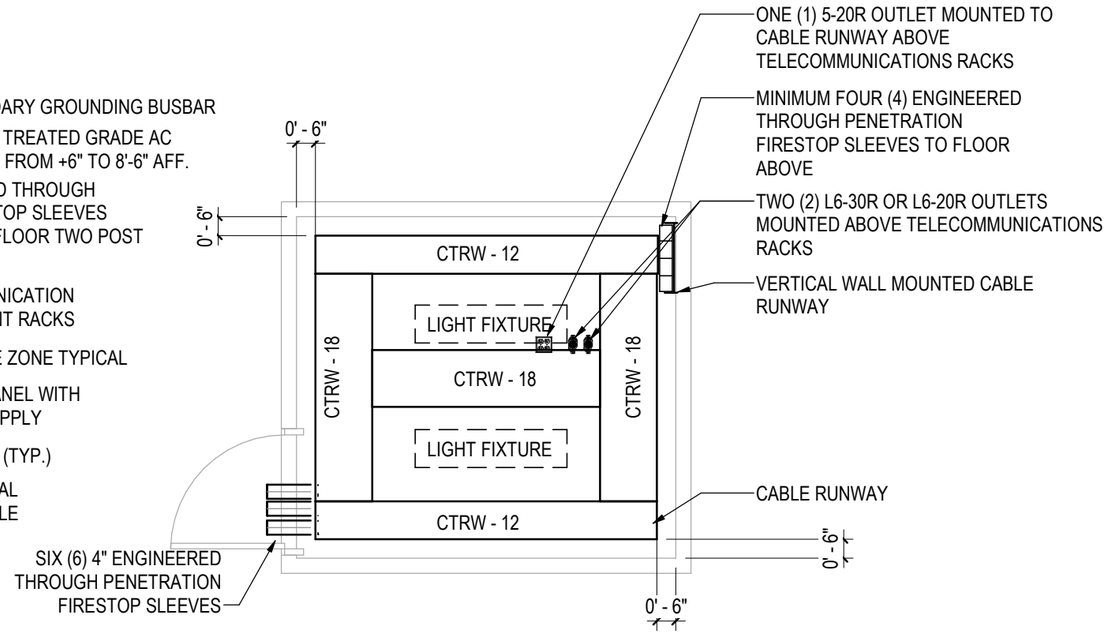
Title
10'X11' TR ENLARGED PLAN

Detail Number
T029



10'X9' TR ENLARGED PLAN

1/4" = 1'-0"



10'X9' TR CEILING ENLARGED PLAN

1/4" = 1'-0"

<Pick location in Project Information>
6/6/2022 4:04:00 PM

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Notes

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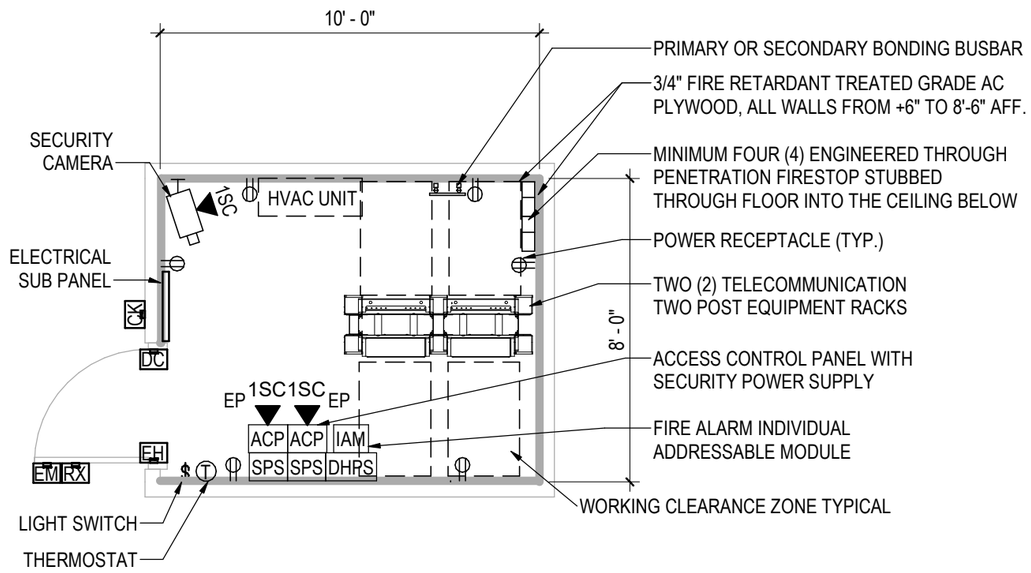
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0

Date 07/31/2020

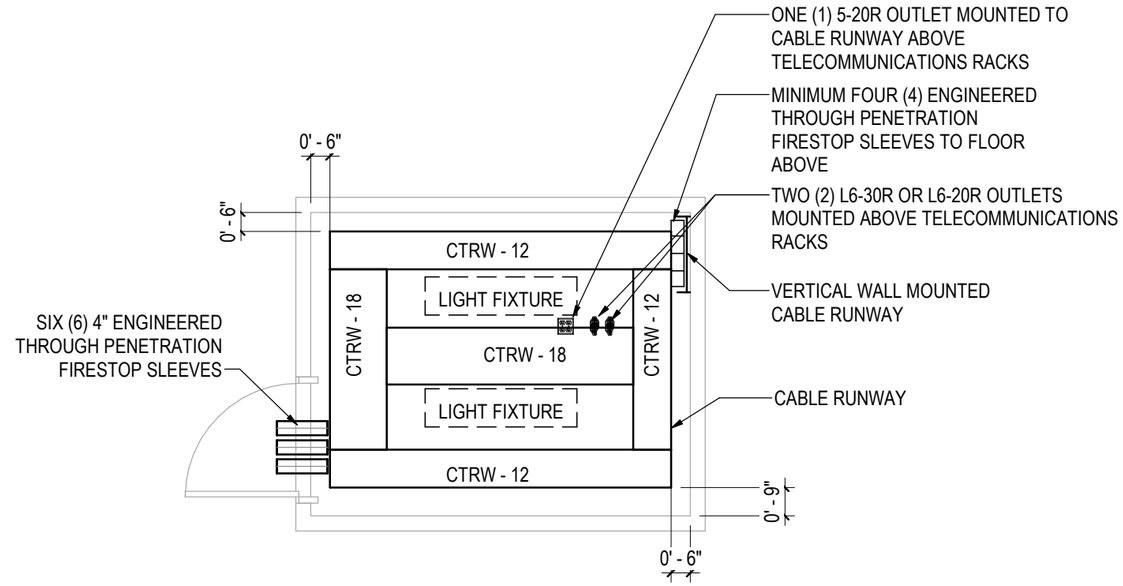
Title
10'X9' TR ENLARGED PLAN

Detail Number
T030



10'X8' TR ENLARGED PLAN

1/4" = 1'-0"



10'X8' TR CEILING ENLARGED PLAN

1/4" = 1'-0"

<Pick location in Project Information>

6/6/2022 4:04:01 PM

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Notes

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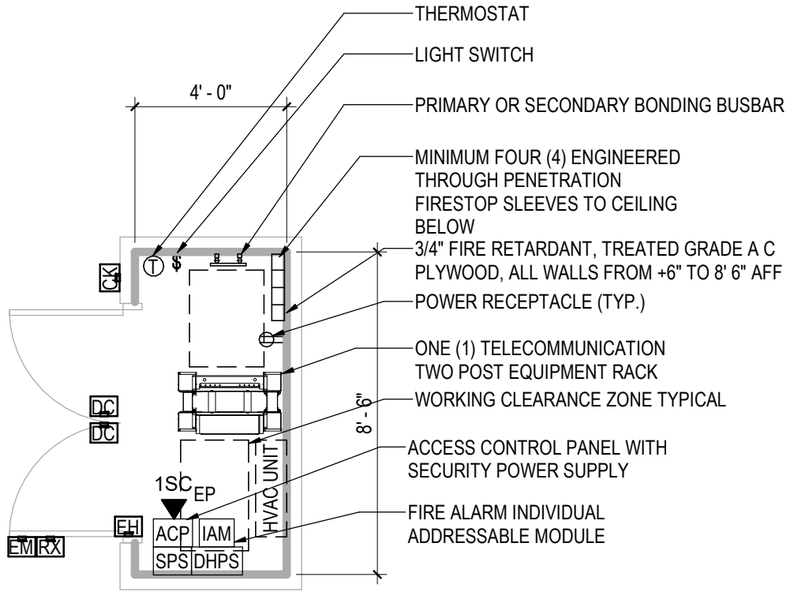
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0

Date 07/31/2020

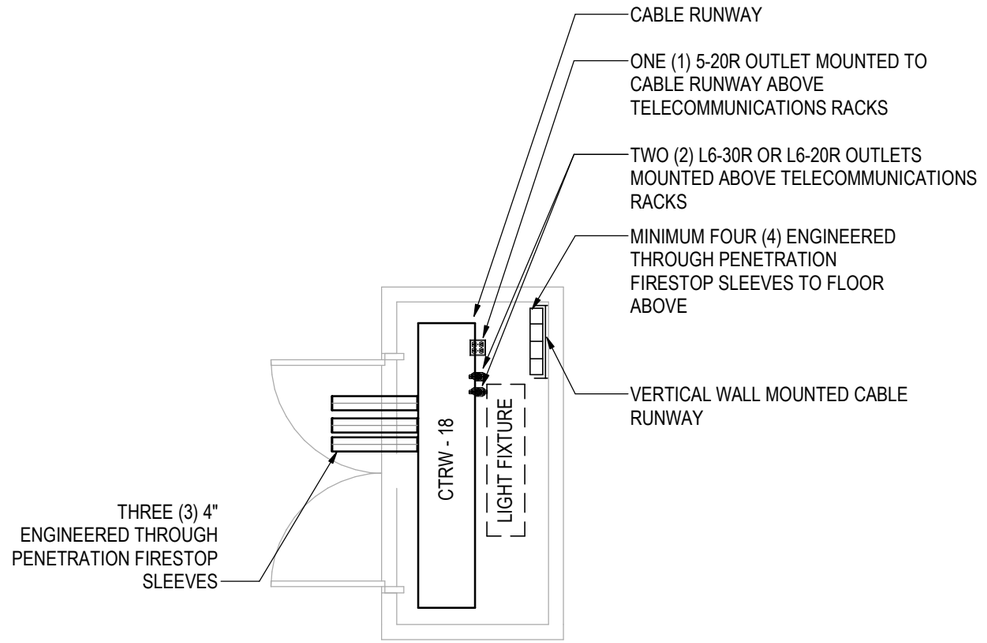
Title
10'X8' TR ENLARGED PLAN

Detail Number
T031



4'X8'-6" STR ENLARGED PLAN

1/4" = 1'-0"



4'X8'-6" STR CEILING ENLARGED PLAN

1/4" = 1'-0"

<Pick location in Project Information>
6/6/2022 4:04:02 PM

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Notes

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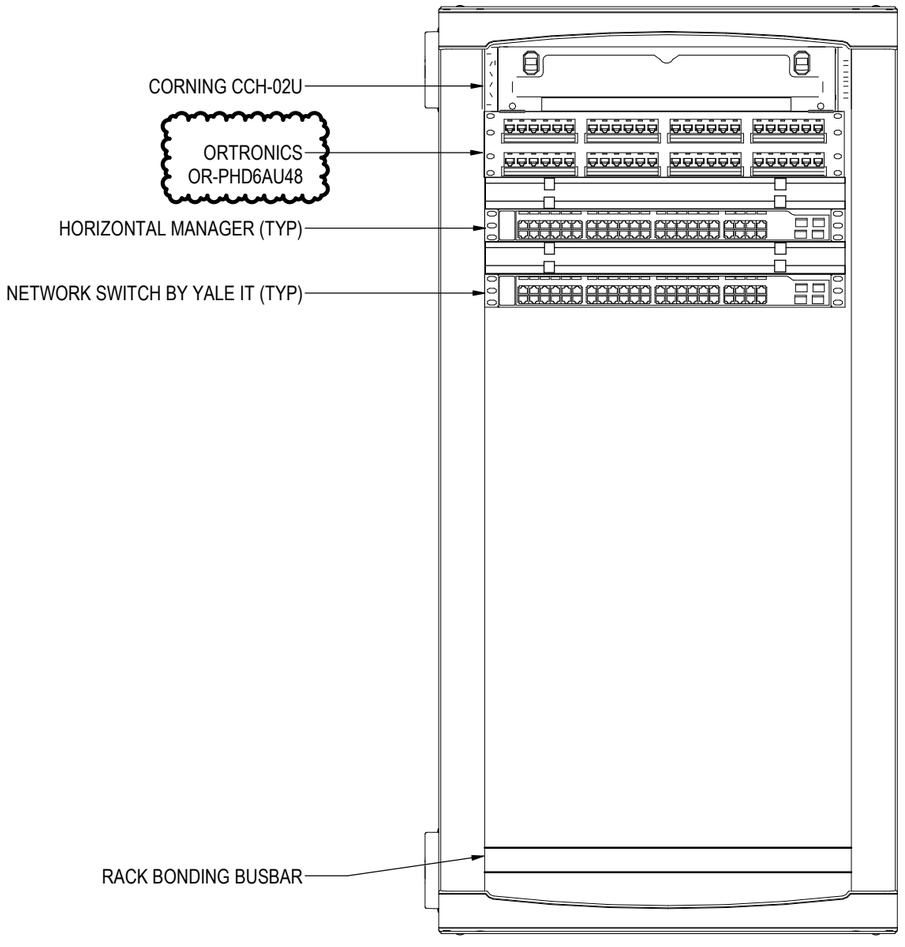
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0
Date 07/31/2020

Title
4'X8'-6" STR ENLARGED PLAN

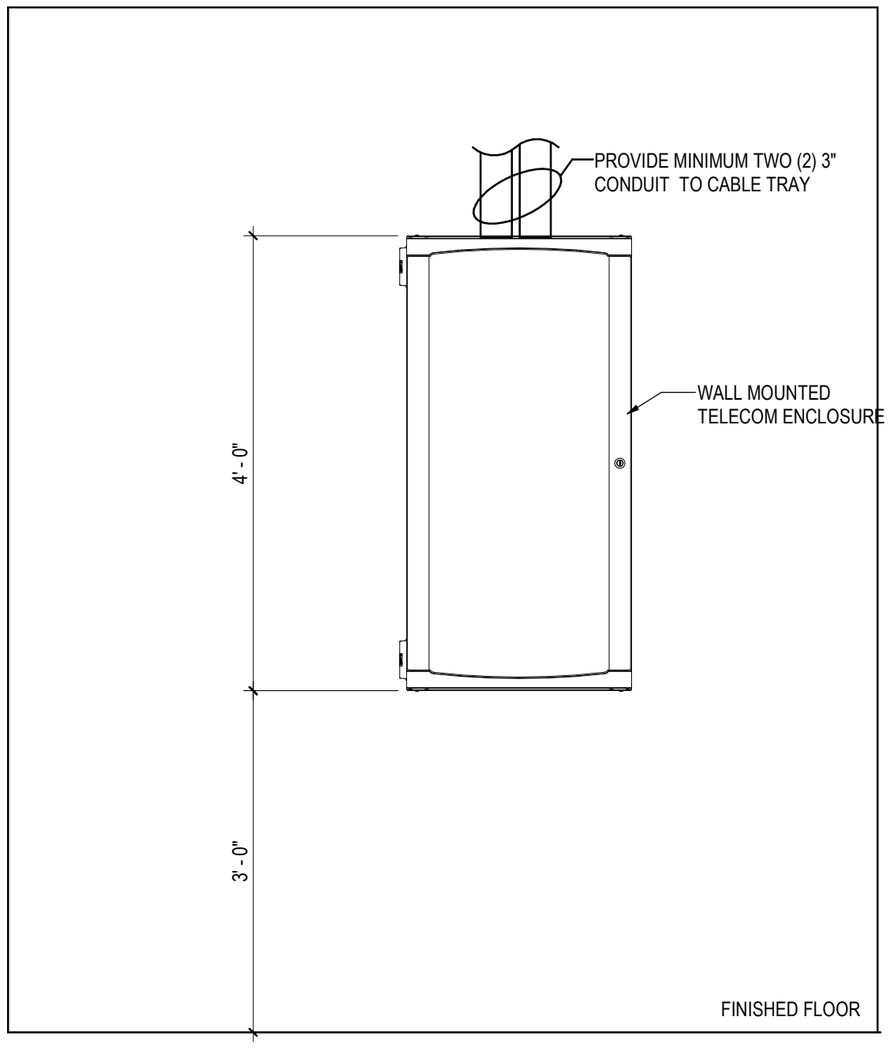
Detail Number
T032

CHATSWORTH PRODUCTS - SET 1 M1521-232



TELECOMMUNICATIONS ENCLOSURE RACK ELEVATION

Not to Scale



TELECOMMUNICATIONS ENCLOSURE WALL ELEVATION

Not to Scale

<Pick location in Project Information>

6/6/2022 4:04:02 PM

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Notes

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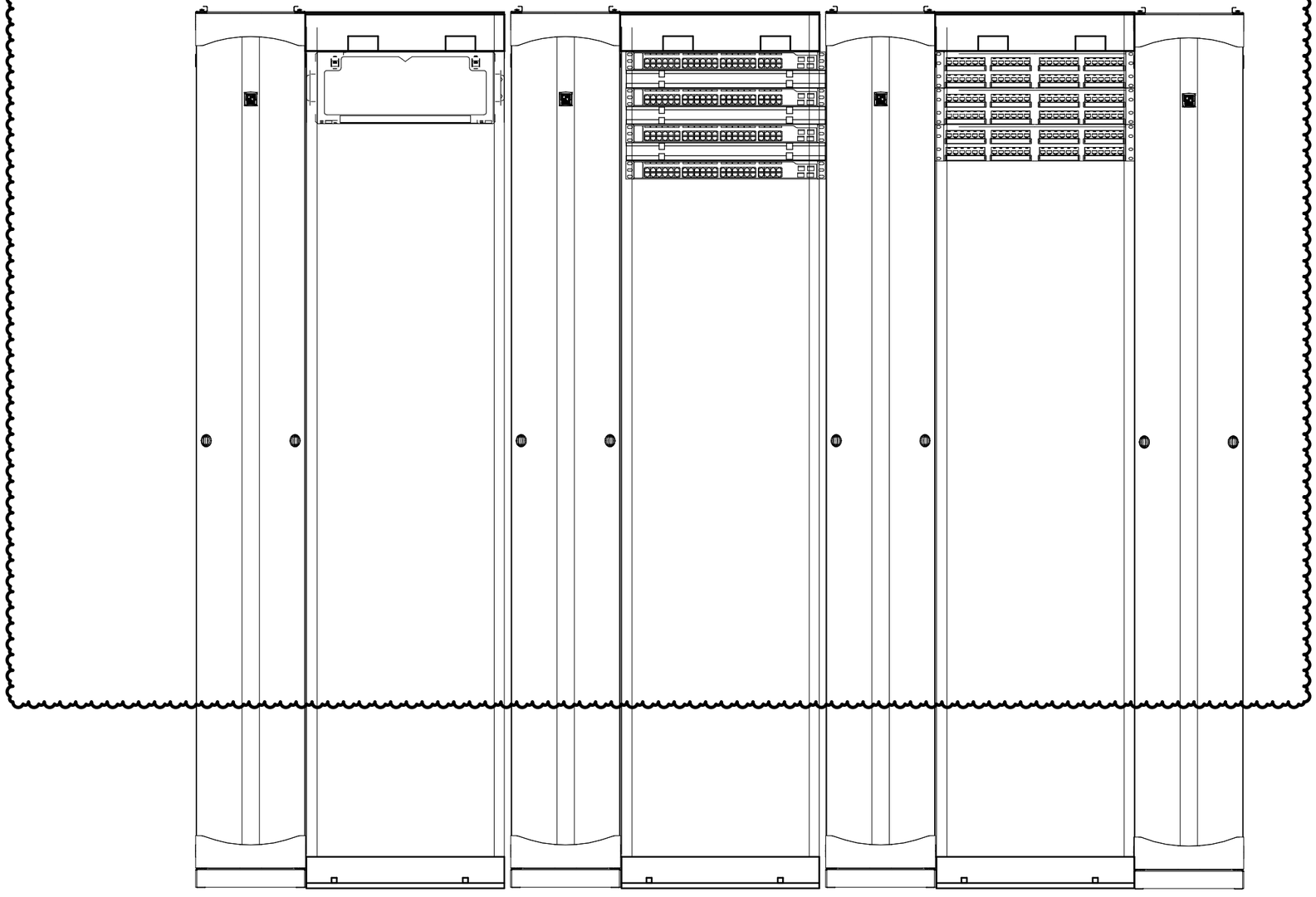
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.2

Date 06/30/2022

Title
TELECOM WALL ENCLOSURE CABINET DETAIL

Detail Number
T033



MDT TELECOM RACK ELEVATION

Not to Scale

<Pick location in Project Information>

6/6/2022 4:04:03 PM

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Notes

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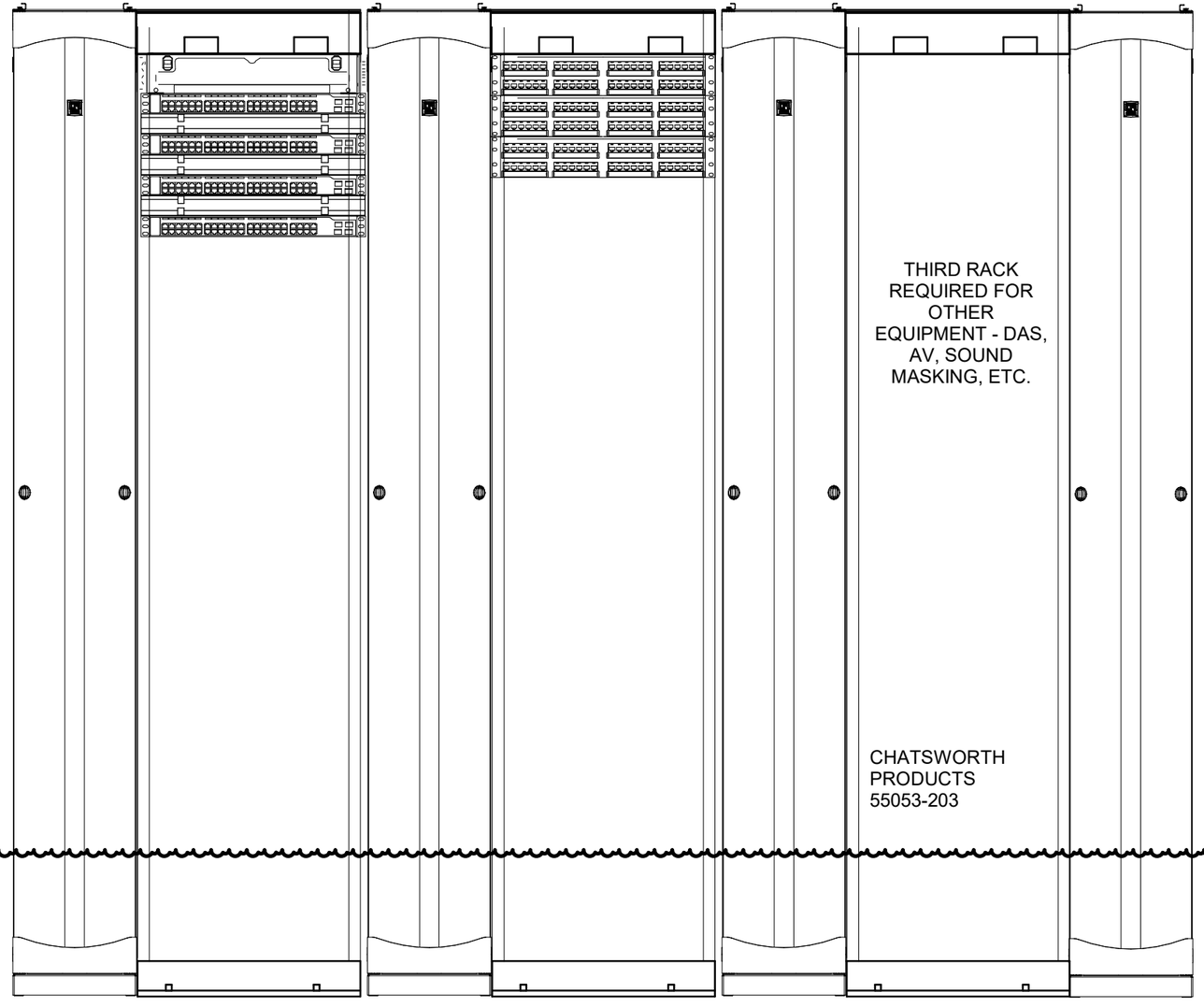
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No.	Date
1.2	06/30/2022

Title
MDT ROOM TELECOM RACK LINE ELEVATION

Detail Number
T034



IDT TELECOM RACK ELEVATION

Not to Scale

<Pick location in Project Information>

6/6/2022 4:04:04 PM

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Notes

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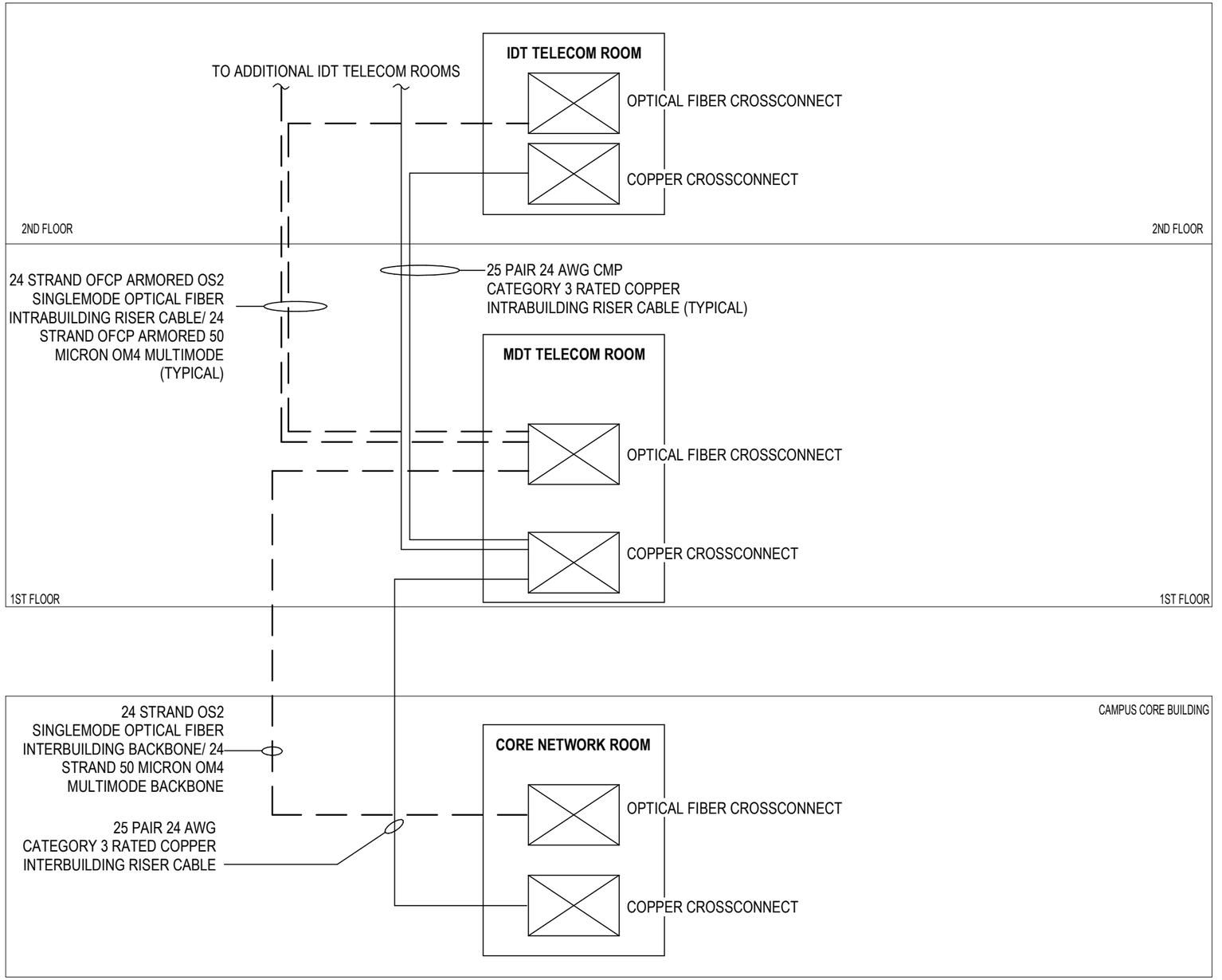
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No.	Date
1.2	06/30/2022

Title
IDT ROOM TELECOM
RACK LINE ELEVATION

Detail Number
T035



TELECOMMUNICATIONS RISER DIAGRAM

Not to Scale

<Pick location in Project Information>

6/6/2022 4:04:04 PM

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Notes

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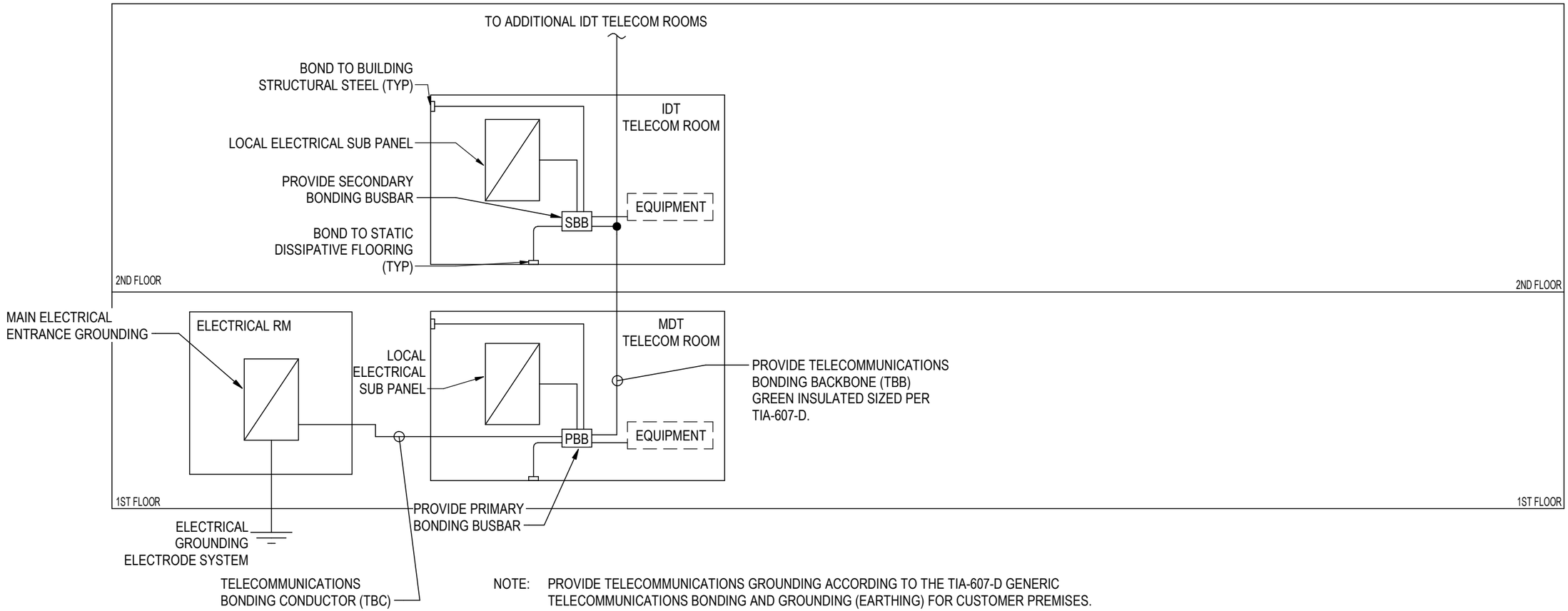
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0

Date 07/31/2020

Title
TELECOMMUNICATIONS RISER DIAGRAM

Detail Number
T036



NOTE: PROVIDE TELECOMMUNICATIONS GROUNDING ACCORDING TO THE TIA-607-D GENERIC TELECOMMUNICATIONS BONDING AND GROUNDING (EARTHING) FOR CUSTOMER PREMISES.

TELECOMMUNICATIONS GROUNDING RISER DIAGRAM

Not to Scale

<Pick location in Project Information>
6/6/2022 4:04:05 PM

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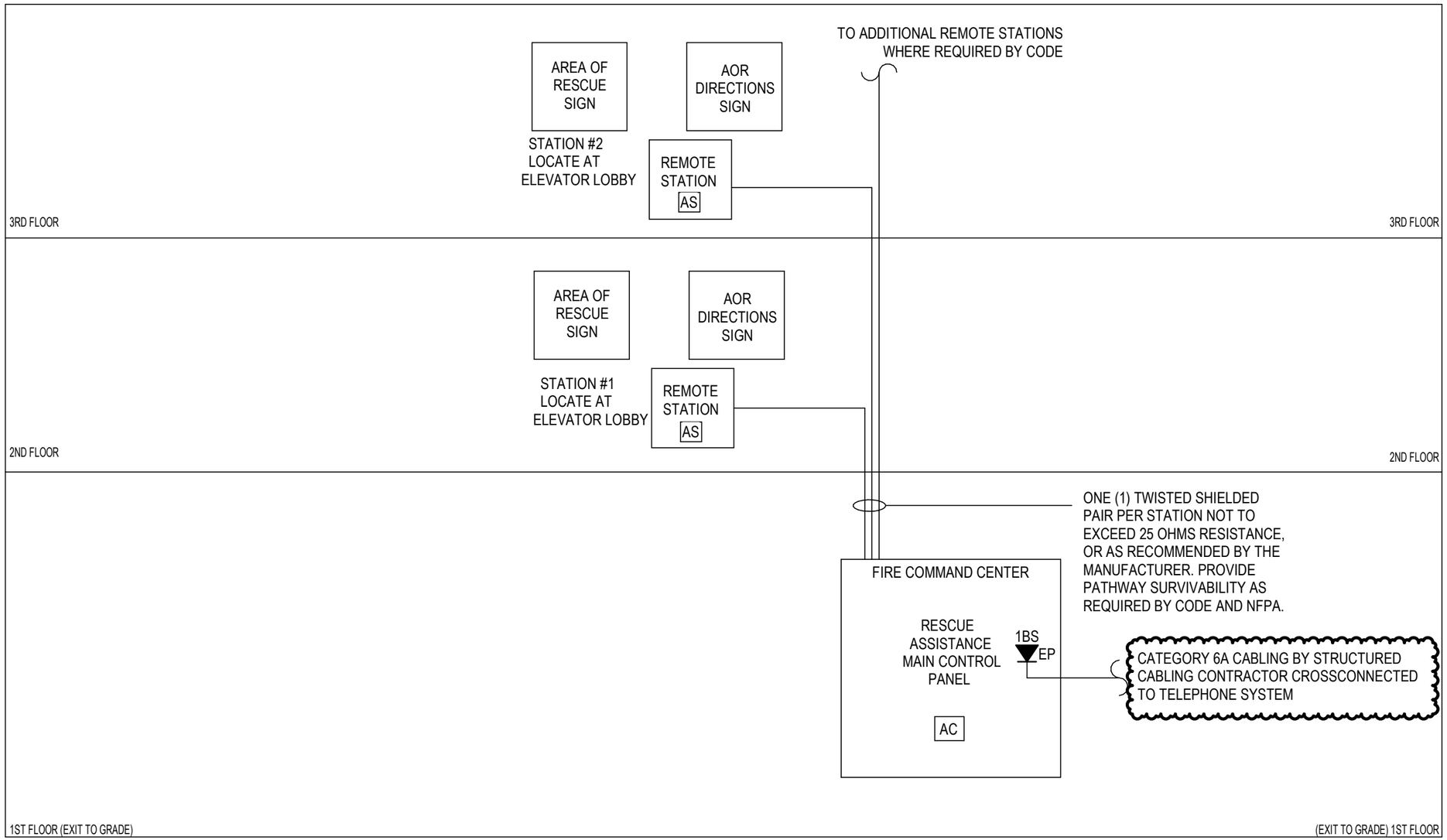
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0

Date 07/31/2020

Title
TELECOMMUNICATIONS GROUNDING RISER DIAGRAM

Detail Number
T037



AREA OF RESCUE (AOR) COMMUNICATIONS RISER DIAGRAM

Not to Scale

<Pick location in Project Information>

6/6/2022 4:04:05 PM

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Notes

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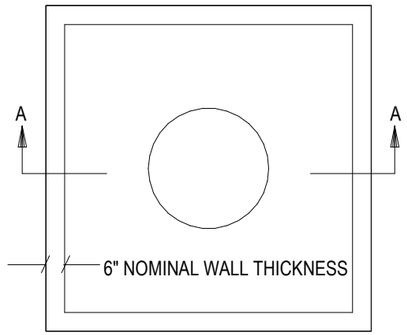
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.2

Date 06/30/2022

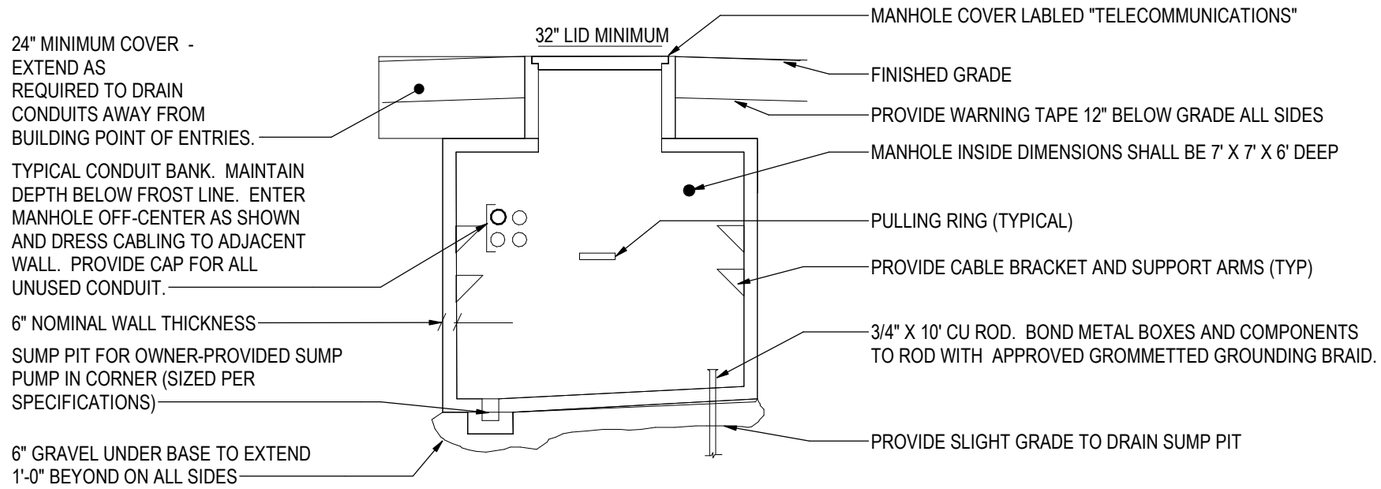
Title
AREA OF RESCUE COMMUNICATIONS RISER DIAGRAM

Detail Number
T038



TYPICAL TELECOMMUNICATIONS MAINTENANCE HOLE

Not to Scale



NOTE:
1. PROVIDE EIGHT (8) UNUSED CONDUIT KNOCKOUTS FOR FUTURE USE ON ALL SIDES OF MANHOLES.
2. DO NOT ROUTE CABLES SIDE TO SIDE IN MANHOLES. DRESS CABLES AROUND THE PERIMETER ON BRACKETS, LEAVE CENTER AREA OF MANHOLES FREE OF ALL WIRE AND CABLING.

TYPICAL TELECOMMUNICATIONS MAINTENANCE HOLE - SECTION A-A

Not to Scale

<Pick location in Project Information>
6/6/2022 4:04:05 PM

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Notes

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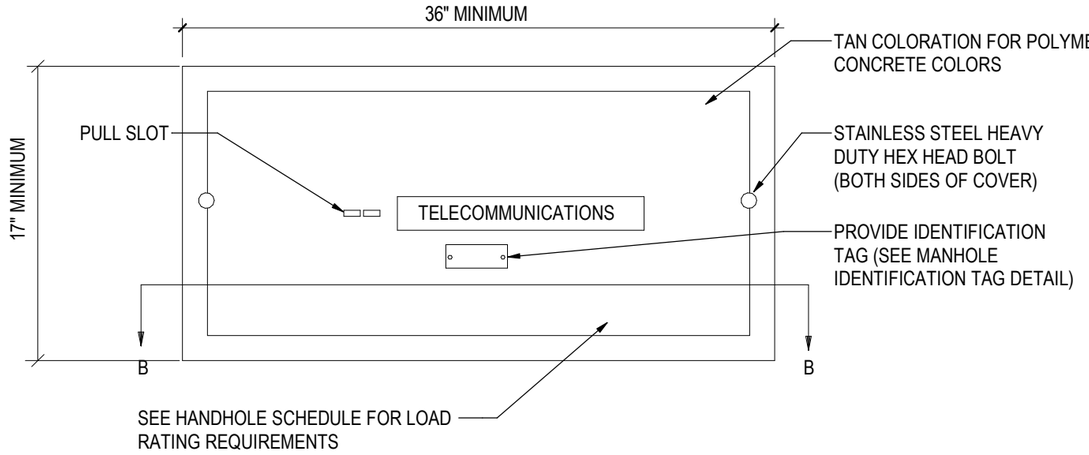
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0
Date 07/31/2020

Title
TELECOM MAINTENANCE DETAILS

Detail Number
T039



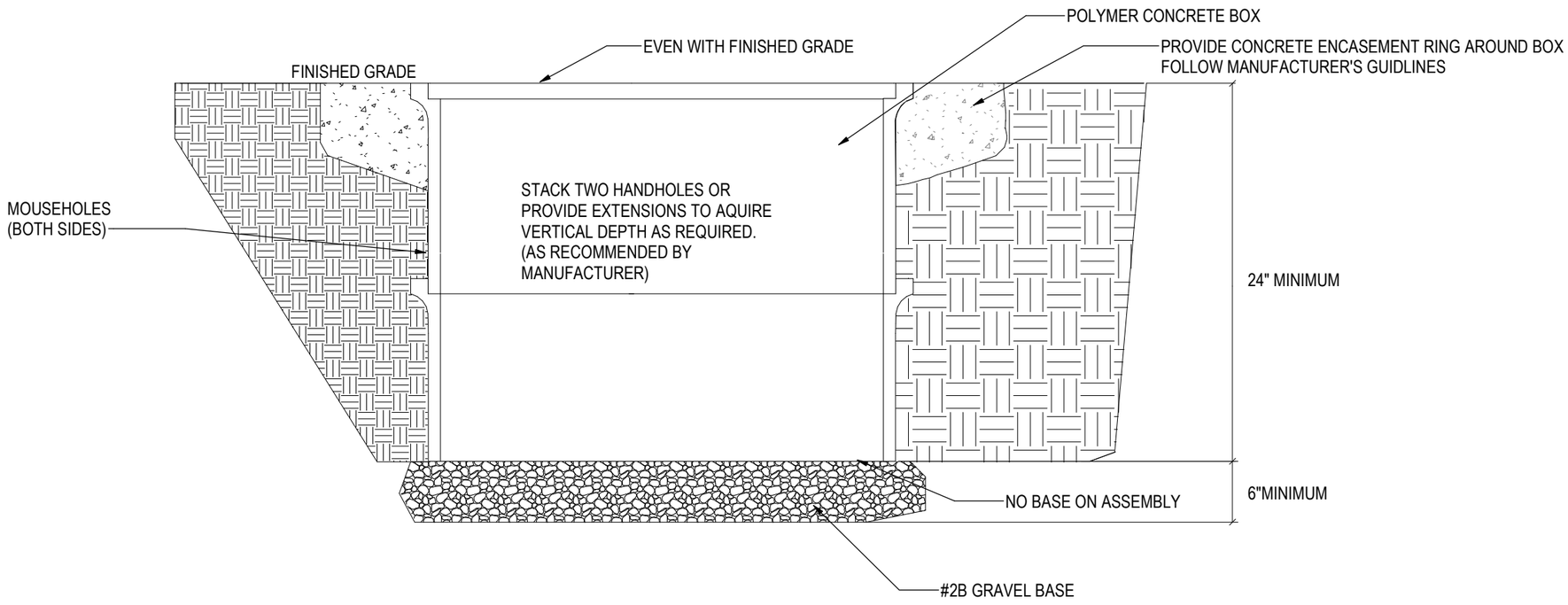
TYPICAL TELECOMMUNICATIONS HANDHOLE PLAN VIEW

Not to Scale

TELECOMMUNICATIONS HANDHOLE SCHEDULE		
HANDHOLE (HH) TYPE	LOAD RATING	APPLICATION
TYPE I	TIER 15	FOR PARKING LOTS AND OFF ROADWAYS WITH OCCASIONALLY NON-DELIBERATE HEAVY VEHICLES
TYPE II	TIER H-20	ROADWAYS AND AREAS SUBJECT TO DELIBERATE VEHICULAR TRAFFIC

TELECOMMUNICATIONS HANDHOLE SCHEDULE

Not to Scale



TYPICAL TELECOMMUNICATIONS HANDHOLE - SECTION B-B

Not to Scale

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ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0

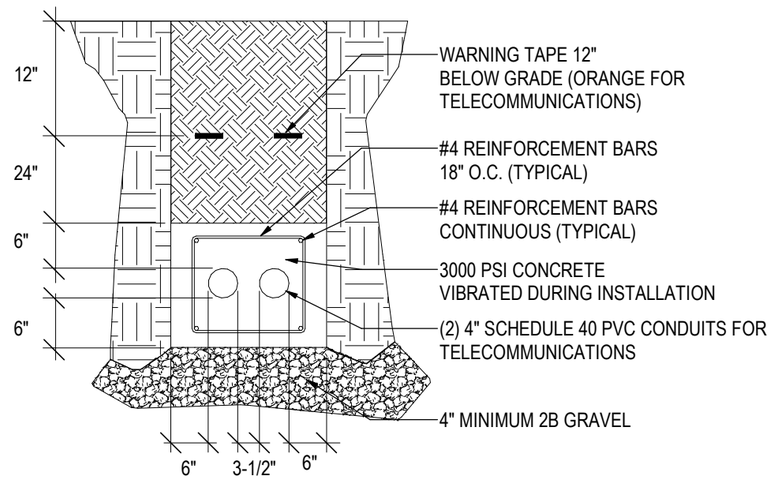
Date 07/31/2020

Title
TELECOM HANDHOLE DETAILS

Detail Number
T040

<Pick location in Project Information>

6/6/2022 4:04:06 PM



TELECOM DUCTBANK DETAILS (TWO CONDUITS)

Not to Scale

6/6/2022 4:04:06 PM <Pick location in Project Information>

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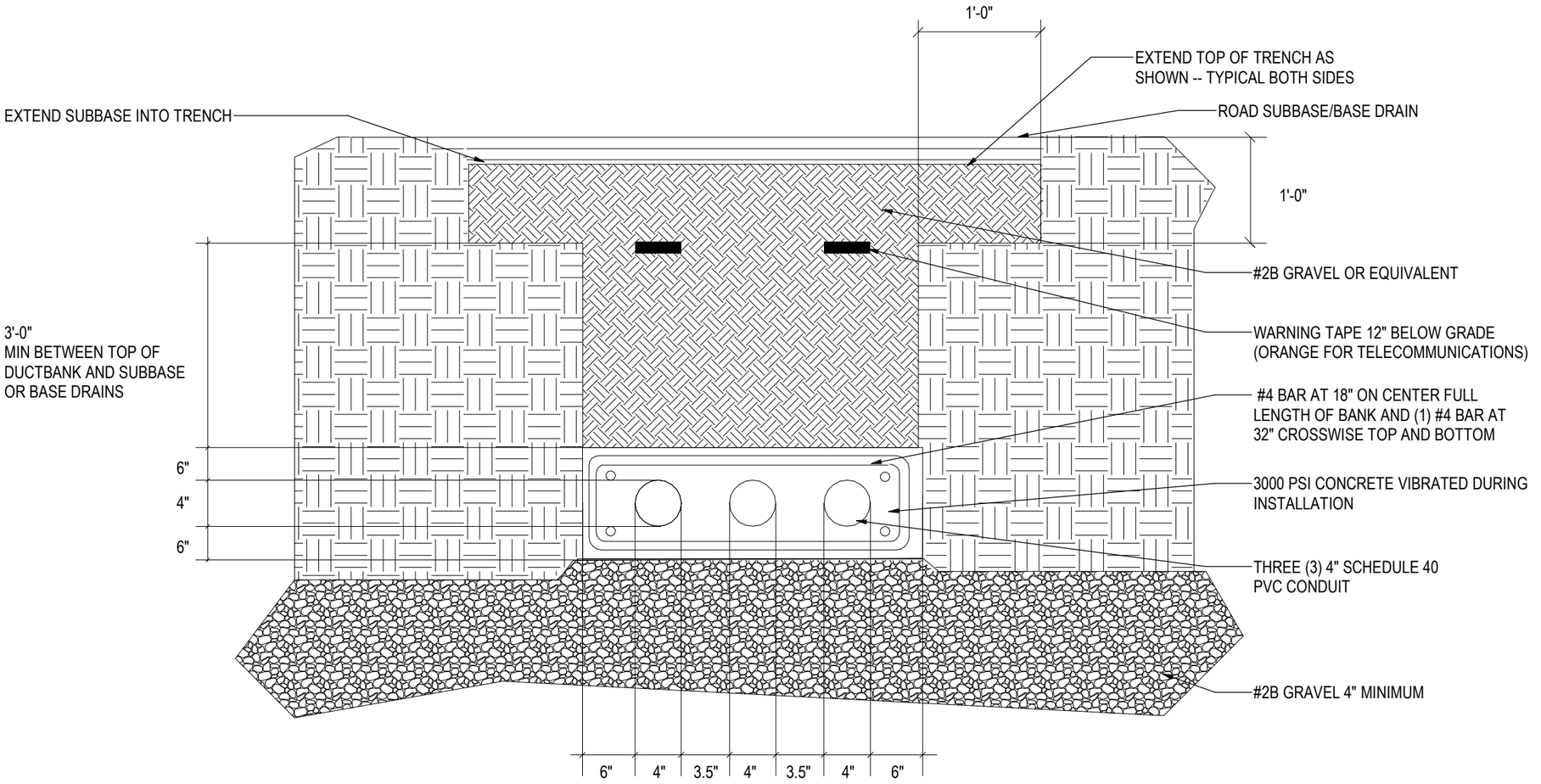
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0

Date 07/31/2020

Title
TELECOM DUCTBANK DETAIL - TWO (2) 4" CONDUITS

Detail Number
T041



TELECOM DUCTBANK DETAILS (THREE CONDUITS)

Not to Scale

<Pick location in Project Information>

6/6/2022 4:04:07 PM

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Notes

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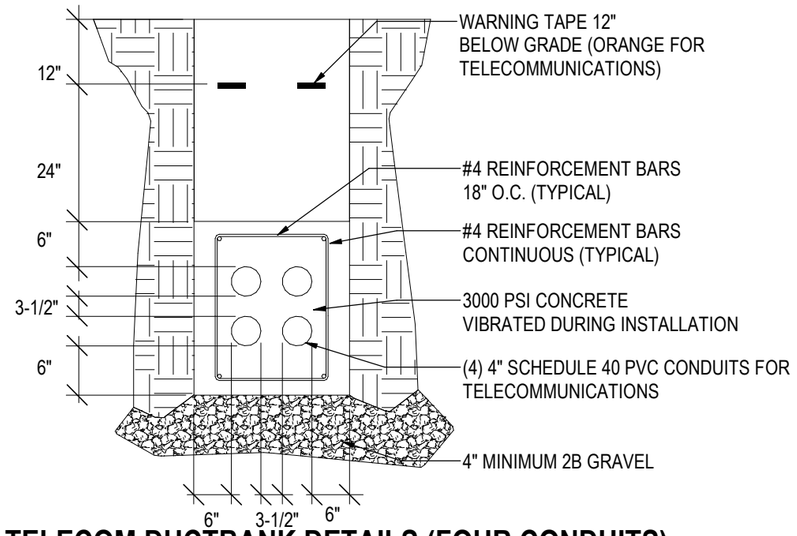
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0

Date 07/31/2020

Title
TELECOM DUCTBANK DETAIL - THREE (3) 4" CONDUITS

Detail Number
T042



TELECOM DUCTBANK DETAILS (FOUR CONDUITS)

Not to Scale

<Pick location in Project Information>

6/6/2022 4:04:07 PM

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Notes

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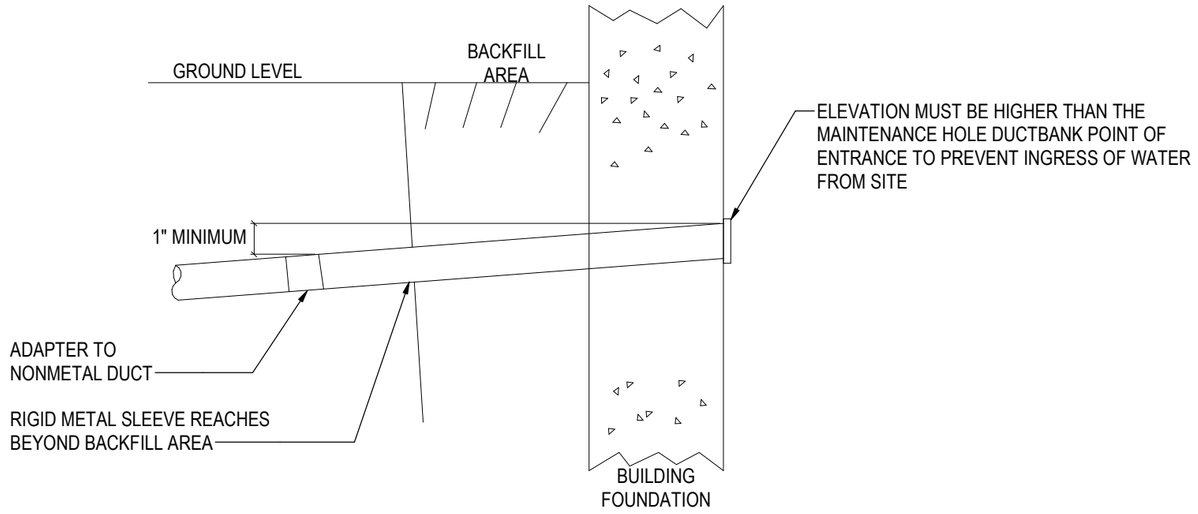
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0

Date 07/31/2020

Title
TELECOM DUCTBANK DETAIL - FOUR (4) 4" CONDUITS

Detail Number
T043



BUILDING POINT OF ENTRANCE SECTION

Not to Scale

<Pick location in Project Information>
6/6/2022 4:04:08 PM

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ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0

Date 07/31/2020

Title
CONDUIT BUILDING POINT OF ENTRANCE DETAIL

Detail Number
T044

ACCESS CONTROL

BR	BIOMETRIC READER
IR	HARDWARE INTEGRATED CARD READER WITH REQUEST TO EXIT AND DOOR POSITION SWITCH
CR	CARD READER
CRM	CARD READER MULLION MOUNT
PR	PARKING GATE CARD READER
EC	ELEVATOR CARD READER
RS	PASSIVE INFRARED REQUEST TO EXIT
LA	LOCAL ALARM
RB	REQUEST TO EXIT PUSH BUTTON
RX	REQUEST TO EXIT SWITCH IN DOOR HARDWARE
EL	ELECTRIC LATCH RETRACTION
DE	DELAYED EGRESS
ES	ELECTRIC STRIKE
ET	ELECTRIC TRIM
EM	ELECTRIC MORTISE
EH	ELECTRIC POWER TRANSFER OR HINGE
ML	ELECTROMAGNETIC LOCK
DC	DOOR CONTACT SWITCH
KS	KEYSWITCH
OC	OVERHEAD DOOR CONTACT SWITCH
AO	AUTOMATIC OPENER
KB	FIREMAN'S KEY BOX
PP	PUSH PLATE ACTUATOR
EK	ELEVATOR KIOSK (FOR DESTINATION BASED ELEVATOR SYSTEM)
	VEHICLE LOOP DETECTOR
MD	MOTION DETECTOR
SUPS	SECURITY SYSTEM UPS
ACP	ACCESS CONTROL PANEL
SPS	SECURITY POWER SUPPLY
DHPS	DOOR HARDWARE POWER SUPPLY
PE	POWER OVER ETHERNET LOCK
DA	DOOR MANAGEMENT ALARM
EK	ELECTRONIC KEY BOX
TC	TIME CLOCK
CK	CARD READER WITH KEYPAD
AO	AUTOMATIC OPENER
(CH)	DOOR CHIME

ELECTRONIC VIDEO SURVEILLANCE

NVR	NETWORK VIDEO RECORDER
CPS	CAMERA POWER SUPPLY
SW	SECURITY WORKSTATION
SM	SECURITY MONITOR DISPLAY
X	SECURITY CAMERA, TYPE AS DEFINED BY "X" A - EXTERIOR, VANDAL RESISTANT WEATHERPROOF FIXED CAMERA B - EXTERIOR, VANDAL RESISTANT WEATHERPROOF PTZ CAMERA C - EXTERIOR, VANDAL RESISTANT WEATHERPROOF WIDE DYNAMIC RANGE (CANOPY) D - INTERIOR, FIXED CAMERA E - INTERIOR, WIDE DYNAMIC RANGE (FACING EXTERIOR DOOR) CAMERA F - INTERIOR, FIXED CAMERA, CORRIDORS G - INTERIOR, FIXED CAMERA, ELEVATORS H - INTERIOR, FIXED, 180 DEGREE MULTI-IMAGER, WIDE DYNAMIC RANGE I - EXTERIOR, FIXED, 180 DEGREE MULTI-IMAGER, WIDE DYNAMIC RANGE J - INTERIOR FIXED, SINGLE SENSOR PANORAMIC FISH EYE K - EXTERIOR, FIXED, 360 DEGREE, WIDE DYNAMIC RANGE L - INTERIOR, FIXED, 360 DEGREE, WIDE DYNAMIC RANGE M - EXTERIOR, FIXED, 360 DEGREE/PTZ, WIDE DYNAMIC RANGE, POLE MOUNTED CAMERA
CLG	CEILING MOUNTED FIXED SECURITY CAMERA
	WALL MOUNTED SECURITY CAMERA
CLG PTZ	CEILING MOUNTED PAN, TILT, ZOOM SECURITY CAMERA
PTZ	WALL MOUNTED PAN, TILT, ZOOM SECURITY CAMERA
360°	CEILING MOUNTED 360° SECURITY CAMERA
360°	WALL MOUNTED 360° SECURITY CAMERA
180°	CEILING MOUNTED 180° SECURITY CAMERA
180°	WALL MOUNTED 180° SECURITY CAMERA

<Pick location in Project Information>

6/6/2022 4:04:08 PM

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ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0

Date 07/31/2020

Title
SECURITY DRAWING SYMBOLS SCHEDULE

Detail Number
T045a

EMERGENCY COMMUNICATIONS

AB	EMERGENCY ALERT BEACON
IS	AUDIO INTERCOM SUBSTATION
IM	AUDIO INTERCOM MAIN STATION
VS	AUDIO/VIDEO INTERCOM SUBSTATION
VM	AUDIO/VIDEO INTERCOM MAIN STATION
PB	PANIC DURESS BUTTON
RR	REMOTE RELEASE
DB	DOOR BELL
EP	EMERGENCY TELEPHONE
BL	EMERGENCY TELEPHONE BLUE BEACON
LA	LOCAL ALARM
AS	AREA OF RESCUE TWO-WAY COMMUNICATION REMOTE STATION
AC	AREA OF RESCUE TWO-WAY COMMUNICATIONS COMMAND UNIT

INTRUSION DETECTION

KP	KEYPAD FOR INTRUSION DETECTION SYSTEM
WC	WINDOW CONTACT SWITCH
HC	ROOF HATCH CONTACT SWITCH
GB	GLASS BREAK DETECTOR
MD	CEILING MOUNTED INTRUSION MOTION DETECTOR
IDP	INTRUSION DETECTION PANEL

ACCESS CONTROL DOOR TYPE ABBREVIATIONS

C1 - CARD READER, SINGLE DOOR
C2 - CARD READER, DOUBLE DOOR
C1D - CARD READER, SINGLE DOOR, DELAYED EGRESS
C2D - CARD READER, DOUBLE DOOR, DELAYED EGRESS
C1F - PREP FOR FUTURE CARD READER SINGLE DOOR
C2F - PREP FOR FUTURE CARD READER DOUBLE DOOR
C1I - CARD READER, SINGLE DOOR, INTERCOM SUBSTATION
C2I - CARD READER, DOUBLE DOOR, INTERCOM SUBSTATION
C1K - CARD READER WITH KEYPAD, SINGLE DOOR
C2K - CARD READER WITH KEYPAD, DOUBLE DOOR
CO - CARD READER, OVERHEAD DOOR
CP - CARD READER, PARKING GATES
C2AO - CARD READER WITH AUTO OPENER, DOUBLE DOOR
CSL - CARD READER, SLIDING DOOR

DE1 - DELAYED EGRESS, SINGLE DOOR
DE2 - DELAYED EGRESS, DOUBLE DOOR

EE - ELECTRIFIED EGRESS
EO - EXIT ONLY
EEO - EMERGENCY EXIT ONLY

M1D - MONITORED, SINGLE DOOR, DELAYED EGRESS
M1R - MONITORED, SINGLE DOOR, REQUEST TO EXIT
M2R - MONITORED, DOUBLE DOOR, REQUEST TO EXIT
M2RI - MONITORED, DOUBLE DOOR, REQUEST TO EXIT, INTERCOM SUBSTATION

S1 - STAIRWELL CARD READER, SINGLE DOOR
S2 - STAIRWELL CARD READER, DOUBLE DOOR
S1R - STAIRWELL RE-ENTRY SINGLE DOOR
S2R - STAIRWELL RE-ENTRY DOUBLE DOOR

V1 - VESTIBULE, ONE SET OF DOUBLE DOORS
V2 - VESTIBULE, TWO SETS OF DOUBLE DOORS
V3 - VESTIBULE, THREE SETS OF DOUBLE DOORS

<Pick location in Project Information>
6/6/2022 4:04:09 PM

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Notes

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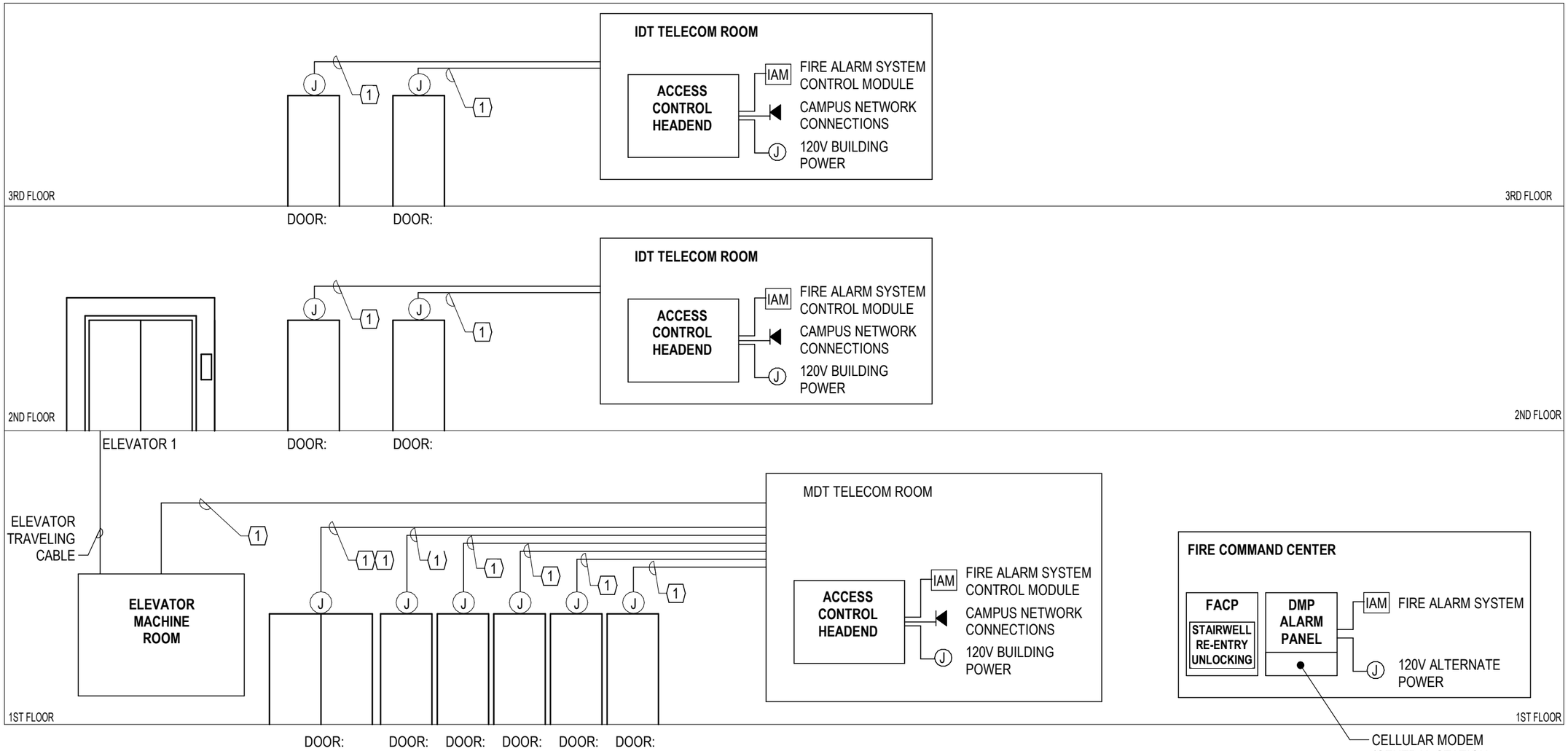
YALE UNIVERSITY

ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0
Date 07/31/2020

Title
SECURITY DRAWING ABBREVIATIONS

Detail Number
T046



ACCESS CONTROL RISER DIAGRAM

Not to Scale

CONDUCTOR/CONDUIT SCHEDULE	
1	ONE (1) COMPOSITE ACCESS CONTROL DOOR CABLE, PLENUM RATED

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Notes

Client/Project
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ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0

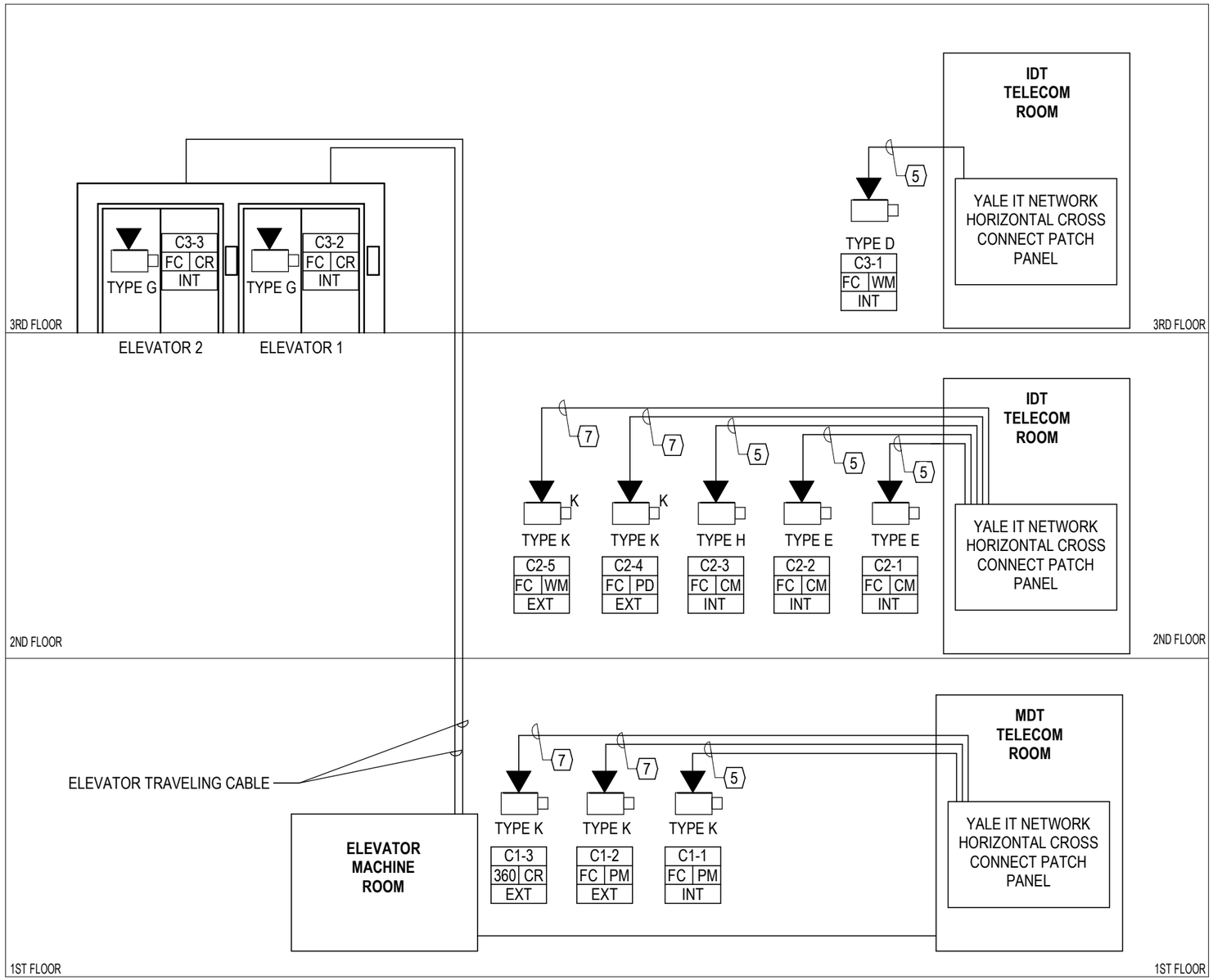
Date 07/31/2020

Title
ACCESS CONTROL RISER DIAGRAM

Detail Number
T047

<Pick location in Project Information>

6/6/2022 4:04:10 PM

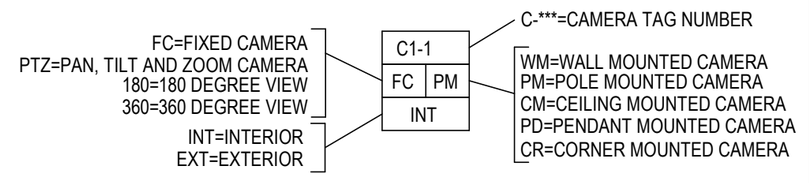


SECURITY CAMERA RISER DIAGRAM

Not to Scale

CONDUCTOR/CONDUIT SCHEDULE	
1	ONE (1) COMPOSITE ACCESS CONTROL DOOR CABLE, PLENUM RATED
2	ONE (1) 22 AWG 3 PR SHIELDED, PLENUM RATED
3	ONE (1) 18 AWG 4C, PLENUM RATED
4	ONE (1) 18 AWG 6C SHIELDED, PLENUM RATED
5	ONE (1) CATEGORY 6A IP POE CONNECTION (PROVIDED BY NETWORK CABLING CONTRACTOR), PLENUM RATED, PURPLE COLOR
6	ONE (1) RG-59U COAXIAL CABLE, PLENUM RATED
7	ONE (1) CATEGORY 6A IP POE NETWORK CONNECTION, INDOOR / OUTDOOR RATED CABLING (PROVIDED BY NETWORK CABLING CONTRACTOR)
8	ONE (1) 18 AWG 2C SOLID NONSHIELDED, PLENUM RATED
9	WIRELESS SYSTEM CONNECTION, PLENUM RATED
10	ONE (1) 6C SOLID NONSHIELDED, PLENUM RATED
11	ONE (1) 22AWG 2C SHIELDED, PLENUM RATED

CAMERA (CCTV) SYSTEM ONE LINE DIAGRAM LEGEND (THIS SHEET ONLY)



<Pick location in Project Information>
6/6/2022 4:04:10 PM

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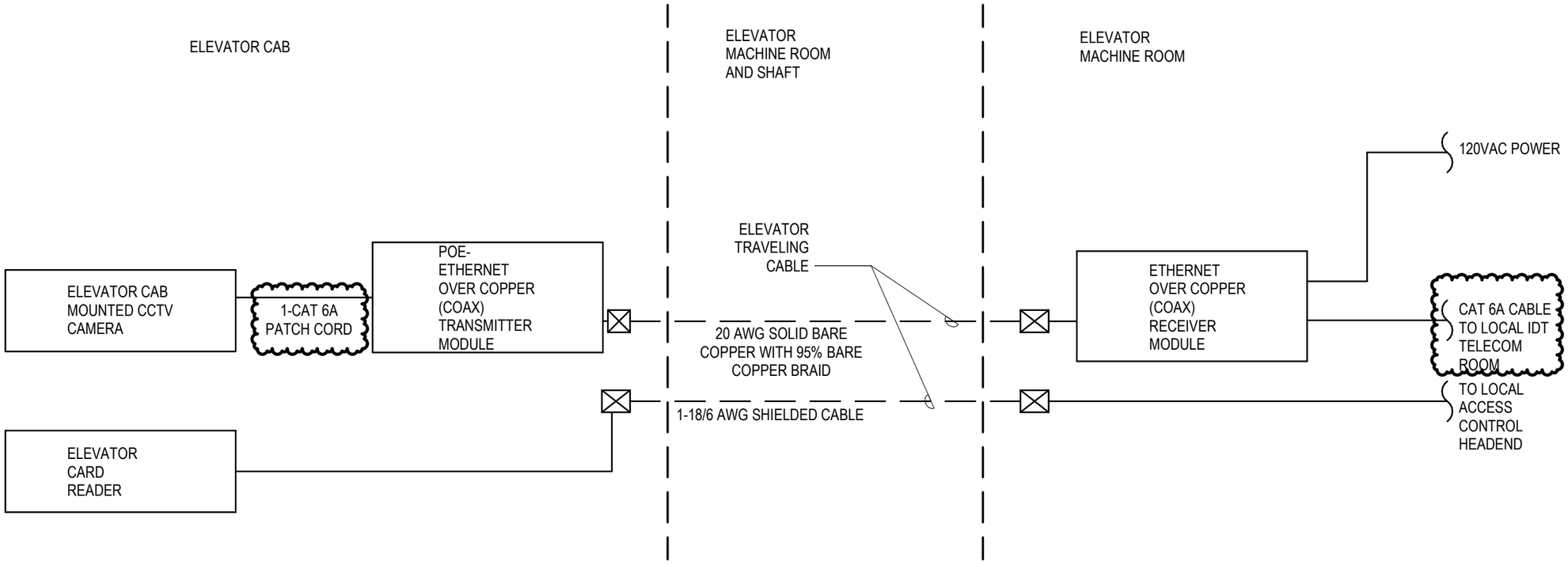
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.2
Date 06/30/2022

Title
SECURITY CAMERA RISER DIAGRAM

Detail Number
T048



TYPICAL ELEVATOR CAB SECURITY RISER DIAGRAM

Not to Scale

<Pick location in Project Information>

6/6/2022 4:04:10 PM

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Notes

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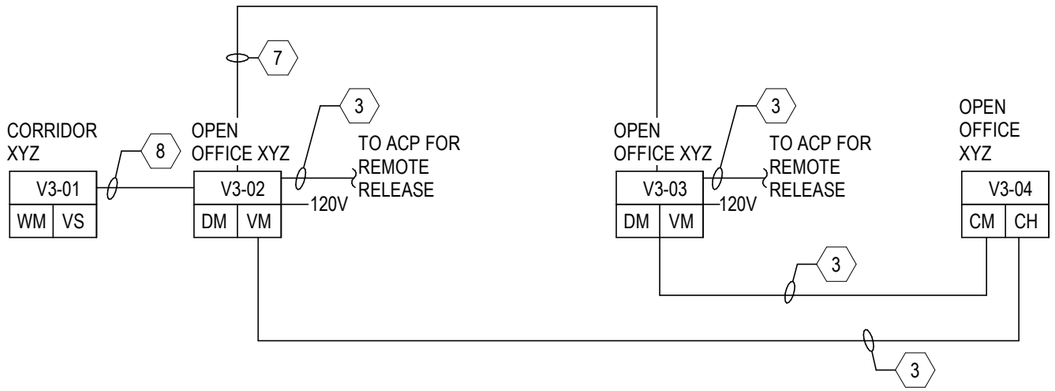
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No.	Date
1.2	06/30/2022

Title
ELEVATOR CAB SECURITY CAMERA RISER DIAGRAM

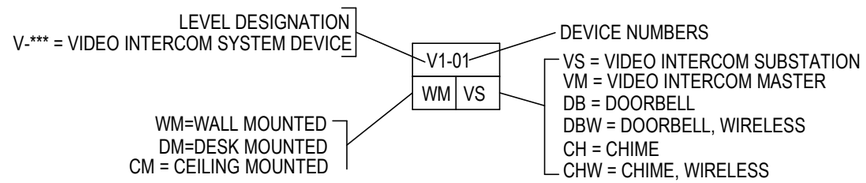
Detail Number
T049



VIDEO INTERCOM SYSTEM RISER DIAGRAM (NON - IP BASED)

Not to Scale

VIDEO INTERCOM SYSTEM ONE LINE DIAGRAM LEGEND (THIS SHEET ONLY)



CONDUCTOR/CONDUIT SCHEDULE	
1	ONE (1) COMPOSITE ACCESS CONTROL DOOR CABLE, PLENUM RATED
2	ONE (1) 22 AWG 3 PR SHIELDED, PLENUM RATED
3	ONE (1) 18 AWG 4C, PLENUM RATED
4	ONE (1) 18 AWG 6C SHIELDED, PLENUM RATED
5	ONE (1) CATEGORY 6A IP POE CONNECTION (PROVIDED BY NETWORK CABLING CONTRACTOR), PLENUM RATED
6	ONE (1) RG-59U COAXIAL CABLE, PLENUM RATED
7	ONE (1) CATEGORY 6A IP POE NETWORK CONNECTION, INDOOR / OUTDOOR PLENUM RATED CABLING (PROVIDED BY NETWORK CABLING CONTRACTOR)
8	ONE (1) 18 AWG 2C SOLID NONSHIELDED, PLENUM RATED
9	WIRELESS SYSTEM CONNECTION, PLENUM RATED
10	ONE (1) 6C SOLID NONSHIELDED, PLENUM RATED
11	ONE (1) 22AWG 2C SHIELDED, PLENUM RATED

<Pick location in Project Information>
6/6/2022 4:04:10 PM

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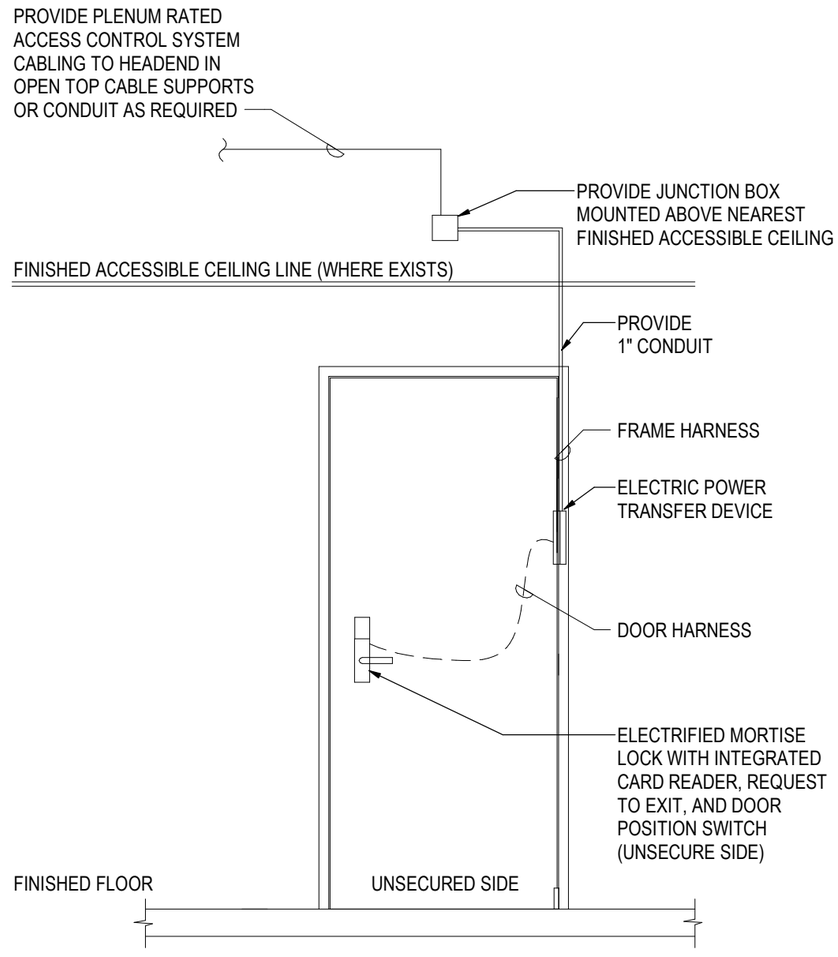
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.2
Date 06/30/2022

Title
VIDEO INTERCOM SYSTEM RISER DIAGRAM

Detail Number
T050



SECURITY DOOR TYPE "C1" - CARD READER, SINGLE DOOR

Not to Scale

<Pick location in Project Information>

6/6/2022 4:04:11 PM

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Notes

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ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0

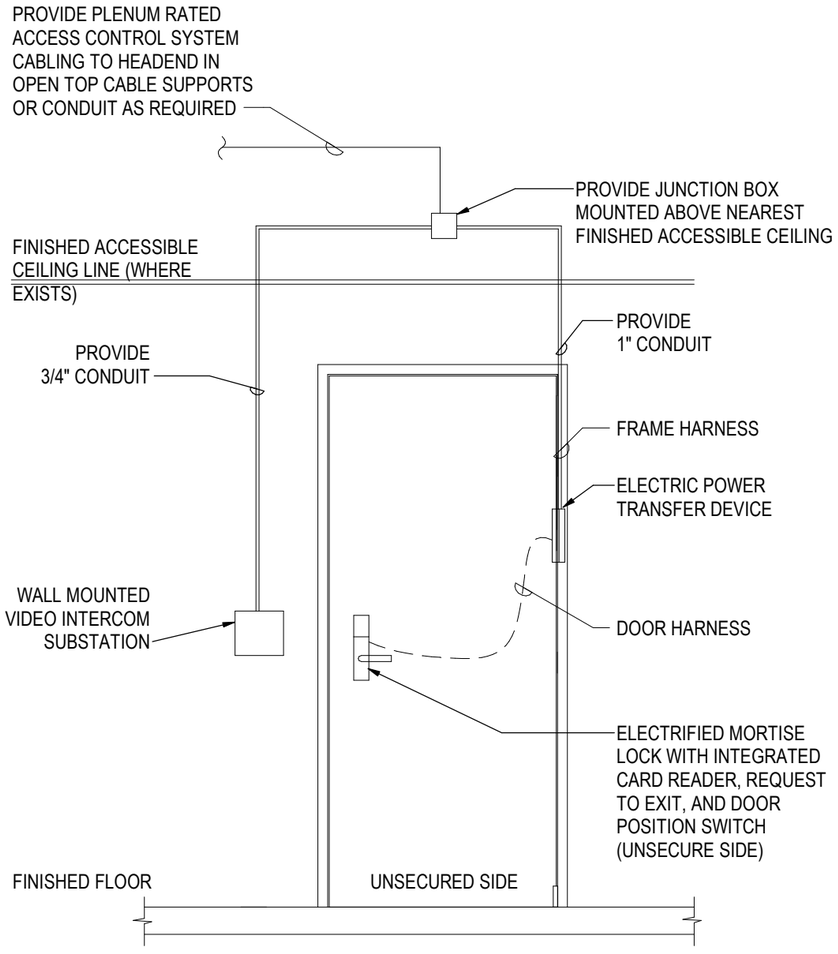
Date 07/31/2020

Title

DOOR TYPE C1 - INTEGRATED CARD READER, SINGLE DOOR

Detail Number

T051



SECURITY DOOR TYPE "C1I" - CARD READER, SINGLE DOOR, INTERCOM SUBSTATION

Not to Scale

<Pick location in Project Information>

6/6/2022 4:04:11 PM

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Notes

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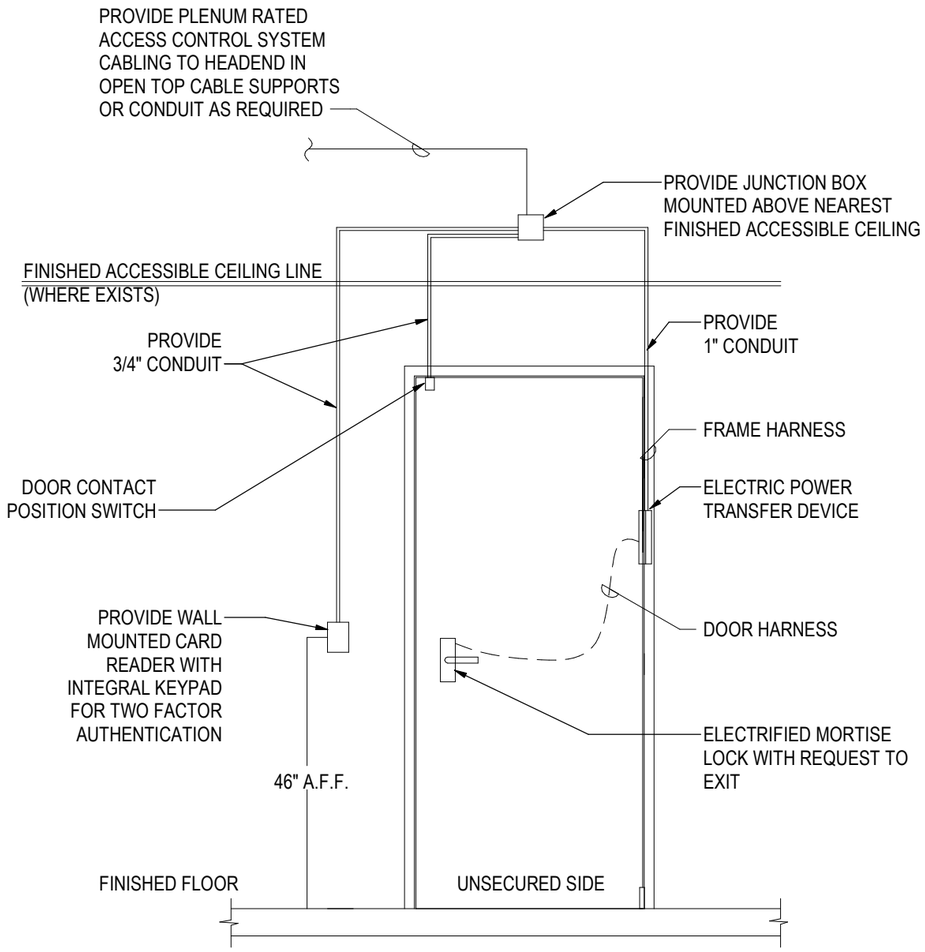
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0

Date 07/31/2020

Title
DOOR TYPE C1I - INTEGRATED CARD READER, SINGLE DOOR, VIDEO INTERCOM

Detail Number
T052



SECURITY DOOR TYPE "C1K" - CARD READER WITH KEYPAD, SINGLE DOOR

Not to Scale

<Pick location in Project Information>
6/6/2022 4:04:12 PM

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Notes

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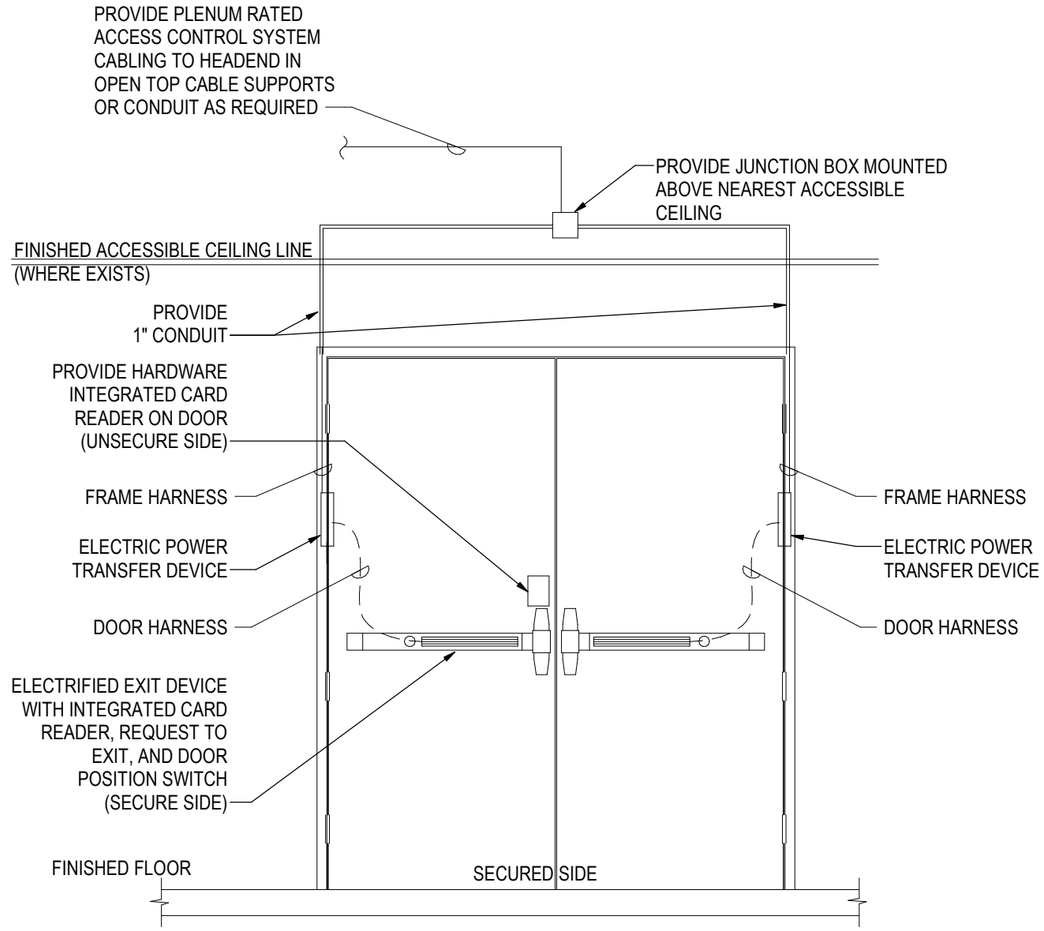
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0

Date 07/31/2020

Title
DOOR TYPE C1K - WALL CARD READER WITH KEYPAD

Detail Number
T053



SECURITY DOOR TYPE "C2" - CARD READER, DOUBLE DOOR

Not to Scale

6/6/2022 4:04:12 PM
<Pick location in Project Information>

Yale

Notes

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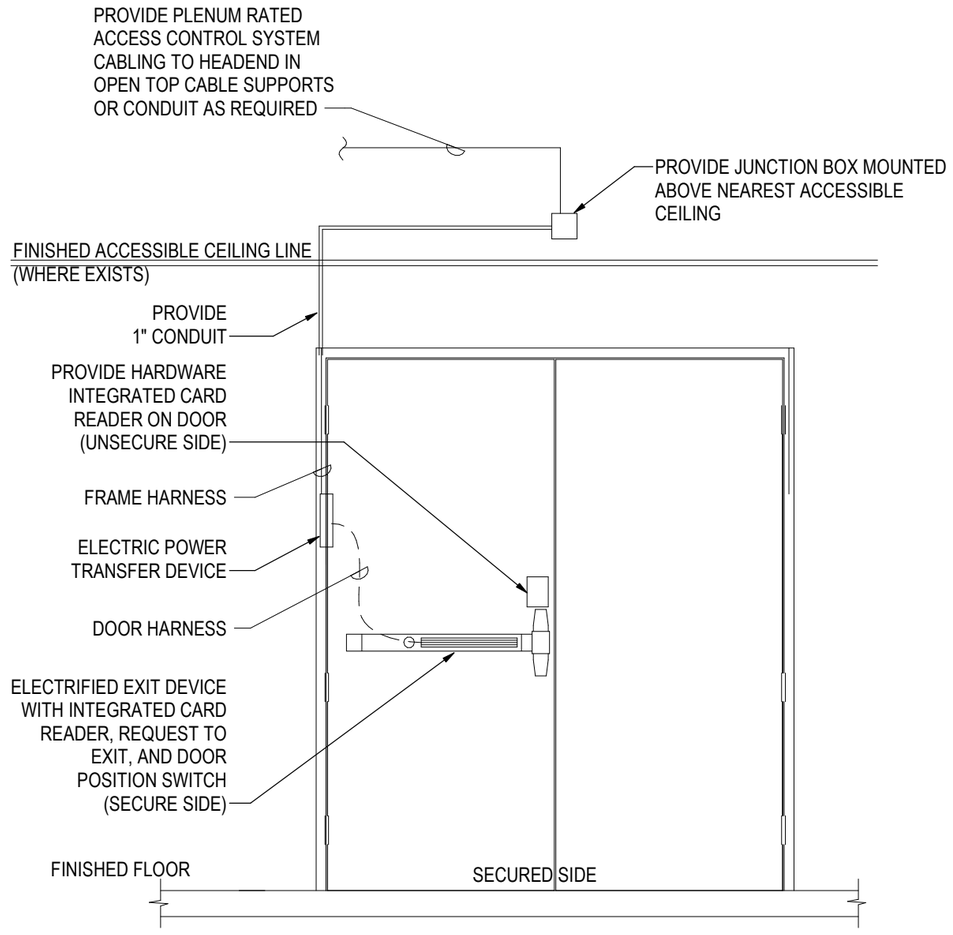
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0

Date 07/31/2020

Title
DOOR TYPE C2 - INTEGRATED CARD READER, DOUBLE DOOR, EXIT DEVICE

Detail Number
T054



SECURITY DOOR TYPE "C2" - CARD READER, DOUBLE DOOR, FIXED LEAF

Not to Scale

6/6/2022 4:04:12 PM
<Pick location in Project Information>

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Notes

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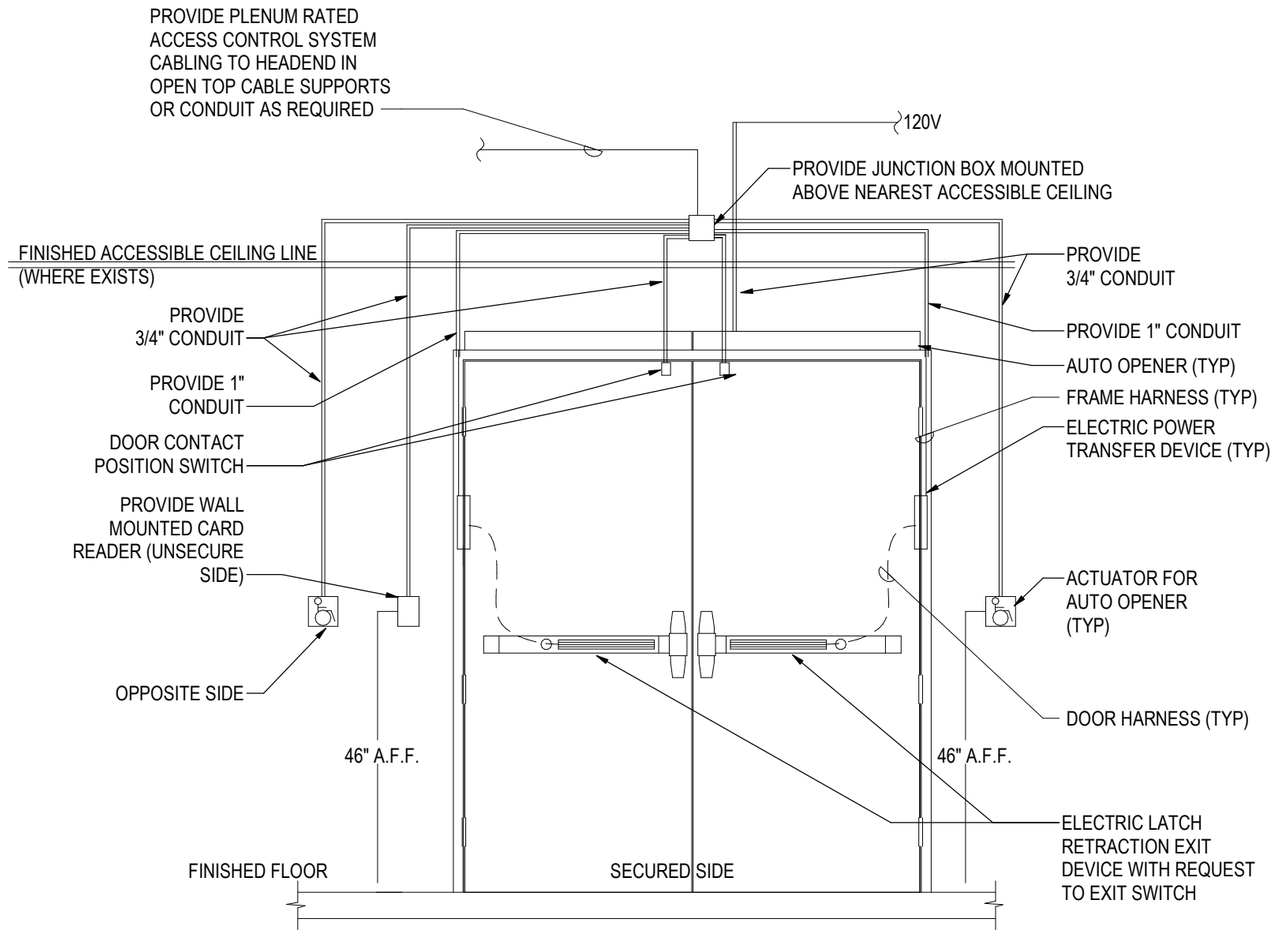
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0
Date 07/31/2020

Title
DOOR TYPE C2 - INTEGRATED CARD READER, DOUBLE DOOR, FIXED LEAF

Detail Number
T055



SECURITY DOOR TYPE "C2AO" - CARD READER WITH AUTO OPENER, DOUBLE DOOR

Not to Scale

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Notes

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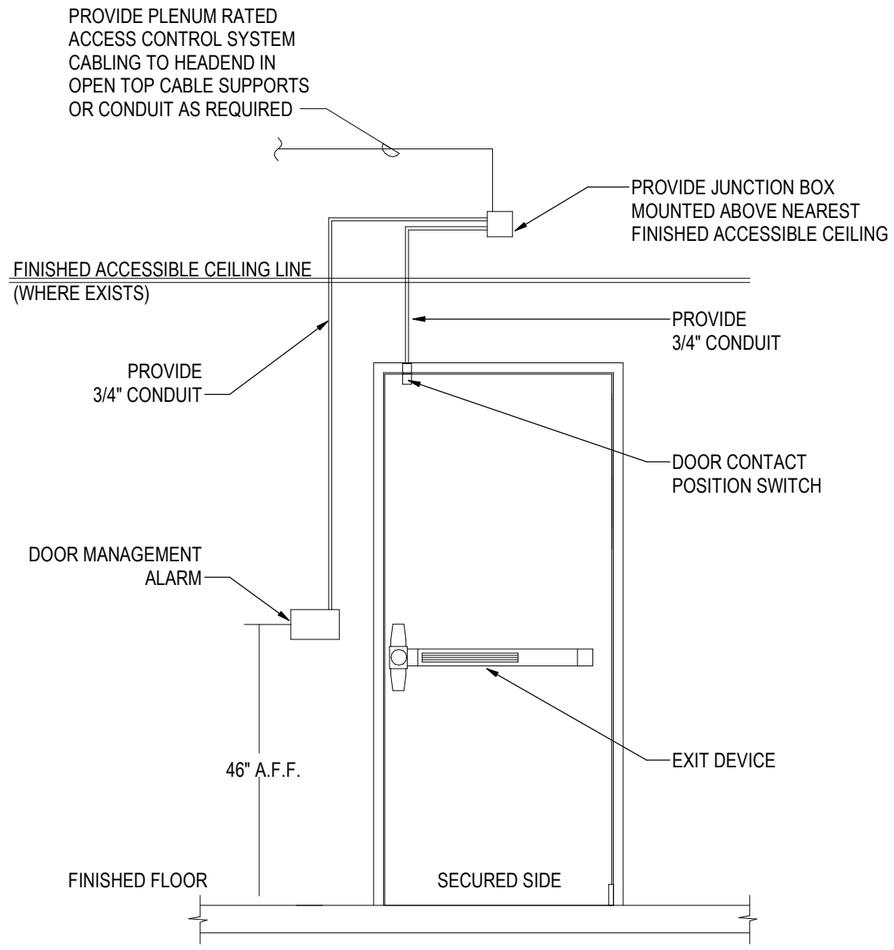
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0

Date 07/31/2020

Title
DOOR TYPE C2AO - CARD READER WITH AUTO OPENER, DOUBLE DOOR

Detail Number
T056



SECURITY DOOR TYPE "EEO" - EMERGENCY EXIT ONLY

Not to Scale

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<Pick location in Project Information>

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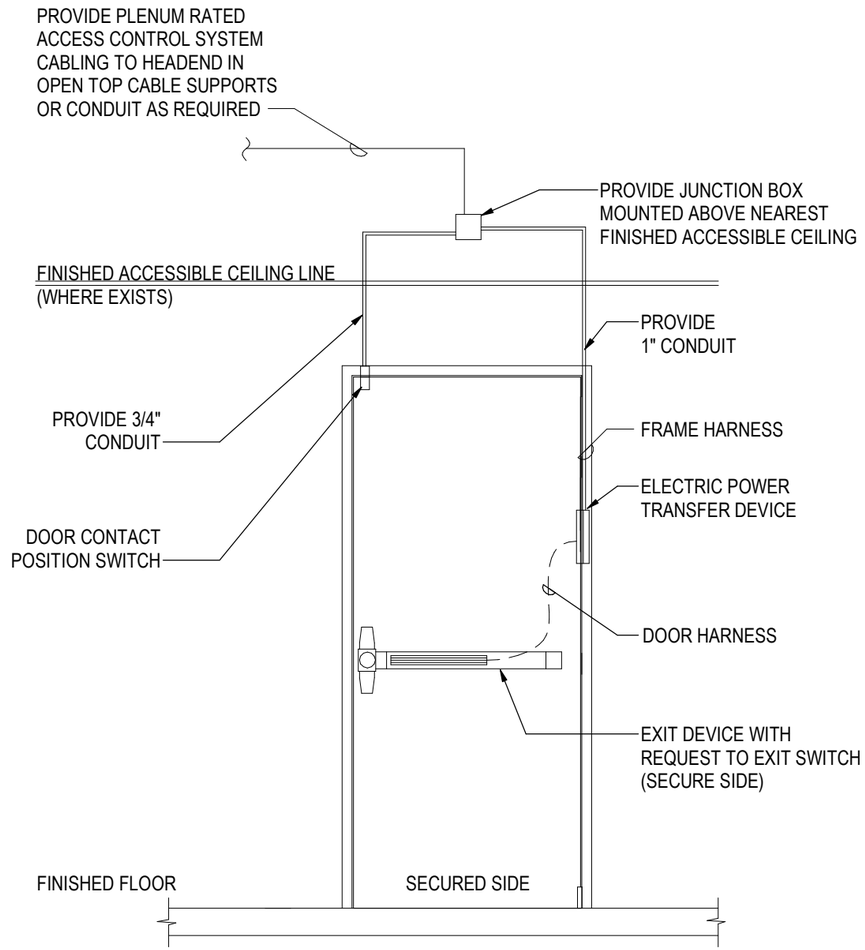
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0

Date 07/31/2020

Title
DOOR TYPE EEO -
EMERGENCY EXIT ONLY

Detail Number
T057



SECURITY DOOR TYPE "EO" - EXIT ONLY

Not to Scale

<Pick location in Project Information>
6/6/2022 4:04:14 PM

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Notes

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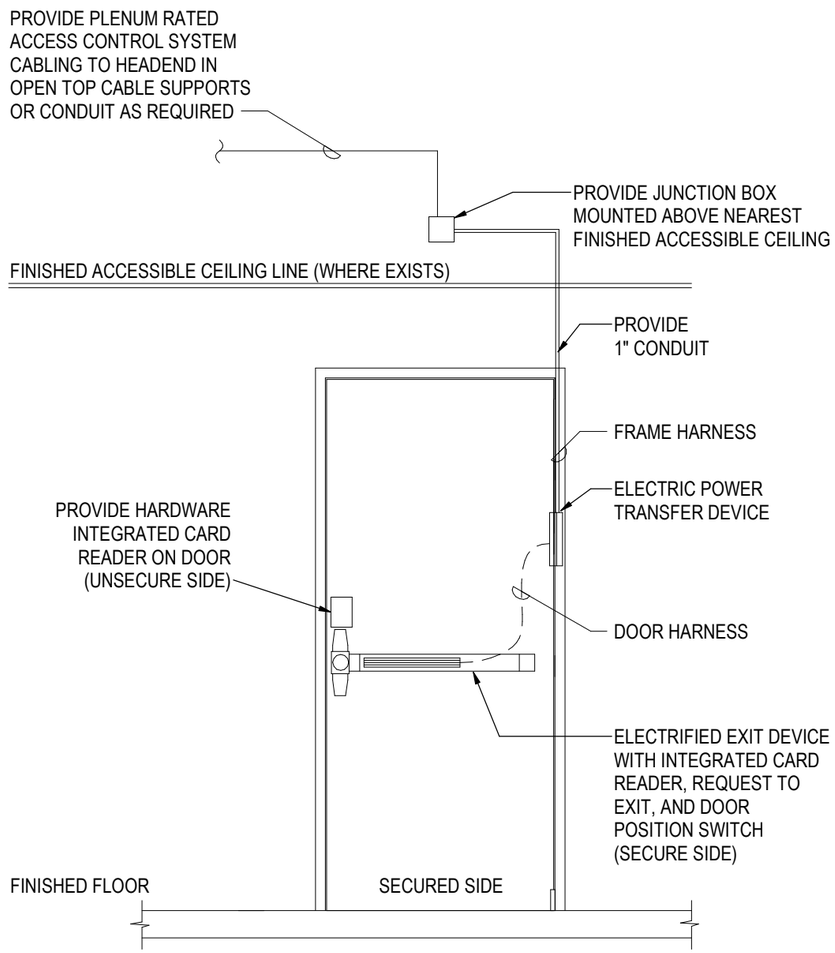
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0

Date 07/31/2020

Title
DOOR TYPE EO - EXIT ONLY

Detail Number
T058



SECURITY DOOR TYPE "S1R" - STAIRWELL RE-ENTRY DOOR

Not to Scale

6/6/2022 4:04:14 PM
<Pick location in Project Information>

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Notes

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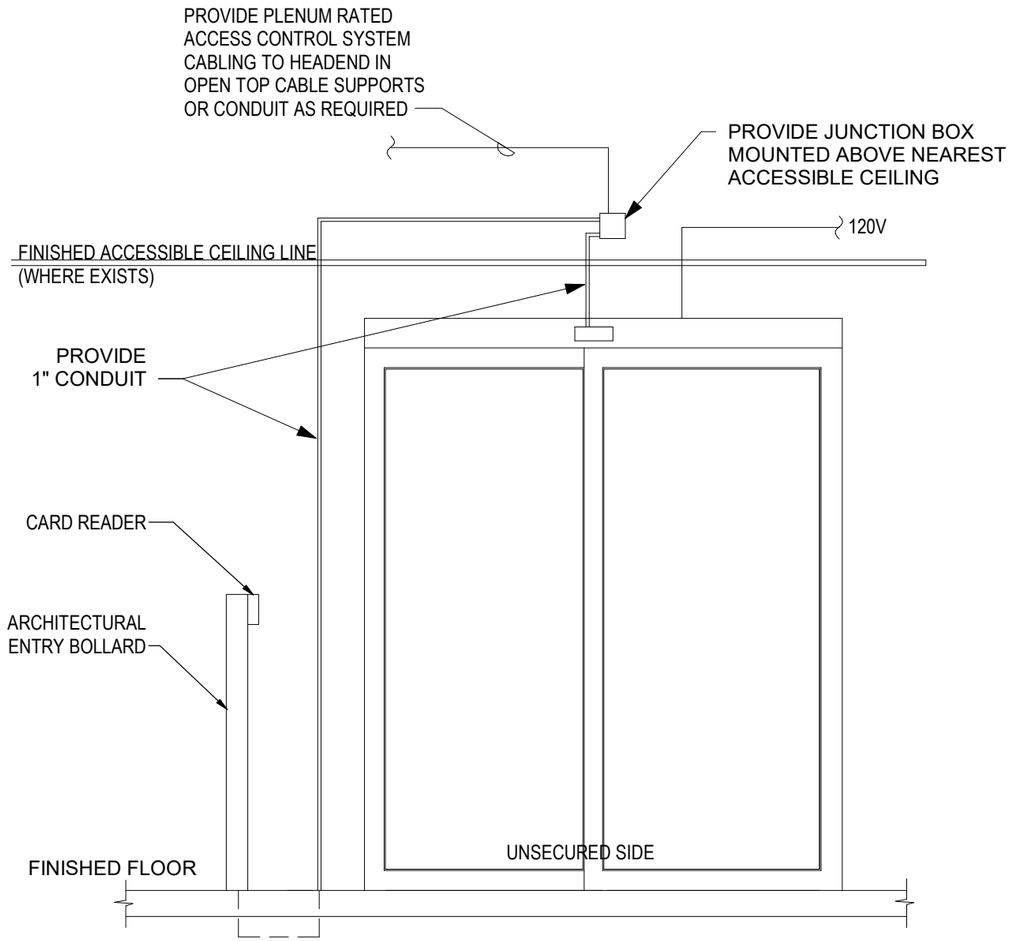
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0
Date 07/31/2020

Title
DOOR TYPE S1R - CARD READER, STAIRWELL RE-ENTRY, SINGLE DOOR

Detail Number
T059



SECURITY DOOR TYPE "CSL" - SLIDING CARD READER DOOR

Not to Scale

<Pick location in Project Information>
6/6/2022 4:04:14 PM

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Notes

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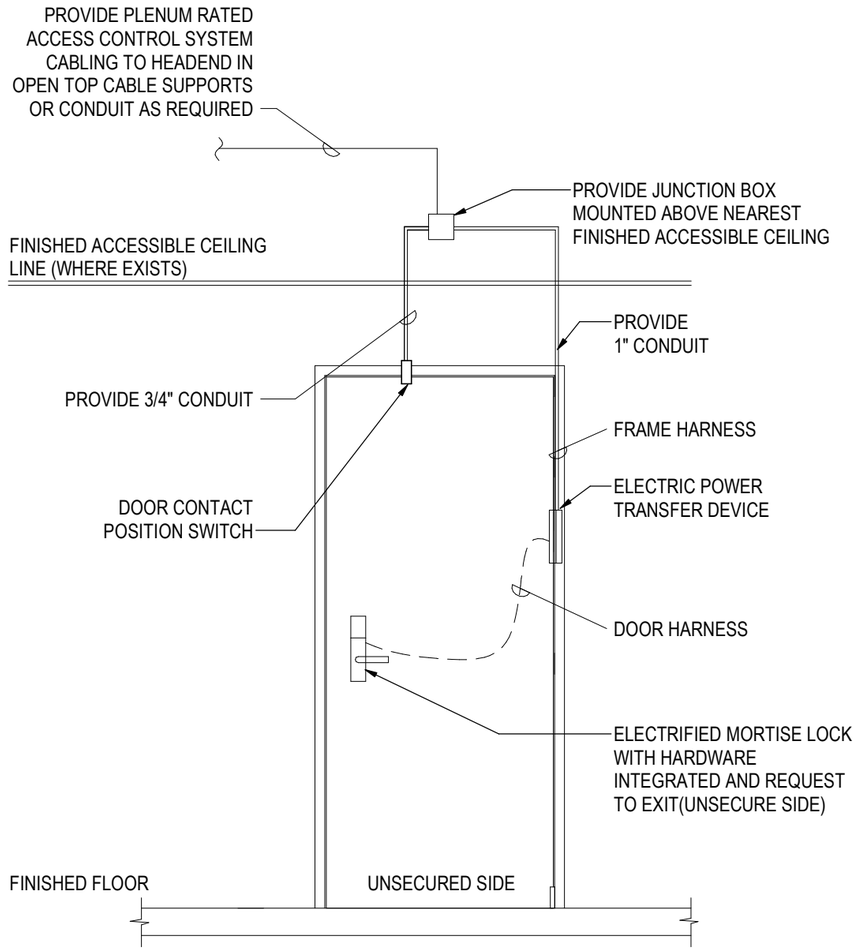
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0

Date 07/31/2020

Title
DOOR TYPE CSL - SLIDING AUTO OPERATOR DOOR

Detail Number
T060



MONITORED SINGLE DOOR

Not to Scale

6/6/2022 4:04:15 PM
<Pick location in Project Information>

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Notes

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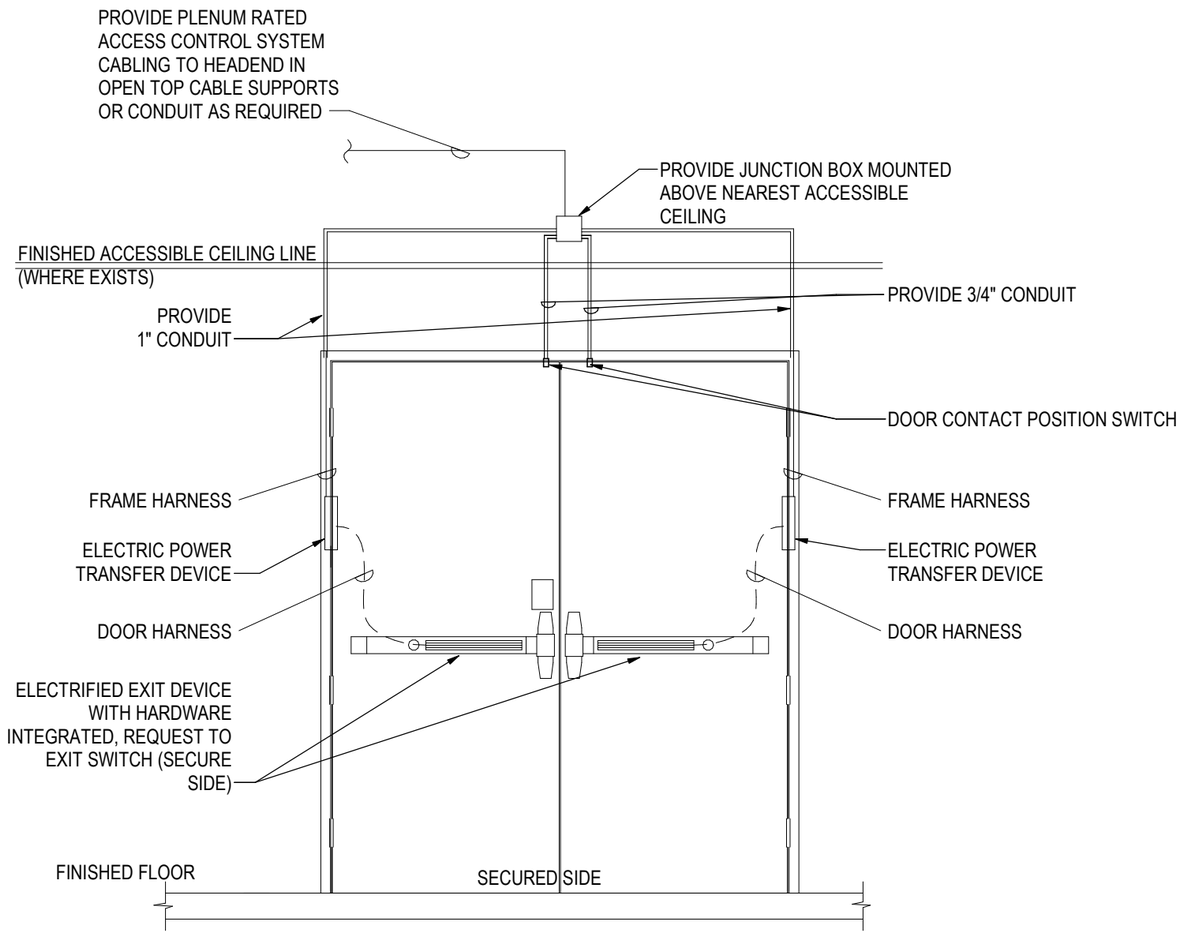
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0
Date 07/31/2020

Title
DOOR TYPE M1 - MONITORED SINGLE DOOR

Detail Number
T061



MONITORED DOUBLE DOOR

Not to Scale

<Pick location in Project Information>
6/6/2022 4:04:15 PM

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Notes

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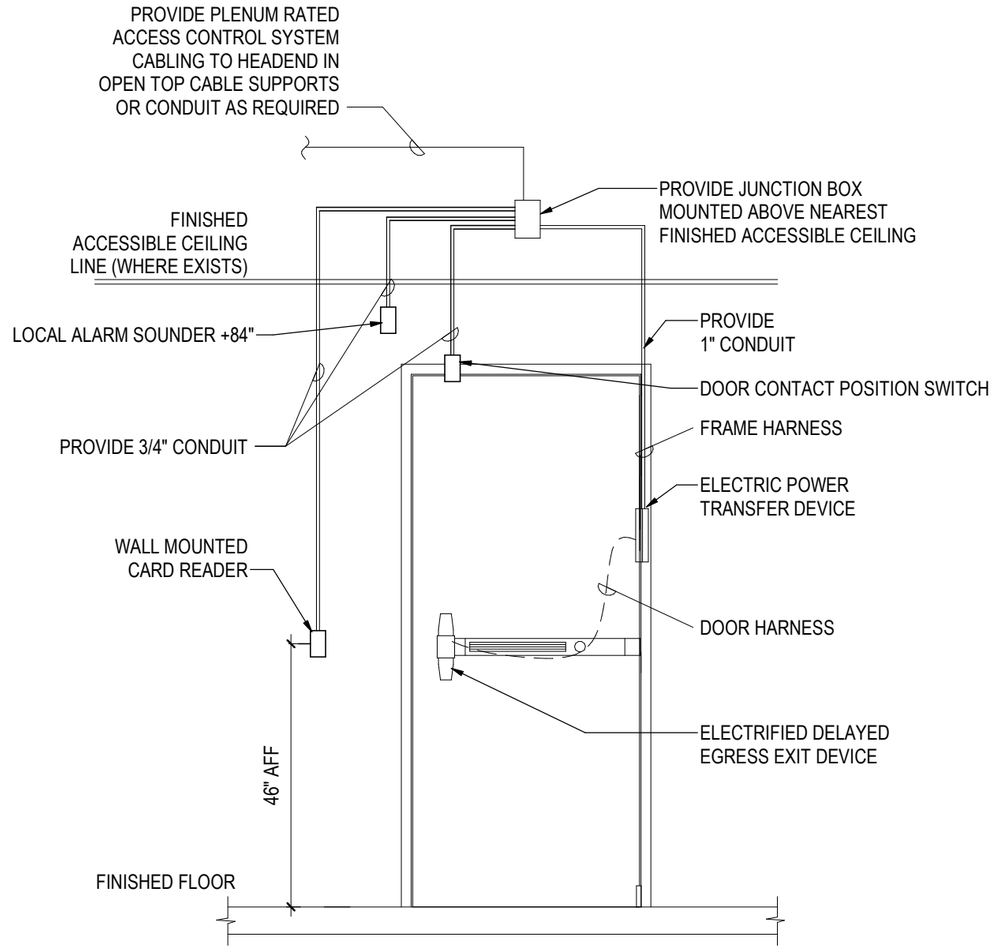
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0

Date 07/31/2020

Title
DOOR TYPE M2 - MONITORED DOUBLE DOOR

Detail Number
T062



DELAYED EGRESS SINGLE DOOR

Not to Scale

<Pick location in Project Information>
6/6/2022 4:04:15 PM

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Notes

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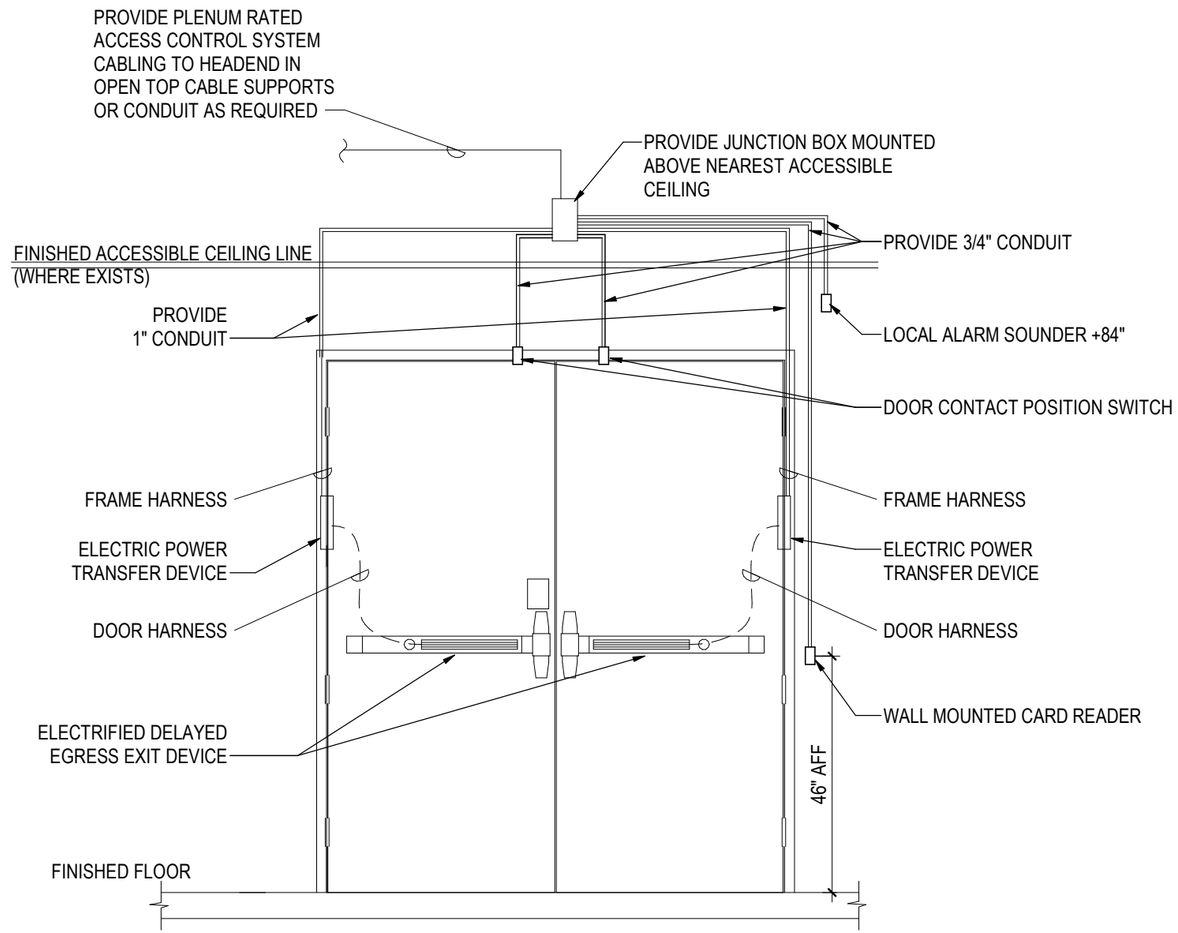
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0

Date 07/31/2020

Title
DOOR TYPE DE1 - DELAYED EGRESS, SINGLE DOOR

Detail Number
T063



DELAYED EGRESS DOUBLE DOOR

Not to Scale

<Pick location in Project Information>
6/6/2022 4:04:16 PM

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ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0

Date 07/31/2020

Title
DOOR TYPE DE2 - DELAYED EGRESS, DOUBLE DOOR

Detail Number
T064

AUDIOVISUAL

CP"X" — AUDIOVISUAL CONTROL PANEL. "X" DEFINTES TYPE

FLAT PANEL DIRECT VIEW MONITOR WITH WALL MOUNT

$PS — PROJECTION SCREEN WALL SWITCH

$PL — PROJECTION LIFT WALL SWITCH

AUDIOVISUAL EQUIPMENT CABINET

AUIDIOVISUAL RACK FRAME MOUNTED IN CASEWORK

WALL MOUNTED SOUND SYSTEM EQUIPMENT CABINET

M — MICROPHONE XLR BALANCED JACK

CEILING MOUNTED PROJECTOR

S X — LOCAL ROOM SYSTEM CEILING SPEAKER

S HC X — LOCAL ROOM SYSTEM CEILING SPEAKER, ZONE "X", HIGH CEILING

W"X" — WALL MOUNTED AUDIOVISUAL BACKBOX

IP "X" — AUDIOVISUAL INPUT/OUTPUT PANEL, "X" DENOTES TYPE

AV — AUDIOVISUAL CONFERENCEING CAMERA

DC — CEILING DOCUMENT CAMERA

IR — CEILING IR SENSOR

TB X — FLUSH TABLE BOX, "X" DENOTES TYPE

BM — TABLE BOUNDARY MICROPHONE ARRAY

CM — PENDANT CEILING MICROPHONE

CM — CEILING ARRAY MICROPHONE

PS X — PROJECTOR SCREEN SCHEDULE EQIUPMENT TAG

PM X — PROJECTOR MOUNT SCHEDULE EQUIPMENT TAG

DP X — DIGITAL PROJECTOR SCHEDULE EQUIPMENT TAG

FP X — FLAT PANEL SCHEDULE TAG

CA X — CAMERA SCHEDULE EQUIPMENT TAG

PO X — PODIUM SCHEDULE EQUIPMENT TAG

ER X — EQUIPMENT RACK SCHEDULE EQUIPMENT TAG

AT — ASSISTIVE LISTENING SYSTEM TRANSMITTER

PR — PARTITION RELAY SENSOR

SS — ROOM SCHEDULING SIGNAGE

<Pick location in Project Information>

6/6/2022 4:04:16 PM

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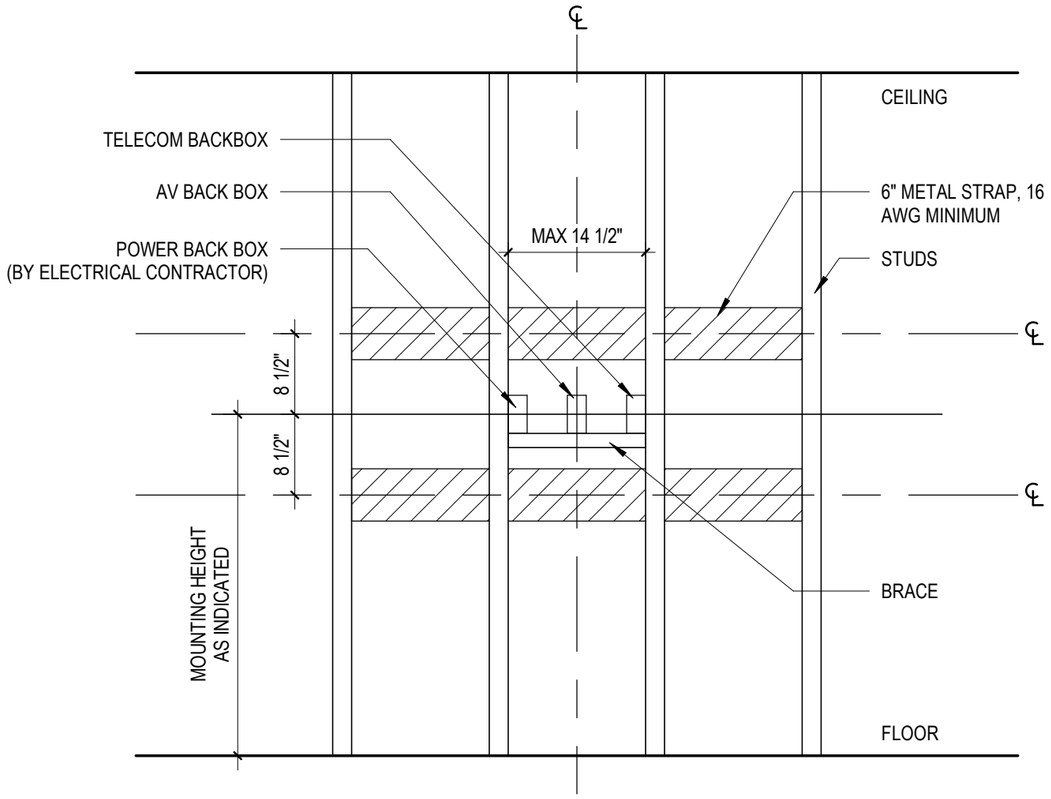
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0

Date 07/31/2020

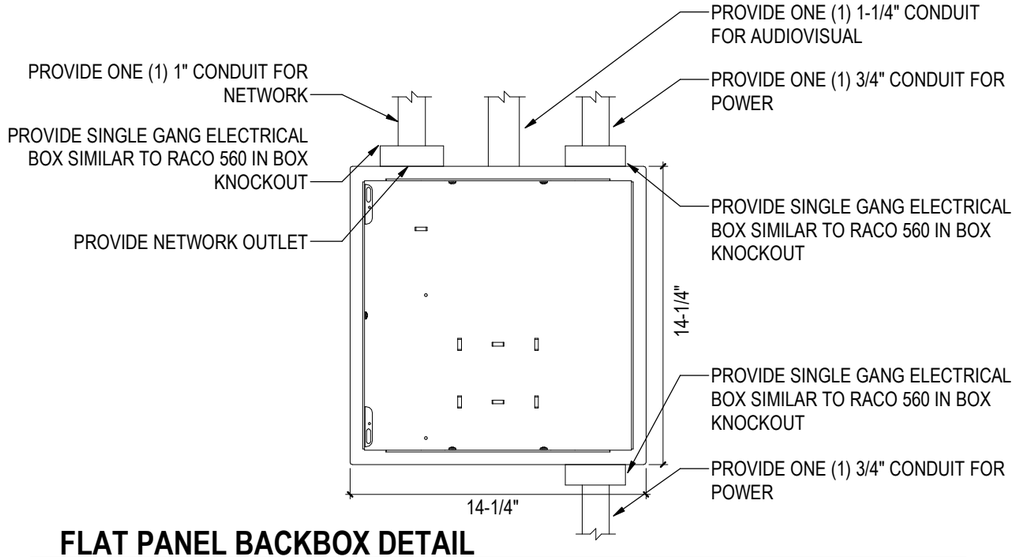
Title
DRAWING SYMBOLS SCHEDULE

Detail Number
T065



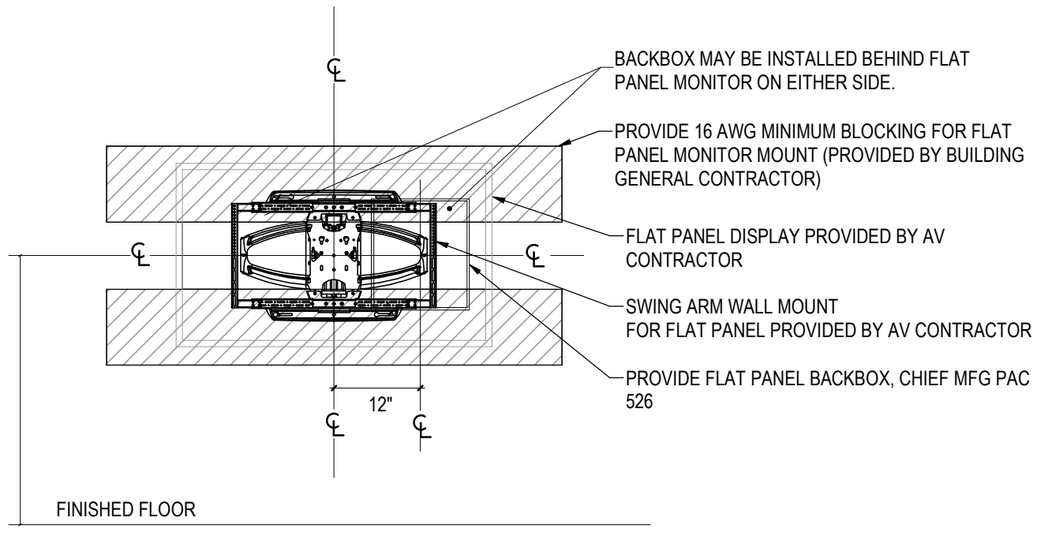
SURFACE MOUNTED FLAT PANEL BACKING DIAGRAM

Not to Scale



FLAT PANEL BACKBOX DETAIL

Not to Scale



FLAT PANEL BACKBOX ELEVATION

Not to Scale

<Pick location in Project Information>
6/6/2022 4:04:17 PM

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Notes

Client/Project
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ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

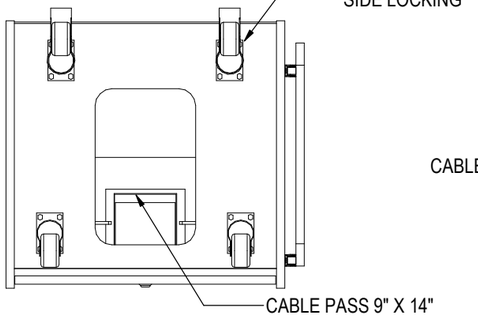
Revision No. 1.1

Date 06/30/2021

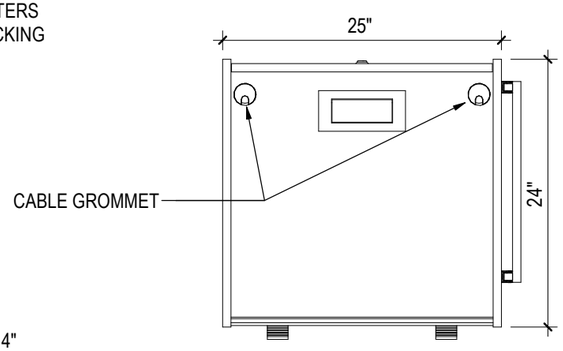
Title
SURFACE MOUNTED FLAT PANEL BACKING DIAGRAM

Detail Number
T066

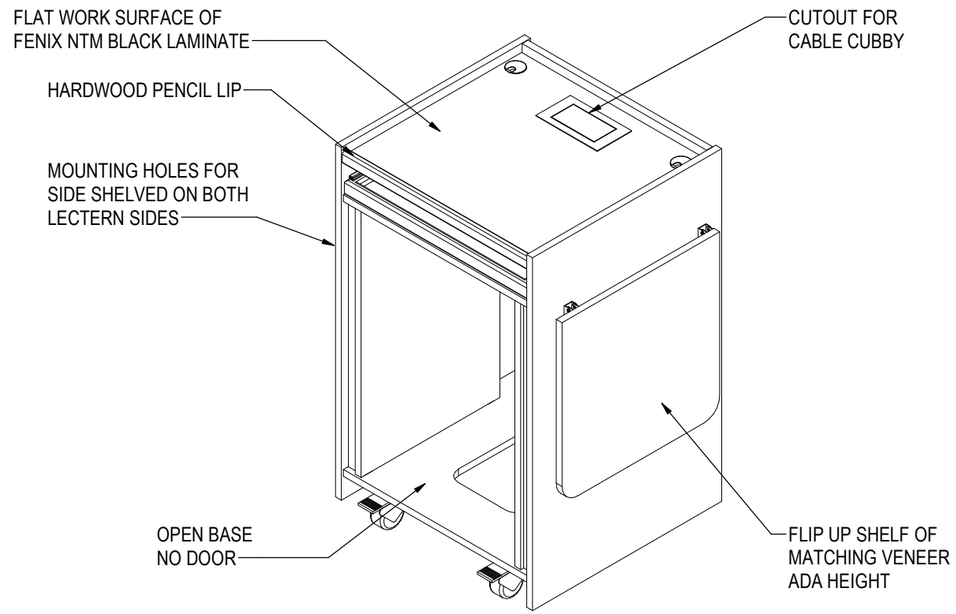
BOTTOM SECTION



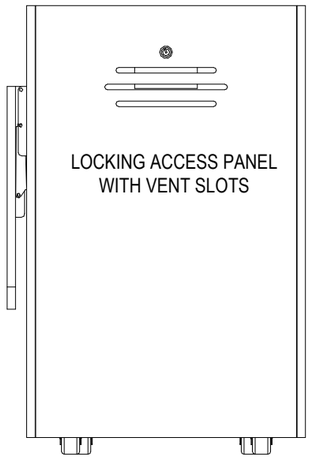
PLAN SECTION



ISOMETRIC SECTION



BACK SECTION



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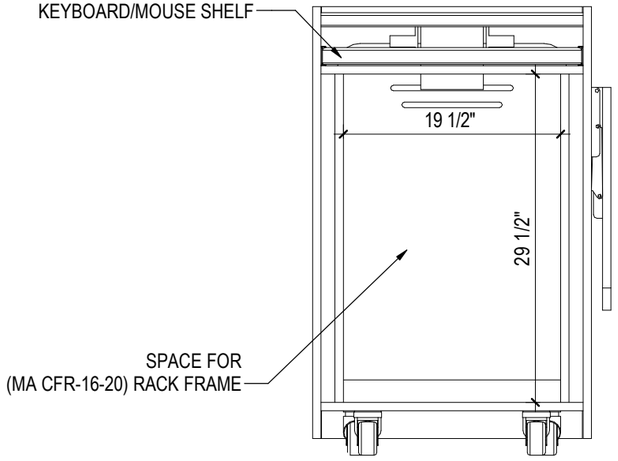

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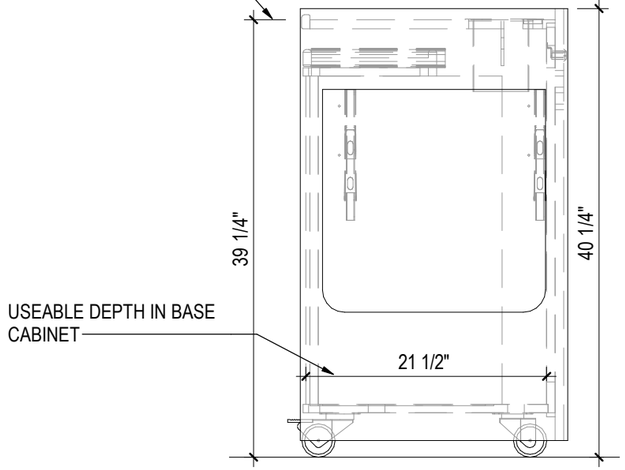

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Notes

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ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0

Date 07/31/2020

Title
COMPACT TEACHING STATION

Detail Number
T067

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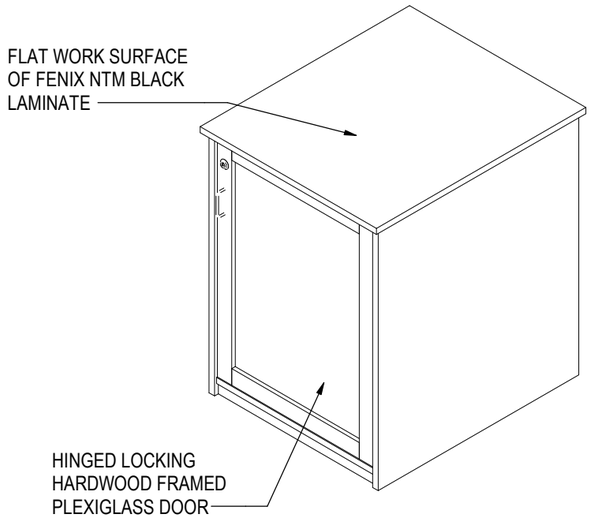

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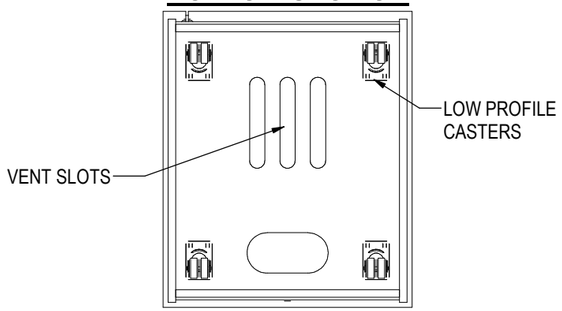

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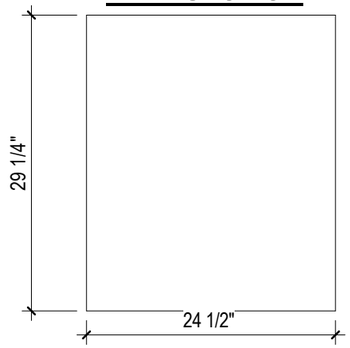

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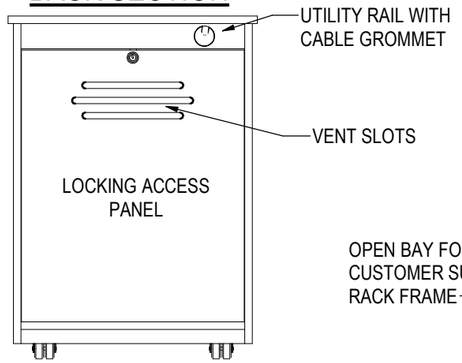

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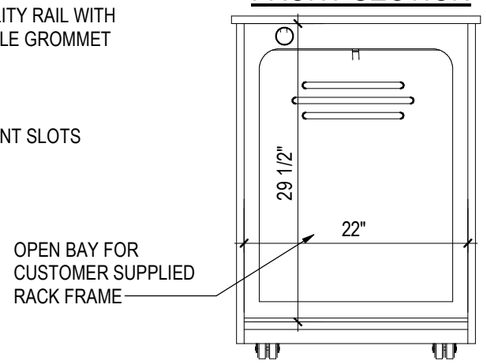

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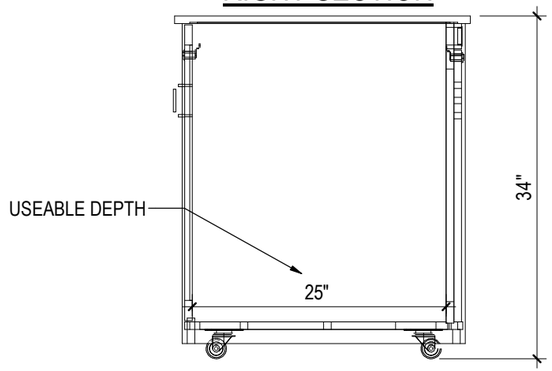

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YALE UNIVERSITY

ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

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Date 07/31/2020

Title
CREDENZA WITH RACK

Detail Number
T068

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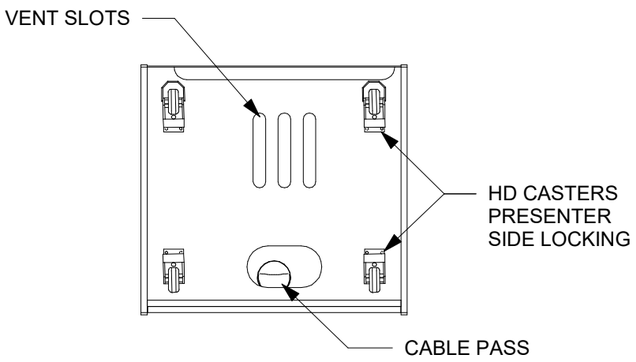

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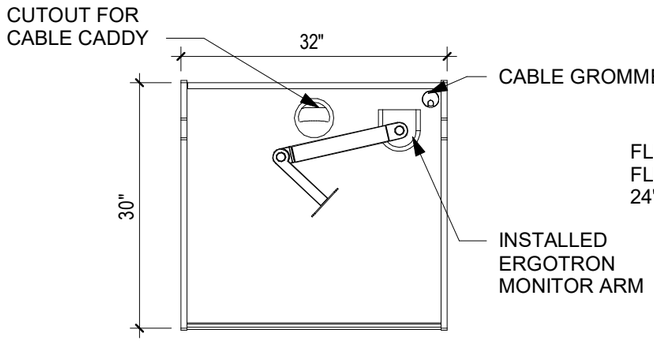

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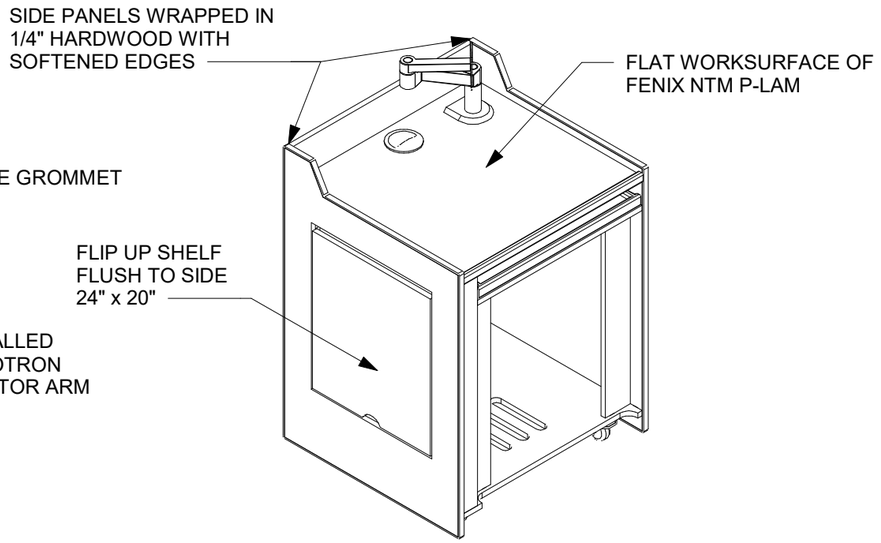

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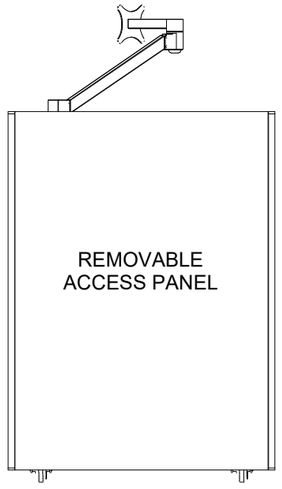

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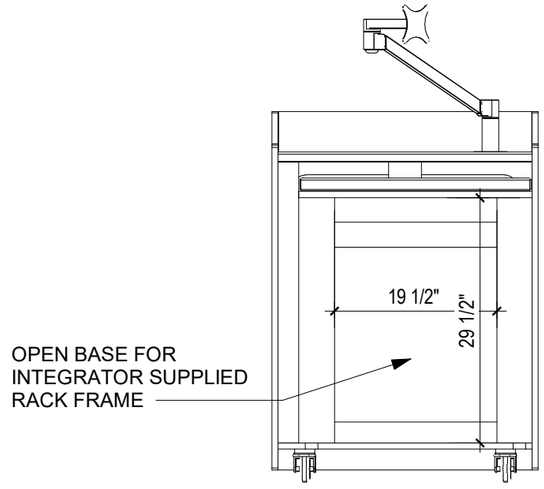

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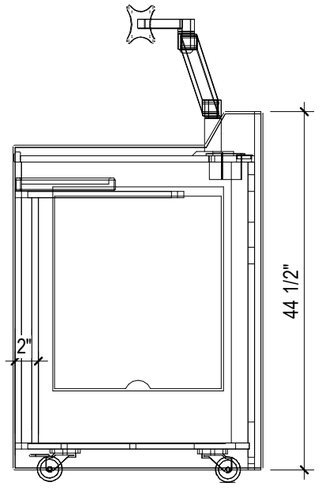

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ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0

Date 07/31/2020

Title
FULL SIZE TEACHING STATION

Detail Number
T069

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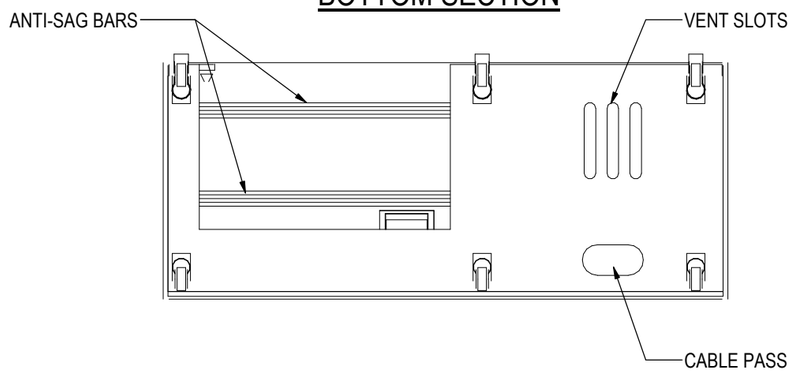

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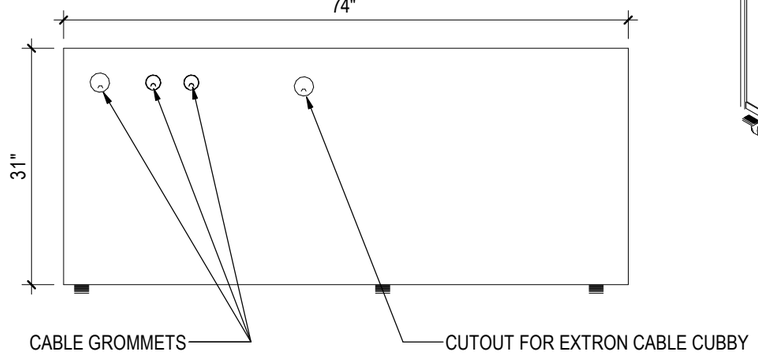

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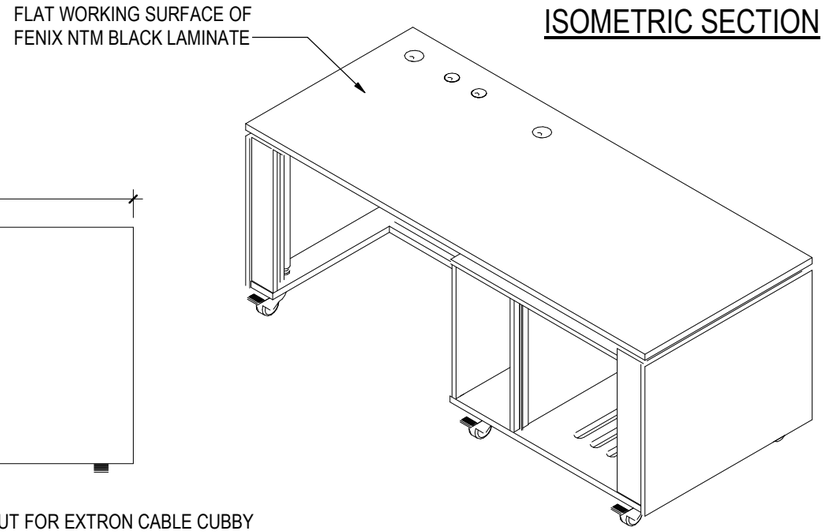

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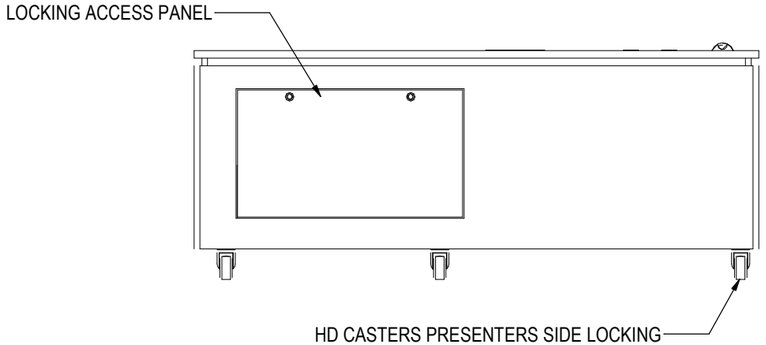

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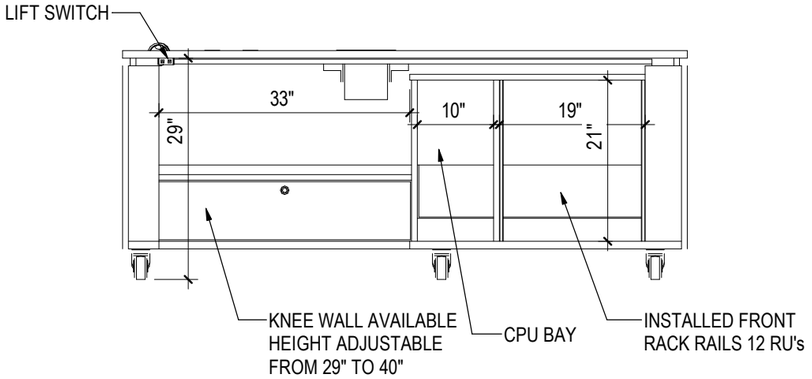

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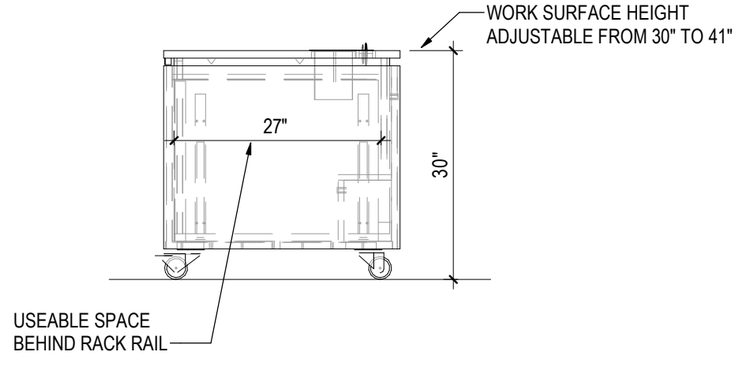

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Notes

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YALE UNIVERSITY

ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

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Date 07/31/2020

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HEIGHT ADJUSTABLE TABLE

Detail Number
T070

Yale University

IT Infrastructure Construction Standards

New Haven, Connecticut

Appendix G

OUTLINE SPECIFICATIONS

DIVISIONS 27 AND 28

July 31, 2020
Revision 1.0

DOCUMENT 000002 – TABLE OF CONTENTS

DIVISION SECTION TITLE

DIVISION 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS
000002 TABLE OF CONTENTS

DIVISION 27 – COMMUNICATIONS
270000 GENERAL COMMUNICATIONS PROVISIONS
270500 COMMON WORK RESULTS FOR COMMUNICATIONS
270526 GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS
270528 PATHWAYS FOR COMMUNICATIONS SYSTEMS
270529 HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS
270534 FLOOR BOXES FOR ELECTRICAL AND COMMUNICATION SYSTEMS
270536 CABLE TRAYS FOR COMMUNICATIONS SYSTEMS
270543 UNDERGROUND PATHWAYS AND STRUCTURES FOR COMMUNICATION SYSTEMS
270544 SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND CABLING
270553 IDENTIFICATION FOR COMMUNICATIONS SYSTEMS
271100 COMMUNICATIONS EQUIPMENT ROOM FITTINGS
271313 COMMUNICATIONS COPPER BACKBONE CABLING
271323 COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING
271513 COMMUNICATIONS COPPER HORIZONTAL CABLING
271523 COMMUNICATIONS OPTICAL FIBER HORIZONTAL CABLING
272000 TWO-WAY COMMUNICATION SYSTEMS
275119 SOUND MASKING SYSTEMS

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY
281300 ACCESS CONTROL
281600 INTRUSION DETECTION
282300 VIDEO SURVEILLANCE
285100 SECURITY INTERCOMMUNICATIONS SYSTEM

END OF TABLE OF CONTENTS

REVISIONS		
NO.	DATE	DESCRIPTION
BOLD UNDERLINE = LATEST REVISION UNDERLINE = PREVIOUS REVISION(S)		

Designer Note: This document is an outline version specification only to be used as a minimum guide and is Not for Construction. The Designer shall provide construction specifications for the project as required in coordination with Yale IT.

OUTLINE SECTION 270000 - GENERAL COMMUNICATIONS PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Project Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Scope of Work.
2. Intent of Drawings.
3. Pre-Bid Site Visit.
4. Definitions.
5. General Standards of Materials.
6. Products and Substitutions.
7. Applicable Codes.
8. Guarantees and Certificates.
9. Quiet Operation and Vibration Control.
10. Temporary Shutdown of Existing Systems.
11. Coordination.
12. Shop Drawings, Product Data, and Samples.
13. Owner Instruction.

1.3 SCOPE OF WORK

A. The scope of the work included under Division 27 of the specifications shall include complete systems as shown in the Contract Documents and specified herein. Any work reasonably inferable or required to result in a complete installation or the intended operation and performance of the systems, shall be included in the Base Bid except where there is specific reference to exclusion and incorporation in other quotations.

B. A brief written Scope of Work appears in Division 01.

C. Contractor shall be solely responsible for all parts, labor, testing, documentation and all other processes and physical apparatus necessary to turn over the completed cabling system and associated infrastructure fully warranted and operational for acceptance by the Owner.

D. Provide the telecommunication system conduit (with pull string), boxes, cable tray, and raceways in complete accordance with the specifications and the information found on the drawings.

E. This section specifies work to be provided by the network communications contractor, to include furnishing and installation of cabling, jacks, terminal blocks and terminations.

Installation of communications cabling and performing any terminations in the MDF or IDF closets and at all room voice and data jacks will be the responsibility of this cabling contractor.

F. This specification includes structured cabling design considerations, product specifications and installation guidelines for low-voltage network systems and associated infrastructure including, but not limited to:

1. Horizontal Copper
2. Intrabuilding Backbone Cabling
3. Interbuilding Backbone Cabling
4. Telecommunications Pathways
5. Communications Racks and Cable Managers
6. Communications Grounding Systems
7. Cabling Labeling and Administration
8. Audiovisual Systems Infrastructure
9. Security Systems Infrastructure

1.4 QUALITY ASSURANCE

1.5 INTENT OF DRAWINGS

1.6 PRE-BID SITE VISIT

1.7 DEFINITIONS

1.8 GENERAL STANDARDS OF MATERIALS

1.9 PRODUCTS AND SUBSTITUTIONS

1.10 APPLICABLE REGULATORY REFERENCES AND CODES

1.11 GUARANTEES AND CERTIFICATES

1.12 QUIET OPERATION AND VIBRATION CONTROL

1.13 TEMPORARY SHUTDOWN OF EXISTING SYSTEMS

1.14 COORDINATION

1.15 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

1.16 RECORD DRAWING DOCUMENTATION

1.17 OWNER INSTRUCTION

END OF SECTION 270000

REVISIONS		
NO.	DATE	DESCRIPTION

Bold Underline = Latest Revision
Underline = Previous Revision(s)

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OUTLINE SECTION 270500 - COMMON WORK FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Project Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

1.3 DEFINITIONS

1.4 SUBMITTALS

1.5 EXCAVATING AND BACKFILLING

1.6 WATERPROOFING

1.7 WEATHERPROOFING LOCATIONS (WP)

1.8 CUTTING AND PATCHING

1.9 ACCESSIBILITY

1.10 PAINTING

1.11 EQUIPMENT FOUNDATIONS, SUPPORTS, PIERS AND ATTACHMENTS

1.12 CLEANING, PROTECTING AND ADJUSTING

1.13 SPECIAL TOOLS

1.14 WELDING

1.15 COMMON REQUIREMENTS FOR COMMUNICATIONS INSTALLATION

1.16 FIRESTOPPING

1.17 DUST, DIRT AND NOISE

END OF SECTION 270500

REVISIONS		
NO.	DATE	DESCRIPTION
Bold Underline = Latest Revision Underline = Previous Revision(s)		

Designer Note: This document is an outline version specification only to be used as a minimum guide and is Not for Construction. The Designer shall provide construction specifications for the project as required in coordination with Yale IT.

OUTLINE SECTION 270526 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Project Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Grounding conductors.
2. Grounding connectors.
3. Grounding busbars.
4. Grounding labeling.

1.3 DEFINITIONS

1.4 ACTION SUBMITTALS

1.5 INFORMATIONAL SUBMITTALS

1.6 CLOSEOUT SUBMITTALS

1.7 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Comply with TIA-607-D Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises and BICSI Telecommunications Distribution Methods Manual, latest edition for grounding and bonding installation and methods.

2.2 CONDUCTORS

2.3 CONNECTORS

2.4 GROUNDING BUSBARS

2.5 GROUND RODS

2.6 IDENTIFICATION

PART 3 - EXECUTION

3.1 EXAMINATION

3.2 INSTALLATION

3.3 APPLICATION

3.4 GROUNDING BUSBARS

3.5 CONNECTIONS

3.6 IDENTIFICATION

3.7 FIELD QUALITY CONTROL

END OF SECTION 270526

REVISIONS		
NO.	DATE	DESCRIPTION
Bold Underline = Latest Revision Underline = Previous Revision(s)		

Designer Note: This document is an outline version specification only to be used as a minimum guide and is Not for Construction. The Designer shall provide construction specifications for the project as required in coordination with Yale IT.

OUTLINE SECTION 270528 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Project Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Optical-fiber-cable pathways and fittings.
4. Metal wireways and auxiliary gutters.
5. Nonmetallic wireways and auxiliary gutters.
6. Metallic surface pathways.
7. Nonmetallic surface pathways.
8. Boxes, enclosures, and cabinets.
9. Polymer-concrete handholes and boxes for exterior underground cabling.

B. Provide raceways as required for the following low voltage systems:

1. Data/Voice/Video Premise Wiring System
2. Audiovisual Cabling Systems
3. Security Systems

1.3 DEFINITIONS

1.4 ACTION SUBMITTALS

1.5 SUBMITTALS

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

2.2 NONMETALLIC CONDUITS AND FITTINGS

2.3 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

2.4 METAL WIREWAYS AND AUXILIARY GUTTERS

2.5 SURFACE METAL PATHWAYS

2.6 SURFACE NONMETALLIC PATHWAYS:

2.7 BOXES, ENCLOSURES, AND CABINETS

2.8 OPEN TOP CABLE SUPPORTS

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

A. Outdoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: IMC.
3. Underground Conduit: Type EPC-40-PVC.
4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R, Type 4.

B. Indoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: GRC. Pathway locations include the following:

    a. Loading dock.
    b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    c. Mechanical rooms.

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Damp or Wet Locations: IMC.
6. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical-fiber-cable pathway,EMT.
7. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: Riser-type, optical-fiber-cable pathway, EMT.

8. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: General-use, optical-fiber-cable pathway, Riser-type, optical-fiber-cable pathway, Plenum-type, optical-fiber-cable pathway, EMT.
9. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel units in damp or wet locations.

C. Minimum Pathway Size: 1 inch for optical-fiber cables.

D. Pathway Fittings: Compatible with pathways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

F. Install surface pathways only where indicated on Drawings.

G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. NECA/BICSI 568.
3. TIA-569-D.
4. NECA 101
5. NECA 102.
6. NECA 105.
7. NECA 111.

B. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

C. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

D. Comply with requirements in Section 270529 "Hangers and Supports for Communications Systems" for hangers and supports.

E. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.

F. Complete pathway installation before starting conductor installation.

G. Contractor shall size conduit large enough to accommodate at least 50% growth. I.e. conduit for 4 cables shall be sized to accommodate 6 cables at less than 40% calculated fill based on cable OD.

H. Interior cable pathways shall utilize 4 inch conduits as connecting points to the communications rooms unless space constraints prevent installation.

I. Additional conduit to the communications rooms shall be installed to provide a 4 to 1 ratio of 40% full conduit to a single empty conduit for future use.

J. Coordinate exact location of backboxes with Architectural drawings prior to installation of raceways and backboxes and before construction of walls and floors.

K. Recessed wall outlet backboxes shall be double ganged, 4 11/16” x 4 11/16” x 2 1/8” minimum size. Provide trim ring on outlet box as required for specific wall construction and size of faceplate.

L. Do not install any Division 27 raceway or conduit below slab on grade unless shown or stated otherwise or approved by the Engineer.

M. Each telecommunication system wall outlet shall have a dedicated outlet box and not be ganged together with power receptacles unless otherwise stated.

N. Do not “daisy-chain” conduit between outlet back boxes for data/voice/video systems unless otherwise stated in specific cases.

O. Coordinate the length and routing of raceway runs to meet cabling length requirements of TIA/EIA 568/569 Standards.

P. Arrange stub-ups so curved portions of bends are not visible above finished slab.

Q. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.

R. Conceal rigid conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

S. Support conduit within 12 inches of enclosures to which attached.

T. Pathways Embedded in Slabs:

1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot intervals.
2. Arrange pathways to cross building expansion joints at right angles with expansion fittings. Comply with requirements for expansion joints specified in this article.
3. Arrange pathways to keep a minimum of 2 inches of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
5. Change from nonmetallic conduit and fittings to RNC and fittings before rising above floor.

U. Stub-ups to Above Recessed Ceilings (only where exposed cable installation is permitted):

1. Use EMT, IMC, or RMC for pathways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

V. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.

W. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.

X. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.

Y. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus one additional quarter-turn.

Z. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure, to assure a continuous ground path.

AA. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.

BB. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Secure pull wire, so it cannot fall into conduit. Cap pathways designated as spare alongside pathways in use.

CC. Surface Pathways:

1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.
2. Install surface pathway with a minimum 2-inch radius control at bend points.
3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

DD. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:

1. 3/4-Inch Trade Size and Smaller: Install pathways in maximum lengths of 50 feet.
2. 1-Inch Trade Size and Larger: Install pathways in maximum lengths of 75 feet.
3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

EE. Install pathway-sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway-sealing fittings according to NFPA 70.

FF. Install devices to seal pathway interiors at accessible locations. Locate seals, so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service pathway enters a building or structure.
3. Where otherwise required by NFPA 70.

GG. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.

HH. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC that is located where environmental temperature change may exceed 100 deg F, and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

    a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
    d. Attics: 135 deg F temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

II. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

JJ. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

KK. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.

LL. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

MM. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

NN. Set metal floor boxes level and flush with finished floor surface.

OO. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 OPEN TOP CABLE SUPPORTS

A. Size to allow a minimum of 50 percent future capacity without exceeding design capacity limits.

B. Do not use ceiling grid support wire or support rods.

C. Hook spacing shall allow no more than 6 inches of slack. The lowest point of the cables shall be no less than 6 inches adjacent to ceilings, mechanical ductwork and fittings, luminaires, power conduits, power and telecommunications outlets, and other electrical and communications equipment.

D. Space hooks no more than 4 feet o.c.

E. Provide a hook at each change in direction

3.4 FIRESTOPPING

3.5 PROTECTION

END OF SECTION 270528

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OUTLINE SECTION 270529 - HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Project Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Steel slotted support systems for communication raceways.
2. Aluminum slotted support systems for communication raceways.
3. Nonmetallic slotted support systems for communication raceways.
4. Conduit and cable support devices.
5. Support for conductors in vertical conduit.
6. Structural steel for fabricated supports and restraints.
7. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
8. Fabricated metal equipment support assemblies.

1.3 ACTION SUBMITTALS

1.4 INFORMATIONAL SUBMITTALS

1.5 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

PART 3 - EXECUTION

3.1 APPLICATION

3.2 SUPPORT INSTALLATION

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

3.4 PAINTING

END OF SECTION 270529

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OUTLINE SECTION 270534 FLOOR BOXES FOR ELECTRICAL AND COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract including Project Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SCOPE

A. The floor box provides the interface between power and communication cabling in a concrete floor, and the workstation where both power and communication device outlets are required. The box provides recessed device outlets that will not obstruct the floor area.

B. These poke-thru devices provide the interface between power, communication and audio/ visual (A/V) cabling in an above grade concrete floor and the workstation or activation location where power communication and/or A/V device outlets are required. These poke-thru devices provide recessed device outlets that will not obstruct the floor area.

1.3 CLASSIFICATION AND USE

PART 2 - PRODUCTS

2.1 MANUFACTURER

2.2 FLOOR BOXES

A. Classification and Use: Floor boxes shall have been examined and tested by Underwriters Laboratories Inc. to meet UL514A and UL514C. Floor boxes shall also conform to the standards set in Section 300-21 of the National Electrical Code. Floor boxes shall meet UL scrub water requirements, but are not suitable for wet or damp locations, or other areas subject to saturation with water or other liquids. Floor boxes shall also have been evaluated by UL to meet the applicable U.S. and Canadian safety standards for scrub water exclusion when used on tile, bare concrete, terrazzo, wood, and carpet covered floors. Floor boxes shall be suitable for use in air handling spaces in accordance with Section 300-22 (C) of the National Electrical Code.

2.3 POKE THROUGH

A. Poke-Thru Assembly

B. Activation Cover

C. Communication Modules Mounting Accessories

PART 3 - EXECUTION

3.1 INSTALLATION

A. Floor Boxes

1. The floor box shall contain four leveling legs to provide full pre-concrete pour adjustment. Additionally, the box shall ship with a disposable cover to prevent the entry of debris during the construction phase. Alternate disposable covers to provide terrazzo pour stops is to be available from the manufacturer. The floor box shall be warranted for one year from the date of final acceptance.

2. Provide conduits to the floor box for various services as required.

3. Field verify final location of all floor boxes.

4. Provide lid activation covers of type, finish, and configuration as required. Final configuration shall be approved by the Architect.

5. Provide finished flooring material within recessed areas of the lid activation covers designed to accept finished flooring. The finished flooring shall match the surrounding floor finishes. Coordinate with the flooring contractor.

6. Provide additional supplemental support for the floor box as needed to securely set it at the proper elevation prior to pour.

7. The contractor shall identify the final finished floor type prior to installation. Consult with the manufacturer for directions and elevations for installing the floor box with that type of floor finish. Provide the complete installation as required for that finished floor type.

8. Provide device brackets for mounting power and communications devices and jacks. Coordinate with the Architect for the final configurations and types required for each floor box. The Contractor shall provide any configuration and type required.

9. Provide floor box lids (activation covers) for every floor box. Coordinate with the Architect for the final lid configuration and type required for each floor box. The contractor shall provide any configuration and type required.

B. Poke Throughs

1. The poke through use is defined by the UL Fire Resistance Directory as a minimum spacing of 2 ft. [610mm] on center and not more than one device per each 65 sq. ft. [6m2] of floor area in each span."

2. Installation shall be completed by pushing unit down into the cored hole. Prior to and during installation, refer to system layout and/or approval drawings. Installer shall comply with detailed manufacturer's instruction sheet included with each device. The unit shall contain a retainer for securing the device in the slab, as well as the necessary intumescent material to seal the cored-hole under fire conditions.

3. Provide conduits to the poke throughs for various services as required.

4. Field verify final location of all poke throughs.

5. Provide lid activation covers of type, finish, and configuration as required. Final configuration shall be approved by the Architect.

6. Provide additional supplemental support for the poke through as needed to securely set it at the proper elevation.

7. The contractor shall identify the final finished floor type prior to installation. Consult with the manufacturer for directions and elevations for installing the floor box with that type of floor finish. Provide the complete installation as required for that finished floor type.

8. Provide device brackets for mounting power and communications devices and jacks. Coordinate with the Architect for the final configurations and types required for each floor box. The Contractor shall provide any configuration and type required.

9. Provide activation covers for every poke through. Coordinate with the Architect for the final lid configuration and type required for each floor box. The contractor shall provide any configuration and type required.

3.2 CLEANING AND PROTECTION

A. Clean exposed surfaces using non-abrasive materials and methods recommended by manufacturer.

B. Protect boxes until acceptance.

END OF SECTION 270534

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OUTLINE SECTION 270536 - CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Wire-mesh cable tray.
2. Cable runway
3. Cable tray accessories.
4. Warning signs.

1.3 REFERENCES

1.4 ACTION SUBMITTALS

1.5 INFORMATIONAL SUBMITTALS

1.6 QUALITY ASSURANCE

1.7 DELIVERY, STORAGE, AND HANDLING

1.8 PROJECT CONDITIONS

1.9 COORDINATION

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR CABLE TRAYS

2.2 GENERAL REQUIREMENT FOR CABLE TRAY

2.3 WIRE-MESH CABLE TRAY

A. Cable tray shall consist of continuous, rigid, welded steel wire mesh cable management system, to allow continuous ventilation of cables and maximum dissipation of heat, with UL Classified splices where tray acts as Equipment Grounding Conductor (EGC). Wire mesh cable tray will have continuous T-welded top side wire to protect cable insulation and installers.

1. Cable tray systems shall include, but are not limited to, straight sections, supports and accessories.
2. Provide splices, supports, and other fittings necessary for a complete, continuously grounded system.

    a. Mesh: 2 by 4 inches.
    b. Straight Section Lengths: 118 inches.
    c. Wire Diameter: Patented design includes varying wire sizes to meet application load requirements; to optimize tray strength; and to allow tray to remain lightweight.
    d. Fittings: Wire mesh cable tray fittings shall be field-fabricated from straight tray sections, in accordance with manufacturer's instructions.
    e. Tape: Painted wire mesh cable tray to include metallic conductive UL tape.

3. Wire-Basket Depth: 4-inch usable loading depth, unless otherwise indicated on the drawings.
4. Length: Cable tray section length shall be 118.1 inches unless otherwise shown on drawings.
5. Cable Tray Material: Carbon steel wire, ASTM A 510, Grade 1008. Wire welded, bent, and surface treated after manufacture.

    a. Electrodeposited Zinc Plating: ASTM B 633, Type III, SC-1.

6. Load Span Criteria:

    a. Install and support cable management system in accordance with NEMA VE-1, with Safety Factor of 1.5.

7. Fittings/Supports: Wire mesh cable tray fittings are field-fabricated from straight tray sections, in accordance with manufacturer's instructions. Supports shall include the FAS (Fast Assembly System) where possible so that screws, bolts, and additional tools are not required for cable tray mounting to reduce installation time; and tray path can adapt to installation obstacles without the need for additional parts. Place supports so that support span does not exceed that shown on the drawings and is capable of supporting total fill capacity loading.

    a. Ceiling-mounted supports mount to ceiling structure directly or with threaded rod sized for total fill capacity.
    b. Wall-mounted supports.
    c. Splices, including those approved for electrical continuity (bonding), as recommended by cable tray manufacturer.

8. Cable tray shall consist of continuous, rigid, welded steel wire mesh cable management system, to allow continuous ventilation of cables and maximum dissipation of heat, with UL Classified splices where tray acts as Equipment Grounding Conductor (EGC).

    a. Cable tray systems shall include, but are not limited to, straight sections, supports and accessories.
    b. Configuration: Wires are formed into a standard 2 inches by 4 inches (50 by 100 mm) wire mesh pattern with intersecting wires welded together. Mesh sections shall have at least one bottom longitudinal wire along entire length of section.
    c. Materials: High-strength-steel longitudinal wires with "T" weld.
    d. Safety Provisions: Wire ends along wire-basket sides (flanges) rounded during manufacturing to maintain integrity of cables and installer safety.
    e. Straight sections shall be furnished in standard 118.1 inches lengths.

9. Connector Assemblies: Listed Snap in couplers or factory assembled bolted couplers that mechanically join adjacent tray wires to splice sections together or to create horizontal fittings.
10. Hardware and Fasteners:

    a. ASTM F 593 and ASTM F 594 stainless steel, Type 316.
    b. Steel, zinc plated according to ASTM B 633.

11. Steel Material: Straight section and fitting side rails and rungs shall comply with the minimum mechanical properties of ASTM A 1008/A 1008M.
12. Steel Tray Splice Plates: ASTM A 1008/A 1008M.
13. Fasteners: Steel complies with the minimum mechanical properties of ASTM A 510/A 510M, Grade 1008.
14. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.4 TELECOMMUNICATIONS ROOM CABLE RUNWAY

A. Size: 1.5 inches high by 0.4 inches wide high tubular steel with 0.065 inch wall thickness.

B. Stringers: 9 feet 11-1/2 inches long.

C. Cross Members: Welded in between stringers on 12 inch intervals/centers beginning 5-3/4 inches with 10 cross members per ladder rack. Open space of 10-1/2 inches between each cross member.

D. Finish and Color: Powder coat paint in black.

E. Provide width as shown on the drawings.

F. Supports shall be positioned as recommended by manufacturer and anchored to the building structure.

G. Cable runway shall be steel and meet ASTM A570.

H. Cable runway shall be finished black.

I. Bond each cable runway joint with a UL listed grounding device and ground tray according to manufacturer's recommendations to maintain UL and NEC grounding requirements and listings.

J. Cable runway shall have UL listing.

2.5 CABLE TRAY ACCESSORIES

A. Horizontal 90° Turns

B. Vertical-To-Horizontal 90° Turns

C. Horizontal-To-Vertical 90° Turns

D. Corner Brackets

E. Splices

F. Grounding Kit

G. Ladder Rack Supports

H. Foot Kit

I. Threaded Ceiling Kit

J. Center Support Kit

K. Rack-to-Runway Mounting Plate

L. Cable Runway Elevation Kit

M. Vertical Wall Brackets.

N. Tool-less Pathway Dividers

O. Cable Retaining Post.

P. Cable Runway Protective End Caps.

Q. Touch-Up Paint: Spray Can in black.

2.6 WARNING SIGNS

2.7 SOURCE QUALITY CONTROL

PART 3 - EXECUTION

3.1 CABLE TRAY INSTALLATION

A. Install cable trays according to NEMA VE 2.

B. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.

C. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.

D. Remove burrs and sharp edges from cable trays.

E. Join aluminum cable tray with splice plates; use four square neck-carriage bolts and locknuts.

F. Fasten cable tray supports to building structure.

G. Place supports so that spans do not exceed maximum spans on schedules and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.

H. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.

I. Support bus assembly to prevent twisting from eccentric loading.

J. Locate and install supports according to NEMA VE 2. Do not install more than one cable tray splice between supports.

K. Support wire-basket cable trays with trapeze hangers and wall brackets.

L. Support trapeze hangers for wire-basket trays with 3/8-inch- (10-mm-) diameter rods.

M. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.

N. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed dimensions recommended in NEMA VE 2. Space connectors and set gaps according to applicable standard.

O. Make changes in direction and elevation using manufacturer's recommended fittings.

P. Make cable tray connections using manufacturer's recommended fittings.

Q. Seal penetrations through fire and smoke barriers.

R. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.

S. Install cable trays with enough workspace to permit access for installing cables.

T. Install warning signs in visible locations on or near cable trays after cable tray installation.

3.2 CABLE TRAY GROUNDING

3.3 CABLE INSTALLATION

A. Install cables only when each cable tray run has been completed and inspected.

B. Fasten cables on horizontal runs with cable clamps or cable ties according to NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.

C. Fasten cables on vertical runs to cable trays every 18 inches (450 mm).

D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 72 inches (1800 mm).

3.4 CONNECTIONS

3.5 FIELD QUALITY CONTROL

3.6 PROTECTION

END OF SECTION 270536

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OUTLINE SECTION 270543 - UNDERGROUND PATHWAYS AND STRUCTURES FOR COMMUNICATION SYSTEMS

1.1 STANDARD

A. Comply with TIA-569-C and TIA-758-C.

1.2 COMPONENTS

A. Metal conduits and fittings.

B. Rigid nonmetallic duct.

C. Flexible nonmetallic duct.

D. Duct accessories, including rigid and fabric innerduct.

E. Precast concrete handholes and boxes.

F. Handholes and Boxes Other Than Precast Concrete:

G. Precast and Cast-in-place concrete manholes.

H. Utility Structure Accessories:

1. Iron frames and covers.
2. Chimney components.
3. Sump frame and grate.
4. Pulling eyes.
5. Pulling-in and lifting irons.
6. Bolting inserts for concrete utility structure cable racks and other attachments.
7. Ground rod sleeve.
8. Expansion anchors.
9. Cable rack assemblies.
10. Fixed ladders.

1.3 SOURCE QUALITY CONTROL

END OF SECTION 270543

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OUTLINE SECTION 270544 - SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND CABLING

1.1 ROUND SLEEVES

A. Steel Pipe Sleeves Description: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated steel, plain ends and integral waterstop.

B. Wall Sleeves, Cast Iron:

1. Description: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop.

C. Sheet Metal Sleeves, Galvanized Steel, Round:

1.2 RECTANGULAR SLEEVES

A. Sheet Metal Sleeves, Galvanized Steel, Rectangular:

1.3 ENGINEERED THROUGH PENETRATION FIRESTOP SLEEVES

A. Classification and Use

1. The fire-rated pathway shall contain a built-in fire sealing system sufficient to maintain the hourly fire rating of the barrier being penetrated. The self-contained sealing system shall adjust to the installed cable loading and shall permit cables to be installed, removed, or retrofitted without the need to remove or reinstall firestop materials.

2. The firestop device for use in through-penetration firestop systems shall have been examined and tested by Underwriters Laboratories Inc. to UL1479 (ASTM E 814) and bear the U.S. UL Classification Mark.

3. The device shall be classified for use in one-, two-, three-, and four-hour rated gypsum, concrete and block walls. The device shall be classified for use in one-, two-, and three-hour rated concrete floors having a minimum 4 1/2" (114mm) thick reinforced lightweight or normal weight (100-150 pcf) (1600-2400 kg/m3). The devices shall also been tested by Underwriters Laboratories Inc. to UL2043 and determined to be suitable for use in air handling spaces.

4. For retrofit applications where no conduit is installed in the wall to protect existing cables, split conduit assembly should be used to protect cables. After installing the split conduit within the wall, a wall plate should be installed to cover any irregularly shaped hole cut in the wall. The firestop device is then installed onto the conduit.

1.4 ENGINEERED SMOKE AND ACOUSTICAL SLEEVES

A. The smoke and acoustical sleeve shall be used to maintain an effective barrier against the spread of smoke and hot gases, and to restore the STC rating in through penetrations in non-fire rated wall and floor assemblies.

B. The smoke and acoustical sleeve pathway shall permit cables to penetrate nonrated walls and floors without the need for smoke sealing. Cables shall be easily added or removed at any time without the need to remove or reinstall caulking materials.

1.5 SLEEVE SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable or between pathway and cable.

1. Sealing Elements: [**EPDM**] [**Nitrile (Buna N)**] rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: [**Carbon steel**] [**Fiber-reinforced plastic**] [**Stainless steel**].
3. Connecting Bolts and Nuts: [**Carbon steel, with corrosion-resistant coating,**] [**Stainless steel**] of length required to secure pressure plates to sealing elements.

1.6 GROUT

1.7 POURABLE SEALANTS

1.8 FOAM SEALANTS

1.9 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Communications penetrations occur when raceways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, fire-rated floor, or wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

F. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.

G. Seal space outside of sleeves with grout for penetrations of concrete and masonry

1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

H. Interior Penetrations of Non-Fire-Rated Walls and Floors

1. Provide fabricated steel sleeves of diameter required for penetrations through walls and floors. Seal annular space between sleeve and wall, using joint sealant appropriate for size, depth, and location of joint.

2. Provide re-enterable sealant suitable for cabling systems and plenum environments within the annular space between the sleeve and cabling bundle.

3. Where shown on the drawings, provide Engineered Smoke & Acoustic Sleeves in lieu of fabricated steel sleeves to serve cable bundle penetrations through walls and floors.

I. Fire-Rated-Assembly Penetrations

1. Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations.

2. Install sleeves and seal raceway and cable penetration sleeves with firestop materials.

3. Provide non-curing, re-penetrable, intumescent firestop materials around communications cable trays or ladder racks penetrating through a fire rated wall.

4. Where shown on the drawings, provide Engineered Through Penetration Fire Stop Sleeves in lieu of fabricated steel sleeves to serve cable bundle penetrations through walls and floors.

J. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

K. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

L. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

END OF SECTION 270544

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OUTLINE SECTION 270553 - IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

1.1 PRODUCTS

A. Labels:

1. Vinyl wraparound labels.
2. Snap-around labels.
3. Self-Adhesive Wraparound Labels: flexible labels with pressure-sensitive adhesive.
4. Self-Adhesive Labels: multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels.

B. Bands and Tubes:

1. Snap-around color-coding bands.

C. Underground-line warning tape.

D. Signs:

1. Baked-enamel signs.
2. Metal-backed butyrate signs.
3. Laminated acrylic or melamine plastic signs.

E. Cable Ties:

1. General-purpose cable ties.
2. UV-stabilized cable ties.
3. Plenum-rated cable ties.

END OF SECTION 270553

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OUTINE SECTION 271100 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Project Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Telecommunications mounting elements.
2. Backboards.
3. Telecommunications equipment racks.
4. Grounding.

B. Related Requirements:

1. Section 270536 "Cable Trays for Communications Systems" for cable trays and accessories.
2. Section 271513 "Communications Copper Horizontal Cabling" for copper data cabling associated with system panels and devices.

C. The intent of this section is to furnish of all necessary labor, supervision, materials, and equipment to fit out all Telecommunication rooms/spaces as shown on the drawings.

D. Provide cable supports, pull boxes, tube supports, fiber distribution units and accessories in telecommunication room/spaces (as indicated on drawings).

E. Provide plywood backboards as required to support newly installed equipment. Anchors for plywood will be sufficient to support equipment apparatus, with attaching hardware flush or not protruding out from the plywood surface.

F. Provide equipment racks, grounding and all necessary hardware in the room to support the low voltage systems.

G. Contractor shall modify rooms and rack equipment to install new equipment with approval from the Owner or Owners Representative prior to installation.

H. Communication grounding and bonding shall be in accordance with applicable codes and regulations. The requirements of TIA-607D shall be observed throughout the entire cabling system.

1.3 DEFINITIONS

1.4 ACTION SUBMITTALS

1.5 INFORMATIONAL SUBMITTALS

1.6 QUALITY ASSURANCE

1.7 RECORD DOCUMENTS

PART 2 - PRODUCTS

2.1 BACKBOARDS

2.2 RACKS/CABINETS

2.3 GROUNDING

2.4 LABELING

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

3.2 INSTALLATION

A. Comply with NECA 1.

B. Comply with BICSI's "Telecommunications Distribution Methods Manual" for layout of communications equipment spaces.

C. Comply with BICSI's "Information Technology Systems Installation Methods Manual" for installation of equipment in communications equipment spaces.

D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

E. Coordinate layout and installation of communications equipment in tracks and in room. Coordinate service entrance configuration with service provider.

1. Meet jointly with systems providers, equipment suppliers, and Owner to exchange information and agree on details of equipment configurations and installation interfaces.
2. Record agreements reached in meetings and distribute them to other participants.
3. Adjust configurations and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize configurations and space requirements of communications equipment.
4. Adjust configurations and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in equipment room.

F. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

G. Backboards:

1. Install from 6 inches to 8 feet, 6 inches above finished floor UON. Ensure that fire-rating stamp is visible after installation. Do not paint plywood backboards.
2. Comply with requirements for backboard installation in BICSI's "Information Technology Systems Installation Methods Manual" and TIA-569-D.

3.3 GROUNDING

3.4 IDENTIFICATION

3.5 FIRESTOPPING

END OF SECTION 271100

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OUTLINE SECTION 271313 - COMMUNICATIONS COPPER BACKBONE CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1.2 SUMMARY

A. Section Includes:

1. High-count Category 3 twisted pair cable for intrabuilding and interbuilding backbones.
2. Grounding provisions for twisted pair cable.
3. Cabling identification.
4. Source quality control requirements for twisted pair cable.

1.3 DEFINITIONS

1.4 COPPER BACKBONE CABLING DESCRIPTION

A. Copper backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

B. Copper backbones rated for intrabuilding and interbuilding outside plant applications shall be required.

C. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.5 ACTION SUBMITTALS

1.6 INFORMATIONAL SUBMITTALS

1.7 CLOSEOUT SUBMITTALS

1.8 QUALITY ASSURANCE

1.9 DELIVERY, STORAGE, AND HANDLING

1.10 PROJECT CONDITIONS

1.11 COORDINATION

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 GENERAL CABLE CHARACTERISTICS

2.3 INTRABUILDING HIGH-COUNT CATEGORY 3 TWISTED PAIR CABLE

2.4 TWISTED PAIR CABLE HARDWARE

2.5 CABLING IDENTIFICATION

2.6 GROUNDING

2.7 SOURCE QUALITY CONTROL

PART 3 - EXECUTION

3.1 WIRING METHODS

3.2 INSTALLATION OF PATHWAYS

3.3 INSTALLATION OF COPPER BACKBONE CABLES

3.4 TERMINATION

3.5 FIRESTOPPING

3.6 GROUNDING

3.7 IDENTIFICATION

3.8 FIELD QUALITY CONTROL

3.9 WARRANTY

END OF SECTION 271313

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OUTLINE SECTION 271323 - OPTICAL FIBER BACKBONE CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1.2 SUMMARY

A. Section Includes:

1. Optical Fiber Backbone Cabling
2. Air Blown Fiber Optic System
3. Optical Fiber Connectors
4. Optical Fiber Termination Cabinets
5. Optical Fiber Splices

1.2 DEFINITIONS

1.3 ACTION SUBMITTALS

1.4 INFORMATIONAL SUBMITTALS

1.5 CLOSEOUT SUBMITTALS

1.6 QUALITY ASSURANCE

1.7 DELIVERY, STORAGE, AND HANDLING

1.8 PROJECT CONDITIONS

1.9 COORDINATION

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.2 OPTICAL FIBER BACKBONE CABLES

2.3 AIR BLOWN FIBER OPTIC SYSTEM

2.4 OPTICAL FIBER CONNECTORS

2.5 OPTICAL FIBER TERMINATION CABINETS

2.6 OPTICAL FIBER SPLICES

PART 3 - EXECUTION

3.1 GENERAL

3.2 WIRING METHODS

3.3 INSTALLATION OF PATHWAYS

3.4 INSTALLATION OF COPPER BACKBONE CABLES

3.5 TERMINATION

3.6 FIRESTOPPING

3.7 GROUNDING

3.8 IDENTIFICATION

3.9 FIELD QUALITY CONTROL

3.10 WARRANTY

END OF SECTION 271323

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OUTLINE SECTION 271513 - COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1.2 SUMMARY

A. Section Includes:
   1. Category 6 twisted pair cable.
   2. Category 6a twisted pair cable.
   3. Twisted pair cable hardware, including plugs and jacks.
   4. Cable management system.
   5. Cabling identification products.
   6. Grounding provisions for twisted pair cable.
   7. Source quality control requirements for twisted pair cable.

B. This document describes the products and execution requirements relating to furnishing and installing Telecommunications Cabling. The intent of this section is to define the requirements for the installation of a gigabit copper-cabling infrastructure.

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

D. All cables and related terminations, support and grounding hardware shall be furnished, installed, wired, tested, labeled, and documented by the Telecommunications contractor.

E. The horizontal cabling system shall extend from a Telecommunication room located on the floor, or the floor above/below to the information outlet location.

F. 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.

G. Install the cabling plant constructed in a physical star topology. Serve information outlets from Telecommunication Rooms (TR) by means of unshielded twisted pair (UTP) Category 6 & 6A copper, and terminate per 568B pin configuration. Some locations may exceed beyond the standard 90 meter installation, for these locations the Contractor will use the manufacturer warranted cable solution as specified.

H. Outlets shall generally consist of reuse of existing device box/ conduits. All UTP cable, information jacks and the faceplates shall be new. In some locations and where permitted by code the Contractor can install box eliminators and/or surface raceway and boxes.

I. All horizontal cabling will terminate on rack mounted patch panels in the Telecommunication Room.

1.3 DEFINITIONS

1.4 COPPER HORIZONTAL CABLING DESCRIPTION

1.5 ADMINISTRATIVE REQUIREMENTS

1.6 ACTION SUBMITTALS

1.7 INFORMATIONAL SUBMITTALS

1.8 CLOSEOUT SUBMITTALS

1.9 QUALITY ASSURANCE

1.10 WARRANTY

1.11 DELIVERY, STORAGE, AND HANDLING

1.12 PROJECT CONDITIONS

1.13 COORDINATION

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 GENERAL CABLE CHARACTERISTICS

2.3 CATEGORY 6 TWISTED PAIR CABLE

2.4 INDOOR/OUTDOOR RATED CATEGORY 6 TWISTED PAIR CABLE

2.5 CATEGORY 6A TWISTED PAIR CABLE (Wireless Access Points)

2.6 TWISTED PAIR CABLE HARDWARE

A. Patch Panel

B. Patch Cords

C. Plugs and Plug Assemblies

D. Jacks and Jack Assemblies

E. Faceplates

2.7 IDENTIFICATION PRODUCTS

2.8 GROUNDING

2.9 SOURCE QUALITY CONTROL

PART 3 - EXECUTION

3.1 WIRING METHODS

3.2 INSTALLATION OF PATCH CORDS

3.3 INSTALLATION OF PATHWAYS

3.4 INSTALLATION OF TWISTED-PAIR HORIZONTAL CABLES

3.5 FIRESTOPPING

3.6 GROUNDING

3.7 IDENTIFICATION

3.8 FIELD QUALITY CONTROL

END OF SECTION 271513

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OUTLINE SECTION 271523 - COMMUNICATIONS OPTICAL FIBER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1.2 SUMMARY

A. Section Includes:

1. 62.5/125-micrometer, multimode, optical fiber cable (OM1).
2. 850 nanometer laser-optimized 50/125 micrometer multimode optical fiber cable (OM3).
3. 850 nanometer laser-optimized 50/125 micrometer multimode optical fiber cable (OM4).
4. 9/125 micrometer, single-mode, indoor-outdoor optical fiber cable (OS2).
5. Optical fiber cable connecting hardware, patch panels, and cross-connects.
6. Grounding.
7. Cabling identification products.

1.3 DEFINITIONS

1.4 OPTICAL FIBER HORIZONTAL CABLING DESCRIPTION

A. Optical fiber horizontal cabling system shall provide interconnections between MDT's/IDT's, and the equipment outlet in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.

1. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the equipment outlet.
2. Bridged taps and splices shall not be installed in the horizontal cabling.

B. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.

1.5 ACTION SUBMITTALS

1.6 INFORMATIONAL SUBMITTALS

1.7 CLOSEOUT SUBMITTALS

1.8 QUALITY ASSURANCE

1.9 DELIVERY, STORAGE, AND HANDLING

1.10 PROJECT CONDITIONS

1.11 COORDINATION

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 62.5/125-MICROMETER, MULTIMODE, OPTICAL FIBER CABLE (OM1)

2.3 850 NANOMETER LASER-OPTIMIZED, 50/125 MICROMETER, MULTIMODE OPTICAL FIBER CABLE (OM3)

2.4 850 NANOMETER LASER-OPTIMIZED, 50/125 MICROMETER, MULTIMODE OPTICAL FIBER CABLE (OM4)

2.5 9/125 MICROMETER, SINGLE-MODE, INDOOR-OUTDOOR OPTICAL FIBER CABLE (OS2)

2.6 OPTICAL FIBER CABLE HARDWARE

A. Cross-Connects and Patch Panels

B. Patch Cords

C. Connector Type

D. Plugs and Plug Assemblies

E. Jacks and Jack Assemblies:

F. Faceplate:

2.7 GROUNDING

2.8 IDENTIFICATION PRODUCTS

2.9 SOURCE QUALITY CONTROL

PART 3 - EXECUTION

3.1 WIRING METHODS

3.2 INSTALLATION OF OPTICAL FIBER BACKBONE CABLES

3.3 FIRESTOPPING

3.4 GROUNDING

3.5 IDENTIFICATION

3.6 FIELD QUALITY CONTROL

3.7 WARRANTY

END OF SECTION 271523

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OUTLINE SECTION 272000 – TWO-WAY COMMUNICATION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1.2 GENERAL DESCRIPTION

A. "Areas of Rescue Assistance" are mandated by the Americans With Disabilities Act (ADA) as a means of providing greater safety to people with disabilities in case of an emergency. An Area of Rescue Assistance system enables two-way communication between a rescue site, such as a stairwell or foyer, and a central command station, such as a main lobby, fire command station, or security office.

B. The Area of Rescue Assistance (ARA) system shall consist of a microprocessor-based Command Unit ARA Stations. This system shall meet the Federal Government's guidelines as an Areas of Rescue Assistance system under the ADA.

1.3 DEFINITIONS

1.4 ACTION SUBMITTALS

1.5 INFORMATIONAL SUBMITTALS

1.6 CLOSEOUT SUBMITTALS

1.7 QUALITY ASSURANCE

1.8 DELIVERY, STORAGE, AND HANDLING

1.9 PROJECT CONDITIONS

1.10 COORDINATION

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.2 OPERATIONAL DESCRIPTION

2.3 FUNCTIONALITY

A. Local Command Unit Phone

B. Call Routing

C. Visual Indicators (Monitoring Panel)

D. Visual Indicator (Strobe)

E. Audible Indicator (Sounder)

F. Call Stations

2.4 INTERFACES

2.5 POWER REQUIREMENTS

2.6 ENVIRONMENTAL

PART 3 - EXECUTION

3.1 INSTALLATION

3.2 WARRANTY

END OF SECTION 272000

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OUTLINE SECTION 275119 - SOUND MASKING SYSTEMS

1.1 QUALITY ASSURANCE

A. Quality Standards: NFPA 70, UL 813, and ASTM E1374.

1.2 PRODUCTS

A. Addressable Sound-Masking Systems: Networked with integrated controls, generators, and amplifiers.

1. Networked control panel with integral sound-masking generator.
2. Control software.

B. Zoned Sound-Masking Systems: Zoned sound-masking[**and paging**] system. Each zone consists of one loudspeaker control unit.

1. Loudspeaker control unit with integral sound-masking generator.

C. Local Sound-Masking Systems: Single-zone sound-masking[**and paging**] system.

1. Control unit with masking-sound generator and amplifiers.

D. Spot Sound-Masking System: Self-contained, plenum-mounted loudspeaker with sound-masking generator and controls.

E. Wire and Cable:

1. Category 6 balanced twisted pair cable and hardware.
2. Loudspeaker cable.
3. Control-circuit conductors.

1.3 INSTALLATION

A. Wiring Method: In raceways.

1. Except in accessible indoor ceiling spaces and attics.
2. Except in hollow gypsum board partitions.

END OF SECTION 275119

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OUTLINE SECTION 281300 – ACCESS CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Project Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. An access control system (ACS) is an electronic card reader system comprised of controllers, card readers and sensing device that manage the entrance and exit of people through secure areas.

B. The ACS shall be based upon distributed system architecture with local door controllers which communicate with an existing ACS server (AMAG). If there is a failure ta the network, the access control decisions may be made locally at the access control panel. Upon the network being restored, the stored alarms on the control panel could then be transmitted to the ACS server for storage and report writing.

C. The ACS shall utilize the campus issued identification (ID) cards.

D. This specification outlines the requirements for an integrated security management/access control system, including integrated subsystems providing VSS. All information herein is intended to present minimum standards of performance, quality and construction.

E. The intent of the ACS is to provide access control for selected portals and monitor the status of selected portals, equipped or not equipped with access control, through the use of electronic equipment.

F. The Security Contractor is responsible for coordinating the selection and installation of the security door hardware. As part of the submittal process, the Security Contractor shall generate a spreadsheet identifying all the doors to receive electronic security devices and validate that the door hardware submittal and doors submittal shall support the required security functions. Should a conflict in function be identified, the security contractor shall alert the Engineer and Architect. The security contractor shall be responsible to ensure that required security functions are met for each door location.

G. The Security Contractor shall be responsible for coordinating the installation with all other trades and shall provide final termination of all conductors, except as provided by the Electrical Contractor.

H. The Security Contractor shall provide complete initialization of the integrated ACS hardware and software. Security Contractor shall consult with Owner to determine Owner's requirements

prior to initialization. Security Contractor shall transfer and/or enter all data into the system databases, including complete hardware and software configuration, alarm point database, time zone database, employee cardholder database, reports configuration, device database, I/O database, guard tours, and any other required set-up.

I. The Security Contractor shall be responsible for coordinating the security requirements of this Section with all other trades.

J. The access control system (ACS) outlined in this section shall be an expansion of the existing operational ACS. The Security Contractor shall provide sufficient license needs to support the card readers added under this project.

K. Certain cameras associated with Access Controlled Doors shall automatically cue-up upon alarm or manually.

1.3 WORK INCLUDED

1.4 SUBMITTALS

1.5 DELIVERY, STORAGE, AND HANDLING

1.6 WARRANTY

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified. Any proposed alternative must meet, or exceed, the product data of the devices identified, and approval must be received by the Engineer and the Owner before supplying.

B. Final approval of security devices and equipment is to occur at the last most reasonable moment to ensure the most current and appropriate technology is installed.

2.2 ACCEPTABLE MANUFACTURERS

2.3 ACCESS CONTROL SYSTEM

A. Access Control Panels

B. Card Readers

C. Request to Exit Devices

D. Power Supplies

E. Door Position Switches

F. Cables

PART 3 – EXECUTION

3.1 GENERAL

3.2 PREPARATION

3.3 LABELING AND IDENTIFICATION

3.4 FIELD QUALITY CONTROL

3.5 TESTING

3.6 FINAL ACCEPTANCE

3.7 ON SITE COMMISSIONING AND TRAINING

END OF SECTION 281300

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OUTLINE SECTION 281600 – INTRUSION DETECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Project Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This section includes a description of access control devices, intrusion detection devices, security access devices, relay control, alarm monitoring controllers, credential creation, and credential holder database and management.

B. The intrusion detection system (IDS) is an electronic system comprised of sensors and process to detect unauthorized entry into, or occupancy of, a space that is restricted to a level pre-defined or time based.

C. The intrusion detection system components will be continuously monitored for normal, alarm, supervisory, and trouble conditions:

1. Normal: Reports the system is, and sensing devices, are in proper working order and that no alarm conditions are active.

2. Alarm: Reports that a sensing device has changed state from “normal” to “alarm" due to a breach or attempted breach.

3. Supervisory: Reports a condition that a device or controller is not functioning as specified.

4. Trouble: Reports a condition that the system is not fully functional. The “trouble” alarm will be used to indicate problems with system component alarms, such as battery failure, open or shorted transmission wiring or a controller failure.

D. The security contractor is responsible to review the design of the intrusion detection system, utilizing DMP as the selected system, and note any proposed modifications and configurations to the head-end layout and wiring configuration during the bid process.

1.3 WORK INCLUDED

1.4 SUBMITTALS

1.5 DELIVERY, STORAGE, AND HANDLING

1.6 WARRANTY

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified. Any proposed alternative must meet, or exceed, the product data of the devices identified, and approval must be received by the Engineer and the Owner before supplying.

B. Final approval of security devices and equipment is to occur at the last most reasonable moment to ensure the most current and appropriate technology is installed.

2.2 ACCEPTABLE MANUFACTURERS

2.3 INTRUSION DETECTION DEVICES

A. Door Position Switch

B. Ceiling Mounted Passive Infrared Motion Detector

C. Wall Mounted Motion Detector

D. Panic/Duress Device

E. Glass Break Detector

F. Laser Detector

G. Shock Senor

H. Plunger Switch

I. Power Supplies

PART 3 – EXECUTION

3.1 GENERAL

3.2 PREPARATION

3.3 LABELING AND IDENTIFICATION

3.4 FIELD QUALITY CONTROL

3.5 TESTING

3.6 FINAL ACCEPTANCE

3.7 ON SITE COMMISSIONING AND TRAINING

END OF SECTION 281600

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OUTLINE SECTION 282300 – VIDEO SURVEILLANCE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Project Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This specification outlines the requirements for a video surveillance system (VSS). All information herein is intended to present minimum standards of performance, quality and construction.

B. The VSS system shall be able to be displayed on any Owner workstation connected to the Owner's network with the appropriate permissions. The cameras added under this project will connect to the Owner's existing operational video surveillance system. The Security Integrator shall provide the required number of licenses to support the cameras added under this project.

C. The new network video recorders associated with this project are to be installed at the Yale Central Command.

D. Pan/Tilt/Zoom (PTZ) camera shall be utilized for the Help Point Intercom / Blue Light Phone. Upon activation of the help point intercom, the PTZ shall be automatically be called to a preset position to allow an operator to assess the emergency.

E. The primary functions of the VSS shall be for alarm assessment, access control verification purposes and general surveillance.

F. The VSS system shall be based upon the use of IP cameras control and managed from a network video management system. The IP cameras shall utilize the structured cabling system (SCS) and the Owner's data network for the transmission and management of the VSS video.

G. The VSS shall be calculated based on the following parameters:

1. Camera Resolution

a. Fixed (standard): 3MP

b. Fixed (elevator): 10809

c. 180° Panoramic: 15MP (SMP/imager)

d. 360° Fisheye: 12MP

e. PTZ: 1080p

2. FPS: 15

3. Video Retention: 30 days

H. The electrical contractor shall provide a data outlet adjacent to the VSS camera. The SCS shall run to the nearest IT closet and terminate into a patch panel. The electrical contractor shall provide a patch connection from the security patch panel to the Owner identified network switch port. The network port will provide IEEE compliant PoE to the IP cameras. The Security Integrator is responsible to coordinate with the electrical contractor as to the locations required for data outlets. Two (2) data outlets shall be provided for each camera. The data outlets, where possible, shall be located in an accessible location.

I. The cameras shall be configured to record per the Owner's standard record rates.

J. The system shall begin real-time recording of designated pre-set alarm positions under an alarm condition. Under the alarm condition, the VSS shall automatically flag the alarm event far easy retrieval. For calculating storage requirements, the security contractor shall assume 60 alarm conditions within a 30 day time frame (video storage requirement).

1.3 WORK INCLUDED

1.4 SUBMITTALS

1.5 DELIVERY, STORAGE, AND HANDLING

1.6 WARRANTY

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified. Any proposed alternative must meet, or exceed, the product data of the devices identified, and approval must be received by the Engineer and the Owner before supplying.

B. Final approval of security devices and equipment is to occur at the last most reasonable moment to ensure the most current and appropriate technology is installed.

2.2 ACCEPTABLE MANUFACTURERS

2.3 VIDEO SURVEILLANCE DEVICES

A. Video Surveillance Camera

B. Network Video Recorder

C. Cables

D. Power Supplies

PART 3 – EXECUTION

3.1 GENERAL

3.2 PREPARATION

3.3 LABELING AND IDENTIFICATION

3.4 FIELD QUALITY CONTROL

3.5 TESTING

3.6 FINAL ACCEPTANCE

3.7 ON SITE COMMISSIONING AND TRAINING

END OF SECTION 282300

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OUTLINE SECTION 285100 – SECURITY INTERCOMMUNICATION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Project Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This section includes a description of access control devices, intrusion detection devices, security access devices, relay control, alarm monitoring controllers, credential creation, and credential holder database and management.

B. 2-way voice communication system between a control point (door station) and a control room (main station).

C. 1-way video to allow operator to visually assess individual initiating the call and the surrounding area.

D. Ability to remote release an electronically access controlled door associated with the door station from the main station through an interface with the AMAG access control system.

E. Ability to call an outside line, Yale Central Command.

F. Health Point Intercom System (HPI) to be connected to the existing Yale University emergency phone system.

G. 2-way emergency voice communication between an individual (help point intercom) and a control room (main station).

H. 1-way video through the use of separately mounted PTZ camera attached to the same pole which will allow the operator to visually assess the individual initiating the call and the surrounding area.

I. Ability for an individual to easily identify the location of a help point intercom through the use a steady blue light illuminates directly above the unit.

J. Ability for attention to be drawn to the help point intercom when an emergency call is initiated.

K. Ability to make a mass notification announcement through a separate speaker unit mounted to HPI.

1.3 WORK INCLUDED

1.4 SUBMITTALS

1.5 DELIVERY, STORAGE, AND HANDLING

1.6 WARRANTY

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified. Any proposed alternative must meet, or exceed, the product data of the devices identified, and approval must be received by the Engineer and the Owner before supplying.

B. Final approval of security devices and equipment is to occur at the last most reasonable moment to ensure the most current and appropriate technology is installed.

2.2 ACCEPTABLE MANUFACTURERS

2.3 SECURITY INTERCOMMUNICATION SYSTEM DEVICES

A. Door Station

1. Door station to be equipped with a single button for initiation of a call.

2. Device shall allow for 2-way audio communication.

3. Device shall equipped with a camera to capture and stream video to the operator receiving the call.

4. Device shall be IP-based.

B. Main Station

1. 2-way audio communication, monitoring of video captured by door station and door release shall be performed by a computer workstation or mobile device with appropriate app installed.

PART 3 – EXECUTION

3.1 GENERAL

3.2 PREPARATION

3.3 LABELING AND IDENTIFICATION

3.4 FIELD QUALITY CONTROL

3.5 TESTING

3.6 FINAL ACCEPTANCE

3.7 ON SITE COMMISSIONING AND TRAINING

END OF SECTION 285100

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