TELECOMMUNICATIONS DISTRIBUTION DESIGN GUIDE

June 1, 2022

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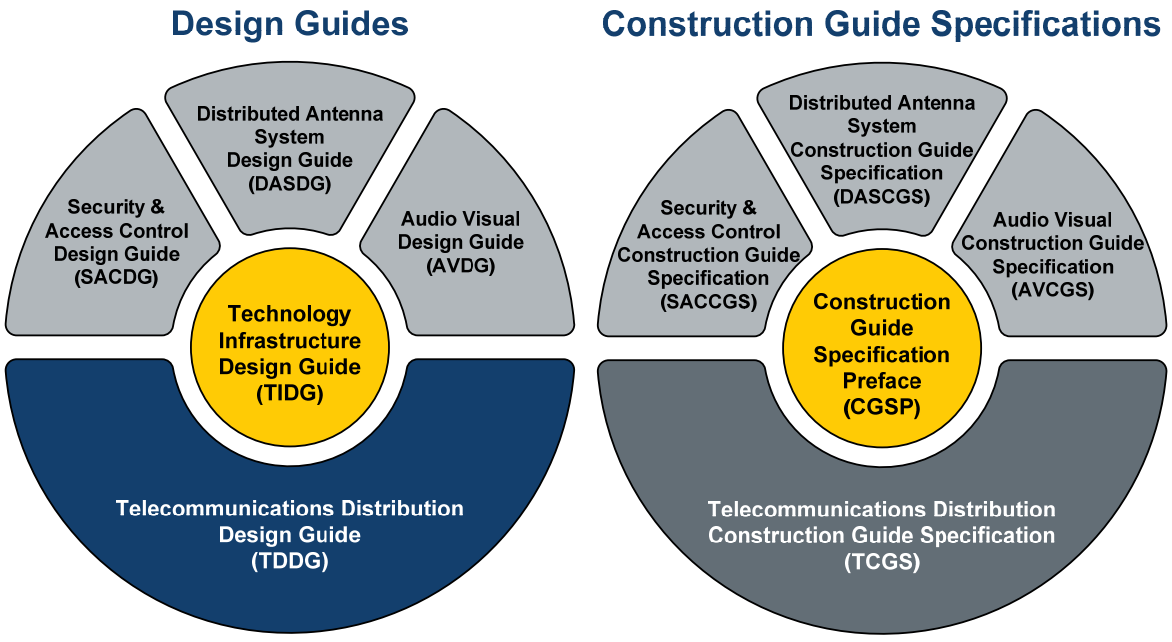
1 Preface

1.1 Introduction

A. The Telecommunications Distribution Design Guide (TDDG) is written to communicate the requirements of Utah Valley University (UVU) for the design and installation of telecommunications distribution infrastructure at UVU facilities.
- The TDDG is written for an audience of Architects, Engineers and Designers who are responsible for the design of new or remodeled facilities for UVU where telecommunications distribution systems currently exist or will be installed.
- It is also intended for other low-voltage telecommunications Contractors installing telecommunications distribution systems at UVU facilities.
- This document also applies to infrastructure designed and installed by UVU staff, when a formal design is not developed.

B. The TDDG belongs to a set of documents (depicted below) that comprise the standard design and installation practices for all facets of technology infrastructure and systems at UVU facilities.

Technology Infrastructure Standards Document Set



C. The Technology Infrastructure Design Guide (TIDG) contains information common to all of UVU's Design Guides.

D. The Telecommunications Construction Guide Specification (TCGS) is a key companion to the TDDG.
- Designers shall adapt the TCGS "as written" for creating specifications for a particular project according to the instructions in the TDDG. In other words, Designers shall use the electronic specification section documents (provided by UVU in MSWord format) and then shall make any project-specific edits to the specifications in those documents. Any changes to the specifications shall be done using the "Revision Tracking" features in MSWord.
- Rewriting the TCGS or modifying the format structure or requirements will not be accepted.

E. Telecommunications distribution systems designed for UVU are expected to support and integrate voice, data, video and other low-voltage systems with common media (fiber optic and unshielded twisted pair (UTP) copper cable).

F. The telecommunications distribution systems Designer shall coordinate with the other designers on a project (architectural, electrical, mechanical, etc.) to determine that other systems are both compatible with and complementary to the telecommunications distribution system. It is critical to coordinate between disciplines during the design phase of a project, rather than making adjustments in the field during construction.

G. The telecommunications Designer shall design new systems to comply with the requirements of this document set and that are consistent with the existing infrastructure at UVU.

H. This document was prepared by the Information Technology Services department at Utah Valley University and by Summit Engineering & Consulting, P.S. As technology and needs evolve, the document will be periodically updated.

- May 1, 2013 – Originally published
- January 4, 2016 – First Revision
- June 1, 2022 – Second Revision

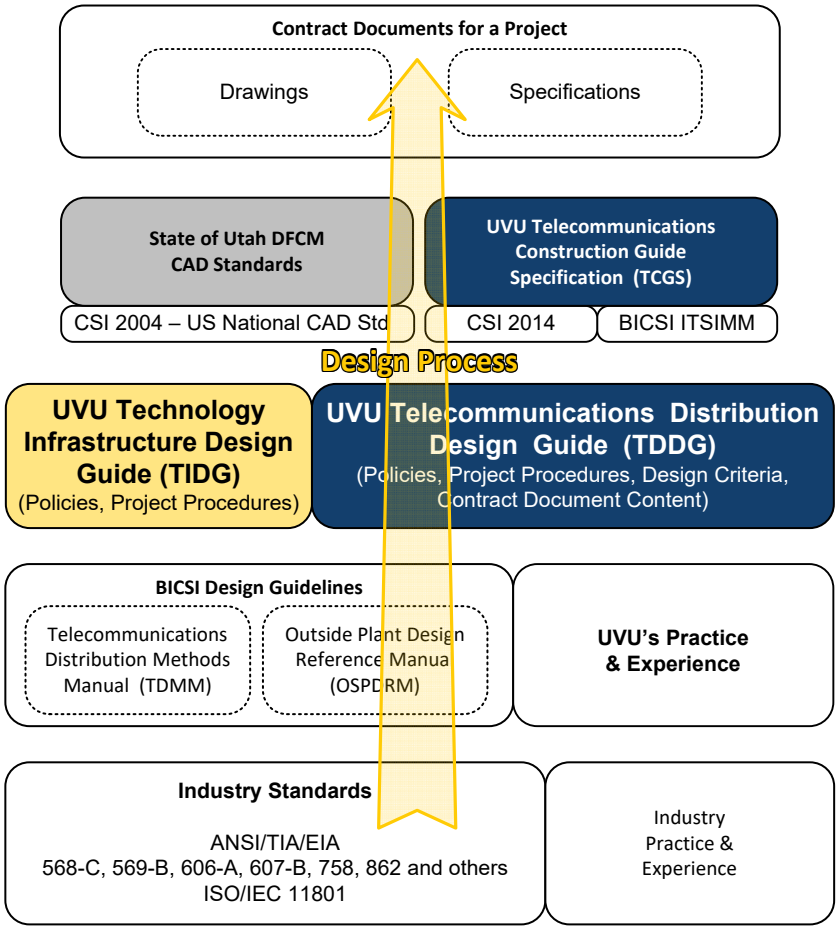
1.2 Document Intent

A. The Design Process diagram below depicts the relationships between the ANSI/TIA/EIA Standards, the BICSI Design Guidelines, the UVU documents (TDDG, TCGS) and the project-specific Construction Documents. Telecommunications distribution infrastructure at UVU facilities shall be designed based on the BICSI design guidelines (the TDMM, the OSPDRM and the ITSIMM) and compliant with the ANSI/TIA/EIA Standards as applied by and illustrated in the UVU TDDG.

B. The TDDG is intended to be used in conjunction with the TDMM and OSPDRM in order to reinforce selected TDMM content as well as highlight any restrictions and/or limitations on TDMM and OSPDRM content in order to meet the specific

requirements of UVU facilities. The TDDG is not intended to replace or detract from the TDMM or OSPDRM.

The Design Process
Based on Industry Standards and Guidelines and UVU's Design Guide and Standard Specifications



C. This document provides directions for making standards-compliant design decisions that will, in due course, be reflected in Construction Documents. The Construction Documents for a project will be comprised of drawings and a system specification that properly incorporates telecommunications infrastructure within a project. The TDDG shall be used in conjunction with the TCGS. Drawings shall conform to the guidelines contained in this document for content and completeness, and the specifications shall be based upon the TCGS.

D. The TDDG is not intended to serve as a master specification nor for stand-alone use on design-build projects. This document should serve as a guide for making standards-compliant design decisions that, in due course, will be reflected in a project specification based upon the TCGS.

E. The TDDG uses many terms and abbreviations that are common in the telecommunications industry. Please refer to the Glossary in the BICSI TDMM and also the Glossary section at the end of the BICSI OSPDRM for definitions.

1.3 Document Structure

The TDDG is organized in the following sections:

1. The **Preface** (this section) describes this document, its intent and its relationship to industry standards, practices and the various audiences affected by the document. It also describes how to use this document.

2. The **Project Procedures** section describes the required qualifications for telecommunications Designers as well as the procedures that Designers must follow when working on telecommunications infrastructure projects at UVU facilities. It includes activities that are required throughout the project as well as phase-specific requirements.

3. The **Design Criteria** section serves two purposes. The first is to describe the general requirements for UVU telecommunications infrastructure along with the typical features required for different categories of building spaces and construction types. The second purpose is to place limitations on the materials and methods described in the BICSI TDMM and OSPDRM. While the TDMM and OSPDRM describe many materials and methods that are generally accepted in the industry for providing telecommunications infrastructure, UVU facilities have some unique characteristics that restrict some of the materials and methods that otherwise might be acceptable. Some of the practices discussed in the TDMM and OSPDRM are expressly prohibited in UVU facilities. Other practices are permitted in certain areas (residential halls, for example) but prohibited in other areas such as academic buildings.

   Generally speaking, if the BICSI TDMM and OSPDRM do not describe a particular material or method for use with telecommunications distribution infrastructure, it will not be allowed for UVU facilities. In addition, the UVU TDDG places further restrictions on the use of some materials and methods that the BICSI design guidelines support.

4. The **Construction Document Content** section defines the minimum level of detail that UVU requires to be present in the telecommunications portion of the Construction Documents for a project. In this section, the required types of details along with the content in the details are both described. This section also briefly describes the specifications that are required for a project.

5. The **Appendices** section provides examples and standard forms and diagrams that are required for UVU telecommunications infrastructure.

1.4 Standards and Guidelines

A. UVU has standardized on the ANSI/TIA/EIA Commercial Building Telecommunications Standards series and has adopted the following BICSI[1] design guide documents as the basis for telecommunications distribution design in UVU facilities:

- BICSI Telecommunications Distribution Methods Manual (TDMM) (13th Edition)
- BICSI Outside Plant Design Reference Manual (OSPDRM) (5th Edition)
- BICSI Information Technology Systems Installation Methods Manual (ITSIMM) (6th Edition)

The UVU TDDG is the guide to the application of the ANSI/TIA/EIA Standards, the BICSI TDMM, the BICSI OSPDRM and the BICSI ITSIMM to the unique circumstances present in UVU facilities and projects.

All references to these manuals shall specifically address only the editions specified above. Newer editions shall be used "for reference only" until authorized by UVU in writing or through a revised edition of the TDDG.

B. Adherence to and compliance with the codes, standards and industry practices listed below, along with the UVU requirements contained in this document, is mandatory:

- State of Utah Division of Facilities Construction and Management (DFCM)
- UVU Facilities Design and Construction Standards
- 2009 International Building Code
- National Electrical Safety Code, American National Standards Institute C2
- National Electrical Code (NEC), National Fire Protection Association (NFPA 70)
- Firestop Contractors International Association (FCIA), Manual of Practice
- ANSI/TIA/EIA 568-C series – Commercial Building Telecommunications Standards
- ANSI/TIA/EIA 569-C series – Commercial Building Telecommunications Standards for Pathways and Spaces
- ANSI/TIA/EIA 606-B series – Administration Standard for Commercial Telecommunications Infrastructure
- ANSI/TIA/EIA 607-B series – Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
- ANSI/TIA/EIA 758-B series – Customer-Owned Outside Plant Telecommunications Cabling Standard
- ANSI/TIA/EIA 862-A – Building Automation Systems Cabling Standard for Commercial Buildings
- ANSI/TIA/EIA 942-A – Telecommunications Infrastructure Standard For Data Centers

[1] BICSI is widely considered to be the industry source for standards-compliant design guidelines for telecommunications distribution systems. See www.bicsi.org for further information.

- ANSI/BICSI 005-2013 - Electronic Safety and Security (ESS) System Design and Implementation Best Practices
- Fiber Optic Test Standards, TIA/EIA 455 (Series)
- Optical Fiber Systems Test Procedures, TIA/EIA 526 (Series)
- Local Area Network Ethernet Standard, IEEE 802.3 (Series)
- Wireless LANs, IEEE 802.11 (Series)

C. The requirements in these documents apply to all technology infrastructure installed in UVU facilities, including infrastructure serving non-UVU tenants.

D. Any request to deviate from the requirements of the National Electrical Code will not be accepted.

E. The Designer shall seek approval for designs that are not consistent with UVU TDDG requirements. Requests to deviate from industry standards or UVU design solutions will be considered on a case-by-case basis by the UVU Information Technology Services Project Manager. Designers shall contact the UVU Information Technology Services Project Manager to discuss proposed alternatives before spending significant time pursuing the option.

F. The requirements contained in the TDDG are considered to be in addition to those required under contract with the State of Utah. Where the requirements differ, the issue shall be brought to the attention of the UVU Facilities Project Manager – otherwise the more stringent requirement shall apply.

1.5 Required Manufacturers (Basis of Design)

A. Telecommunications distribution systems shall be designed for construction using materials from the current product lines of the manufacturers required by UVU.

B. The copper infrastructure basis of design is defined as solutions comprised of Siemon-plus-CommScope:

- For copper termination materials (patch panels, faceplates and jacks), UVU requires the Siemon Company product line.
- For copper cabling materials, UVU requires products from CommScope. CommScope provides 20-year warranties on telecommunications cabling terminated with Siemon products when installed by CommScope Systimax certified contractors.

C. The fiber optic infrastructure basis of design is defined as solutions comprised of products from Corning:

- For fiber optic materials (both cabling and termination), UVU requires Corning products. Products from other manufacturers who incorporate Corning glass into their product are not acceptable.

D. The racking basis of design is defined as solutions comprised of products from Chatsworth Products, Inc.

E. Designs shall comply with the requirements of these manufacturers such that they will certify the installation with their warranty. The construction documents shall require that the Contractor's installation workmanship fully comply with the current installation requirements from the manufacturers of these products, even if those requirements exceed industry standard practices.

F. The Designer shall incorporate manufacturers consistently throughout the entire project (unless otherwise directed by UVU) and design a telecommunications distribution system that will be suitable for the use of products from this manufacturer.

Required manufacturers and their products are identified in the TCGS.

- For example, ladder racking in all telecommunications rooms shall be manufactured by a single manufacturer and cabling system materials shall be manufactured by a single manufacturer. However, it is not required that cabling and ladder racking be from the same manufacturer.

The construction documents shall require that the installation workmanship fully comply with the current installation requirements from the manufacturers of these products.

1.6 UVU Personnel

A. There are several specific UVU personnel roles defined in the TIDG and referenced in this document. The Designer shall interact with these individuals as direct points of contact.

B. UVU personnel should be aware of the instructions, requirements and guidelines for Designers contained in this document. Also, the TCGS contains additional requirements related to telecommunications distribution system materials and installation methods applicable at UVU facilities.

C. UVU personnel should be familiar with these requirements with respect to their application on both large-scale telecommunications distribution projects and small-scale "moves/adds/changes" projects. These requirements also apply to in-house operations and maintenance of existing telecommunications distribution systems.

1.7 Copyright

Summit Engineering & Consulting has authored similar documents for many other organizations. The document is intended (in part) to describe best practices that are found in some segments of the industry. As a result, portions of this document are similar to comparable content in documents previously prepared by Summit Engineering & Consulting for other organizations. This document does not contain any information that is proprietary or confidential to other organizations.

2 Project Procedures

A. The Project Procedures section contains guidelines for architects, engineers and telecommunications distribution designers regarding the procedures that UVU requires for projects that include telecommunications distribution systems. This applies both to projects that entail primarily telecommunications distribution work (such as telecommunications infrastructure replacement projects) as well as to architectural projects and other work (such as a new building) that involve telecommunications design.

B. This section is not intended to supersede State of Utah contract requirements, but rather to complement them, providing additional requirements that apply specifically to telecommunications design projects at UVU facilities.

C. It is intended that the requirements in this section be considered contractually binding for professional design firms providing telecommunications design services.

2.1 Designer Qualifications

A. See the TIDG for other qualifications requirements and for instructions about where the services of a professional engineer and fire protection engineer are required.

B. For the purposes of this document, the term “Designer” shall mean a person who is a Registered Communications Distribution Designer (RCDD) who is currently in good standing with BICSI. Telecommunications designs on UVU projects shall be produced by the RCDD. This means that the telecommunications design shall be produced by the Designer. UVU’s communications with the telecommunications consultant shall be mainly through the RCDD. On projects where the RCDD is not the prime consultant, the RCDD shall keep the prime consultant (Architect/Engineer (A/E)) informed of all direct communications with UVU.

- The Registered Information Technology Professional (RITP) certification from BICSI is not an acceptable substitute for the RCDD.

C. In addition to the RCDD certification, it is preferred that the RCDD have one or more of the following qualifications.

- Professional Engineer (P.E.) in the electrical engineering field
- RCDD/ESS certification from BICSI
- RCDD/OSP certification from BICSI

D. In addition, the RCDD shall have the following qualifications.

- The RCDD shall demonstrate a minimum of 5 years of experience in the design of inside plant telecommunications distribution systems. Experience designing telecommunications infrastructure on UVU projects is desirable, but is not required.
- Experience not directly related to the design of telecommunications distribution systems, such as sales and/or marketing, project management, or installation experience, is not sufficient.

- The RCDD shall demonstrate that he/she has designed or has had personal design oversight of a minimum of five projects similar in size and construction cost to the current UVU project.
- The RCDD shall be independent from and unaffiliated with any manufacturer associated with the telecommunications distribution system industry.
- The RCDD shall be completely familiar and conversant with industry and UVU telecommunications standards.

2.2 Procedures Related to Project Phases

In addition to the procedures described in the TIDG Section 2.5 for each project phase, the following requirements are specific to telecommunications infrastructure:

2.2.1 CONSTRUCTION OBSERVATION

2.2.1.1 CABLE TRAYS

Verify that the installed cable trays meet the following requirements:

- Wherever cable tray passes through a wall, the wall penetration shall be finished (no sheetrock visible) and firestopped if the wall is a fire-rated wall.
- To protect technicians and cabling, all cuts to cable tray materials shall be finished smooth. Cable trays shall not have rough or sharp edges or points.
- Each segment of the cable tray requires a ground conductor bonding lug.
- When cable trays, walls and ceilings are painted, care shall be taken to not paint the cabling. Cable manufacturers will not warrant any painted cabling.

2.2.1.2 CABLE LABELING

Verify that cable labeling matches actual room numbering. Sometimes room numbering can change late in the project, and the labeling should adjust to match final room numbering.

2.3 General Procedures

2.3.1 PROCUREMENT AND INSTALLATION

A. The Designer shall inquire which procurement method will be used for a particular project. The construction documents prepared by the Designer shall be suited for the procurement method designated for the project.

B. Typically, the construction contract scope of work includes the complete telecommunications infrastructure (pathways, spaces, cabling and terminations).

- The network electronics are usually handled as a separate contract managed by UVU OIT Infrastructure Services.

3 Design Criteria

A. The UVU TDDG is not intended to be a comprehensive design guide resource for telecommunications design at UVU facilities. The Designer shall refer primarily to the BICSI TDMM for design guidance. The Construction Documents produced for each project shall be consistent with the installation practices described in the BICSI Information Transport Systems Installation Methods Manual (ITSIMM).

B. Where ANSI/TIA/EIA standards or BICSI manuals offer multiple choices with a preferred method identified, and where the UVU TDDG does not select one method over another or define specific requirements precluding use of the preferred method, the ANSI/TIA/EIA or BICSI-preferred method shall be selected.

C. Where ANSI/TIA/EIA Standards or BICSI manuals identify warnings regarding potential adverse effects from certain design or installation methods, the design or installation method used shall typically be the method with the least potential for adverse effects. The Designer shall notify the UVU TPM of any such decisions.

D. Any request to deviate from the requirements of the National Electrical Code or the manufacturer's warranties will not be accepted. The Designer shall seek approval for designs that are not consistent with UVU TDDG requirements through the UVU Standards Variance Request (SVR) process. Requests to deviate from industry standards or UVU design solutions will be considered on a case-by-case basis by the UVU TPM. Designers may contact the UVU TPM to discuss proposed alternatives before spending significant time researching or preparing an SVR.

E. Telecommunications distribution infrastructure shall fully comply with the current UVU TDDG, the current ANSI/TIA/EIA Commercial Building Telecommunications Standards and the National Electrical Code (NEC).

F. Please refer to the Bibliography and Resources section and Glossary section of the BICSI TDMM for definitions, abbreviations, acronyms and symbols used for describing and documenting telecommunications infrastructure at UVU facilities.

G. The following subsections are arranged to mirror the chapter sequence of the BICSI TDMM 13th Edition (the subsection numbers below are in the form of 4.x where x corresponds with the chapter number in the BICSI TDMM).

- Each TDDG subsection contains commentary and requirements regarding the application of the BICSI TDMM to UVU projects. In particular, each section contains limitations and prohibitions on specific materials and methods discussed in the BICSI TDMM.

3.1 Principles of Transmission

Please refer to Chapter 1, *Principles of Transmission* in the BICSI TDMM for general information regarding the design of telecommunications distribution infrastructure.

3.2 Electromagnetic Compatibility

Please refer to Chapter 2, *Electromagnetic Compatibility* in the BICSI TDMM for general information regarding the electromagnetic interference (EMI) with and clearance requirements for telecommunications infrastructure. The following requirements take precedence over the BICSI TDMM guidelines for telecommunications infrastructure at UVU facilities:

A. The BICSI TDMM includes tables listing minimum separation distances from sources of EMI. Telecommunications infrastructure shall not be installed closer than the minimum separation distances listed in the BICSI TDMM. Where the NEC or local codes require greater separation distances than those listed in the BICSI TDMM, the greater separation distance shall be maintained.

B. Separation distances apply equally to both copper cabling and fiber optic cabling. Even though fiber optic cabling is impervious to EMI, once a pathway is established for fiber, it could later be used for copper cabling.

C. OSP telecommunications infrastructure designs shall adhere to the governing clearance requirements of the NEC and NESC.

3.3 Telecommunications Spaces

Please refer to Chapter 3, *Telecommunications Spaces* in the BICSI TDMM for general information regarding the design of telecommunications rooms. The following requirements take precedence over the BICSI TDMM guidelines for telecommunications infrastructure at UVU facilities:

A. In UVU facilities, the TRs in a building may also serve as low-voltage systems equipment rooms, typically containing electronic equipment intended to serve the building or a portion of the building. The TR shall not be shared with electrical installations other than those necessary for telecommunications.

3.3.1 TELECOMMUNICATIONS ROOM LOCATION

A. The Designer shall be responsible to inform the Architect of the sizing and location requirements for Telecommunications Rooms during the Schematic Design phase of the project.

B. The most desirable location for telecommunications rooms shall be located as centrally and closely as possible to the area being served. In addition, for multi-story buildings, telecommunications spaces shall be vertically aligned. This allows for clean, vertical pathway to be easily provided to each space. It also

reduces the number of bends and offsets that the intra-building backbone pathway must undergo as it connects each of the telecommunications rooms. Please see the discussion in TDDG Section 3.4.1 Intra-building Backbone Pathways for further information.

C. There shall be a minimum of one TR per building. Additional TRs shall be added when the area to be served exceeds 10,000 square feet or where the cable lengths will exceed 295 feet between a TR and the work area telecommunications outlet, including allowance for cable slack loops. Generally, each floor of a building shall be served by a TR located on that floor.

1. When specifically approved by the UVU ITPM, a TR may be designed to serve multiple floors of a building.

D. Telecommunications Rooms shall not be co-located with any type of electrical room or mechanical room. The TR location shall maintain the separation distances identified in the Electromagnetic Compatibility subsection of this document.

E. The telecommunications room shall not be located in any of the locations listed below:
1. Areas subject to water or steam infiltration, particularly basements. Floor drains (with deep traps and/or other method to prevent backflow and entry of gasses) are required if there is any risk of water entry. Do not use trap primers.
2. Areas exposed to excessive heat or direct sunlight.
3. Areas exposed to corrosive atmospheric or environmental conditions.
4. Near or adjacent to potential sources of electromagnetic interference (EMI) or radio frequency interference (RFI) such as large electric motors, power transformers, arc welding equipment, or high-power radio transmitting antennas.
5. In a shared space with electrical equipment other than equipment serving the telecommunications system.

3.3.2 TELECOMMUNICATIONS ROOM SIZING

A. Telecommunications rooms shall typically be one of the following sizes in Table 4.4 below (or larger where required):

Table 3.1 Telecommunications Room Sizes (Interior Dimensions)

MDF Dimensions	# of Racks	Day 1 Design Limitations	MDF Comments
22’ x 10’	**6**	**336 CAT6A / 13 Fiber Cables**	**Standard MDF**
16’ x 12’	6	336 CAT6A / 13 Fiber Cables	Only when specifically approved by the ITPM
18’ x 10’	5	336 CAT6A / 8 Fiber Cables	Only when specifically approved by the ITPM
15’ x 10’	4	336 CAT6A / 6 Fiber Cables	Only when specifically approved by the ITPM
16’ x 9’	4	336 CAT6A / 6 Fiber Cables	Only when specifically approved by the ITPM

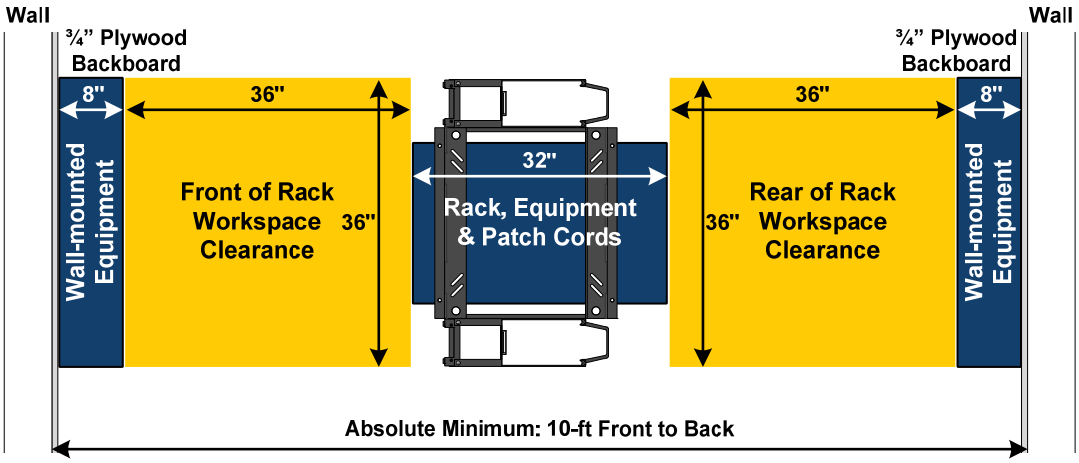
IDF Dimensions	# of Racks	Day 1 Design Limitations	IDF Comments
15’ x 10’	4	336 CAT6A / 6 Fiber Cables	Commonly used
16’ x 9’	4	336 CAT6A / 6 Fiber Cables	Commonly used
12’ x 10’	**3**	**288 CAT6A Cables**	**Standard IDF**
9’ x 10’	2	**192 CAT6A Cables**	Only when specifically approved by the ITPM
6’ x 10’	1	**96 CAT6A Cables**	Only when specifically approved by the ITPM
4’ x 10’	1	**96 CAT6A Cables**	Only when specifically approved by the ITPM

Please note that the above room sizes are minimum interior dimensions, and are not representative of acceptable square footage allocations.

- For example, a 12’ x 10’ space totals 120 square feet. A 5’ x 24’ room would be an unacceptable space, even though it also totals 120 square feet.
- Telecommunications rooms shall be rectangular. Unconventional shapes are not acceptable.
- All room dimensions listed in this document are interior dimensions, independent of the thickness of the walls.

See the sample telecommunications room plan drawings in Appendix 5.3 of the TDDG for further information.

B. The 10’ dimension is derived from the following space allocation requirement:



C. If project circumstances prevent the establishment of adequately-sized telecommunications spaces, the following options may be considered on a case-by-case basis, subject to the approval of the UVU ITPM:

1. Reach-in closets and small room designs for minor remodel construction projects may be considered through the SVR process.
2. Wall-mounted swing cabinets may be appropriate for some remodel applications serving small numbers of people and where floor space for a full telecommunications room would be unavailable or impractical.

D. Telecommunications room sizing shall be increased if other low-voltage systems

equipment is intended to be hosted in the TR; for example, fire alarm panels, security system equipment, etc. The Designer shall seek input from the UVU ITPM regarding room sizing.

E. Telecommunications rooms in new construction and modernization projects shall be sized such that ADA-required space is available after racks and equipment have been installed.

3.3.3 ARCHITECTURAL PROVISIONING

A. The Designer shall be responsible to inform the Architect early in the Design Development phase of the project of the architectural provisioning requirements for Telecommunications Rooms.

B. The Designer shall be responsible to review project documents and determine that the architectural requirements for the telecommunications spaces are met as described in this document. For projects where an Architect is involved, the Designer shall coordinate directly with the Architect, and verify that the Architect's design documentation meets these requirements. For projects without an Architect, the Designer shall alert UVU where additional architectural adjustments are needed to meet the requirements.

C. Doors shall open out (180-degree swing) from telecommunications spaces wherever possible and shall be a minimum of 36" wide and 80" high, fitted with a strike cover, lock and electronic access control. Coordinate lock and key requirements with UVU. Doors shall be located in hallways or other common areas. Telecommunications room doors shall never be located in another building occupant's designated space.

D. Minimum clearance height within a telecommunications space shall be 8 feet. False ceilings (t-bar ceilings, ceiling grids, etc.) shall not be installed in telecommunications spaces. The floor, walls, and ceiling shall be sealed to reduce dust.

E. Finishes shall be light in color to enhance room lighting. Flooring materials shall be light colored and slip resistant – carpet is not acceptable for telecommunications rooms. Interior floor finish and floor covering materials shall also meet the requirements in the International Building Code.

F. The walls in telecommunications rooms shall be covered with plywood and shall be fire retardant. There are two approved methods to accomplish this:

- Plywood that has been treated with fire retardant chemicals by a pressure impregnation process, then painted with primer and two coats of white paint.

- Untreated plywood that has been painted with a UL-listed, non-toxic fire retardant intumescent coating having a Class A surface flame spread rating. A small plaque shall be attached to the backboard near the door, listing the fire spread rating of the backboard, the manufacturer and the product number

of the fire-retardant intumescent coating. This information may be helpful for future maintenance activities and to satisfy the authority having jurisdiction.

Plywood backboards shall extend from 6” above the floor up to a height of 8’6” above the finished floor.

All painting shall be completed prior to the installation of telecommunications equipment.

3.3.4 ENVIRONMENTAL PROVISIONING

A. Environmentally friendly solutions shall be considered in the design of cooling systems for technology spaces, incorporating heat reclamation and non-mechanical cooling features where reasonable and practical. Utah DFCM requires LEED Silver for new buildings.

B. The Designer shall be responsible to inform the Mechanical Engineer early in the Design Development phase of the project of the environmental provisioning requirements for Telecommunications Rooms.

C. The Designer shall be responsible to determine that the mechanical HVAC requirements for the telecommunications spaces are met as described in this document. For projects where a Mechanical Engineer is involved, the Designer shall coordinate directly with the engineer, and verify that the engineer’s design documentation meets these requirements. For projects without the involvement of a Mechanical Engineer, the Designer shall alert UVU where adjustments to the mechanical infrastructure are needed to meet the requirements.

D. The Designer shall coordinate with the Mechanical Engineer to ensure that the HVAC requirements for the telecommunications spaces are met and also that HVAC ductwork and motors do not conflict with cable tray or conduit routing.

   a. Minimum clearance height in the TR shall be eight feet without obstructions (light fixtures, ducting, etc.).

E. In addition to the requirements in the BICSI TDMM, telecommunications rooms shall be environmentally provisioned as follows:

   1. A fundamental design assumption is that all TRs will at some time contain active electronic equipment (hubs, routers, switches, etc.) even if the current design does not call for such devices. Network electronics require an HVAC system capable of operating on a 24 / 7 / 365 basis. If the building system cannot assure continuous cooling operation, a stand-alone cooling unit shall be provided for the TR.

      - This unit and any roof penetrations shall be located away from and not directly above electronics of any kind, to avoid damage from condensate drip and roof leaks.

In addition, a positive pressure differential with respect to surrounding areas is required to help keep dust and other particles out of the room.

- Where practical, UVU encourages the use of heat reclamation features.
- Environmental management and monitoring systems shall be designed for TRs.
- Typically, the building's central air conditioning system should cool the telecommunications rooms during summer months. During the months when the central air conditioning system is not running, a stand-alone air conditioning system shall be used to cool the telecommunications rooms.
- The temperature controls (including a thermostat) shall be located inside the telecommunications rooms and connected to the building environmental control system. Alarm conditions shall be configured to alert both OIT and Facilities personnel.
- The heat load in some small telecommunications rooms can be low enough that simply exhausting the air may be sufficient to maintain the temperature in the room. In these cases, positive pressure must still be maintained in the space to prevent the collection of dust.

2. UVU typically provides network electronics that provide Power-over-Ethernet. The Designer shall request power consumption data for the equipment that UVU will use, and work with the mechanical systems designer to ensure that the cooling capacity is sufficient to support the POE heat load.

3.3.5 FIRE SUPPRESSION SYSTEMS

A. UVU prefers dry-type preaction fire suppression systems in telecommunications rooms.

- Sprinkler guards shall be provided where sprinklers are installed less than 8 feet above the floor.
- Sprinkler heads and sprinkler piping shall not be located our routed directly above equipment racks or the equipment they will contain.

3.3.6 CABLE TRAY ENTRANCE

A. Horizontal cabling shall be routed into telecommunications rooms via cable tray entrance slots permitting the tray to pass through the walls, protruding 2" into the room. Cable trays shall terminate above the ladder racking in the telecommunications rooms and have a radius fitting ("waterfall") to protect the cabling as it drops to the ladder rack.

B. See Section 3.7 *Firestop Systems* for requirements for treating fire-rated walls through which cable trays pass.

C. The Designer shall design cable trays and entrance slots sufficient to support the maximum number of cables that the room can accommodate (twice the Day-1 design limit).

D. See Appendix 5.3 for examples of cable tray entrance slots.

E. See Appendix 5.2 for rack elevation samples indicating the total number of cables allowable for Day 1, and also showing the additional future 48-port patch panels that the racks could support if necessary.

3.3.7 FLOOR-STANDING EQUIPMENT RACKS AND CABINETS

A. Each telecommunications room shall be provisioned with a full set of floor-standing 7’ high x 19” wide ANSI/TIA/EIA standard open-frame equipment racks to fill the room, regardless of whether or not equipment is required at the time of construction.

- For minor remodel construction, this requirement may be waived given budget, project size, or other limiting factors.
- The use of a wall-mounted swing rack or a wall-mounted hinged bracket may be acceptable, subject to UVU approval via the SVR process.

B. The rack arrangement shall be selected from the options shown in Appendix 5.2, and shall be sized to accommodate, at a minimum, all existing and new equipment that is to be installed in the rack plus an additional 50% of space for additional equipment that may be added in the future.

3.3.7.1 FLOOR-STANDING EQUIPMENT RACKS

A. See the sample floor plan details in Appendix 5.3 of the TDDG for rack arrangement guidance.

B. Floor-standing racks shall be securely bolted to the floor, and shall be braced to the wall with cable ladder racking. Multiple racks in the same TR shall be interconnected with cable ladder racks.

C. Racks shall be equipped with horizontal and vertical cable management modules both front and rear, with strain relief brackets to support proper cable bend radius and to maintain strain relief for the cabling. Vertical cable management modules shall include spools/posts to manage cable slack.

1. Vertical cable management between racks shall be 12” wide.
2. Vertical cable management on the sides of racks shall typically be 6” wide. Some applications, however, may require 8” or 10” wide vertical cable management.

D. Sometimes an equipment cabinet is required for larger IT equipment (servers, large UPSs, etc.) with both front and rear mounting rails. The Designer shall discuss with UVU the network electronics that will be hosted in each TR and shall design appropriate racks and cabinets to support the equipment. Racks and cabinets shall be shown on the rack elevation details in the plan drawings.

E. Ladder racking shall be provided at 7 feet above finished floor, circling the room

and crossing the room over the tops of the equipment racks, as shown in Appendix 5.3 and Appendix 5.4.

3.3.7.2 TELECOMMUNICATIONS CABINETS

A. When planning the size and location of TRs in existing buildings, the Designer shall make every reasonable effort to meet the requirements for telecommunications rooms. In certain instances, the only viable alternative may be the use of one or several telecommunications cabinets in lieu of TRs.

B. UVU uses wall-mounted cabinets in Lab spaces.

C. In minor remodel projects, some buildings may not justify a separate room as the telecommunications room. In some circumstances, sufficient space may not be available for a telecommunications room. In these instances, a wall-mounted or floor-standing telecommunications cabinet may be used.

D. Wall-mounted cabinets shall be double-hinged to permit access to both the front and rear of the equipment. Care shall be taken to specify cabinets with strong hinges that do not begin to sag over time due to the weight of the cabinet's contents. Telecommunications cabinets shall be constructed of heavy gauge steel with lockable doors:

- If the cabinet will be located in an occupied space, use a Plexiglas® door to reduce noise.
- If the cabinet is not located in an occupied space, use a mesh-screened door to improve ventilation.

D. Cabinets shall be sized to allocate space for cabling termination infrastructure, network electronics, and UPS equipment, and shall also include space allocated for future growth. Wall space shall be allocated to permit cabinets to fully swing open.

E. Cabinets shall be equipped with horizontal wire management modules with strain relief brackets to support proper cable bend radius and to maintain strain relief for the cabling.

F. Power and telecommunications cables for equipment housed within the cabinet are to be contained within the cabinet. Exposed wiring or cables are not permitted. Power and telecommunications cables routed to or from the cabinet shall be contained in conduit, surface-mounted raceway, or concealed within the adjacent wall.

- Technical power outlets serving cabinets shall be mounted inside the cabinet.

G. Each cabinet that hosts equipment that produces a significant heat load shall have front and rear screen doors, allowing air flow through the equipment. Cooling fans are typically not required.

H. Each cabinet shall have a telecommunications grounding busbar (TGB) installed inside, in accordance with the grounding requirements discussed in the BICSI TDMM Chapter 8 *Bonding and Grounding (Earthing)*.

I. The cabinet shall not be located in or adjacent to areas containing sources of electromagnetic interference (EMI). See TDDG Section 3.2 *Electromagnetic Compatibility* (above) for further information.

3.3.8 POWER REQUIREMENTS

A. The Designer shall be responsible to determine that the power requirements for the telecommunications spaces are met as described in this document. For projects where an Electrical Engineer is involved, the Designer shall coordinate directly with the engineer, and verify that the engineer's design documentation meets these requirements. For projects without the involvement of an Electrical Engineer, the Designer shall alert UVU where additional power infrastructure is needed to meet the requirements.

B. UVU typically provides network electronics that provide Power-over-Ethernet. The Designer shall request power consumption data for the equipment that UVU will use, and work with the electrical power distribution designer to ensure that the cooling capacity is sufficient to support the POE heat load.

3.3.8.1 BACKUP POWER (GENERATOR & UPS)

A. All telecommunications rooms require backup power from both a standby generator and an uninterruptible power supply (UPS). Devices that depend on Power-over-Ethernet to operate require that network switches remain operational. The UPS equipment is intended to provide power long enough to allow the generator to strike up and deliver stable power.

B. The Designer shall work with the Electrical Engineer to design an appropriately sized standby generator to provide power to:

- All telecommunications rooms
- All mechanical cooling serving telecommunications rooms

C. UVU typically provides rack-mounted UPS equipment.

- Centralized UPS equipment is primarily reserved for data center-class spaces. The Designer shall inquire with UVU on a project-by-project basis whether a centralized UPS is desired for the project.

D. The Designer shall work with the Electrical Engineer to design appropriate power receptacles that will be suitable to serve the Owner-provided UPS equipment that will be used on the project.

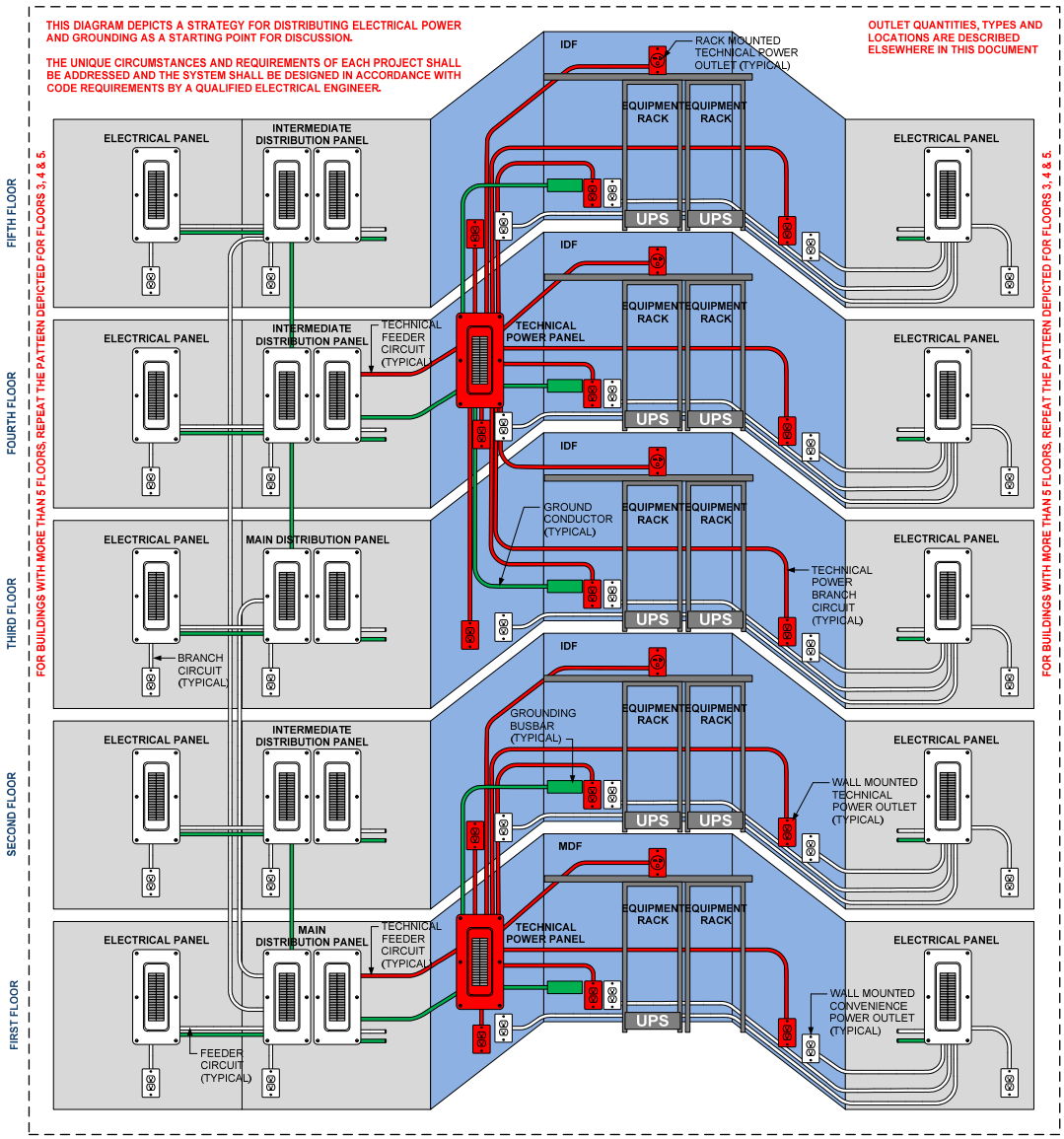
E. The Designer shall reserve sufficient space at the base of an equipment rack in each telecommunications room to hold the Owner-provided UPS equipment.

3.3.8.2 ELECTRICAL POWER PANELS

A. The technical power circuits in each telecommunications room shall originate from an electrical power panel (non-dedicated) located **outside** of the telecommunications room. In the absence of other influencing circumstances, the panel shall be sized for 100 Amp service (minimum). The power panel shall not be used to supply power to sources of EMI such as large electric motors, arc welding, or industrial equipment.

B. The following diagram depicts UVU's strategy for distributing technical power to telecommunications rooms, with UPS equipment distributed to each telecommunications room:

POWER AND GROUNDING FOR TELECOMMUNICATIONS ROOMS WITH DISTRIBUTED UPS EQUIPMENT



3.3.8.3 TECHNICAL POWER OUTLETS

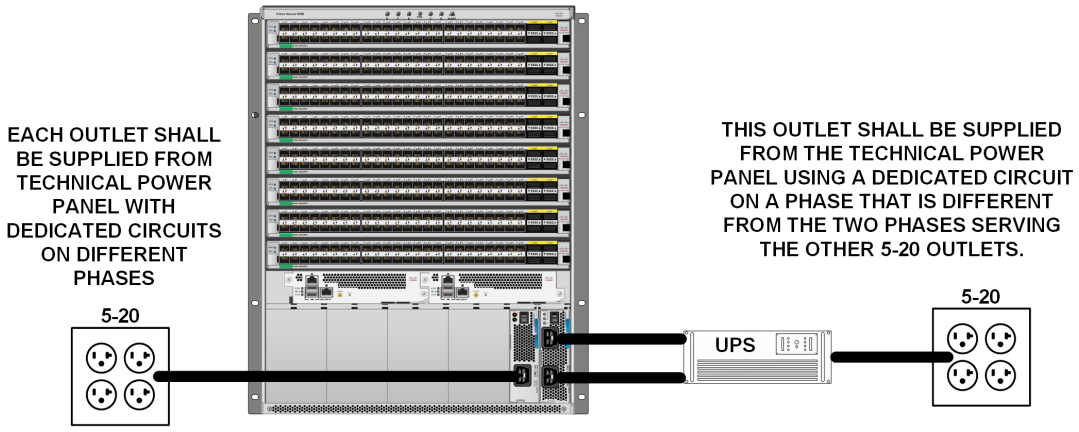
A. The Designer shall obtain electrical power connection/load requirements from UVU for each piece of equipment, and tabulate the information for review and confirmation by UVU. This equipment may include network electronics, UPS equipment, computers/servers, phone system equipment, voice mail systems, video equipment and service provider equipment.

B. UVU intends to provide UPS equipment for each telecommunications room that requires two 240V 30 Amp power sources:

- One with unconditioned utility power
- One with generator-backed power

The Owner-provided UPS equipment will have 120VAC or 208VAC outlets to meet the needs of the Owner-provided network equipment, and will connect to power distribution units supporting rack-mounted equipment. The Designer shall show a power strip in the middle of racks (on back side) containing active electronics.

The diagram below depicts the required power architecture:



C. Technical power outlets shall be provided (each with dedicated circuits) for exclusive use by telecommunications-related electronic equipment as follows:

- 120VAC/20A technical power outlets are required. Outlets shall be equipped for “straight-blade plugs” (NEMA 5-20R). Do not use twist-lock style receptacles.
- Each outlet shall be equipped with a dedicated insulated solid copper equipment-grounding conductor. Ground conductors serving technical power outlets shall ***not*** be *isolated* ground conductors.
- Outlets shall be colored orange, and shall show the panel and circuit numbers.

D. Technical power outlet quantities shall be as follows:

Rooms with 1 Rack	2 quad outlets	Mount outlets on wall adjacent to rack, 14" behind rack.
Rooms with 2 Racks	2 quad outlets	Mount outlets at the base of racks, inside the rear side of the vertical cable management. Power conduits shall stub up through floor to each outlet (preferred) or route from the wall low across the floor, just above the rack foot plates to each outlet.
Rooms with 3 Racks	2 quad outlets	
Rooms with 4 Racks	3 quad outlets	
Rooms with 5 Racks	4 quad outlets	
Rooms with 6 Racks	5 quad outlets	

- See the telecommunications room plan details in Appendix 5.3 of the TDDG for technical power outlet locations.

E. The Designer shall specifically investigate the potential need for voltage or current requirements other than the typical 120VAC/20 Ampere power outlet. Some UPS and network switch equipment requires specialized plugs or electrical service. The Designer shall inquire with the UVU ITPM to determine whether any dedicated or specialized circuit requirements exist.

F. Care shall be taken during the design process and during construction observation to make sure that power outlets are located such that they are conveniently aligned with the equipment racks to avoid inadvertent disconnection of the power cords.

3.3.8.3.1 FOR NEW CONSTRUCTION AND MODERNIZATION PROJECTS

A. Faceplates for power receptacles and light switches in the TR shall be mounted at the surface of the plywood backboard (as opposed to being recessed into a cutout in the plywood backboard). The device boxes shall be recessed into the wall, and the conduits shall be concealed in the wall (not surface-mounted).

B. Conduits serving convenience power outlets shall be concealed in walls behind backboards.

C. In addition to the outlets intended to serve the racks, a minimum of one duplex technical power outlet shall be provided per wall (centered on the wall) except for the wall adjacent to the racks. For walls more than 10’ in length, a minimum of 2 outlets shall be provided, and at intervals of no more than 6 feet between outlets.

3.3.8.3.2 FOR MINOR REMODEL PROJECTS

Where telecommunications backboards are applied to existing walls with existing power outlets and light switches, the design shall require backboards to be provided with cutouts permitting access to the existing electrical devices.

3.3.8.4 CONVENIENCE POWER OUTLETS

Convenience power outlets shall be provided on telecommunications room walls for use with power tools and other non-technical devices. Conduits serving convenience power outlets shall be concealed in walls behind backboards.

3.3.9 GROUNDING, BONDING, AND ELECTRICAL PROTECTION

All equipment racks, metallic conduits and exposed non-current-carrying metal parts of telecommunications and information technology equipment in the TR shall be bonded to the TMGB or TGB. Refer to Chapter 8 *Bonding and Grounding* in the BICSI TDMM and TDDG Section 3.8 *Bonding and Grounding (Earthing)* for more information regarding the design of grounding, bonding and electrical protection systems.

- Grounding and bonding conductors shall be sized according to the requirements in ANSI/TIA/EIA J-STD-607A.

3.3.10 CABLES ENTERING TELECOMMUNICATIONS ROOMS

All cables shall be fully supported and properly transitioned throughout their lengths, including proper bend radius fittings at pathway transitions.

Where cabling is routed vertically, it shall be appropriately secured such that the weight of the cabling does not subject the cabling to stresses that could potentially reduce the performance of the cabling.

- Provide vertically oriented ladder racking, attached to walls, to carry riser/backbone cabling vertically between telecommunications rooms.

3.3.11 PROHIBITED ITEMS

The following items shall not be located in telecommunications rooms:

- Electrical power transformers
- Electrical power panels
- Lighting control panels
- EMI-producing equipment such as HVAC VAV boxes.
- Water piping (except for fire suppression systems)

3.3.12 ENTRANCE FACILITIES

3.3.12.1 OUTSIDE PLANT CONDUIT ENTRANCE

All UVU utility services are delivered to the main demarc on campus. Therefore, the concept of an Entrance Facility at UVU's buildings is limited to entrance conduits from the outside plant into the main telecommunications room in the building. Typically, UVU prefers to co-locate the entrance facility with the main telecommunications room.

3.3.12.2 ROOFTOP CONDUIT ENTRANCE

The top most telecommunications room in each building shall have a minimum of two 2" conduits routed to the roof. The conduits shall be terminated above the roof with a weatherhead.

Rooftop conduits can be used to serve antennae for service inputs (satellite, emergency responder radio, cellular service) or provide pathway for cabling serving cameras or other devices mounted on the roof.

3.3.13 SERVER ROOMS

For projects that include server rooms or equipment rooms, the requirements of Section 3.3 *Telecommunications Spaces* apply. The following additional features are required for server rooms. (For full-scale Data Centers, see Section 3.18 *Data Centers* below.)

3.3.13.1 RAISED / ACCESS FLOOR

Server Rooms shall have raised/access flooring (minimum depth of 12") to support cable tray and cabling without restricting airflow.

Floor tiles shall have an anti-static finished surface, without carpet. Tiles shall be 2'x2' in size and non-concrete filled. Tiles shall be held in place by friction and not screwed in place.

Flooring materials and cable tray shall be properly grounded.

3.3.13.2 ELECTRICAL POWER

Conditioned power that is protected with UPS and connected to a generator backup system shall be provided, typically distributed below the raised flooring to adequately support computer equipment that is installed in the server room.

Power distribution equipment shall not be housed in the server room, including transformers, UPS equipment, electrical panels and large PDU equipment.

The Designer shall coordinate the efforts of the Electrical Engineer to be sure that these features are included in the design. The Designer shall involve the UVU ITPM to accurately assess the power load requirements of the Owner-provided equipment.

3.3.13.3 LOCATION

The server room shall be located adjacent to the MDF.

3.3.13.4 PATHWAYS

Cable tray pathways shall route directly between the MDF and the server room.

Like telecommunications rooms, server rooms shall have a horizontal ladder rack circling the room and crossing the room a few inches above all equipment racks/enclosures.

3.3.13.5 ENVIRONMENTAL PROVISIONING

In addition to temperature, humidity control shall also be connected to the building environmental control system. Alarm conditions shall be configured to alert both OIT and Facilities personnel.

Server rooms shall have a secondary/backup heat displacement system that is manually controlled, reversible from outside-supply to outside-exhaust.

The Designer shall coordinate the efforts of the Mechanical Engineer to be sure that these features are included in the design. The Designer shall involve the UVU ITPM to accurately assess the heat loads associated with the Owner-provided equipment.

3.3.13.6 SECURITY

In addition to access control, surveillance video monitoring shall be provided.

3.4 Backbone Distribution Systems

Please refer to Chapter 4, *Backbone Distribution Systems* in the BICSI TDMM, Chapter 5, *Cabling Infrastructure* and Chapter 6, *Pathways and Spaces* in the BICSI OSPDRM, and Chapter 2, *Pathways and Spaces* in the BICSI ITSIMM for general information regarding the design of backbone distribution pathway and cabling. The following requirements take precedence over the guidelines in those documents for telecommunications infrastructure at UVU facilities:

3.4.1 INTRA-BUILDING BACKBONE PATHWAYS

A. Intra-building backbone pathway shall utilize a physical star topology. The Designer, however, shall inquire whether another pathway topology would be appropriate for a given application. Backbone raceway shall consist of conduit, chases or shafts, sleeves, and/or vertically-mounted ladder racking.

B. All cables shall be fully supported and properly transitioned throughout their lengths, including proper bend radius fittings at pathway transitions. Where cabling is routed vertically, it shall be appropriately secured such that the weight of the cabling does not subject the cabling to stresses that could potentially reduce the performance of the cabling.

C. In new construction and remodel projects:

1. The main telecommunications room in the building shall have a direct pathway connection to the entrance facility.

2. All intermediate telecommunications rooms shall have direct pathway connections to the main telecommunications room in the building.

    - This is usually accomplished with vertical riser pathway (Specified Technologies Inc. (STI) Ez-Path).

3. For buildings requiring multiple intermediate telecommunications rooms on a given floor, the secondary telecommunications rooms do not require a direct backbone pathway to the main telecommunications room. Instead, the first intermediate telecommunications room on a floor shall have a direct pathway. The other telecommunications rooms shall connect to the first via the main cable tray on that floor.
    - This solution is typically adequate when backbone cables are relatively small compared to the horizontal cable load in the cable tray.
    - Even though ***pathway*** from one telecommunications room may connect to another telecommunications room before connecting to the main telecommunications room, backbone ***cabling*** shall not cross-connect in the interposing telecommunications room. Intra-building backbone cabling shall be continuous (non-spliced) between the main telecommunications room and each intermediate telecommunications room.

3.4.1.1 BACKBONE RACEWAY SIZE AND QUANTITY REQUIREMENTS

A. Future growth requirements shall be considered when sizing intra-building backbone pathways. The cost to install additional spare pathways during initial construction is significantly less than the cost of retrofitting additional pathway in the future.

B. In general, for new construction and modernization projects, UVU requires a minimum of four 4” Ez-Path sleeves leaving the main telecommunications room/entrance facility enroute to the intermediate telecommunications rooms on floors above. However, for buildings higher than five floors, additional Ez-Path sleeves shall be provided.

3.4.1.1.1 SINGLE-STORY BUILDINGS

A. For single-story buildings with multiple telecommunications rooms, 4” conduit pathways shall be routed through the ceiling, not in or under the floor slab. The Designer shall determine the number of 4” conduits required to serve initial and future backbone cabling requirements.

1. In cases where it is not possible to route 4” conduits to each of the telecommunications rooms, three 2” conduits may be substituted for each required 4” conduit.

3.4.1.1.2 MULTI-STORY BUILDINGS

A. In new construction and modernization projects, telecommunications rooms shall

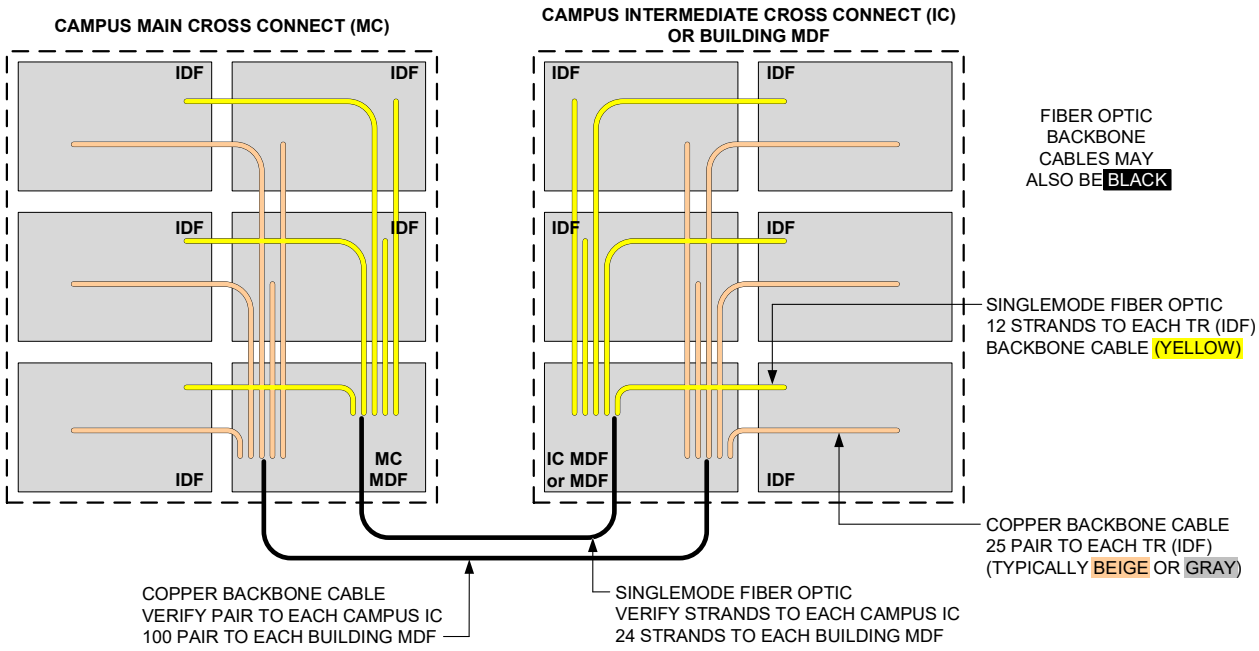
be vertically aligned (stacked) floor-to-floor wherever possible. Sleeved vertical pathways shall be extended to the roof (or to an attic space with access to the roof) to facilitate access for future antennas or other telecommunications equipment. Conduits terminating on a roof shall be capped with a weatherhead.

B. Ladder racking shall be vertically-mounted in the stacked telecommunications rooms to route and support backbone cable passing from the room below to upper rooms.

3.4.2 INTRA-BUILDING BACKBONE CABLING

The diagram below depicts intra-building and inter-building backbone cabling requirements (including strand and pair counts) for UVU buildings:

OSP AND ISP BACKBONE CABLING



3.4.2.1 INTRA-BUILDING BACKBONE CABLE TYPES

A. UVU uses two types of telecommunications cabling for intra-building backbone systems:

- Multipair copper voice backbone cable
- 8/125µm OS2 singlemode fiber optic cabling (yellow color)

B. Splices are prohibited for backbone cabling.

C. Indoor-rated backbone cabling is acceptable for intra-building backbone applications between phyically contiguous buildings. This cabling must be plenum-rated.

D. Outdoor-rated cabling shall be used where buildings are not physically contiguous. This cabling must terminate within 50 ft. of entry.

3.4.2.2 STRAND AND PAIR COUNTS

A. The diagram above indicates all standard strand and pair counts.

B. Backbone cable sizing (# of strands, # of pairs) shall be considered with respect to possible future requirements. The cost to add additional backbone pairs and strands during the initial installation is significantly less than the cost of adding another cable in the future.

The Designer shall inquire with the UVU ITPM and TPM on a case-by-case basis about strand and pair counts for backbone connections between the Campus MC and a Campus IC.

3.4.2.3 PATCH CORDS

A. Patch cords with a connector boot shall be factory-manufactured by the SCS manufacturer. Patch cords shall be certified by the manufacturer to match the cable type used in the backbone cabling.

- Field-connectorized patch cords are not acceptable. Any existing field-connectorized patch cords used in areas affected by a project shall be replaced under the project with factory-manufactured patch cords.

B. See Appendix 5.1 for a diagram that depicts UVU's standard patch cord colors.

C. The Designer shall quantify and specify the required patch cords in the Contract Documents to be furnished by the Contractor for each particular project, as shown in Table 4.3, below:

Table 3.2 Patch Cord Requirements

Type & Color	Patch Cord Requirements, Quantities	Lengths
Singlemode Duplex Yellow	Require fiber optic patch cords to be furnished by the Contractor for 30% of the fiber strands terminated in the building. Half SC-LC and half SC-SC.	• 30% - 1 meter • 40% - 2 meters • 30% - 3 meters

3.4.2.4 CABLE SEGREGATION

In no case shall copper or fiber optic backbone cabling be run in the same raceways as those used by electrical power conductors. However, copper, fiber optic and other low-voltage cables are permitted to run together in shared raceways.

3.4.2.5 INNERDUCT

Plenum-rated innerduct (white colored) is required for all intra-building fiber optic installations at UVU facilities. Intra-building innerduct shall be sized 1 ¼" and shall be distributed via cable trays (not in conduit).

3.4.3 INTER-BUILDING (CAMPUS) BACKBONE PATHWAYS

The Designer shall follow the guidelines in the BICSI TDMM and the BICSI OSPDRM when designing underground outside plant pathways.

3.4.3.1 DUCTBANK

3.4.3.1.1 CONDUIT TYPES

A. UVU requires 4" Schedule 40 PVC for all outside plant pathway.

B. A 10AWG trace wire shall be installed along the route of the ductbank. The trace wire shall terminate on a ground rod in each handhole or maintenance hole. The termination shall be detachable so that the wire can be used with tracing equipment.

C. OSP conduit shall transition from PVC to PVC-coated rigid steel conduit when it enters within 10 feet of the building foundation and shall route from that point to the building entrance facility. PVC-coated, rigid steel conduit is intended to defend against the shearing effects of differential ground settling around the building foundation. It also increases the protection against future landscaping activities near the building.

- Transition back to PVC conduit after passing five feet inside the building foundation is acceptable as long as the conduit remains in or under the slab, otherwise it shall transition to rigid galvanized steel conduit.

- A maximum of fifty feet of outdoor-rated cable is permitted in a building space. Therefore, rigid galvanized steel conduit shall be used to route the cable until it is close enough to its termination point that fifty feet or less of outdoor-rated cable (including slack loops) will be exposed.

D. UVU also permits directional boring in certain applications. Conduits installed via directional boring shall be 1¼" trade size and shall be continuous from endpoint to endpoint.

E. The use of flexible metallic conduit is prohibited.

3.4.3.1.2 BURIAL DEPTH AND SLOPE

A. The preferred ductbank depth is 36" to the top of the conduit. Where this is unattainable, a 30" depth is permitted.

- Under no circumstances will ductbanks be permitted shallower than the extent of the frost zone. In Orem, the frost zone reaches 30" below the surface, according to Utah County[2].

B. Directional boring applications shall route a minimum of 48" deep, except where the conduits are surfacing.

C. Conduit to be used for routing entrance cables from third party service providers to an entrance facility shall be installed per the service providers' requirements, generally 36 to 48 inches deep. The Designer shall consult with the service providers prior to designing conduits serving an entrance facility.

D. A continuous drain slope should exist at all points along the ductbank to allow drainage and prevent the accumulation of water.
- A drain slope of ¼" per foot is desirable where possible.
- Where ¼" per foot is not possible due to inadequate natural slope or long duct runs, a drain slope of no less than 1/8" per foot is acceptable.
- If no other option exists, the Designer shall require the Contractor to provide a "center crown" drain slope by sloping the first half of the ductbank up towards the midpoint, and then down from the midpoint to the end. Of course, the center crown technique cannot be used for conduits between a maintenance hole and a building, because water would then drain into the building.

3.4.3.1.3 CONDUIT SWEEPS (BENDS)

A. UVU has standardized on the use of factory-manufactured fiberglass sweeps with a minimum bend radius of 48" for all OSP ductbanks with the following exceptions and alternatives:

- Shallow curves comprised of continuous lengths of individual straight RNC conduit are permissible with a minimum sweep radius of 40 feet.

- Where cabling larger than 400-PR UTP copper is intended to be installed, conduit bends shall have a radius larger than 48". The Designer shall consult with the UVU ITPM on a case-by-case basis to select appropriately-sized conduit sweeps.

B. The Designer shall minimize the effects of sidewall pressure between the cable and conduit at bend points where possible by designing bends with the tightest bend radii to be near the cable feed end of the duct section rather than the middle or end of the duct bank.

3.4.3.1.4 DUCTBANK ENCASEMENT

UVU requires controlled-density fill (CDF) encasement with full-length reinforcement and formed sides for all ductbanks.

[2] Click the Design Criterion tab: http://www.utahcounty.gov/Dept/ComDev/BuildingInsp/index.asp

A. Prior to concrete being poured, the UVU ITPM or a designated representative shall observe the OSP conduit installation to identify unacceptable installations that need to be corrected prior to concrete encasement.

B. Should the use of direct-buried conduit ductbank be warranted, the Designer shall ensure that all bends in the ductbanks are encased.

C. Wherever cold-joints are required in concrete encasement, the design shall require rebar spanning the joint between ductbank encasement segments to avoid differential settling.

3.4.3.1.5 NUMBER OF DUCTS

A. The OSP pathway system shall accommodate the requirements for signal and low-voltage cabling systems at UVU facilities. The Designer shall inquire with the UVU ITPM and FPM about the potential for future buildings or building expansions that may adversely affect an existing or proposed distribution pathway, and accommodate those plans within the design.

B. The number of 4" conduits in a ductbank should meet the needs of the specific application and should offer future expansion capability. The following list is a guideline for consideration when designing a new ductbank.

- Small utility buildings up to 5,000 sq. ft.: 2 ducts (approvable on a case-by-case basis)
- Buildings up to 100,000 sq. ft.: 4 ducts
- Buildings 100,000 sq. ft. to 300,000 sq. ft.: 6 ducts
- Buildings larger than 300,000 sq. ft.: multiple redundant entrances with 6 ducts each
- Buildings serving as data centers or communications centers: 6 ducts

3.4.3.1.6 DUCTBANK LENGTH

A. In general, ductbank systems shall be designed with section lengths averaging 400 feet, and as straight as possible.

B. The maximum permissible ductbank length (between maintenance holes and/or buildings) is 600 ft. Ductbank runs that exceed this distance require intermediate maintenance holes or handholes. This requirement may be waived through the SVR process in rare cases having the following conditions:
- The ductbank run has no bends.
- The Designer can demonstrate that the pulling tension of UVU's standard OSP telecommunications cable types will not be exceeded during installation.

3.4.3.1.7 SEPARATION FROM OTHER UTILITIES

A. In general, ductbank used as pathway for telecommunications and other low-voltage cabling should not be routed with other utilities. Budgetary constraints, space limitations, and various obstructions can make this difficult to achieve at times. Should shared routing be a necessity (perhaps for overbuild construction

projects), the Designer shall ensure that adequate separation exists between ducts used for telecommunications and ducts used for other utilities.

B. The pathway system shall be designed such that telecommunications and other low-voltage systems do not share conduits, maintenance holes, handholes or tunnels with the electrical power distribution system. The telecommunications distribution pathway shall also maintain minimum separation distances from electrical power distribution infrastructure as required by UVU.

The vertical and horizontal separation requirements for OSP telecommunications pathways from other underground utility infrastructure are as follows:

3.4.3.1.7.1 Proximity to Power or Other Foreign Conduits

NESC requirements state that outside plant telecommunications conduits shall not be installed closer to power conduits or other unidentified underground conduits than:

- 3” where the surrounding material is concrete
- 4” where the surrounding material is masonry
- 12” where the surrounding material is well-tamped earth

The NESC requirements above are focused on safety issues, and the performance of telecommunications systems can be negatively affected by the presence of nearby sources of EMI, even though the NESC safety-related separation requirements are met. Where the Designer is concerned about EMI due to the proximity of power distribution infrastructure, the Designer shall discuss the issue with the UVU ITPM.

3.4.3.1.7.2 Proximity to Water, Gas or Oil Conduits

Outside plant telecommunications conduits shall not be installed closer to conduits that can be identified as not containing electrical power distribution conductors than:

- 6” where the conduits cross
- 12” where the conduits run parallel to each other

Telecommunications conduits running parallel to water, gas or oil conduits shall not be installed vertically above the other conduits, but rather to the side of the conduits. This arrangement should contribute to decreased disruption to the telecommunications conduits in the event of excavation maintenance activities associated with the other nearby conduits.

3.4.3.1.8 INNERDUCT

Innerduct is required for all interbuilding fiber optic installations at UVU facilities. Both 1” and 1¼” innerduct can be used as appropriate for the application. When designing cabling runs through outside plant conduit:

1. Design copper cabling without innerduct.
2. Design fiber optic cabling runs using innerduct
3. Fill the remaining space in a used conduit with empty innerduct, with pull strings in each empty innerduct.
4. Do not fill vacant conduits with innerduct.

3.4.3.1.9 COORDINATION WITH UTILITY SERVICE PROVIDERS

The Designer shall inquire with the UVU ITPM to determine whether services from utility service providers will be necessary. If so, the Designer shall contact the utilities to obtain their entrance pathway, entrance facility and demarcation point requirements.

3.4.3.2 MAINTENANCE HOLES AND HANDHOLES

A. Most of the buildings at the UVU Orem campus are physically contiguous or connected with corridors. As a result, outside plant ductbank is primarily used for small building applications such as Converted Residential Offices. Handholes are typically sufficient for these applications.

B. UVU has successfully used products from Oldcastle Precast, specifically polymer concrete handhole models 2436 and 3048 with a 24" body.

- The Designer shall be responsible to select an appropriate handhole for each application, especially taking into consideration the potential traffic load that may contact the handhole.

C. Typically, maintenance holes are installed for main ductbanks (i.e. ductbanks used for routing large portions of the telecommunications system backbone), and handholes/pullholes are installed for subsidiary ductbanks (i.e. ductbanks serving a single small building).

D. Maintenance holes and their covers shall be appropriately sized for the application.

- Diamond plate hinged covers are not permitted for maintenance holes at UVU.

E. Telecommunications maintenance holes and handholes shall not be shared with electrical power distribution infrastructure. In general, powered devices should not be located in telecommunications maintenance holes and handholes.

F. The number of duct entrances in a maintenance hole or handhole should be sized for both immediate and future requirements. Also, splayed duct entrance arrangements are preferred over center entrances.

- It is desirable to have ducts enter and exit from opposite ends of a maintenance hole or handhole. Sidewall duct entrances should be avoided because such entrances may obstruct racking space, cause cable bends to exceed limits, interfere with cable maintenance activities, and increase construction costs during cable installation.

- UVU recognizes that sidewall duct entry may be necessary or desirable in some circumstances. In these cases, sidewall ducts shall enter and exit at diagonally opposite corners – ducts shall not enter and exit at the midpoints of the endwalls or sidewalls. The Designer shall ensure that endwall and

sidewall duct entry in a maintenance hole or handhole will not hinder access to the maintenance hole or the proper installation and maintenance of cabling.

G. Ducts shall be designed to enter the maintenance holes and handholes starting at the lowest conduit knockouts and moving upward, preserving remaining knockouts accessible for future conduit additions. The Designer shall design the duct entrances such that the relative position of each duct does not change as it enters and exits the maintenance hole or handhole. Also, the Designer shall endeavor to design ductbank arrangements so that the conduits enter and exit a sequence of maintenance holes or handholes in the same relative positions.

H. Splices in backbone fiber optic cable are not allowed, and while splices in backbone copper cable may be permitted in some rare cases (through an approved ADR), they are discouraged. However, when sizing OSP telecommunications maintenance holes, the design shall require the Contractor to provide space for possible future splice closures when required (for example, to repair cable breaks).

I. Some situations may require placement of maintenance holes at below-typical depths. In such cases, the top of the maintenance hole shall be placed at normal depth and the height of maintenance hole shall be increased through the use of intermediate riser extensions between the base and the top. UVU wishes to avoid deep-collar entrance portals wherever possible, to improve lighting and ventilation.

3.4.3.3 AERIAL DISTRIBUTION

Aerial distribution of telecommunications cabling at UVU facilities is not authorized. If an application requires aerial distribution, permission to use this method shall be requested through the SVR process.

3.4.3.4 BRIDGE AND WATERWAY CROSSINGS

A Civil Engineer shall review the construction of bridge and waterway crossing distribution systems. The design and installation shall also be reviewed by the UVU ITPM.

3.4.3.5 WIRELESS AND RADIO SYSTEM DISTRIBUTION

A. UVU facilities use wireless or radio systems for telecommunications with mobile units and personnel, both on and off campus. These systems typically use one or more radio antennas connected by cabling to radio transceiver equipment. In some cases, the radio equipment may be interfaced into the telephone system. The outside plant telecommunications substructure shall be designed with adequate cable routing pathways between antenna locations, radio transceiver locations, and the telephone backbone cabling system.

B. Radio antenna transmission cables that connect the antenna to the radio transceiver emit radio frequency (RF) radiation. These cables may be routed

through the common telecommunications ductbank and maintenance hole system if necessary, but shall be routed in a separate conduit from non-fiber optic telecommunications cables. Cables containing RF radiation shall be shielded cables.

C. Radio interconnection cables (for analog or digital signaling to remote radio operating positions or to the telephone system) typically emit low levels of radio frequency radiation. These interconnection cables shall be routed through the common telecommunications ductbank and maintenance hole system. Individual conduits may be shared for these interconnection cables and other telecommunications services, and available cable pairs in telephone backbone cables may be used for these interconnections, provided that the signaling is analog or digital signaling, and is not direct radio frequency signal.

3.4.3.6 WIRELESS AND RADIO SYSTEM DISTRIBUTION

UVU facilities frequently use rooftop satellite, wireless or radio systems. These systems typically use one or more radio antennas connected by cabling to radio transceiver equipment. Pathways shall be designed from rooftop locations down to the main telecommunications room to serve these applications.

3.4.4 CAMPUS CABLING

When OSP cabling is required, the Designer shall follow the guidelines in the BICSI TDMM and the BICSI OSPDRM.

A. The design shall require that a slack loop be installed inside the nearest maintenance hole or handhole (not stored in the TR). The Designer shall require that sufficient racking hardware be provided in the maintenance hole or handhole to support the slack loop.

B. The length of the loop shall be a minimum of 25 feet. The Designer shall consider the arrangement of the telecommunications room and the possibility of a rearrangement that might consume the cable slack. If necessary, additional slack shall be required in the design, up to the NEC limit of 50 feet of exposed OSP-rated cabling.

3.4.4.1 UTILITY SERVICES

At UVU, telephone services, cable television services and Internet services are typically provided via campus infrastructure. The Designer shall request from the UVU ITPM information about any needed telecommunications infrastructure to support the required services.

3.4.4.1.1 NON-UVU TENANT DEMARC

The Designer shall also request similar information from the UVU FPM for requirements to support non-UVU tenants of the building. Generally speaking:

- UVU does not generally provide utility services to non-UVU tenants unless specified otherwise in the client's contract with UVU.
- Any utility services needed by a non-UVU tenant shall demarc at the campus headend and then be delivered to a building via the campus backbone cabling.

3.4.4.2 WIRELESS AND RADIO SYSTEM DISTRIBUTION

A. Outdoor-rated backbone cabling shall be designed to serve rooftop satellite, wireless or other radio system applications. Lightning protection equipment shall also be designed as appropriate.

B. Radio antenna transmission cables that connect the antenna to the radio transceiver emit radio frequency (RF) radiation. These cables may be routed in a separate conduit from other telecommunications cables. Cables carrying signals that produce RF radiation shall be shielded cables.

3.5 Horizontal Distribution Systems

Please refer to Chapter 5, *Horizontal Distribution Systems* in the BICSI TDMM for general information regarding the design of horizontal distribution pathway and cabling. The following requirements take precedence over the BICSI TDMM guidelines for telecommunications infrastructure at UVU facilities:

3.5.1 DEVICE BOX CONSIDERATIONS

A. Device boxes for telecommunications outlets shall be mounted at standard outlet mounting height, matching electrical power outlets. Typically this is 18" above finished floor.

B. Device boxes shall include double gang mud rings that support a double gang faceplate. Single gang faceplates are not acceptable. See the photo in Section 3.5.2.1, above.

C. For projects using Category 6A (Augmented) cabling, the commonly-used 4"x4" device boxes are too small to provide sufficient cable bend radius – for example, when there are 4 or more cables terminating in the box. Therefore, where device boxes are used with CAT6A cabling, 5"x5" device boxes are required, with reducing extension rings and faceplates with angled jacks. The Designer shall verify cable dimensions and bend radius limitations with the cable manufacturer to determine whether larger boxes are required.

- As of this writing, there are several known sources of 5"x5" device boxes:
  - RANDL Industries, Inc. (www.randl-inc.com)
  - Hubbell
  - Thomas & Betts
  - Siemon (www.siemon.com)

D. Within the limitations of the project budget, the provision of spare outlets and spare ports in a work area is encouraged, to provide flexibility for future needs.

E. Both telecommunications cabling and CATV coaxial cabling are permitted to be terminated in a shared device box.

F. Device boxes intended for use with low-voltage cabling (telecommunications, CATV, etc.) shall not host electrical power receptacles or power wiring. "Combo boxes" (divided, multi-gang device boxes for power and data behind a single faceplate) are not permitted.

3.5.1.1 FLOOR BOXES

A. Device boxes shall not be mounted in the floor (i.e. "floor boxes") except where no suitable alternative exists. If device boxes must be mounted in the floor, each device box shall be served with its own individual conduit – floor boxes shall not be "daisy-chained" together.

B. Power outlets may be combined with telecommunications cabling in floor boxes if the power wiring is routed to the floor boxes separately from the telecommunications cabling, and if the floor box provides for metallic barrier segregation of the power and telecommunications cabling within the box.

C. In many cases, floor boxes will be intended to host audio visual cabling in addition to telecommunications and power. In such cases, coordinate with the audio visual designer and the AVPM to achieve both telecommunications and audio visual objectives. See the floor box requirements in the AVDG.

D. Floor boxes shall be one of the following options depending on size requirements, cable handling requirements, and construction circumstances:

- FSR FL-500P-x series with assocated accessories
- FSR FL-600P-x series with assocated accessories
- Hubbell CFB7Gx series with assocated accessories

- Poke-thru: Legrand Evolution xATC series with assocated accessories

The Designer shall review the selection of floor box for each application with the ITPM.

3.5.1.2 FOR NEW CONSTRUCTION AND FULL REMODEL

A. A device box shall be provided for each telecommunications outlet. Device boxes shall be 4"x4"x3-½" (where 2-¼" is the depth of the box and 1-¼" is the depth of the extension ring, with an overall depth of 3-½"). Device boxes shall be recess-mounted.

- If Category 6A cabling will be used, the Designer shall require 5"x5" device boxes regardless of the cable count.

B. Surface-mounted device boxes are not acceptable. However, for concrete

masonry unit (CMU) walls or other wall types that may obstruct cable or conduit installation, the Designer shall request direction from the UVU TPM on a case-by-case basis.

3.5.1.3 FOR OTHER PROJECTS

A. Existing device boxes and conduits shall be reused where they are standards-compliant, or where it can be verified that the existing conduits and boxes will permit telecommunications cabling to be installed without negatively affecting the performance of the cabling. The bend radius of the cabling inside each box shall be considered carefully in evaluating existing boxes. For concealed conduits that cannot be verified, the Designer shall assist the UVU TPM to consider conduit length, number of bends and cable fill percentage, then decide on a case-by-case basis whether they are suitable for reuse.

B. A device box shall be provided for each telecommunications outlet. Device boxes shall be recess-mounted wherever possible and shall be 4”x4” and at least 2 ½” deep (a 3 ½” depth is preferable). Surface-mounted device boxes (if required) may be standard single gang (2” x 4”) and at least 2 ½” deep.

C. Where cabling can be fished through interstitial wall spaces, it is typically permissible to use faceplate mounting brackets in lieu of device boxes.

3.5.2 WORK AREAS

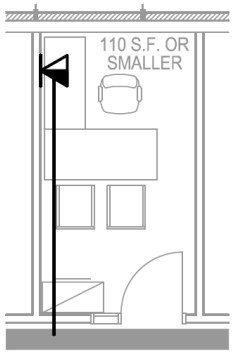
3.5.2.1 STANDARD TELECOMMUNICATIONS OUTLETS

A. All cabling shall be plenum-rated.

B. Each outlet shall have 2 jacks (ports) total, as shown in the photo at right:
- 2 data jacks, each served with a separate Category 6A cable. Do not under any circumstances split pairs on data jacks.

3.5.2.2 PERMANENT OFFICE SPACES

There are three sizes of permanent office spaces depicted below, with outlet locations identified for each case:



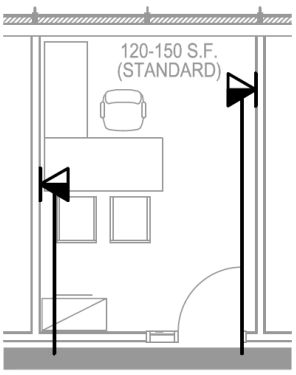
3.5.2.2.1 SMALL OFFICES (110 SQUARE FEET OR SMALLER)

A. Provide one outlet in the corner opposite the door.

3.5.2.2.2 STANDARD OFFICES (120 TO 150 SQUARE FEET)

A. Provide two outlets on opposite sides of the room. The outlets shall be arranged as shown in the floor plan below, intended to complement the possible furniture orientations and maximize patch cord coverage in the room.

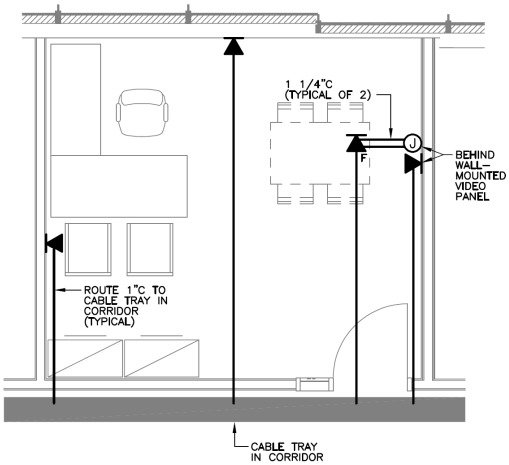
B. If an exterior wall will not support outlets due to windows, it is acceptable to place two outlets on a single wall if they are spread apart and one of the outlets is near the exterior wall.



3.5.2.2.3 LARGE OFFICES (150 SQUARE FEET OR LARGER)

A. For larger offices, a third outlet shall be provided on the exterior wall, as shown in the floor plan below.

B. If an exterior wall will not support outlets due to windows, it is acceptable to place two outlets on a single wall if they are spread apart and one of the outlets is near the exterior wall.



150 S.F. OR LARGER

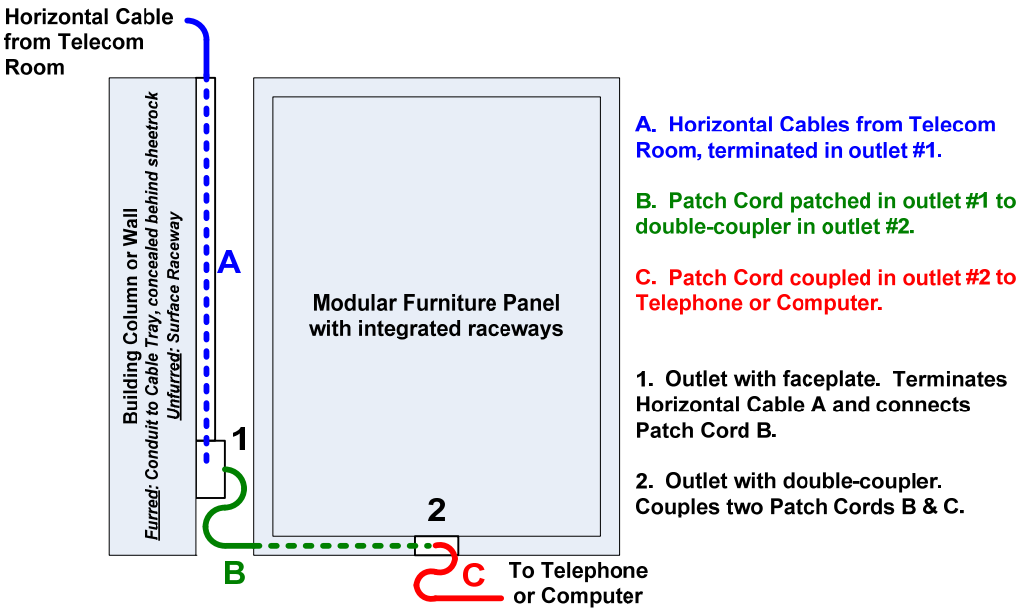
3.5.2.3 OPEN OFFICE / MODULAR FURNITURE

A. UVU prefers to serve open office areas using permanently mounted outlets in the wall nearest the modular furniture. Where modular furniture is not located adjacent to a wall, floor boxes are required.

- It is usually preferable to route cabling inside concealed conduits or through interstitial wall spaces. Therefore, columns that are wrapped or furred are preferable because conduits and device boxes can be concealed inside.
- The TPM may authorize the use of surface-mounted raceway in certain projects for columns that are not able to conceal raceway.
- Where columns and floor boxes do not exist and cannot be added, utility poles shall be designed as a last resort.
- Where columns are available, raceways shall route cabling down from the ceiling space to two outlets on opposite sides of each column, allowing furniture to sit against the columns on the sides without outlets.
- Outlets on columns shall have up to 6 ports per outlet.

B. Raceways integrated into modular furniture shall have separate channels for power and data. The channels shall be designed with abrasion protection features.

C. The standard treatment for each modular furniture office space (cubicle) is two data jacks with two Category 6A cables and two voice jacks with one Category 5E cable split between the two ports. The following diagram depicts UVU's preferred method of routing cabling to modular furniture:



D. Furniture shall not obstruct access to power or telecommunications outlets. Where necessary, access panels shall be provided and/or holes shall be cut through obstructions to allow access to the outlets.

3.5.2.4 TELECOMMUNICATIONS OUTLETS FOR WIRELESS ACCESS POINTS / IP CAMERAS

A. UVU currently uses Cisco wireless access point equipment in its buildings. This equipment operates with Power-over-Ethernet (POE) and requires two Category 6A cables per device (plenum-rated). The Designer shall accommodate POE equipment in the design, including the power and cooling requirements.

B. The Designer shall work cooperatively with the UVU ITPM to design telecommunications infrastructure to appropriately support wireless technologies. The Designer shall show the locations where wireless access points (WAP) are desired on the drawings. On occasion, UVU may request services to identify appropriate WAP locations and prepare associated coverage and signal strength maps.

3.5.2.4.1 STANDARD PROVISIONS

A. Generally speaking, outlets serving wireless access points shall be provided in a grid-like pattern for each 900 square foot portion throughout the occupiable building space. Additional outlets shall be provided to support higher density occupation as needed.

B. Outlets serving wireless access points shall be mounted above a T-bar ceiling or

higher than 120" above finished floor where the ceiling is exposed. Outlets shall be attached to structure, walls, or cable tray. Do not mount outlets for WAPs above inaccessible ceilings.

C. Outlets serving wireless access points shall be distributed around the room near locations where WAPs will be deployed.

D. Each standard outlet (5-square box) shall have two Category 6A cables.

E. These outlets may also serve IP video surveillance cameras, requiring additional cables for that purpose. See Section 3.5.2.5 for information about video surveillance applications.

F. The Owner will install all WAP equipment and patch cords after the Contractor installs the cabling.

3.5.2.4.2 GENERAL BUILDING COVERAGE

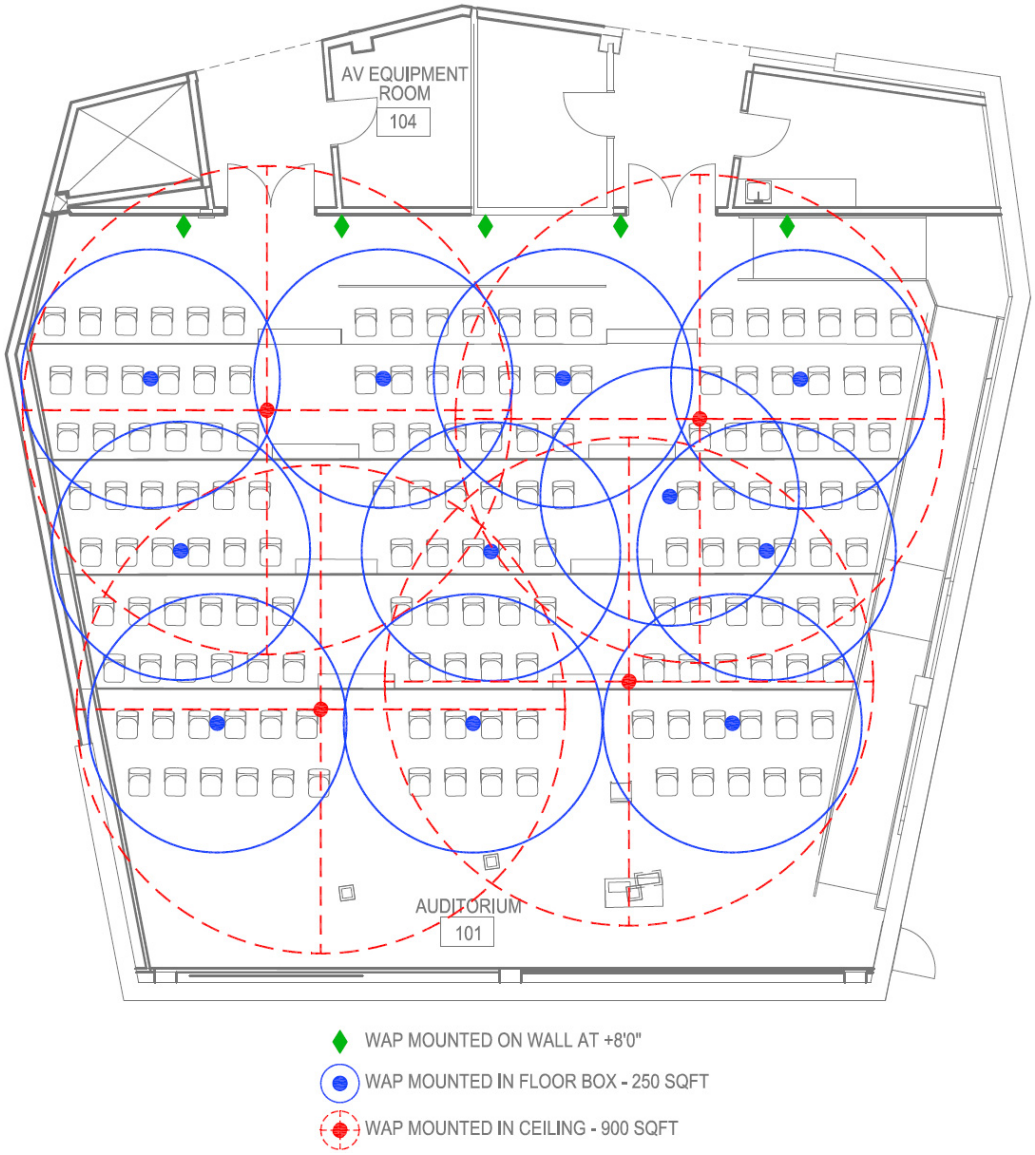
Outlets for WAPs shall be provided for every 900 square feet of building space, distributed uniformly throughout the building.

3.5.2.4.3 AREAS OF HIGHER WAP CONCENTRATION

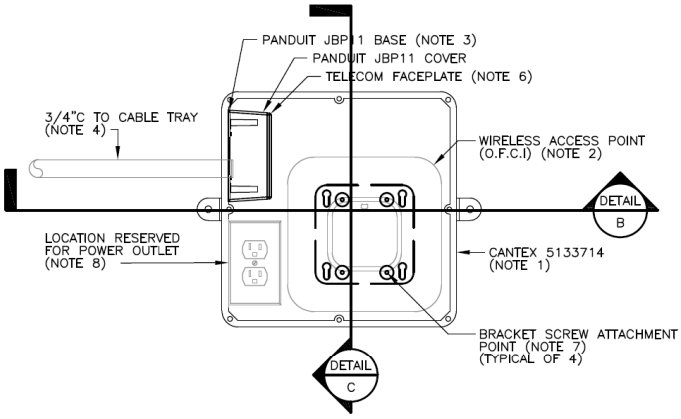
The following WAP outlets shall be provided in addition to the General Building Coverage WAPs described above.

Classrooms and Lecture Halls	Outlets and Cables
50 seats or less	• One outlet with **two** data cables in the center of the ceiling
51 to 100 seats	• Two outlets with **two** data cables each, spread evenly in the ceiling
101 to 150 seats	• For every 250 square foot space, one floor box 14"x14"x8" with **two** data cables • One outlet with **six** data cables in the center of the ceiling
151 seats or more (See diagram below)	• Five outlets spread evenly along the widest wall of the room (typically the rear wall) with **two** data cables each, mounted below the ceiling • For every 250 square foot space, one floor box 14"x14"x8" with **two** data cables. See floor box detail below. • For every 900 square foot space, one outlet with **two** data cables in the ceiling • **Two** data cables installed in every fourth seat in every third row (for student use with patch cords – not WAPs)

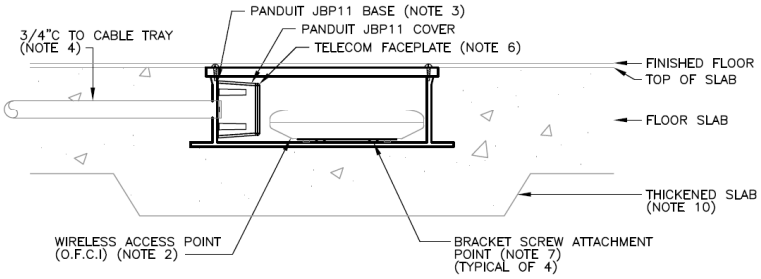
WAP Locations for Auditoriums with more than 150 Seats



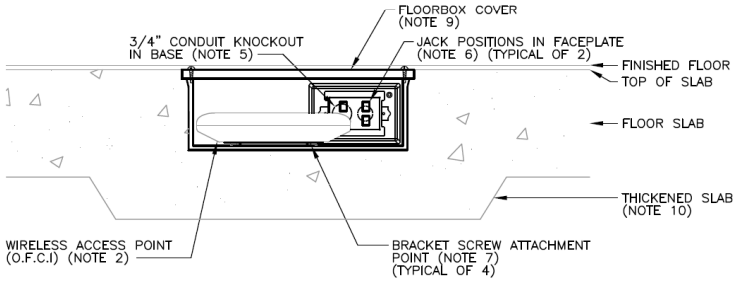
WAP Floor Box Detail for Auditoriums with more than 150 Seats



DETAIL A
FLOOR BOX FOR WIRELESS ACCESS POINT
TOP VIEW



DETAIL B
FLOOR BOX FOR WIRELESS ACCESS POINT
SIDE VIEW (CONDUIT)



DETAIL C
FLOOR BOX FOR WIRELESS ACCESS POINT
SIDE VIEW (FACEPLATE)

NOTES:

1. PROVIDE CANTEX 5133714 FLOOR BOX AND TWO COVERS (NO EXCEPTIONS).
2. INSTALL OWNER–FURNISHED WIRELESS ACCESS POINT AND MOUNTING BRACKET. PROVIDE NETWORK PATCH CORDS.
3. PROVIDE PANDUIT JBP11 BOX WITH AN OVERALL HEIGHT OF 2.27 INCHES (THIS DIMENSION IS ESSENTIAL TO THE DESIGN). REMOVE 3/4" KNOCKOUT AND ORIENT BASE AS DESCRIBED IN NOTE 5 BELOW. ATTACH BASE OF BOX TO INSIDE OF FLOOR BOX WALL, CENTERED VERTICALLY AND SECURE WITH CONDUIT LOCKNUT AND PER MANUFACTURER REQUIREMENTS.
4. PROVIDE 3/4" CONDUIT THROUGH FLOOR TO WALL, THEN UP WALL AND TO CABLE TRAY IN CORRIDOR. MINIMIZE CONDUIT BENDS AS SPECIFIED. DO NOT DAISY–CHAIN MULTIPLE FLOOR BOXES. EACH FLOOR BOX SHALL BE SERVED WITH A DEDICATED CONDUIT. CUT HOLE FOR CONDUIT THROUGH SIDEWALL OF FLOOR BOX. SEE NOTE 5.
5. ORIENT BASE (AND CONDUIT PENETRATION) AS SHOWN, WITH THE 3/4" KNOCKOUT CLOSER TO THE CENTER OF THE SIDEWALL. THIS ORIENTATION IS ESSENTIAL TO THE DESIGN OF THE APPLICATION TO ALLOW SPACE FOR CABLE TERMINATIONS.
6. PROVIDE TELECOMMUNICATIONS FACEPLATE WITH 4 JACK SPACES. FOR APPLICATIONS DESIGNATED WITH 3 CABLES AND JACKS, USE THE JACK SPACES IN THE FACEPLATE AS SHOWN SO THAT THE PATCH CORDS DON'T COLLIDE WITH THE WIRELESS ACCESS POINT. PROVIDE BLANK INSERTS FOR UNUSED SPACES.
7. ATTACH BRACKET (OWNER–FURNISHED) TO BOTTOM OF BOX PER BRACKET MANUFACTURER'S RECOMMENDATIONS. ENSURE THAT THE BRACKET POSITION WILL ALLOW WIRELESS ACCESS POINT TO FULLY SLIDE INTO SLOTS FOR MOUNTING PEGS. BRACKETS SHALL BE POSITIONED TO HOLD THE WIRELESS ACCESS POINT CLOSE TO THE TWO SIDEWALLS AS SHOWN WITHOUT MAKING CONTACT.
8. SOME FLOOR BOX APPLICATIONS MAY ALSO REQUIRE A POWER OUTLET. IF SO, THE POWER OUTLET SHALL BE MOUNTED FACE UP AS SHOWN IN THE LOCATION INDICATED. A CONDUIT FOR THE POWER CIRCUIT SHALL BE TERMINATED THROUGH THE SIDE WALL NEAR THE POWER OUTLET. THIS ARRANGEMENT IS ESSENTIAL TO THE DESIGN OF THE APPLICATION. NO EXCEPTIONS TO THESE REQUIREMENTS SHALL BE PERMITTED.
9. POSITION FLOOR BOX SUCH THAT THE TOP OF THE COVER IS FLUSH WITH THE TOP SURFACE OF THE CONCRETE FLOOR SLAB. PROCURE A SECOND COVER TO REPLACE THE ORIGINAL COVER USED DURING THE CONCRETE POUR AND ROUGH–IN WORK, AND INSTALL SECOND COVER JUST PRIOR TO THE INSTALLATION OF CARPET OR AFTER FLOOR GRIND/POLISH. REMOVE ANY CONSTRUCTION DEBRIS AND DUST. AFFIX GASKET TO UNDERSIDE OF COVER TO PERMIT PROPER GASKETED INSTALLATION. WHERE A FLOORING MATERIAL IS APPLIED TO THE SURFACE OF THE SLAB (CARPET, TILE, ETC.) ALSO APPLY THE MATERIAL TO THE COVER OF FLOOR BOX, WITH OPENINGS TO ACCESS THE SCREWS IN THE COVER.
10. THICKEN THE SLAB AS REQUIRED UNDER THE FLOOR BOX FOR STRUCTURAL REINFORCEMENT.
11. IF THE PLAN DRAWINGS SHOW OUTLET WITH CONDUIT, PROVIDE CONDUIT. DO NOT USE THE WIRE BASKET TO ROUTE CABLING, ESPECIALLY THROUGH PLENUM–RATED SPACES.

3.5.2.5 TELECOMMUNICATIONS OUTLETS FOR SPECIAL INDOOR APPLICATIONS

A. IP video surveillance camera applications shall be provided one data cable each, terminated near the desired camera location.

- Mount the data outlet between 12” and 24” above accessible ceiling tiles or above the lighting plane of an exposed ceiling.
  - For hard-lid (gypboard) unaccessible ceilings, provide a wall-mounted data outlet below the ceiling or a downward-facing ceiling-recessed data outlet.
- Provide a single gang mud ring and faceplate.
- Use a patch cord to connect the camera to the jack in the data outlet.

B. An ADA-compliant courtesy telephone (Owner provided, model number 2554, wall phone) may be required in a main floor gathering space. The Designer shall inquire with the Architect and UVU FPM whether courtesy telephones are included in the project and shall design a wall-phone outlet for each location.

C. Recent Code revisions (IBC 2012 1007.8) require that an elevator emergency two-way communication device be located on each floor near elevator doors. UVU currently uses the device below for this application:

- E-1600-30A from Viking Electronics, Inc. http://www.vikingelectronics.com/

Each device requires a single CAT5e voice cable, terminated directly onto terminals of the phone device which is installed into a 4”x4” device box.

D. The following table lists several special applications and the corresponding provisions for voice, data and power:

Application	Conduits	Voice	Data	Power
Vending Machines	one 1”		1 cable per machine	1 single gang receptacle per machine
Touch Screen Kiosks	one 1”		1 cable per machine	1 single gang receptacle per 2 machines
Teacher Stations	See AVDG	1 cable, 2 jacks	6 cables	1 single gang receptacle
Courtesy Telephones	one 1”	1 cable, 1 jack		
Pay Telephones	one 1”	1 cable, 1 jack		
Digital Signage (Flat Panel Display + Digital Media Player)	one 1”		2 cables	1 single gang receptacle
Televisions	one 2”		1 cable	1 single gang receptacle
Ceiling-mounted Projectors	one 2”		1 cable	1 single gang receptacle

Active Door Signage	one 1”		1 cable	1 single gang receptacle
Conference Room A/V Junction Wall Box	See AVDG		4 cables	1 single gang receptacle
Lighting Control System Main Panel	one 1”		2 cables	

E. Outlets mounted in raised floor applications shall be fed from Siemon MUTOA termination boxes. Provide 2 cables to each outlet from the MUTOA, with a maximum of 12 cables per MUTOA.

- Otherwise, UVU rarely accepts consolidation point solutions.

F. Outlets shall be provided to connect power monitoring equipment to the network.

G. Outlets will be required in mechanical and electrical spaces to provide network services to mechanical control equipment, electrical power monitoring equipment and lighting control panels. The Designer shall address these needs on a project-by-project basis.

H. The following applications require case-by-case direction. The Designer shall work with the the UVU FPM, ITPM, TPM and non-UVU tenants to determine the appropriate solutions for these applications:

- Fire alarm panels
- Elevators
- Security systems
- Access control systems
- Security systems
- Security scanning stations
- Point-of-sale equipment
- ATM Machines
- Irrigation controllers

I. UVU considers undercarpet telecommunications cabling (UTC) solutions to be undesirable in most cases. The Designer shall discuss any apparent justifications for undercarpet cabling with the UVU TPM prior to its inclusion in a design and shall also discuss the next best alternative to using undercarpet cabling.

J. Structural backing shall be designed into walls to support wall-mounted equipment. See the manufacturer’s guidelines for each piece of wall-mounted equipment. The Designer shall discuss this topic with the UVU ITPM.

K. The Designer shall inquire about the requirements for any special design considerations, including compliance with the Architectural Barriers Act Accessibility Standard (ABAAS).

3.5.2.6 OUTDOOR WIRELESS ACCESS POINTS AND SURVEILLANCE VIDEO CAMERAS

Outdoor gathering spaces shall be designed to have wireless network coverage. Outdoor-rated outlets may be required to serve outdoor wireless access points and outdoor surveillance video cameras.

3.5.2.6.1 BUILDING ROOF TOP-MOUNTED

If a roof top mounting is useful, the Designer shall incorporate the following features:

- Lightning protection (surge suppression)
- Camera housing heat

An example of a roof top application at UVU is shown at right.

Note: this application is intended for parapet walls that are no more than 24” thick. For thicker parapet walls, pockets in the wall are required to provide a recess with a wall thickness of 24” or less.

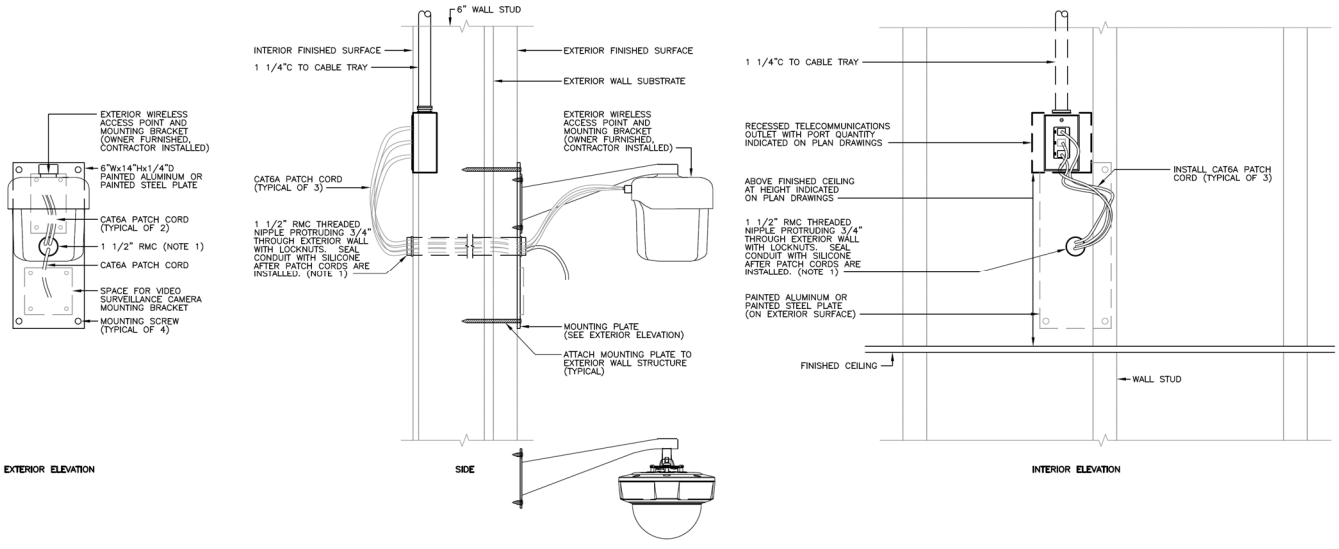
3.5.2.6.2 POLE-MOUNTED

If a roof-top mounting is useful, an enclosure will be required at the pole to house the WAP equipment. The Designer shall incorporate the following features:

- Lightning protection (surge suppression)
- Camera housing heat
- Vandalism protection
- Aesthetic integration

3.5.2.6.3 BUILDING WALL-MOUNTED

A. Where useful and practical, UVU prefers to combine outdoor WAP locations with outdoor security camera applications. One possible solution to accomplish this is depicted below.



3.5.2.1 TIME INFORMATION MANAGEMENT SYSTEM

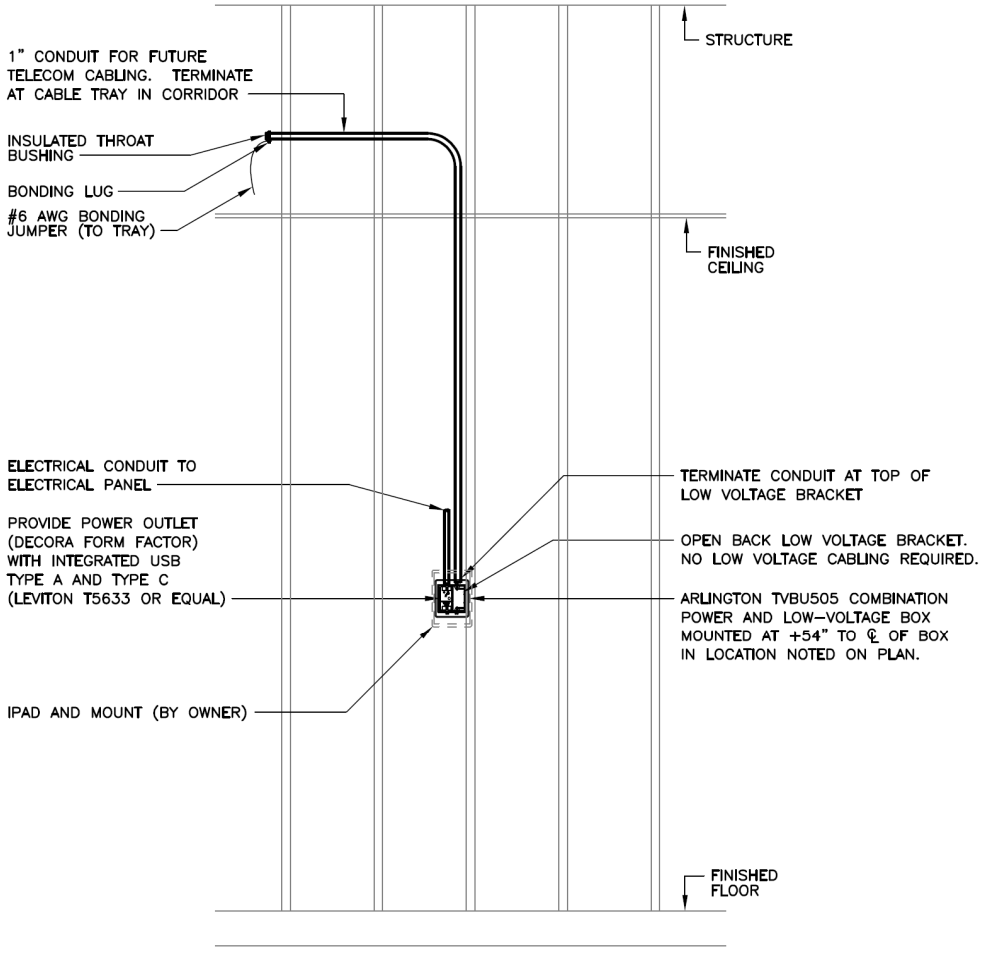
A. UVU uses a custom application for tracking employee time called the Time Information Management System (TIMS). This application consists of an Arlington TVBU505 combination power and low voltage box recessed in a wall behind an Owner-provided iPad tablet mounted in an Owner-provided mounting frame. The box shall contain a power outlet with USB form-factor 5V supply ports (Leviton T5633). The box shall be painted to match the wall.

B. The iPad tablet will receive power to charge the battery from a transformer plugged into the power outlet.

C. The iPad tablet will communicate via WiFi and therefore will not require telecommunications cabling. However, a 1" conduit to the cable tray shall be provided for future telecommunications cabling.

D. The Designer shall discuss this application with the ITPM to coordinate any desired adjustments.

E. The detail below depicts the TIMS application:



3.5.2.2 WORKSTATION POWER OUTLETS

A. There shall be at least one general-purpose convenience power outlet (120VAC, 20 Ampere minimum) located within three feet of every telecommunications outlet. The Designer shall discuss any application-specific needs with UVU OIT staff and adjust the power outlet locations and amperage accordingly.

- In the case of new construction and modernization projects, the power outlet associated with each telecommunications outlet shall be a 4”x4” device box (dual gang) with four power receptacles. It is the Designer’s responsibility to coordinate with the electrical engineer to ensure that power outlets are located near telecommunications device boxes.

- In the case of minor remodel, historical building remodel and telecommunications-only projects, it may be difficult to meet this requirement. Therefore, where existing power outlets are not located within six feet of each telecommunications outlet, the Designer shall alert the UVU TPM and request consideration of the situation on a case-by-case basis.

3.5.3 HORIZONTAL CABLING SYSTEMS

3.5.3.1 GENERAL

A. The Designer shall work with the UVU FPM and the UVU TPM to identify and understand the needs and requirements for the facility on a project-by-project basis. This includes understanding the expected future uses of the facility. The Designer shall design the horizontal cabling accordingly.

B. Telecommunications infrastructure designs and specifications shall be based upon products from approved manufacturers, as defined in TDDG Section 1.5 *Required Manufacturers (Basis of Design)*, above.

C. All horizontal cabling shall be plenum-rated.

D. In addition to the manufacturers listed above, UVU has selected several manufacturers of products for telecommunications cabling systems (cable, connectors, termination blocks, patch panels, etc.) and telecommunications distribution hardware (racks, cable tray, enclosures, etc.). The Designer shall incorporate only these manufacturers into the design, and shall design a telecommunications distribution system that will be suitable for the use of products from these manufacturers.

E. Whenever moves, adds or changes (MAC) are made to existing systems, the new cabling shall follow the routes of existing established telecommunications cabling pathways.

3.5.3.2 TOPOLOGY

UVU has standardized on the star topology for all horizontal cabling, with some exceptions for certain building automation systems that require or benefit greatly from ring or other topologies.

3.5.3.3 HORIZONTAL DATA APPLICATIONS

A. At UVU facilities, horizontal distribution copper cable and components for data applications shall be rated for and installed in compliance with the IEEE 802.3ab 10GBase-T standard. UVU requires 4-pair, 100-ohm, 24 AWG, unshielded twisted-pair (UTP) copper Category 6A-rated cabling for all horizontal data cabling applications.

B. Horizontal cables shall be terminated at the work area end and patch panel end with modular jacks.

1. UVU has standardized on the color white for horizontal data cabling.
2. The color of the modular jack shall match the color of the cable.
3. Category 6A data jacks shall be angled.

C. In existing buildings, where additions are made to an existing Category 5 or 5e installation, the Designer shall seek direction from UVU regarding whether to install Category 6 or Category 6A cabling. If the number of additional cables to be installed is small compared to the installed base, UVU will likely wish to add new Category 6 cabling. If the number of new cables to be installed is relatively large, UVU may choose to use Category 6A cable and matching components.
1. Category 5 cable and components shall not be installed under any scenario.
2. Category 6 cables shall be terminated at the work area end with a modular jack matching the category of the cabling.

3.5.3.4 HORIZONTAL VOICE APPLICATIONS

A. UVU uses VOIP telephones for voice applications in all new buildings. Therefore, these voice applications require standard white data cabling matching the cabling intended for use with network applications.

Fax machines will use Owner-provided VOIP-analog gateway devices.

However, there are a few cases where Category 5e cables shall be provided for non-VOIP uses, even in buildings where Category 6A cabling is provided for data applications:

1. Elevator phones, the main fire alarm panel and sometimes the area of refuge communication devices require analog telephone circuits (POTS). The Designer shall verify whether any of these systems are required for a given project.
2. For some limited remodel projects in existing buildings where digital telephones are in service, UVU may choose to add more digital

telephones to match the existing telephones in operation in those buildings.

B. Non-VOIP horizontal voice cables shall be:

1. Blue-colored Category 5e cables.
2. Terminated at the work area end with two modular USOC RJ-14c jacks (split the pairs on a single cable).
3. Terminated in telecommunications rooms on 110 blocks.
4. Category 3 and 5 cable and components shall not be installed under any scenario.

3.5.3.5 LOW-VOLTAGE AND BUILDING AUTOMATION SYSTEMS

A. During planning for intra-building telecommunications cabling installations, the Designer shall identify options for supporting power-limited (low-voltage) and building automation systems with the common structured cabling system, and present the options to UVU for consideration. These options shall comply with ANSI/TIA/EIA 862 – Building Automation Systems Cabling Standard for Commercial Buildings.

B. By providing a common cabling distribution system for the various building automation systems, it may be possible to reduce construction costs and operational costs while creating an intelligent building that can contribute many other benefits (see TDMM Chapter 14 *Building Automation Systems* for further information). Low-voltage systems that are capable of using a common structured cabling system (either backbone or horizontal cabling) shall be designed to use telecommunications cable and termination hardware wherever possible.

C. The Designer shall request from UVU a list of systems that will require telecommunications outlets for operations. The Designer shall then include horizontal cabling in the design as necessary to meet the listed requirements.

D. Some low-voltage and building automation equipment benefits from installing a connector directly onto the horizontal cable without first terminating it in a jack.

- One significant uniqueness for horizontal telecommunications cabling intended for use with permanently mounted equipment is detailed in the new standard ANSI/BICSI D005 - *Electronic Safety and Security (ESS) Information Technology System (ITS) Design and Implementation Best Practices*. This standard is currently under industry review and is expected to be adopted soon.
    - This standard permits horizontal cabling to be terminated on the device end of the cable using a connector (as opposed to a jack) allowing the horizontal cable to plug straight into the device.
    - The horizontal cable does not need to terminate in a faceplate-mounted jack.

E. Other low-voltage and building automation equipment uses terminals that require the cable to be terminated directly onto the equipment without using a modular jack. There is no method of testing a cable in this configuration.
- This application is not standards-compliant, and is unlikely to be approved by the TPM.
- In most cases, it is possible to terminate the horizontal cable in a standard outlet inside a panel, field-manufacture a half-patch cord to plug into the outlet, and then terminate the raw end of the half-patch cord directly onto the terminals of the equipment.

3.5.3.6 HORIZONTAL CROSS-CONNECT (HC)

All Category 6A horizontal cabling serving a data application shall be terminated on a rack-mounted patch panel.

All Category 5E horizontal cabling serving a voice application shall be terminated on 110 blocks.

3.5.3.7 GPON HORIZONTAL CABLING SOLUTION

UVU does not currently use GPON, and does not anticipate doing so in the near future. However, the Designer shall discuss with the ITPM whether GPON might be beneficial for a given application.

GPON tends to be useful for Residential applications that require CATV service. However, since UVU does not operate student residential buildings, and since UVU's television distribution is an IPTV solution, it is unlikely that GPON will be worthwhile at UVU.

3.5.3.8 PHYSICAL SEPARATION REQUIREMENTS

There are currently no UVU-driven applications or procedures that require certain cables to be physically segregated from other cables. The only expected source of such a requirement would come from a regulatory authority. The Designer shall consider whether any such regulations exist when designing cabling applications for UVU.

3.5.3.9 PATCH CORDS

B. Patch cords with a connector boot shall be factory-manufactured by the SCS manufacturer. Patch cords shall be certified by the manufacturer to match the cable type used in the horizontal distribution.

- Field-connectorized patch cords are not acceptable. Any existing field-connectorized patch cords used in areas affected by a project shall be replaced under the project with factory-manufactured patch cords.

C. See Appendix 5.1 for a diagram that depicts UVU's standard patch cord colors.

D. The Designer shall quantify and specify the required patch cords in the Contract Documents to be furnished by the Contractor for each particular project, as shown in Tables 4.1 and 4.2, below:

Table 3.3 Patch Cord Requirements for Telecommuncations Rooms

Type & Color	Patch Cord Requirements, Quantities	Lengths Telecom Room (Patch Panel)
CAT6A **White**	Require patch cords to be furnished by the Contractor for **each Category 6A cable terminated on a patch panel port**.	• 25% - 3 ft • 50% - 5 ft • 25% - 7 ft
CAT6A **Blue**	Require patch cords to be furnished by the Contractor for each Category 6A cable terminated on a patch panel port **that will serve an Audio Visual device**. For each **Blue** patch cord, delete a white patch cord from the above count.	• 25% - 3 ft • 50% - 5 ft • 25% - 7 ft

Table 3.4 Patch Cord Requirements for Work Areas (Outlets)

Type & Color	Patch Cord Requirements, Quantities	Lengths Work Area (Outlet)
CAT6A **White**	Require patch cords to be furnished by the Contractor for **40% of total Category 6A cables terminated on patch panel ports**.	• 50% - 12 ft • 40% - 15 ft • 10% - 25 ft
CAT6A **Blue**	Require patch cords to be furnished by the Contractor for 80% of the Category 6A cables terminated on patch panel ports **that will serve an Audio Visual device**. For each **Blue** patch cord, delete a white patch cord from the above count.	• 30% - 3 ft • 50% - 5 ft • 20% - 7 ft

E. The Owner will install all patch cords. This includes routing patch cords through modular furniture, connecting to telephones, and also the patch panel-to-switch connections in the telecommunications rooms.

3.5.4 HORIZONTAL PATHWAY SYSTEMS

The process of selecting the type of pathway that would be appropriate for a particular project shall be a cooperative effort involving the Designer and the UVU TPM.

3.5.4.1 GENERAL PATHWAY DESIGN CONSIDERATIONS

A. All cables shall be fully supported and properly transitioned throughout their lengths, including proper bend radius fittings at pathway transitions. Where cabling is routed vertically, it shall be appropriately secured such that the weight of the cabling does not subject the cabling to stresses that could potentially reduce the performance of the cabling.

B. UVU prefers generally to use a combination of cable tray, conduits and junction boxes for all telecommunication and other low-voltage pathways.

C. The Designer shall discuss pathway type and size options with the UVU TPM.

1. The Designer shall discuss the relative merits of the pathway options available and shall assist the UVU TPM and the project design team to select the most appropriate pathway solution for the project.
2. The future growth anticipated for the facilities affected by the project shall be discussed. Horizontal feeder pathways (cable trays, conduits from TRs to distribution junction boxes) shall be sized to support the initial cabling installation plus a minimum of 25% growth.
3. For new construction and full remodel projects, J-hook pathways are not permitted. J-hook pathways are only acceptable for minor remodel projects, and only when approved by the UVU TPM. When used, J-hook pathways shall be sized to support 100% additional cables after the original cabling installation. In other words, the pathway shall be no more than 50% full after installation is completed.

D. Spare pathway shall be designed to terminate at building perimeters where future expansion of the building is anticipated.

E. When considering the design of a ceiling-located cable tray or J-hook pathway, the Designer shall verify that the pathway locations will comply with accessibility and clearance requirements. Cable tray and J-hook pathways routed through ceiling spaces shall be designed such that all installed cable is conveniently accessible after construction, both for cable maintenance and to install subsequent cable additions. J-hooks shall be installed at approximate intervals of 4 to 5 feet. Conduit shall be used to span inaccessible areas where the pathway will cross “hard-lid” ceilings, where ceiling tiles are not readily removable, or where accessibility is impeded.

F. Pathway routing shall remain on the same floor as the telecommunications room and telecommunications outlets served by the pathways. Where project-specific conditions exist that justify other routing, the Designer shall request UVU approval through the SVR process.

G. “Poke-thru” penetrations to the ceiling space of the floor below are normally not permitted. For minor remodel construction, poke-thru penetrations may be allowed given budgetary, project size, or other limiting factors. Permission to use poke-thru pathways in any circumstance requires an SVR on a project-by-project basis, and always requires the services of a structural engineer to avoid irreparable structural damage.

H. All wall and floor penetrations for cabling shall be fully sleeved with bushings, and protected in accordance with the requirements in the International Building Code.

I. For on-grade slab construction, telecommunications conduits shall not be routed in or under the slab (a designated wet environment) unless no other options exist.

- Floor boxes under conference tables in Meeting Rooms and under Teacher Stations in Classrooms are exceptions to this requirement.
- In any application (including Meeting Rooms and Classrooms) where telecommunications conduit passes in or under an on-grade slab, outdoor-rated cabling shall be provided.

3.5.4.2 PATHWAYS FOR NEW CONSTRUCTION AND MODERNIZATION PROJECTS

A. Where ceiling spaces will be inaccessible after construction, the only permitted pathway option is conduit. Cable tray and wire basket are not permitted if ceiling spaces will be difficult to access after construction.

B. Surface raceways and surface-mounted device boxes are not permitted.

C. J-hook pathways are not permitted.

3.5.4.3 PATHWAYS FOR MINOR REMODEL AND TELECOMMUNICATIONS-ONLY PROJECTS

A. For minor remodel construction, there may not be an existing (or suitable space for a new) telecommunications room available on the same floor as an outlet. While pathways shall generally be designed from the device box serving the telecommunications outlet to the nearest telecommunications room on the same floor as the outlet, this requirement may be waived by the TPM.

B. Existing pathways shall be reused where existing raceway is standards-compliant or where it can be verified that the existing pathway will permit telecommunications cabling to be installed without negatively affecting the performance of the cabling. Where a pathway is concealed or cannot otherwise be verified, the Designer shall request direction from the UVU TPM on a case-by-case basis.

C. Where existing pathways cannot be reused, or where additional pathways are required:

1. J-hook pathway may be used. D-ring and bridal-ring pathways are not permitted. J-hook pathways shall be established through concealed spaces. J-hook pathways shall be sized for a minimum of 100% expansion. In other words, the pathway shall be no more than 50% full after installation is completed.

2. When 30 or more cables are designed to be routed through an area, the use of cable tray or conduit shall be considered in lieu of J-hooks.

D. It may be permissible to use faceplate mounting brackets in lieu of device boxes. In these cases, cabling is routed to the outlet location through interstitial wall

spaces. UVU permission for this method is required on a project-by-project basis.

3.5.4.4 CABLE TRAY PATHWAY SYSTEMS

A. On the UVU campus, most buildings are constructed contiguously, allowing people to walk from building to building without going outdoors. UVU's standard practice is to link buildings together via cable tray installed in the corridors.

B. In general, cable tray systems shall be located in corridor or office throughway spaces, and shall not be installed above office or classroom space. Distances from EMI/RFI sources shall be maintained according to Section 3.2, *Electromagnetic Compatibility* (above), regardless of whether the raceway is routing copper- or fiber optic-based media.

C. UVU prefers that all cable tray be the ladder-rung style, with an open-rung bottom and sidewall channels.

- Ladder racking shall be used only in telecommunications rooms. It shall not be used anywhere else.
- Spine-style tray is not acceptable.

D. For main distributions (corridors) 12" x 4" tray is the minimum allowable size. The Designer shall design cable tray that is filled to no more than 50% of its allowable rating on Day 1.

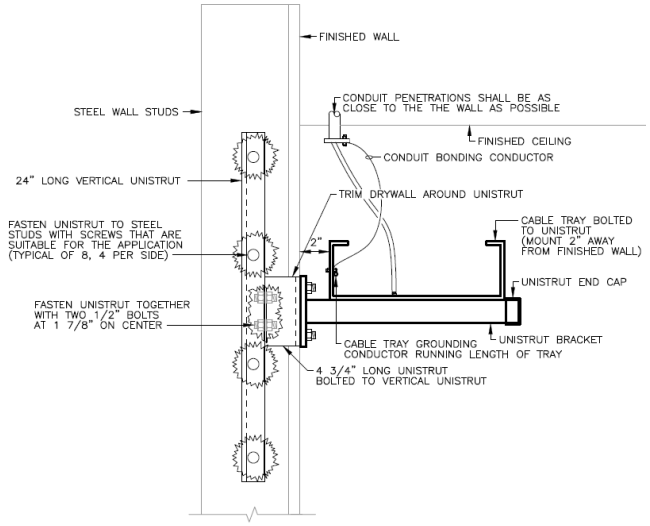
- For example, if a Category 6A cable has a 0.35 in O.D., a 12" x 4" tray could hold 200 such cables given a 40% allowable fill. The Designer could select a 12" x 4" cable tray if fewer than 100 Category 6A cables would be carried by this tray on Day 1. In other words, the Owner should be able to double the amount of cable in that tray in the future.

E. Steel cable tray is preferred over aluminum because aluminum is much easier to dent and deform through careless handling.

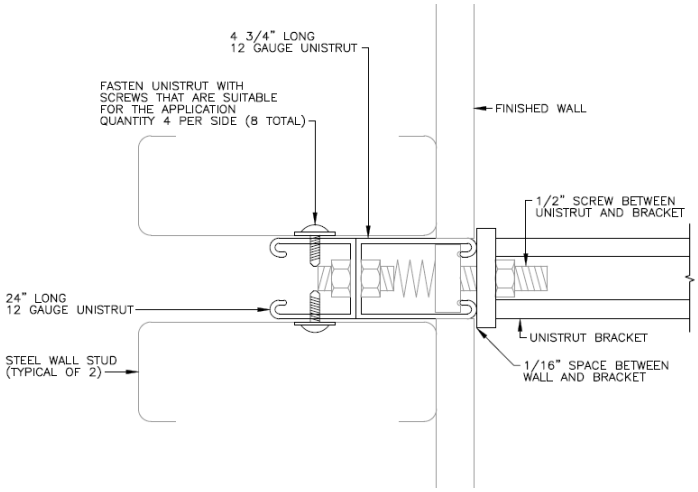
- UVU prefers a galvanized finish, un-painted to match its surroundings, to minimize the presence of the tray.
- The Designer shall coordinate the selection of the cable tray materials with the design intent of the Architect or interior designer.

F. A continuous ground conductor shall be run the length of the cable trays, and shall terminate on the telecommunications grounding busbar in the telecommunications room. Each segment of cable tray shall be bonded to this conductor with a bonding lug. Even though most cable tray manufacturers offer solutions to use the tray as a grounding conductor, those solutions shall not be used at UVU.

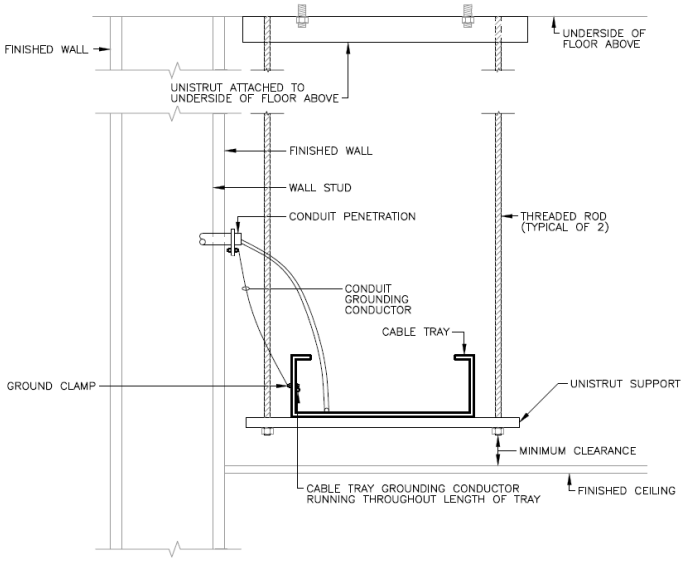
G. When cable tray is wall-mounted, the contact points for each mount shall be reinforced. The diagram at right depicts a possible solution for reinforced wall mounts:



The diagram at right depicts a detailed view of the point of wall-mount attachment:



When cable tray is ceiling-hung, use trapeze-style supports. The diagram at right depicts a possible solution:



H. Telecommunications cable trays shall not be shared with power cables.

3.5.4.4.1 CABLE TRAY CLEARANCES

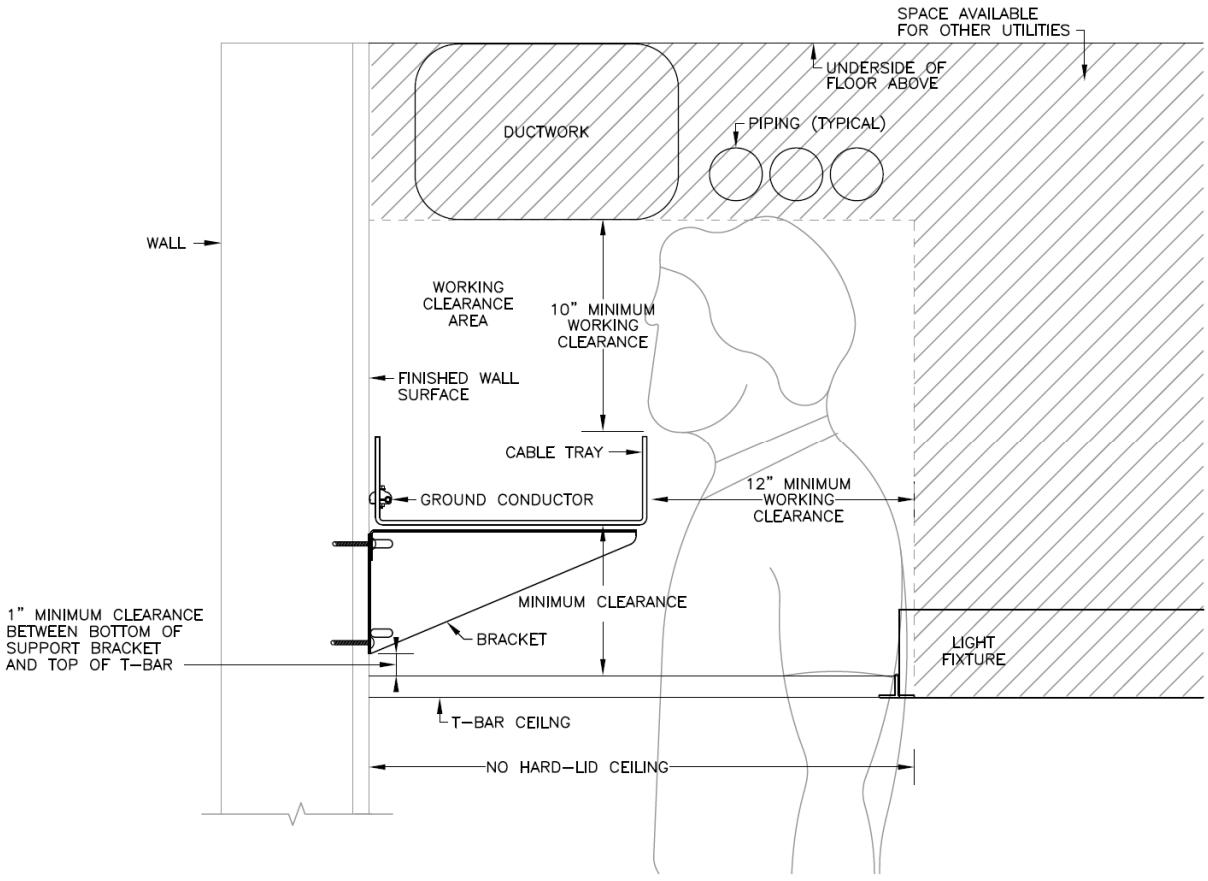
UVU uses cable trays to distribute cabling throughout its buildings. Cable trays shall be installed in corridors or other accessible spaces. Ceilings below cable trays must be accessible. Hard-lid / gypboard ceilings prevent access to cable trays.

Do not design cable tray routing above offices or classrooms.

To preserve access to the cable trays post-construction, the Designer shall coordinate the routing of cable trays through ceiling spaces with the designers of mechanical systems and other electrical systems, incorporating the tray into the project's BIM model. The design shall also be coordinated with the architects desiging ceiling spaces. The minimum space required for cable tray along the entire length of main corridor ceilings is:

- A minimum clear space of 12 inches adjacent to the side of the cable tray, to allow technicians to stand next to the tray (on a ladder) and add or remove cabling.
- A minimum clear space of 10 inches (head height) above the cable tray, to allow for cables to be added or removed from the tray.

As shown in the diagram below, if a 12"x4" cable tray were used, the minimum overall cross-sectional area for and the associated working space is 24" wide x 14" high.



Occasional obstructions to the cable tray are permissible as long as access to the tray (as depicted above) is restored within 36" (arm's reach).

3.5.4.5 CONDUIT AND JUNCTION BOX PATHWAY SYSTEMS

A. Conduits both in and under the ground floor slab are considered "wet locations" where indoor-rated cabling is not permitted. Therefore, conduit serving the main floors of such buildings shall be routed in walls and ceilings – not in or under the slab. Intra-building and horizontal pathways shall only be installed in "dry" locations where indoor cabling can be protected from humidity levels and condensation that are beyond the intended range of indoor-only rated cable.

- Floor boxes in an on-grade slab are the only permissible exception. This application also requires outdoor-rated Category 6 cabling.

B. Where conduit runs terminate at cable trays, the conduits shall be arranged in an organized, uniform manner to facilitate an orderly cable transition from conduit to cable tray. Conduits shall terminate within a range of 3" to 18" of the cable tray.

C. Where conduit runs terminate in telecommunications rooms, the conduits shall be arranged in an organized, uniform manner to facilitate an orderly cable transition from conduit to ladder rack.

D. Non-metallic conduit and flex conduit shall not be used for horizontal pathways.

E. Conduits shall not be filled beyond 40%. The Designer shall verify the outer diameter of the cabling for a project at the time of the design to determine the maximum number of cables that can be placed inside a conduit without exceeding the 40% fill limitation.

F. In new construction, all work area outlets shall have a minimum 1" conduit routing from the device box to an accessible cable pulling location. The conduit size shall be increased as necessary for the quantity of cables to be installed. Where new conduit is installed in existing buildings, the Designer shall notify UVU when existing conditions prevent the use of one-inch trade size conduit as a minimum conduit size.

- Conduit used to route cabling from the cable tray to a work area outlet shall be sized a minimum of 1".

G. Device boxes shall not be "daisy-chained." Each device box shall be complete with its own dedicated conduit to the nearest distribution point/pathway.

H. Junction boxes and pull boxes shall be oriented for access doors to open from the area where the cable installer will normally work. For ceiling-mounted boxes, this is typically from the bottom (floor) side of the box.

I. Ceiling access to junction boxes and pull boxes shall be designed to allow full access to the door, adequate working room for the installation personnel, and proper looping of the cable during installation.

J. Junction boxes and pull boxes shall be located in spaces that are easily accessible during normal working hours, such as hallways and common areas. Junction boxes and pull boxes shall not be located in conference rooms or offices unless there is an overriding design reason for doing so, dependent upon approval from UVU.

K. See the AVDG for pathway requirements specific to audio visual applications.

3.5.4.6 SURFACE RACEWAY

A. Surface raceway may be permissible in areas where no suitable alternatives exist. Surface raceway shall conform to bend radius requirements for the cable type being installed.

B. Surface raceway may be either plastic or metal.

C. Where Category 6A (Augmented) cabling is routed through surface raceway, the Designer shall verify cable dimensions and bend radius limitations with the cable manufacturer to determine whether the surface raceway will be deep enough. Typically only two jacks will fit in a faceplate, and the jacks must be side-entry style in order to meet cable bend radius requirements.

3.5.4.7 UNDERFLOOR DUCT SYSTEMS

A. The design of new underfloor duct systems is prohibited.

3.5.4.8 ACCESS FLOORS

A. Data Centers typically require access flooring.

B. While some open office circumstances may require access flooring, it may be more expensive than other pathway options. When considering solutions to provide cabling in open office situations, the Designer shall consider other solutions (such as floor boxes) ahead of an access flooring solution.

3.6 ITS Cables and Connecting Hardware

Please refer to Chapter 6, *ITS Cables and Connecting Hardware* in the BICSI TDMM for information regarding the design of telecommunications cables and connecting hardware. The following requirements take precedence over the BICSI TDMM guidelines for telecommunications infrastructure at UVU facilities:

3.6.1 COPPER CABLING

A. 110-style termination blocks and connectors are required in the design of new telecommunications infrastructure for voice applications at UVU facilities.

B. The design of new telecommunications infrastructure at UVU facilities shall not include the following termination blocks or connectors:

- 66-style blocks or connectors
- BIX-style blocks or connectors
- LSA-style blocks or connectors
- 50-position miniature ribbon connectors

3.6.2 FIBER OPTIC CABLING

A. UVU uses singlemode fiber optic cabling for all fiber applications. While there is some existing multimode fiber optic cabling on campus, no new multimode fiber shall be installed.

B. Fiber optic cabling shall be terminated at both patch panels and outlets using SC-style connectors. All other connector styles (including LC, ST, and MTRJ) are prohibited for new fiber optic cabling at UVU facilities.

C. Where an application requires connectors with more than two strands of fiber (high bandwidth applications, pre-terminated cables, etc.) MPO connectors shall be used in accordance with manufacturer recommendations. Other connector types may be approved by the UVU ITPM on a case-by-case basis.

D. Where equipment does not support SC-style connectors, the Designer shall specify hybrid patch cords with SC connectors on one end and the other end matching the requirements of the equipment.

3.6.3 SPLICING

Splicing or coupling copper or fiber optic cable is prohibited for inside plant infrastructure.

3.7 Firestop Systems

Please refer to Chapter 7, *Firestop Systems* in the BICSI TDMM for general information regarding the design of firestopping for telecommunications infrastructure. The following requirements take precedence over the BICSI TDMM guidelines for telecommunications infrastructure at UVU facilities:

A. The Designer shall pay careful attention to the fire ratings of existing and new walls. Wherever penetrations are made through fire-rated walls, the Drawings shall identify the firestopping requirements.

B. Penetrations through fire-rated walls and floors shall be firestopped in accordance with the requirements of the manufacturer of the firestopping materials, and to satisfy local code officials.

C. The Designer shall avoid design solutions calling for penetration of fire walls, fire

barriers, fire partitions, smoke barriers, and smoke partitions when other reasonable cable-routing options exist.

D. The predominant color of fire-rated pathway devices shall be red.

E. UVU prefers to use STI Ez-Path for penetrations through fire-rated walls and floors. This preference is based on the experience that it is difficult to keep putty-based materials intact inside conduit sleeves, especially vertically oriented sleeves, particularly through multiple moves-adds-changes.

3.8 Bonding and Grounding (Earthing)

Please refer to Chapter 8, *Bonding and Grounding (Earthing)* in the BICSI TDMM for general information regarding the design of grounding, bonding and electrical protection systems. The following requirements take precedence over the BICSI TDMM guidelines for telecommunications infrastructure at UVU facilities:

- Grounding and bonding conductors shall be sized according to the requirements in ANSI/TIA/EIA J-STD-607A.

3.9 Power Distribution

Please refer to Chapter 9, *Power Distribution* in the BICSI TDMM for general information regarding the design of power distribution for telecommunications infrastructure. The following requirements take precedence over the BICSI TDMM guidelines for telecommunications infrastructure at UVU facilities:

A. The Designer shall be responsible to determine that the electrical power distribution requirements supporting the telecommunications infrastructure are met as described in this document.

B. For projects where an Electrical Engineer is involved, the Designer shall coordinate directly with the engineer, and verify that the engineer's design documentation meets these requirements. For projects without the involvement of an Electrical Engineer, the Designer shall alert UVU where additional power infrastructure is needed to meet the requirements.

1. Please refer to Chapter 5, *Horizontal Distribution Systems* in the BICSI TDMM and also in TDDG Section 3.5.2 *Work Areas* for power outlet requirements for work areas.

2. Please refer to Chapter 3, *Telecommunications Spaces* in the BICSI TDMM and also in TDDG Section 3.3 *Telecommunications Spaces* for information on the power outlet requirements for TRs.

    - UVU typically provides network electronics that provide Power-over-Ethernet.
    - The Designer shall request power consumption data for the

equipment that UVU will use, and shall size the power distribution infrastructure sufficiently to support this equipment.

3. Please refer to Chapter 18, *Data Centers* in the BICSI TDMM and also in TDDG Section 3.18 *Data Centers* for information on the power outlet requirements for data centers.

    - UVU data centers will typically be either Tier II or Tier III systems.
    - The Designer shall inquire which tier is to be designed for each project, and design appropriate power distribution systems to support the Tier designation.

C. The Designer shall inquire which type of power conditioning / power protection equipment should be designed for each project.

3.10 Telecommunications Administration

Please refer to Chapter 10, *Telecommunications Administration* in the BICSI TDMM for general information regarding the documentation and labeling of telecommunications infrastructure. The following requirements take precedence over the BICSI TDMM guidelines for telecommunications infrastructure at UVU facilities:

3.10.1 IDENTIFICATION STRATEGY

A. The “identifier” is the unique name or description assigned to a given telecommunications infrastructure component. The Designer shall assign identifiers to the telecommunications infrastructure components listed below and clearly show the identifier assignments on the Construction Documents.

B. While it is the Contractor’s responsibility to provide marked-up drawings to the Designer indicating any construction-related changes to the identifiers, the Designer shall verify that the identifiers are clearly and accurately shown on the record drawings.

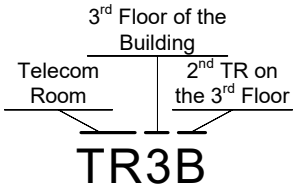
C. Telecommunications components shall ***not*** be labeled with an application-specific identifier. Ports shall ***not*** be labeled with the name or function of the device that is served by the port (server names, computer types. Also, the use of “V-#” and “D-#” are inconsistent with the industry standard-based philosophy of designing cabling systems that are independent of the application, and are therefore not permitted.

D. The Designer shall prepare construction specifications that shall contain a comprehensive listing of the identification strategy requirements.

3.10.1.1 NEW TELECOMMUNICATIONS DISTRIBUTION SYSTEMS

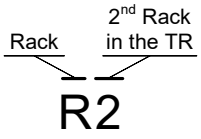
The items listed below shall be shown on the Construction Documents. The Designer shall assign the identifiers to the telecommunications components based on the following required identification strategy.

A. Telecommunications Rooms, Equipment Rooms and Data Centers shall be identified by room number. The Designer shall work with the FPM to assign room numbers to all telecommunications rooms.
   - For example: a telecommunications room located in Room #1242 in a building would be identified as "1242".
   - The Designer shall pay attention to this issue throughout construction. If the room numbering changes during construction, instructions shall be given to the Contractor to ensure that the labeling matches the final room numbering signage.

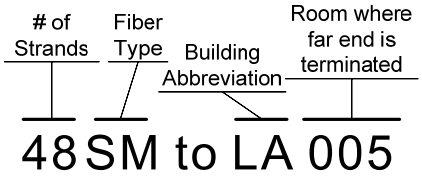


However, if a telecommunications room does not have an assigned room number, then the Designer shall work with the ITPM to assign room numbering in the form of "TR#@", where "#" is the floor number on which the telecommunications room resides, and "@" represents a sequentially assigned letter to distinguish between multiple rooms on the floor.
   - For example: a building with two un-numbered telecommunications rooms on the third floor would have rooms labeled "TR3A" and "TR3B". This is permitted only on the approval of the ITPM.

B. Racks in telecommunications rooms shall have identifiers of the form "R#" where "R" stands for "Rack" and "#" is the sequential rack number within a given TR, numbered left to right while facing the front of the racks.
   - For example: the first rack in a given telecommunications room would have the label "R1", the second "R2" and so on.

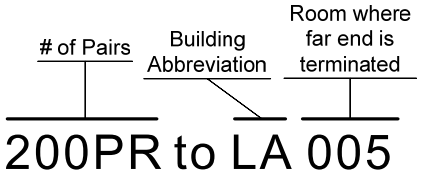


C. Fiber Optic Patch Panels shall have identifiers in the form of "##SM to BB rm#" where "##" is the number of strands, "SM" is the fiber type, "BB" is the building abbreviation and "rm#" is the telecommunications room or lab where the far end of the cable is terminated. Since each patch panel is used to terminate a single cable, no further labeling is required.
   - For example: a 48-strand singlemode cable whose far end terminates in telecommunications room 005 in building "LA" would be labeled on the near end "48SM to LA 005".
   - See paragraph A above for room number information.

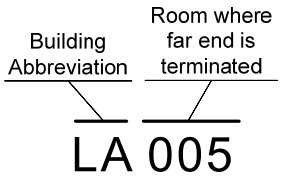


D. Backbone Cables (both fiber optic and copper) shall be labeled on both ends within 6 feet feet of entrance into a telecom room where they terminate, and also within 12" of the termination equipment (fiber patch panel or 110-block).

- Fiber optic cable labeling shall be identical to the fiber optic patch panel labeling. See paragraph C above.
- Copper backbone cable labeling shall have identifiers in the form of "###PR to BB rm#" where "###PR" is the number of copper pairs, "BB" is the building abbreviation and "rm#" is the telecommunications room where the far end of the cable is terminated.
- For example: a 200PR copper backbone cable whose far end terminates in telecommunications room 005 in building "LA" would be labeled on the near end "200PR to LA 005".

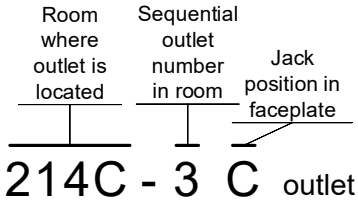


E. Microduct shall be labeled within 6 feet of the telecommunications room entrance and again within 12" of each end. The labels shall identify the far end of the innerduct, in the form of "BB rm#", where "BB" is the building abbreviation and "rm#" is the telecommunications room.



a. For example: an innerduct whose far end terminates in telecommunications room 005 in building "LA" would be labeled on the near end "LA 005".

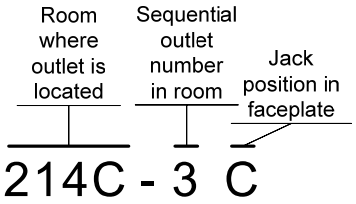
F. Faceplates on Workstation Outlets shall have two types of labels: One label type provides the identifiers for each jack, labeled in the form "###-X@" where "###" is the room number where the outlet is located, "X" is the sequential number of the outlet within the room, and "@" is either A, B, C or D corresponding to the jack location within the faceplate. The second type of label indicates the room number of the telecommunications room (such as "201D") where the cables terminate. This label shall be placed in the lower right label window on the doublegang faceplate.



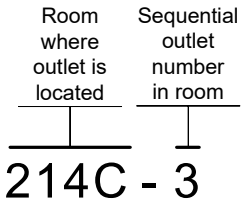
- For example: if room number 214C has 3 outlets, and the third outlet is used to terminate two data cables coming from telecommunications room 201D, the labels on the faceplate would indicate: "214C-3A", "214C-3B", a blank label and "201D". Where labeling space is limited, it is permitted to combine labels, for example "214C-3A B".

G. Ports on Workstation Patch Panels are typically pre-labeled by the manufacturer with sequential numbers (i.e. 1 to 48). In addition to these labels, label each port with the same number used on the faceplate for that cable, minus the building abbreviation.

- For example: in the case of a port on a patch panel terminating a horizontal copper data cable that terminates in room number 214C in the 3rd outlet in the lower left position in the faceplate, the label on the patch panel port would indicate: "214C-3C".



H. Terminations on 110-Blocks for horizontal voice cables shall be labeled with the room number and outlet number that appears on the faceplate label (no need for the building abbreviation or jack position).
   - For example: in the case of a voice termination on a 110-block terminating a horizontal copper voice cable that terminates in room number 214C in the 3rd outlet, the label on the 110-block termination would indicate: “214C-3”.



3.10.1.2 MOVES, ADDS AND CHANGES (MAC)

The only exception to the above identification scheme is for small projects relating to moves or changes to existing cabling, or the addition of new outlets terminated among other existing cables in existing TRs. In such cases (where the amount of new work is small compared to the overall system), the identification scheme for the new cables shall be consistent with the existing identification scheme.

For projects where there are larger amounts of change, the Designer shall inquire with UVU whether it is desirable to re-label the existing cables when new cabling is being installed.

3.11 Field Testing of Structured Cabling

Please refer to Chapter 11, *Field Testing of Structured Cabling* in the BICSI TDMM for general information regarding the field testing of telecommunications cabling. The following requirements take precedence over the BICSI TDMM guidelines for field testing at UVU facilities:

A. The Designer shall require the Contractor to test 100% of field-terminated cabling and at least 10% of all pre-terminated cables.

   - UVU reserves the right to require the Contractor to test more than 10% of all pre-terminated cables if the 10% test results are unsatisfactory.
   - Copper cables shall be Link tested (not Channel tested).

B. Cable tester equipment shall be manufactured by Fluke.

C. The Designer shall require the Contractor to submit the actual native machine test result files downloaded from the test equipment, and also the same test results in a PDF document. Printed (hard copy) test reports are not necessary or desirable.

D. The Designer shall review the cable test results submitted by the Contractor. In particular, the Designer shall check for the following items on the cable test reports:

   - The cable test report shall be automatically produced by the test equipment.
   - The report shall indicate that the cable passed the test. It shall also indicate the date of calibration, the software version and the name of the technician or

conducted the test. The reports shall also include graphical results of the performance curves obtained during the testing.
- Indications that the cabling meets distance limitation requirements.
- Indications that the wire-map of the cable is correct.
- Indications that the cable test equipment was properly configured. For copper cabling, the test equipment's configuration parameter for Nominal Velocity of Propagation (NVP) shall match the value stated by the cabling manufacturer for the type of cable installed.
- Marginal test results (typically indicated with an asterisk "*") are only acceptable when the condition is "over length" and when the over-length situation was intentional during design. For example, a low bandwidth device might be served by a cable that would otherwise be too long to support a high bandwidth device. Over-length issues due to choice of routing or extra service loops are not acceptable.
- For Fiber Optic Cabling: the cable test report shall indicate a headroom dB value that is equal to or better than the value calculated in the link-loss budget.

E. The cabling performance characteristics shall meet or exceed the performance guaranteed by the manufacturer, which may exceed standard industry requirements. In other words, even though a particular cable might pass its tests, the cable might still be rejected (requiring re-termination or replacement) if it does not meet the higher standard of performance that the manufacturer may list for its products.

F. UVU may choose to spot-test cabling to back-check the Contractor's test results.

G. UVU may choose to hire a third-party cable test company to conduct an independent cabling test.

H. The final test results shall have been verified by the Designer to be acceptable before submission to UVU. Test results shall be submitted to UVU in electronic form, both in PDF form and also the original test result data files.

I. Contractors shall be required to retain a copy of the test reports for a period of at least 5 years after installation.

3.12 Outside Plant

Please refer to Chapter 12, *Outside Plant* in the BICSI TDMM and the BICSI OSPDRM for information regarding the design of outside plant telecommunications infrastructure.

See Section 3.4 *Backbone Distribution Systems* above.

3.13 Audio/Visual Systems

Please refer to Chapter 13, *Audiovisual Systems* in the BICSI TDMM for information regarding the design of telecommunications infrastructure to support audio/visual systems, private CATV distribution systems, and distributed paging systems at UVU facilities.

3.13.1 AUDIO/VISUAL SYSTEMS

The Designer shall coordinate with the AVPM and reference the Audio/Visual Design Guide (AVDG) for information about the telecommunications infrastructure required to support audio/visual applications at UVU.

3.13.2 DISTRIBUTED PAGING SYSTEMS

A campus-wide fire alarm system with a fiber optic backbone is used on campus. The system supports public safety annunciation.

The Designer shall inquire with UVU to determine whether a given project should include infrastructure to support a stand-alone paging system.

3.13.3 PRIVATE CATV DISTRIBUTION SYSTEMS

UVU no longer provides conventional television (via coaxial cabling) to television locations on campus. Instead, IPTV is now used, requiring a single jack Category 6A outlet for each television location.

However, the Designer shall inquire with UVU to determine whether conventional coaxial cable-based television distribution is required for any application. If so, then content in Chapter 13 of the BICSI TDMM would apply.

3.14 Building Automation Systems

Please refer to Chapter 14, *Building Automation Systems* in the BICSI TDMM for information regarding the design of telecommunications infrastructure to support building automation systems at UVU facilities.

A. ANSI/TIA/EIA-862 applies to telecommunications infrastructure serving building automation systems (BAS). The Designer shall pay particular attention to the following BAS issues:
   - Verify that the voltage and current requirements of each BAS application are satisfied by the cabling materials to be installed.
   - Verify that a suitable horizontal connection point (HCP) is installed for each BAS application.

B. BAS devices are increasingly converging onto structured cabling systems. While the design of these systems is typically outside the scope of work of the telecommunications infrastructure designer, the Designer shall design the

telecommunications cabling required to support these systems.

C. UVU requires that all telecommunications infrastrucure supporting the network functions of BAS systems be designed by the Designer and installed under Division 27 by the qualified telecommunications contractor. The BAS designer shall not design this cabling or associated raceways. The BAS contractor shall not install this cabling.

D. The Designer shall coordinate with the other consultants on the project to make sure that the telecommunications and networking needs of the following systems are properly designed by the Designer:
- HVAC control systems
- Lighting control systems
- Irrigation control systems
- Power monitoring systems
- Security systems

E. Typically, BAS systems require telecommunications cabling routed from the devices to a patch panel termination point in a designated mechanical room or other location managed by building maintenance personnel. In addition to the device-specific cables, homerun cables shall be provided between the telecommunications rooms and the BAS patch panels, to permit these systems to gain access to the enterprise data networks.

F. Horizontal consolidation points (HCP) are only required for BAS applications. Do not use an HCP for typical voice/data/video applications.

3.14.1 FIRE ALARM SYSTEM

A. The fire alarm system at UVU's campus communicates via one of three singlemode fiber optic rings and also uses two analog phone circuits for each Fire Alarm Control Panel (FACP).

B. The Designer shall include in the design a biscuit jack outlet with two Category 5e telephone cables for backup alarm dialing, inside the FACP in a new building.

C. In addition, the Designer shall include in the design singlemode fiber, continuously spliced (patch cords are not acceptable) from the FACP in a new building through the nearest IDF or the MDF (splice) to an ITPM designated point where it can intercept an established ring.

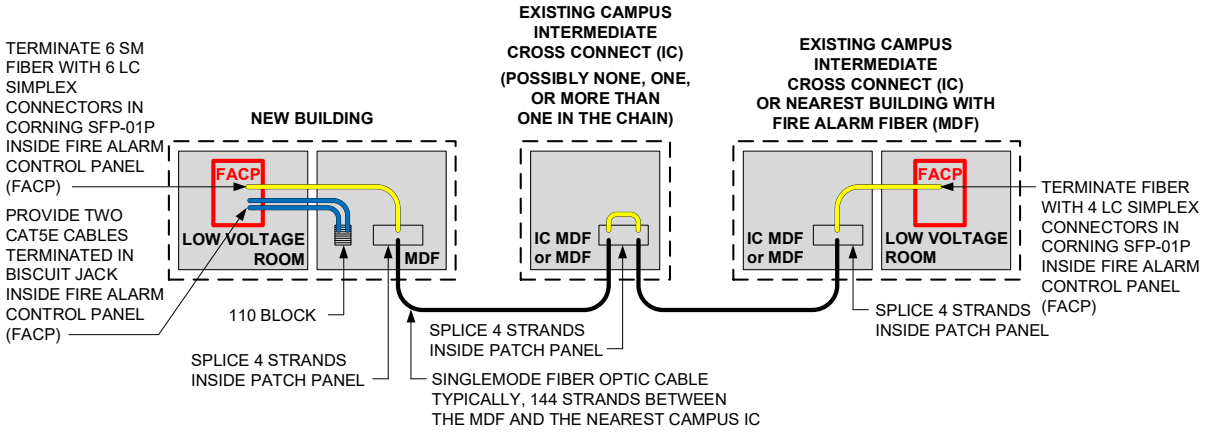
The fiber ring requires 4 strands of singlemode fiber. For the horizontal fiber segment (between the FACP and the splice panel in the nearest telecommunications room), provide a 6-strand cable. Terminate all 6 strands on a Corning SPH-01P mounted inside the FACP. In the telecommunications room, splice 4 of the strands to backbone strands enroute to intercept the ring and leave the other 2 strands unterminated but available for future use.

D. All fiber optic cabling and Category 5e cabling serving fire alarm applications

shall be installed by the telecommunications contractor. The construction scope of work will include splicing activities in other buildings outside of the new or remodeled building in order to connect the fire alarm system to an existing campus ring. The Designer shall include these requirements on the Contract Documents.

E. The diagram below depicts the cabling and splicing requirements for the fire alarm system. The Designer shall work with the ITPM to determine the best location on campus to insert a new link into an existing fiber loop.

SINGLEMODE BACKBONE FIBER AND CAT5E CABLES FOR THE FIRE ALARM SYSTEM



3.15 Data Networks Design

Please refer to Chapter 15, *Data Networks Design* in the BICSI TDMM for general information regarding the design of telecommunications infrastructure for serving local area networks. The following requirements take precedence over the BICSI TDMM guidelines for telecommunications infrastructure at UVU facilities:

A. All UVU facilities use the Ethernet LAN protocol. Telecommunications infrastructure for all UVU facilities shall be designed, installed, and tested to support the Institute of Electrical and Electronic Engineers (IEEE) Ethernet 802.3 standards. UVU networks use the 1000Base-X Gigabit Ethernet protocol based on the IEEE 802.3z standard to the workstation and 10GBase-X in the backbone. All newly installed cabling shall support this protocol.

B. The design of the network electronics is done by UVU and is outside the scope of work of the telecommunications Designer.

C. The Designer shall coordinate with the UVU ITPM to determine the requirements for supporting the network electronics in each space. The design shall provide rack space to host UVU's network equipment.

3.16 Wireless Networks

Please refer to Chapter 16, *Wireless Networks* in the BICSI TDMM and the BICSI Wireless Design Reference Manual (WDRM) for information regarding the design of telecommunications infrastructure to support wireless and microwave telecommunications systems at UVU facilities.

3.16.1 WIFI NETWORKS

See Section 3.5.2.4 *Telecommunications Outlets for Wireless Access Points / IP Cameras* for information about wireless access points.

3.16.2 DISTRIBUTED ANTENNA SYSTEMS

UVU requires the services of an RF Distribution Engineer to properly design distributed antenna systems (DAS) for campus buildings. The Designer shall work with the ITPM to involve an RF Distribution Engineer on the project and to discuss project-specific requirements.

All fiber optic cabling serving DAS applications shall be installed by the telecommunications contractor.

3.16.2.1 EMERGENCY RESPONDER RADIO

A. For compatibility with the radio systems of the various nearby emergency responder organizations, UVU deploys an 800 MHz distributed antenna system in each building. UVU has standardized on the use of DAS equipment from Solid (www.solid.com).

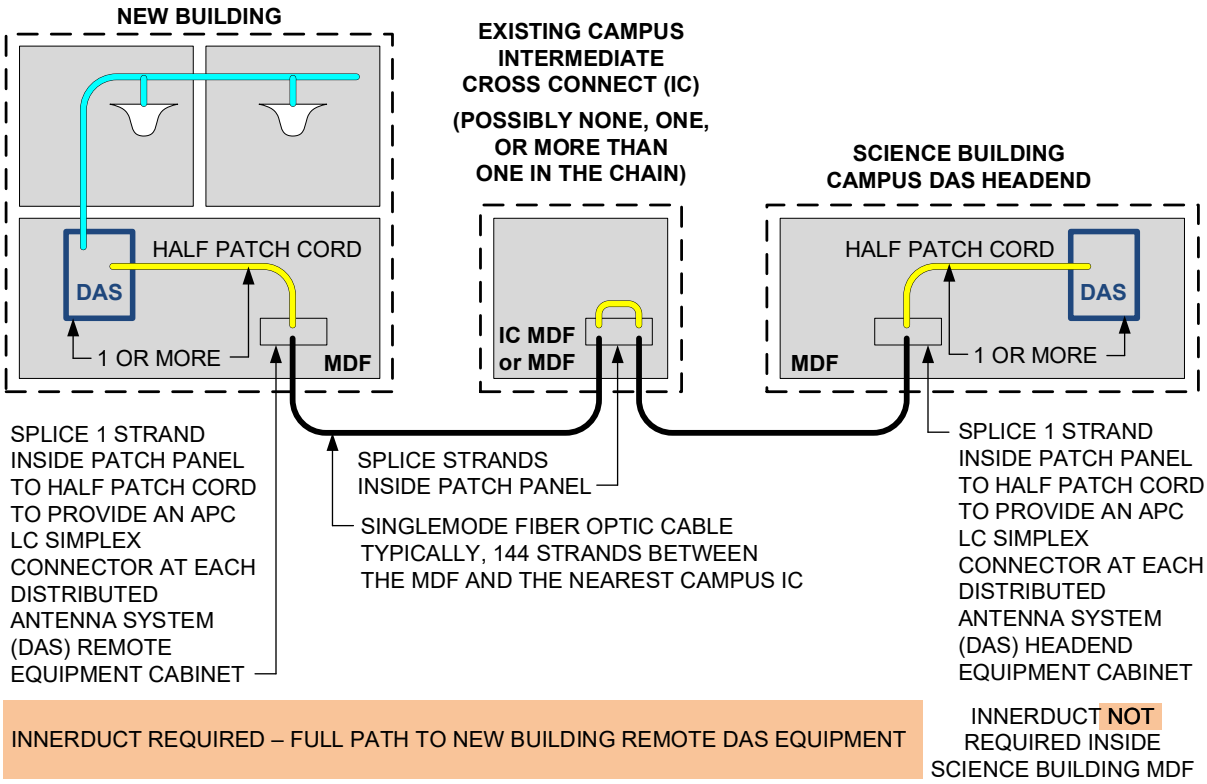
B. Campus facilities will typically require more than one antenna. It is possible that a given building may require multiple radios (typically no more than 4). The DAS design will likely not be completed until late in the construction phase. The telecommunications Designer shall inquire with the DAS designer about the requirements of the DAS system and provide instructions to the contractor as necessary. Each radio requires a single fiber optic strand.

C. The fiber optic cabling path requires continuous fiber strands (spliced) across campus. Patch cords are not acceptable for cross-connection.

D. At the endpoints, an APC connector is required. Provide single strand fiber optic patch cords with APC connectors, cut them in half, and splice them onto the end of the fiber optic cable to allow the cables to plug directly into the equipment.

E. The diagram below depicts UVU's standard fiber optic cabling infrastructure for DAS applications. The Designer (RF Distribution Engineer) shall include requirements in the Construction Document for the Contractor to provide splicing in multiple buildings (as required) including locations that are not otherwise part of the project.

SINGLEMODE BACKBONE FIBER FOR DISTRIBUTED ANTENNA SYSTEMS



3.16.2.2 CELLULAR TELEPHONE SERVICE AUGMENTATION

Currently, UVU does not provide augmented cellular service coverage within its buildings. The Designer shall inquire with the ITPM to determine whether this feature should be designed for a specific project.

3.17 Electronic Safety and Security

Please refer to Chapter 17, *Electronic Safety and Security* in the BICSI TDMM for general information regarding the design of telecommunications infrastructure for serving electronic safety and security systems.

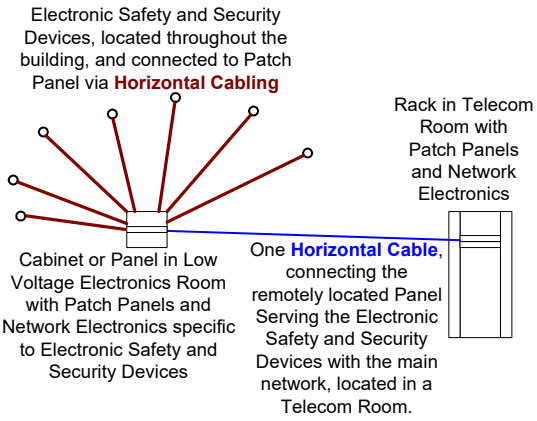
Electronic safety and security (ESS) devices are increasingly converging onto structured cabling systems. While the design of these systems may fall outside the scope of work of the telecommunications infrastructure designer, the Designer shall design the telecommunications cabling required to support these systems, and the telecommuncations cabling subcontractor shall install the telecommunications cabling.

Sometimes ESS systems require telecommunications cabling routed from the devices to a patch panel termination point in a designated low-voltage electronics room or other location managed by building security personnel. In addition to the device-specific cables, additional

cables shall be designed from the telecommunications rooms to the ESS patch panels, to permit these systems to gain access to the data networks.

Other times, ESS systems can be cabled directly to patch panels in the telecommunications rooms just like any other computer or telephone device.

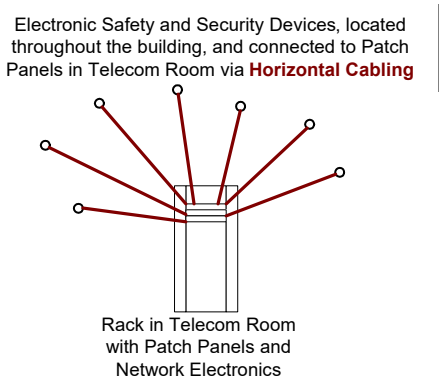
The diagrams at right depict the differences between these two solutions. The Designer shall inquire on a project-by-project basis which solution to apply to a given project. Non-technical issues will commonly affect which solution is used.



3.18 Data Centers

Please refer to Chapter 18, *Data Centers* in the BICSI TDMM for general information regarding the design of telecommunications infrastructure for serving data centers. Generally speaking, UVU follows the TIA-942 Data Center Standard in the design of data centers and larger equipment rooms. The requirements below take precedence over the BICSI TDMM guidelines.

The requirements for small-scale equipment rooms are the same as for telecommunications rooms.



The Designer shall inquire with UVU whether an equipment room in a given project is intended to be designed with telecommunications room features or data center features.

3.18.1 SIZING CONSIDERATIONS

A. The Designer shall consult with the UVU ITPM to determine any sizing requirements for the Data Center on a project-by-project basis. The design shall include a minimum of 50% vacant space for future growth.

B. The power consumption profile of equipment to be hosted in the data center and its associated heat-load profile are the two key parameters for sizing a data center. The Designer shall work with UVU ITPM to identify the power consumption per cabinet footprint, which will have a direct correlation to the cooling requirements of the space. The quantity of equipment cabinets that can be powered and cooled in the space drives the sizing plan.

- During the life of the data center, advances in technology may shrink the space requirements for each server, making more physical space available for additional servers. However, if there is not sufficient power to support another server, or sufficient cooling capacity to remove the heat produced by another server, then the additional space is unusable.

C. The UVU ITPM shall approve the final space requirements and design layout for the equipment and racks.

3.18.2 TIER CLASSIFICATION

UVU data centers are typically designed for Tier II+ classification (redundant components, single distribution path, and N+1 redundancy). However, the Designer shall inquire with the ITPM on a project-by-project basis for the desired Tier classification of each data center or equipment room.

3.18.3 ARCHITECTURAL CONSIDERATIONS

The Data Center shall be separated from other occupancies within the building by fire-resistant-rated construction of not less than 1 hour.

Raised flooring with antistatic tiles is required.

3.18.4 ENVIRONMENTAL PROVISIONING

Environmentally friendly solutions shall be considered in the design of data center cooling systems, incorporating heat reclamation and non-mechanical cooling features where reasonable and practical. Utah DFCM requires LEED Silver for new buildings.

Environmental management and monitoring systems shall be designed for data centers.

Consideration shall be given to both cooled cabinets and whole-room cooled air solutions.

Air conditioning systems for technology/server and UPS rooms shall be supported by emergency power systems. Typically, a generator will perform this function.

3.18.5 FIRE DETECTION AND SUPPRESSION

All Data Centers shall be protected by a non-water-based suppression system.

Very Early Smoke Detection Aparatus (VESDA) systems shall be considered for this application.

3.18.6 FLOOR-STANDING EQUIPMENT RACKS

Some IT equipment requires an equipment rack with both front and rear mounting rails. The Designer shall discuss with UVU the network electronics that will be hosted in each rack in each Data Center, and shall show this equipment on the rack elevation details in the plan drawings. The Designer shall also discuss with UVU the potential for future additional racks, and identify spaces for the future racks on the plan drawings.

3.18.7 TELECOMMUNICATIONS CABINETS

A. Other styles of equipment racks and cabinets might be used in the Data Center, some of which may be proprietary to a particular system or service provider. The Designer shall plan the Data Center layout to make allowances for proprietary cabinets and racks, and allow expansion room for future equipment.

B. Floor-standing cabinets shall have hinged doors (front and rear) to permit access to both the front and rear of the equipment. Telecommunications cabinets shall be constructed of heavy-gauge steel. The side panels of the cabinet shall be removable for maintenance accessibility.

C. Each cabinet shall be vented and, where appropriate, equipped with cooling fans.

3.18.8 POWER REQUIREMENTS

3.18.8.1 TECHNICAL POWER PANELS

A. A standby generator is required for each Data Center.

B. A separate supply circuit serving the room shall be provided and terminated in its own electrical panel located in the Data Center. This power panel shall be designated as “Data Center Technical Power.” The Data Center technical power panel shall be used exclusively for supplying power to electronics equipment in the equipment room. Sizing of electrical power supply is dependent upon the equipment types and equipment load, and shall be calculated on a case-by-case basis, including sufficient spare capacity for future growth.

C. The technical power circuits in each Data Center shall originate from a technical power panel, dedicated to serving the Data Center. The technical power panel shall not be used to supply power to sources of EMI such as large electric motors, arc welding, or industrial equipment.

D. Power for critical network components such as servers, routers, switches, and telephone systems shall always be provided through at least one uninterruptible power supply (UPS).

E. UVU will consider the use of centralized UPS equipment as applications warrant, such as for Data Centers. However, if UVU wishes to use a centralized UPS, the following requirements shall be met:

- The UPS battery bank shall be sized to provide a minimum of two hours of run time for the supported low-voltage systems hardware. The Designer shall request direction from the UVU ITPM regarding project specific needs for increased run time.
- Upon installation, a qualified electrician shall test new centralized UPS units for correct output voltage prior to connecting electronic equipment.
- Centralized UPS equipment shall be provided with a network interface card

so that the UPS can communicate via the network with servers and other equipment to orchestrate a coordinated safe-shutdown of the equipment in the event of an extended power outage. The telecommunications cabling design shall require a telecommunications outlet located in the centralized UPS room near each UPS to support the UPS's network connection.

- UVU recognizes that flywheel-based UPS equipment is available. However, the initial cost of flywheel equipment is typically very high. As a result, the return on investment is low, with a lengthy time to payback. For most applications, flywheel-based UPS systems are probably cost-prohibitive.

F. UVU typically uses network electronics that provide Power-over-Ethernet (POE).

G. The Designer shall request power consumption data for the equipment that UVU will use, and will size the power distribution infrastructure sufficient to support this equipment.

3.18.8.2 TECHNICAL POWER OUTLETS

A. Generally, the power outlet requirements applicable to telecommunications rooms are also applicable to equipment rooms. See TDDG Section 3.3.8 *Power Requirements* (above).

B. The Designer shall obtain connection/load requirements from UVU for each piece of equipment, and tabulate the information for review and confirmation by UVU. This equipment may include network electronics, UPS equipment, computers/servers, phone system equipment, voice mail systems, video equipment and service provider equipment.

C. Some telephone PBX equipment, UPS equipment and network switch equipment requires specialized plugs or electrical service. The Designer shall specifically investigate the potential need for voltage or current requirements other than the typical 120VAC/20 Ampere power outlet, and shall coordinate with the design team to design the electrical power infrastructure to serve the needs of the equipment.

3.18.8.2.1 FOR REMODEL PROJECTS

If an equipment room is truly required in a remodel project, budget limitations and other constraints shall be resolved through actions that do not deviate from the requirements of this document. In particular, the electrical power requirements of equipment in an equipment room shall not be discounted or taken lightly.

3.18.8.3 CONVENIENCE POWER OUTLETS

Convenience power outlets shall be provided as described (above) in TDDG Section 3.3.8.4 *Convenience Power Outlets* (above).

3.18.9 GROUNDING, BONDING, AND ELECTRICAL PROTECTION

All equipment racks, metallic conduits and exposed non-current-carrying metal parts of telecommunications and information technology equipment in the Data Center shall be bonded to the TGB. Please refer to Chapter 8, *Bonding and Grounding (Earthing)* in the BICSI TDMM and TDDG Section 3.8 for more information regarding the design of grounding, bonding and electrical protection systems.

- The Data Center requires a dedicated/isolated ground wire routed inside a metallic conduit directly from the main electrical service-grounding electrode for PBX equipment. This ground wire is in addition to and separate from the telecommunications grounding system.

- Grounding and bonding conductors shall be sized according to the requirements in ANSI/TIA/EIA J-STD-607A.

3.19 Health Care

Please refer to Chapter 19, *Health Care* in the BICSI TDMM for general information regarding the design of telecommunications infrastructure for serving health care facilities.

UVU owns very few health care-related facilities. The likelihood of encountering a project of this type is low.

3.20 Residential Cabling

Please refer to Chapter 20, *Residential Cabling* in the BICSI TDMM for information regarding the design of telecommunications infrastructure to support residential facilities within UVU facilities.

UVU currently does not include any residential-type facilities. The likelihood of encountering a project of this type is low.

Generally speaking, UVU-owned residential facilities shall be provided with the same telecommunications infrastructure materials and methods as are used for all other UVU facilities, except where specifically noted in this document.

3.21 Business Development and Project Management

Please refer to Section 3 in both the TIDG and TDDG for Project Management requirements that are specific to UVU.

Please refer to *Appendix A: Codes, Standards and Regulations* in the BICSI TDMM for general information regarding the codes, standards and regulations that apply to telecommunications infrastructure.

4 Construction Document Content

This section of the TDDG describes the content requirements that the Designer shall include when creating the Construction Documents. This content is in addition to the content found in some generally accepted document sets.

The services provided by the Designer and the resulting documents shall comply with the State of Utah's contract requirements. In addition to these requirements, the Designer shall also meet the requirements in this document, including the Construction Document content requirements in this section.

Construction Documents shall communicate a fully detailed and coordinated design (rather than making adjustments in the field during construction) and are expected to result in reduced construction costs and fewer change orders. The level of detail required to meet this objective may be substantially greater than some telecommunications designers may be accustomed to providing.

The Designer shall include the following content in the Construction Documents:

4.1 Plans and Drawings

4.1.1 GENERAL

The telecommunications portion of the Construction Drawing set shall include the following:

- Cover Sheet
- Sheet List
- Site Map
- Symbol Schedule
- List of Abbreviations
- Plan Sheets
- Elevation Diagrams
- Schematic Diagrams
- Construction Details
- Demolition

All plan sheets shall be scaled, shall indicate the scale and shall show a north arrow. All plan sheets shall show a key plan when the building or site is too big to fit on a single sheet.

Equipment and cable identifiers shall be shown on the drawings and diagrams.

4.1.2 OUTSIDE PLANT SITE PLAN DRAWINGS

A. Provide drawings showing a scaled telecommunications distribution site plan. These drawings shall show the following:

- Maintenance hole or handhole locations (labeled with their identifiers)
- Complete ductbank routing, details and elevations
- Conduit sizes, quantities and arrangements
- Section cuts
- Existing and new surface conditions
- Outside plant copper telecommunications cabling, including pair counts
- Outside plant fiber optic telecommunications cabling, including fiber types and strand counts
- Locations of buildings, roads, poles, existing underground utilities and other obstructions

B. The site plan shall show the cabling from the service providers (cable television, telephone, etc.) and shall indicate the requirements for owner-provided maintenance holes or handholes and pathway to the point of demarcation.

C. These sheets should also identify coordination arrangements where conflicts with site work for other disciplines could possibly arise, in particular indicating the separation distances between low-voltage and power or steam. The sequencing of site work also should be shown, if applicable.

4.1.3 MAINTENANCE HOLE/HANDHOLE BUTTERFLY DIAGRAMS

A. Butterfly diagrams are a combination of tabular information and a schematic diagram used to organize and communicate information related to the conduits and cabling in each maintenance hole and handhole. These diagrams are CAD files to be included in the project's drawing set.

B. The Designer shall provide a set of butterfly diagrams depicting each maintenance hole or handhole affected by the project and showing new cabling as well as existing cabling to remain in the maintenance hole or handhole.

- Ducts to be used for new cabling shall be assigned during the course of design, not during construction. Duct assignments must be approved by UVU prior to the release of the Construction Documents.

C. A second set of butterfly diagrams shall be provided for each maintenance hole or handhole that contains existing cabling intended to be demolished under the project.

D. The diagrams shall be formatted as shown in the sample butterfly diagram in the Appendix 5.5. Upon request, UVU will provide an electronic AutoCAD file of this diagram to be used as a template, as well as electronic CAD files for each butterfly diagram affected by a project.

4.1.4 INSIDE PLANT PLAN DRAWINGS

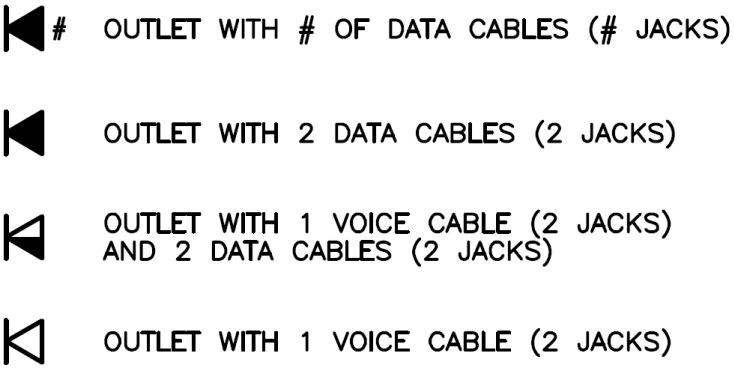
A. Scaled plan drawings shall be provided for each building showing the

telecommunications applications and cabling inside the building. These drawings shall show the following:

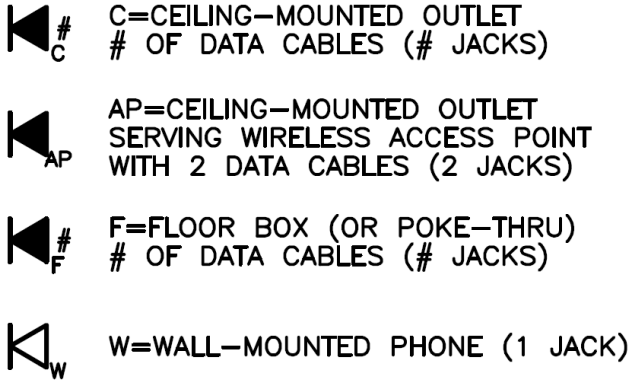
- Routing of new pathway to be constructed during the project.
  - The content of the drawings shall be coordinated with other disciplines and shall be representative of the complete pathway route that the Contractor shall use, rather than a schematic depiction.
  - It is expected that the Designer will expend considerable coordination effort during the design process. Non-coordinated pathway/raceway is not acceptable to UVU.
- Approximate locations of junction boxes and conduit bends.
- The cable quantities and the raceway at any given point in the system.
- Backbone distribution cabling.

B. Where new cabling will be pulled into existing conduits, the Construction Documents shall show the routes of each *existing* conduit. Where it is not possible to determine the routing of existing conduits, the Designer shall inform the UVU TPM and seek direction on whether to use the existing conduits or design new conduits for use on the project. Typically, the Designer is required to identify such conditions during field investigation activities.

C. Telecommunications outlet symbols shall be shown on drawings as follows:



D. The subscript on outlet symbols shall be shown on drawings as follows:



4.1.5 DEMOLITION

A. Any existing equipment and cabling intended to be no longer in use following the new installation shall be removed (salvaged and returned to the Owner undamaged and in working condition) as a part of the project. UVU uses salvaged equipment as spare parts to support the existing equipment in other buildings.

B. Existing cabling to be demolished shall be shown on the plans and schematic diagrams. Separate demolition plan sheets and schematic diagrams shall be provided for projects with extensive cable demolition.

4.1.6 TELECOMMUNICATIONS ROOM PLAN DETAILS

A. Construction Documents for UVU projects shall show scaled plan drawing details for the telecommunications spaces. The details shall show the footprint and location of each of the major components in the room including at least the following:

- Backboards
- Ladder Racking
- Work Area
- Backbone Cable Routing
- Entrance Conduits
- UPS Equipment
- Termination Blocks
- Grounding Busbar
- Space Reserved for Utility Demarc
- Racks and Vertical Cable Mgmt
- Space for other low-voltage systems
- Entrance Protection Equipment
- PBX and Voice Mail Equipment

B. For modifications to existing telecommunications rooms, it may be necessary to provide a demolition plan.

C. Sample telecommunications room plan diagrams are included in Appendix 5.3.

4.1.7 ELEVATION DIAGRAMS

A. The Designer shall provide scaled wall elevation details for each TR and ER affected by the project.

B. For remodel projects, the Designer shall produce digital photographs of each wall depicting the existing conditions where future TRs and ERs will be located. These photos shall be provided with the wall elevation details in the Construction Documents.

C. The wall elevation details shall show the components that are mounted on the walls in the room, including at least the following:

- Backboards
- Ladder Racking
- Cable Slack Loops
- Grounding Busbar
- Existing Devices
- Backbone Cable Routing
- Cable Management
- Termination Blocks
- Power Receptacles
- Entrance Conduits
- Wall-mounted Electronic Equipment
- Wall-mounted Swing Racks & Contents
- Racks and Vertical Cable Mgmt
- Entrance Protection Equipment
- Other low-voltage systems

- Work Area
- UPS
- Entrance Pit
- Space for Future Racks
- PBX and Voice Mail
- Space for Future Equipment
- Space Reserved for Utility Demarc

D. Elevation details for each of the telecommunications racks in each TR and ER shall also be provided. Rack elevation details shall show the racks and any components that are mounted on or near the racks including at least the following:

- Patch Panels
- UPS Equipment
- Existing Devices
- Shelves / Drawers
- Termination Blocks
- Power Receptacles
- Space for Future Equipment
- Electronic Equipment
- Cable Management

E. The details shall depict the telecommunications materials that are listed in the specification.

F. Where a project involves additions to existing racks, the elevation details shall show the existing equipment in the racks and indicate which items are existing, in addition to indicating which items are “new, to be provided under the Contract.”

G. Examples of rack elevation details are included in Appendix 5.2. An example wall elevation detail is included in Appendix 5.4.

4.1.8 INTRA-BUILDING BACKBONE SCHEMATIC DIAGRAMS

A. A schematic diagram shall be provided showing the sizing and routing of fiber optic and copper backbone cables.

B. On projects where existing intra-building distribution cabling is to be removed, it may be useful to provide a separate schematic diagram depicting cabling to be demolished.

4.2 Project Manual

A. The State of Utah DFCM publishes requirements for the Project Manual.

B. In addition to these requirements, the Project Manual shall contain the following items as described below:

- Horizontal Cabling Labeling Spreadsheet
- Fiber Link-Loss Budget Analyses
- Cutover Plans

4.2.1 SPECIFICATIONS

4.2.1.1 UVU TELECOMMUNICATIONS CONSTRUCTION GUIDE SPECIFICATION

A. The UVU Telecommunications Construction Guide Specification (TCGS) is a *guide* specification as opposed to a *master* specification. It does not include an exhaustive listing of all possible products or installation methods that could be employed in a telecommunications infrastructure project.

B. The TCGS is an example of a specification that shall be used for an infrastructure replacement project or for a new facility project. It has verbiage that identifies issues that the Designer shall consider throughout the adaptation process. The Designer shall adapt the sections in the TCGS to the particular requirements of the given project.

C. The Designer shall directly edit the TCGS for use on each project. The Designer shall notify the UVU ITPM and TPM where changes or additions to the specifications are desired. Edits to the documents shall be performed with the "Revision Tracking" feature activated. At the various project milestones when the documents are submitted to UVU for review, the specifications shall be printed showing the revision markings.

D. The Designer shall be responsible for adding any necessary content to the specification that is applicable to the project and not already contained in the TCGS.

E. Please refer to the more detailed instructions contained in the TCGS, both in the Preface of that document as well as in the "hidden text" comments contained in the electronic files.

4.2.1.2 COMMON SPECIFICATION SECTIONS

There are several specification sections that are commonly used for telecommunications systems or contain content that supports telecommunications functionality.

Sections typically provided by the Architect, but requiring Designer input:

- 09 91 00 – Painting
- 07 84 00 – Firestopping

Sections typically provided by the Telecommunications Engineer:

- 27 05 00 – Common Work Results for Communications
- 27 05 26 – Grounding and Bonding for Communications Systems
- 27 05 29 – Hangers and Supports for Communications Systems
- 27 05 33 – Conduits and Backboxes for Communications Systems
- 27 05 36 – Cable Trays for Communications Systems
- 27 11 00 – Communications Equipment Room Fittings
- 27 13 00 – Communications Backbone Cabling
- 27 15 00 – Communications Horizontal Cabling

- 27 16 00 – Communications Connecting Cords, Devices, and Adapters
- 27 32 00 – Voice Communication Telephone Sets
- 33 81 26 – Communications Underground Ducts, Manholes, and Handholes
- 33 82 00 – Communications Distribution
- 33 82 43 – Grounding and Bonding for Communications Distribution

4.2.2 CUTOVER PLAN

The Designer shall provide a detailed Cutover Plan that is coordinated with other disciplines on the project as well as with UVU data and telephone equipment cutover requirements. Verbiage describing the sequence of work tasks to accomplish the cutover shall be provided in this section. Limitations on the permissible downtime allowed and temporary service arrangements shall be discussed in the Cutover Plan.

The Cutover Plan shall also include a rollback strategy to enable reversion to the existing system if a problem develops that is serious enough to render cutover unfeasible.

Not all projects will require a Cutover Plan.

4.2.3 FIBER LINK-LOSS BUDGET ANALYSIS

A. The Designer shall provide (in the Construction Documents) a link-loss budget analysis for each fiber optic cable.

B. The link-loss budget analysis shall be formatted as shown in Appendix 5.6 of the TDDG. Upon request, UVU will provide an electronic spreadsheet file to be used as a template.

4.3 Record Drawings and Documentation

The State of Utah DFCM publishes requirements for Record Drawings and submittals. The following requirements related to Record Drawings and submittals are **in addition** to those published by the State:

4.3.1 RECORD DRAWING CONTENT

- The Record Drawings shall show the identifiers for the telecommunications equipment and cabling as constructed.
- The Record Drawings shall show actual measured signal levels and lengths of television distribution cabling as constructed.

4.3.2 RECORD DRAWING DELIVERABLES

The original copy of hard-copy as-built and record drawings shall be provided to UVU Facilities.

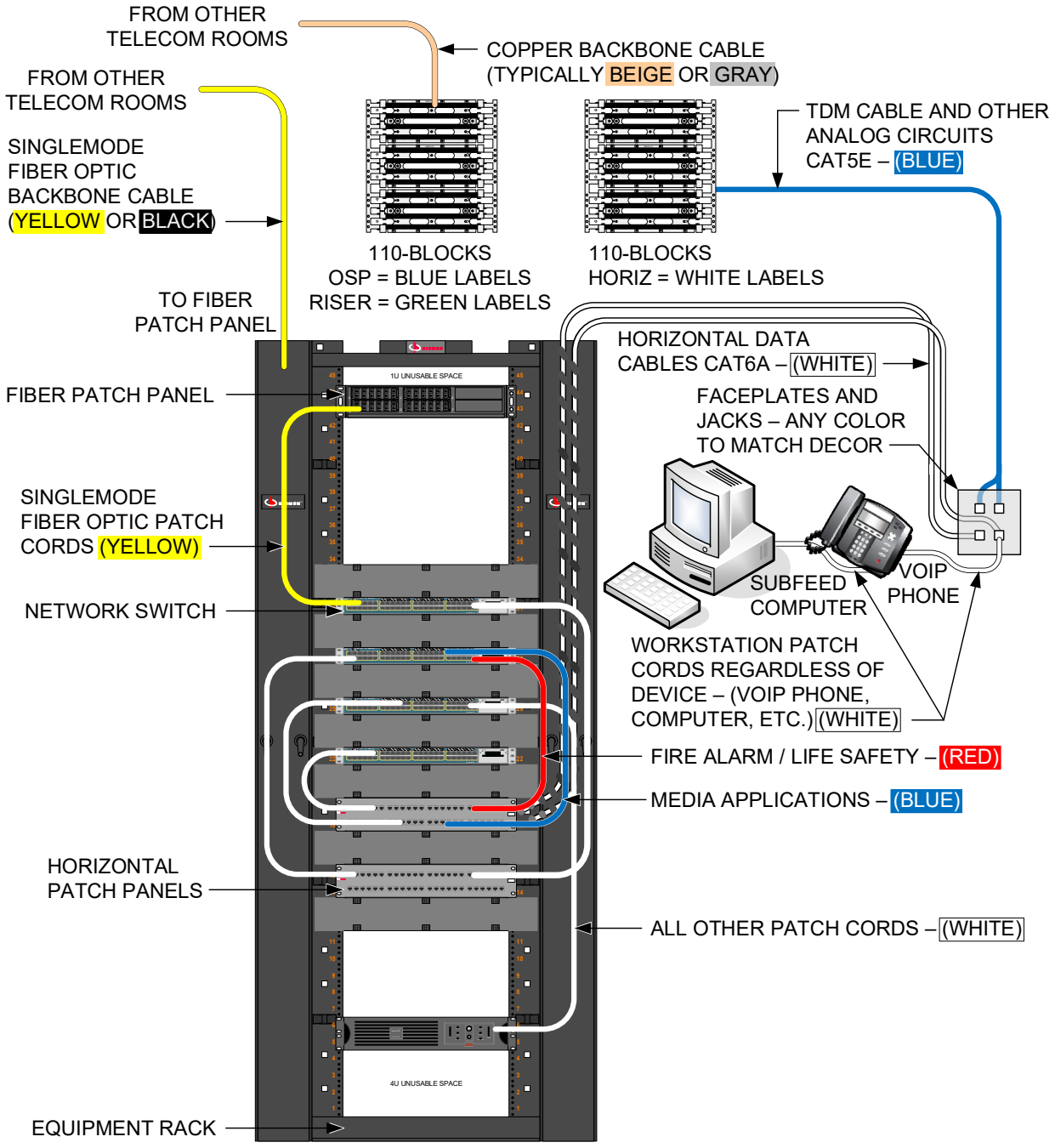
In addition to paper copies, at least two copies of the following electronic file sets shall be delivered to UVU (for Facilities and OIT):

- One CDROM containing editable 2D AutoCAD drawings (with all xrefs bound to the drawing) of the telecommunications plans, elevations and details, in addition to the Revit or BIM model files.
- One CDROM containing the digital photographs taken by the Designer during the project shall be delivered to UVU Facilities Planning and Construction.

5 Appendix

5.1 Cable Color Scheme

The following graphic depicts the approved cable color scheme for UVU projects:



5.2 Sample Rack Elevation Details

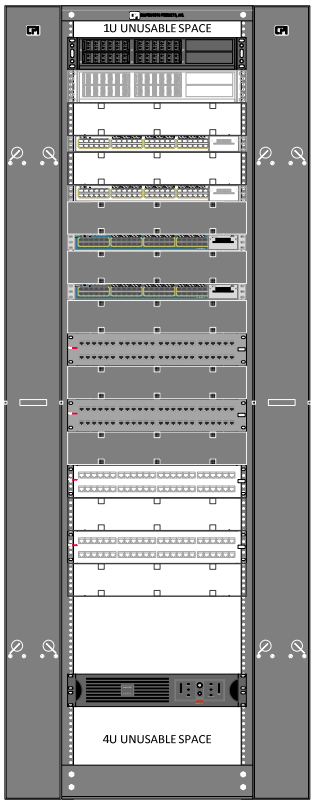
The Designer shall provide scaled rack elevation details in the project drawings (similar to the details below), and shall identify the racks, vertical and horizontal cable management, patch panels, shelves and drawers in each detail. The drawings below depict maximum Day-1 design capacity, with accommodations for future growth shown in outline form.

Note that the designated contents in each rack are intentionally arranged for optimal operational considerations. If the adjacent wall is on the left side of a row of multiple racks, the designer shall invert the arrangement.

5.2.1 IDF: 1 RACK

This example is suitable for a Day-1 design with a maximum of 96 horizontal cables (leaving room for future growth).

A one-rack room is rarely adequate, because it has very limited space for future equipment or cabling to be added. Therefore, it shall only be used as a last resort, and then only with the approval of the ITPM.

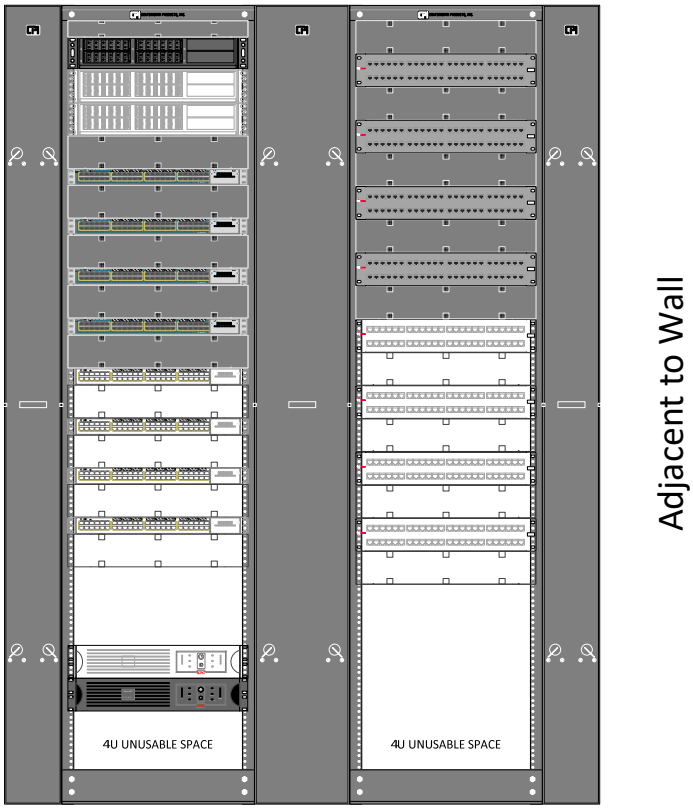


Rack 1
Fiber Optic, Horizontal &
Network Electronics

5.2.2 IDF: 2 RACKS

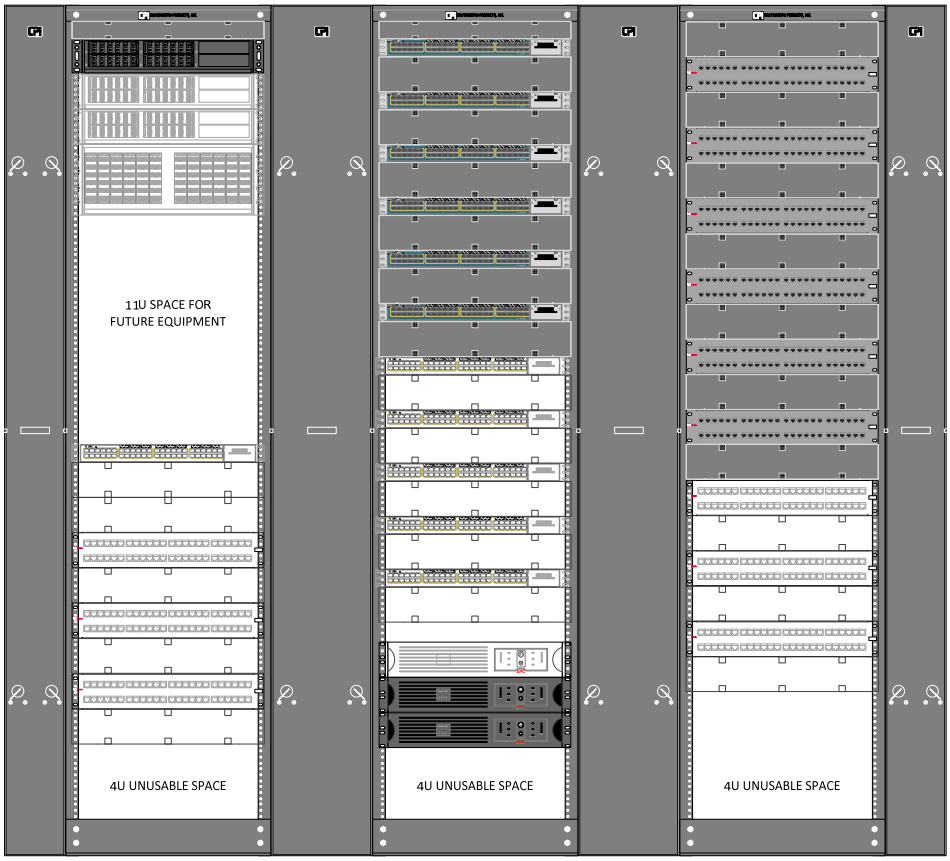
This example is suitable for a Day-1 design with a maximum of 192 horizontal cables (leaving room for future growth).

A two-rack room is rarely adequate, because it has very limited space for future equipment or cabling to be added. Therefore, it shall only be used as a last resort, and then only with the approval of the ITPM.



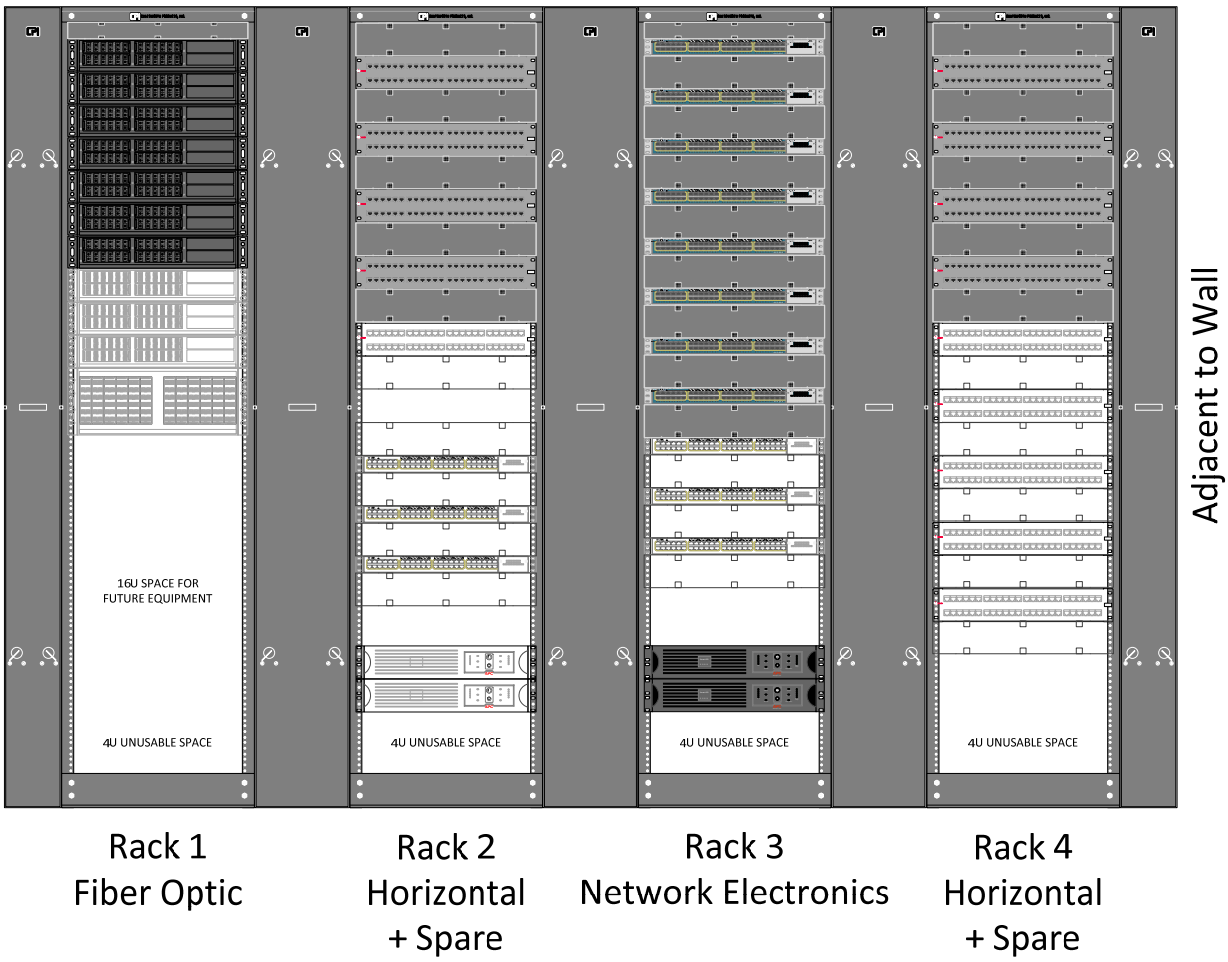
5.2.3 IDF: 3 RACKS

This example is suitable for a Day-1 design with a maximum of 288 horizontal cables (leaving room for future growth).



5.2.4 MDF: 4 RACKS

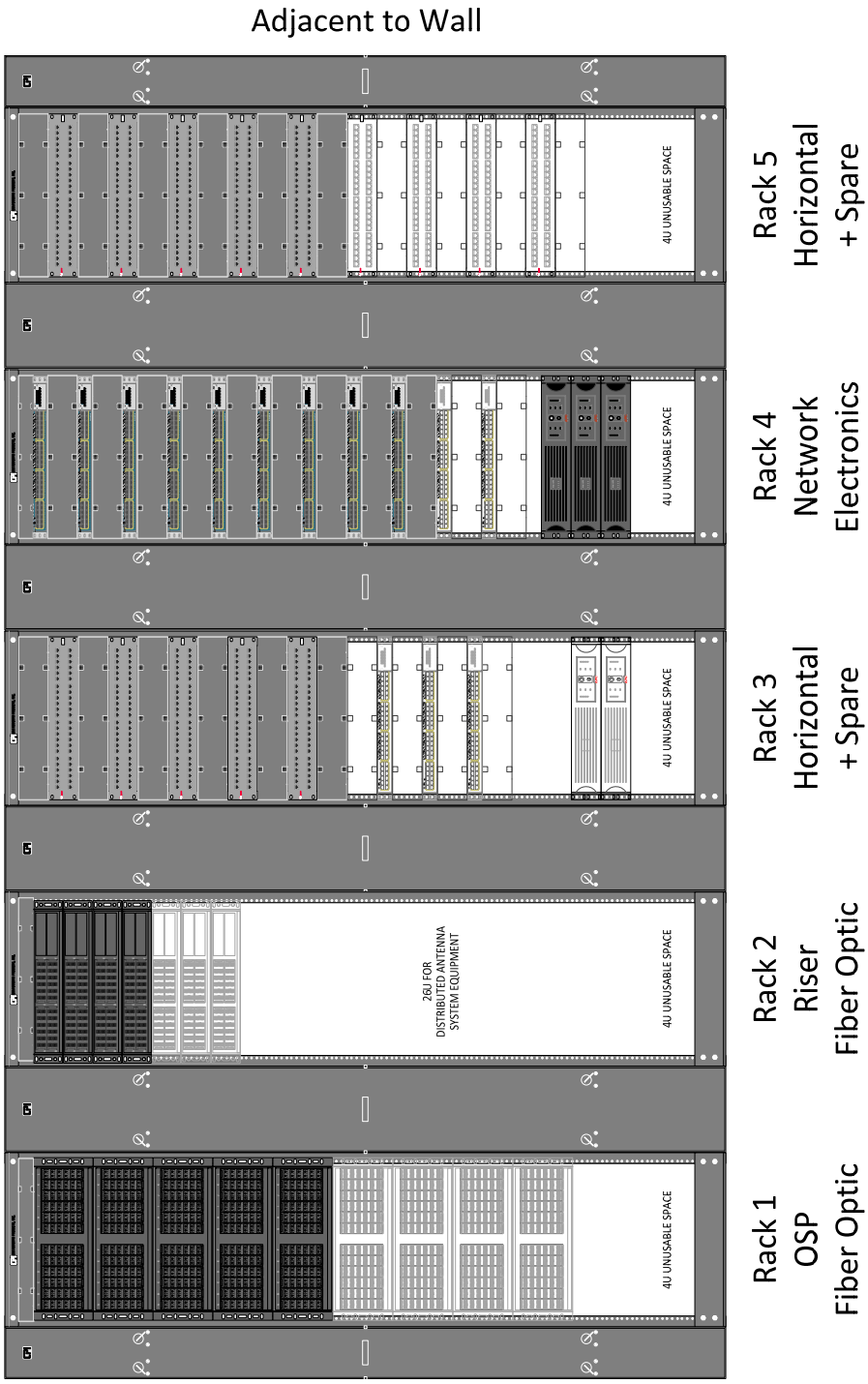
This example is suitable for a Day-1 design with a maximum of 336 horizontal cables and 6 fiber optic cables (leaving room for future growth).



When four racks are designed in a two-row arrangement (see Section 5.3.6, below), split the rows between racks 2 and 3.

5.2.5 MDF: 5 RACKS

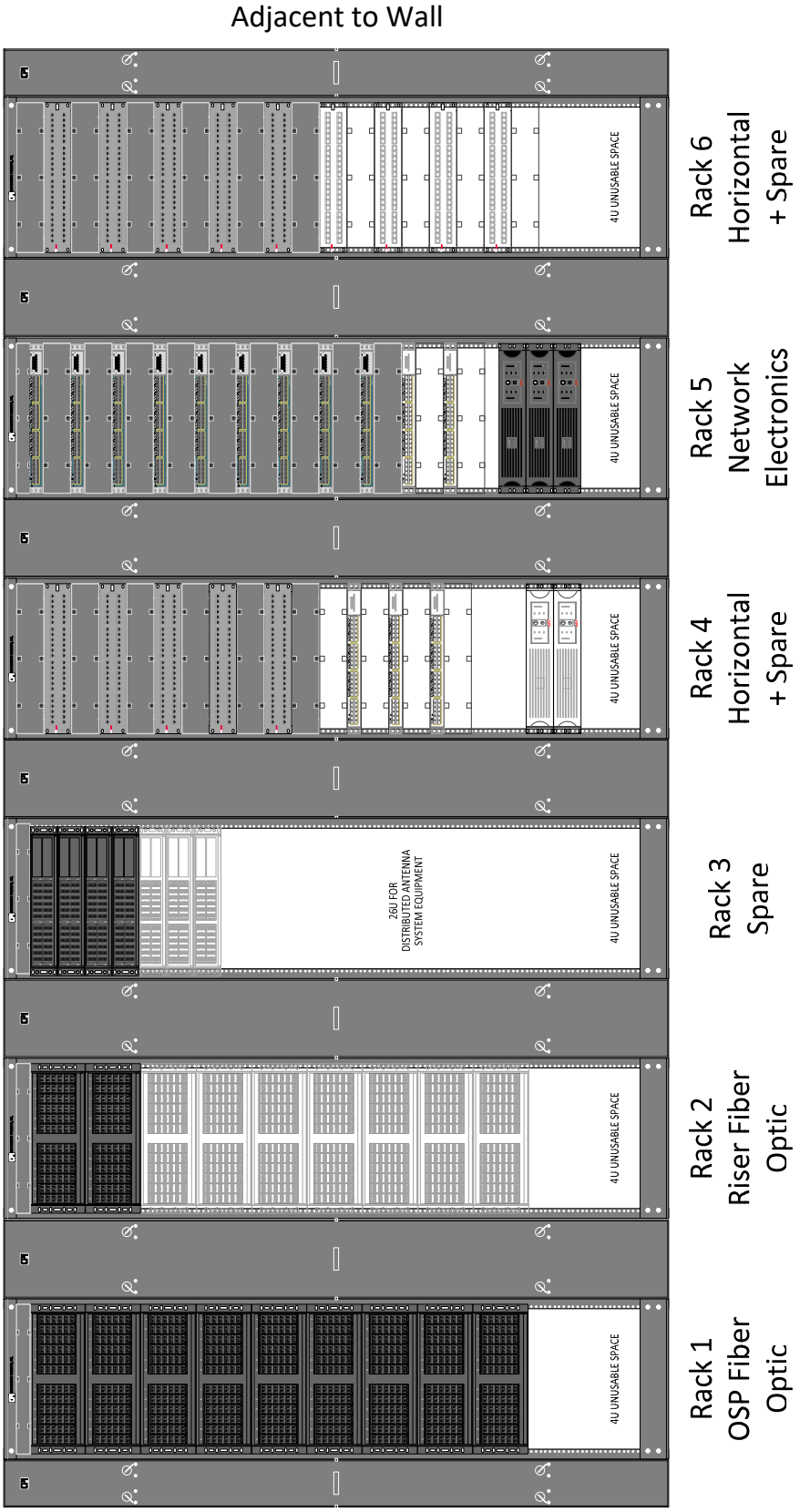
This example is suitable for a Day-1 design with a maximum of 336 horizontal cables and 8 fiber optic cables (leaving room for future growth).



5.2.6 MDF: 6 RACKS

This example is suitable for a Day-1 design with a maximum of 336 horizontal cables and 13 fiber optic cables (leaving room for future growth).

When six racks are designed in a two-row arrangement (see Section 5.3.9), split the rows between racks 3 and 4.



5.3 Sample Telecommunications Room Plan Details

Below are sample plan details for several sizes of telecommunications rooms. The Designer shall provide similar details and information for each telecommunications room and equipment room affected by the project. This information shall be provided in the Construction Documents.

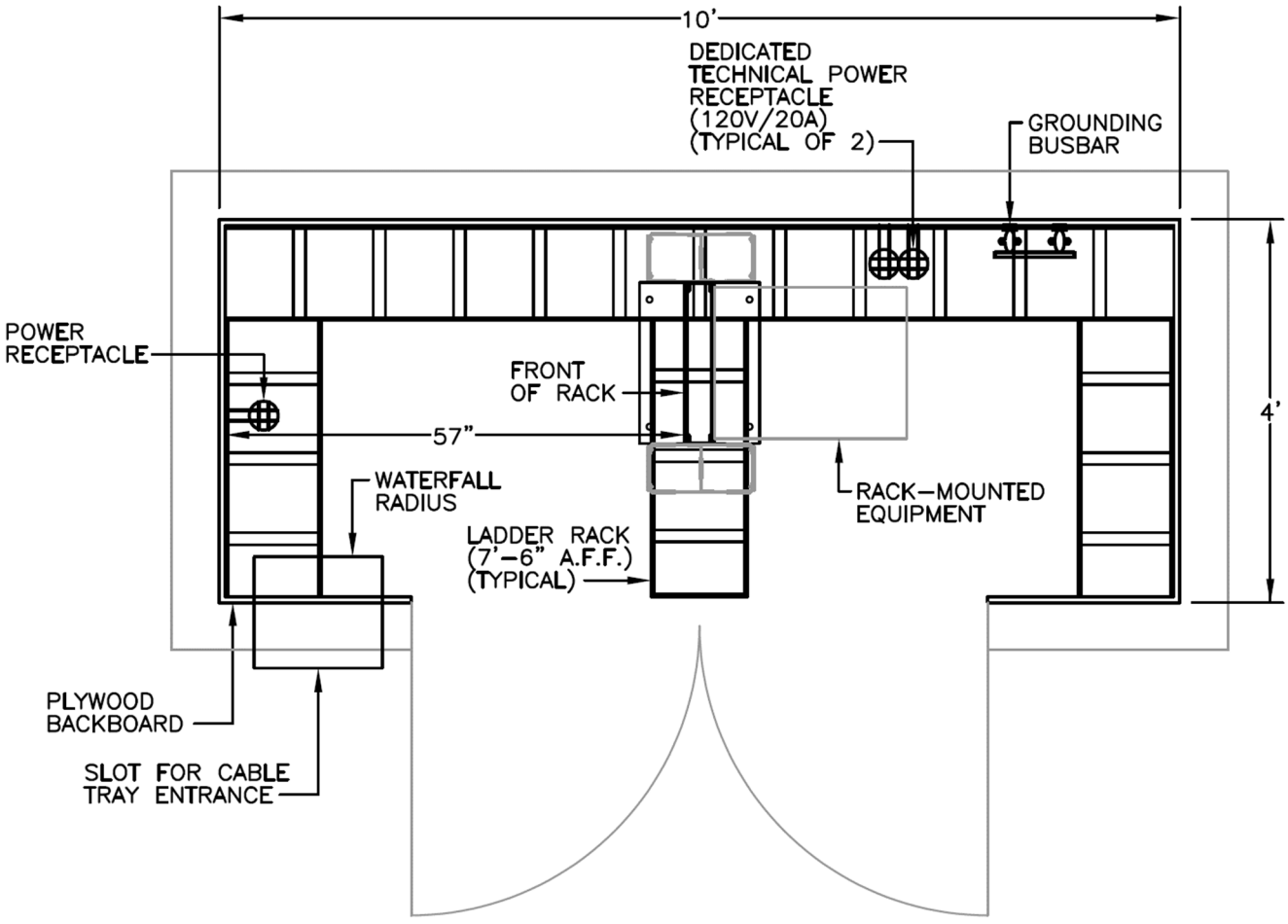
These sample plan details have been pre-approved for use at UVU. The Designer shall use this layout wherever appropriate and shall discuss project-specific alternatives with the ITPM.

The room dimensions shown are considered to be acceptable minimums.

5.3.1 IDF: 1 RACK REACH IN – 10' X 4' (INTERIOR DIMENSIONS)

This example is suitable for a Day-1 design with a maximum of 96 horizontal cables (leaving room for future growth).

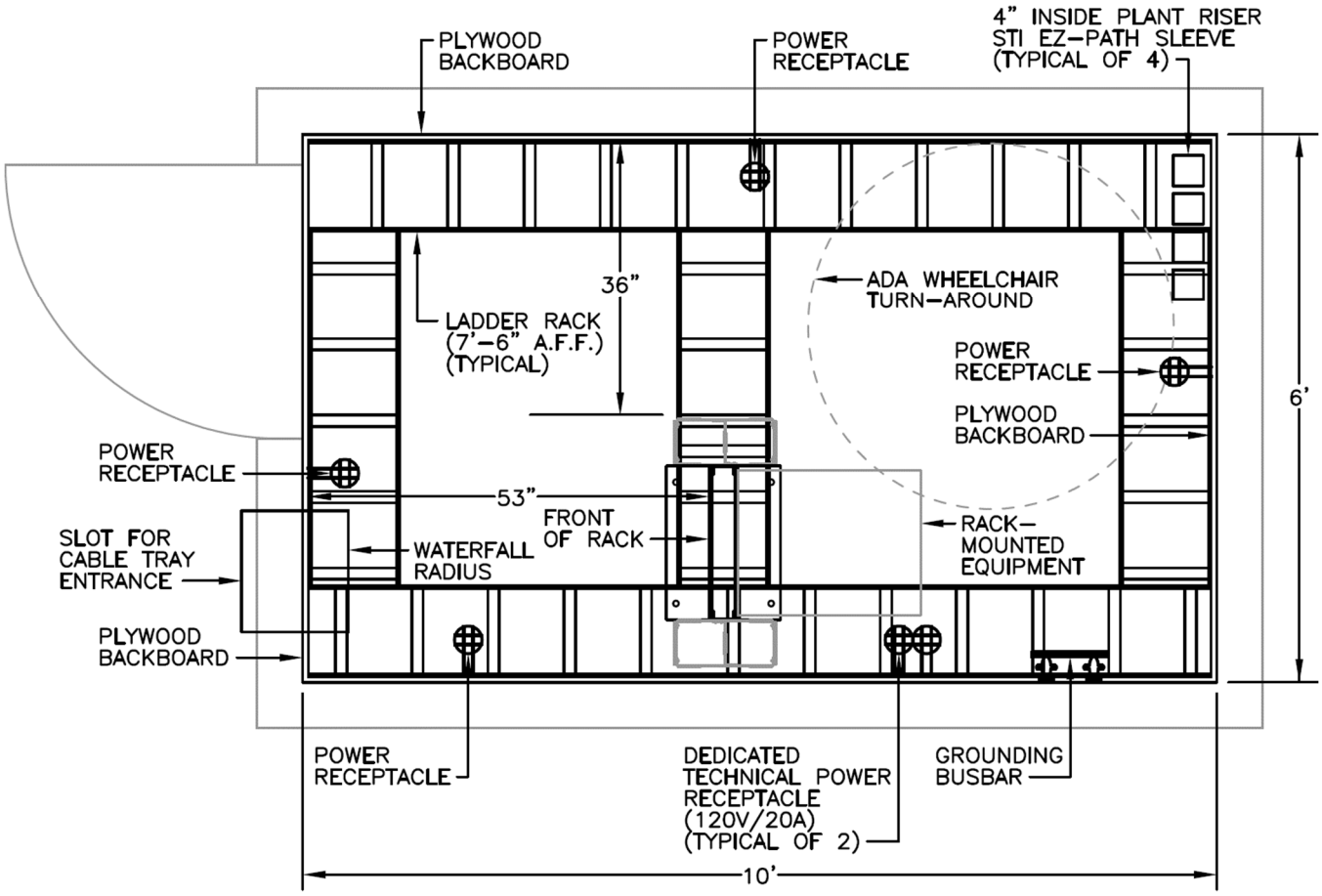
A one-rack room is rarely adequate, because it has very limited space for future equipment or cabling to be added. Therefore, it shall only be used as a last resort, and then only with the approval of the ITPM.



5.3.2 IDF: 1 RACK – 10' X 6' (INTERIOR DIMENSIONS)

This example is suitable for a Day-1 design with a maximum of 96 horizontal cables (leaving room for future growth).

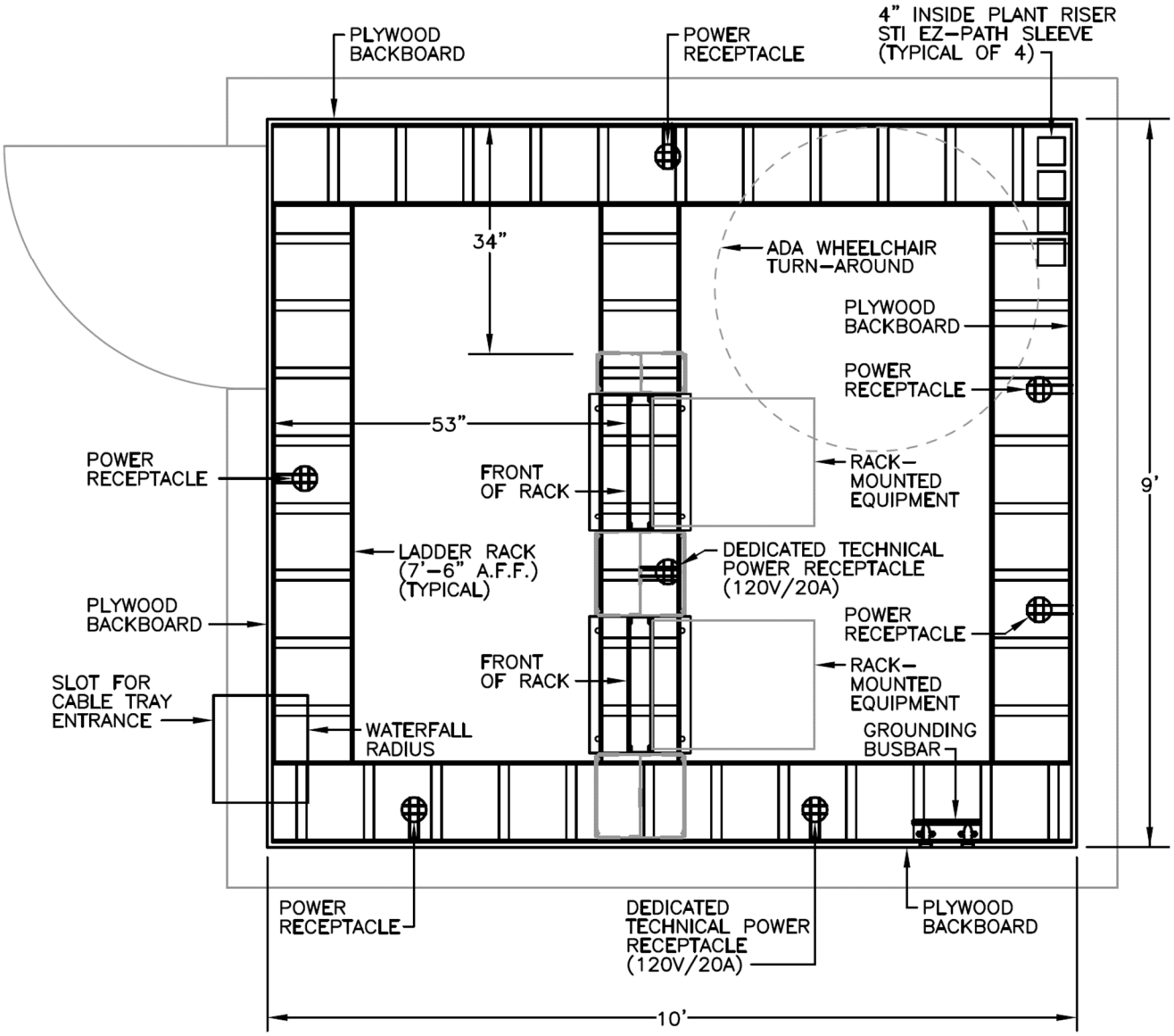
A one-rack room is rarely adequate, because it has very limited space for future equipment or cabling to be added. Therefore, it shall only be used as a last resort, and then only with the approval of the ITPM.



5.3.3 IDF: 2 RACKS – 10' X 9' (INTERIOR DIMENSIONS)

This example is suitable for a Day-1 design with a maximum of 192 horizontal cables (leaving room for future growth).

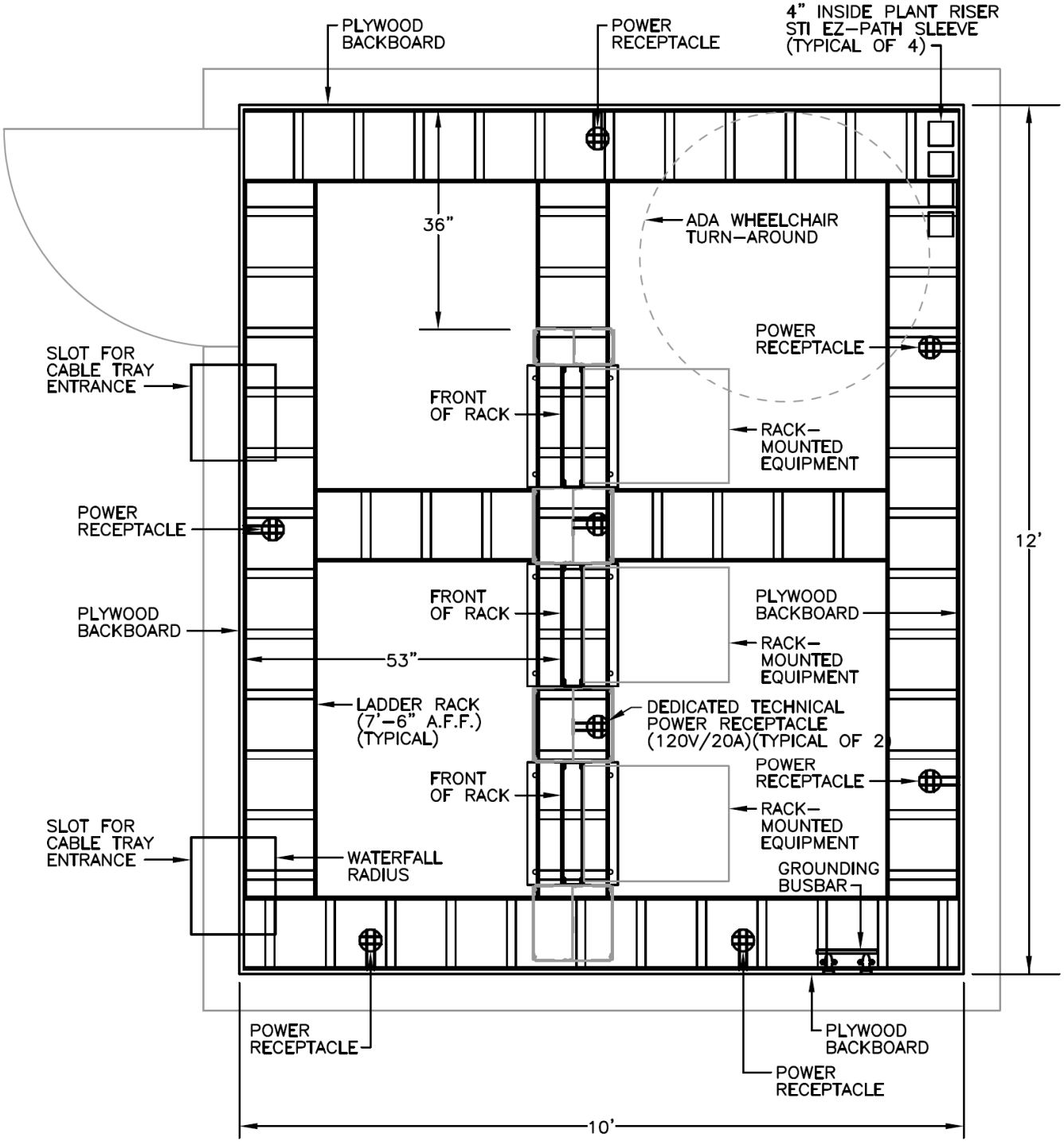
A two-rack room is rarely adequate, because it has very limited space for future equipment or cabling to be added. Therefore, it shall only be used as a last resort, and then only with the approval of the ITPM.



5.3.4 IDF: 3 RACKS – 10' X 12' (INTERIOR DIMENSIONS)

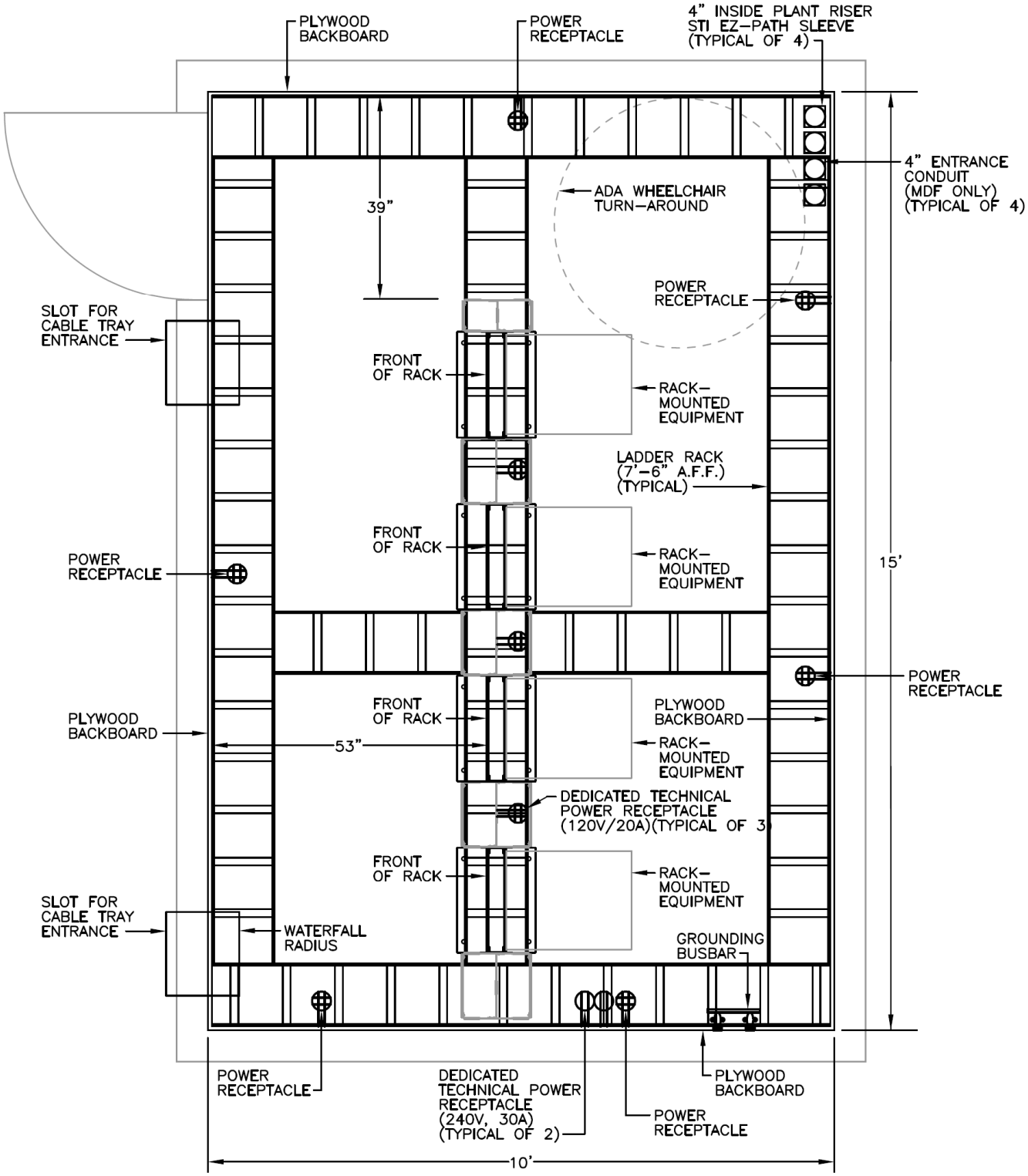
This example is suitable for a Day-1 design with a maximum of 288 horizontal cables (leaving room for future growth).

This is the standard IDF configuration.



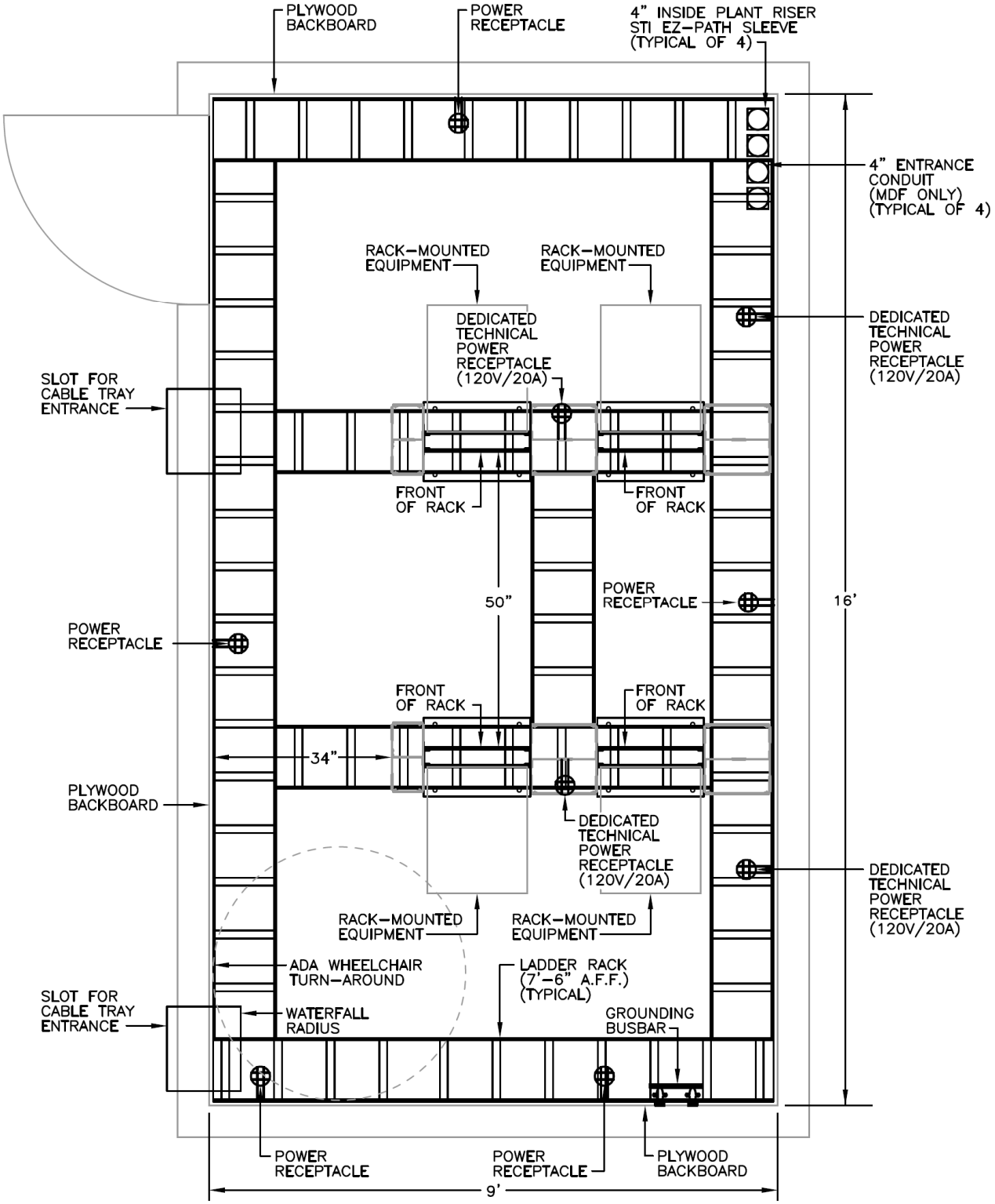
5.3.5 IDF / MDF: 4 RACKS – 10' X 15' (INTERIOR DIMENSIONS)

This example is suitable for a Day-1 design with a maximum of 336 horizontal cables and 6 fiber optic cables (leaving room for future growth).



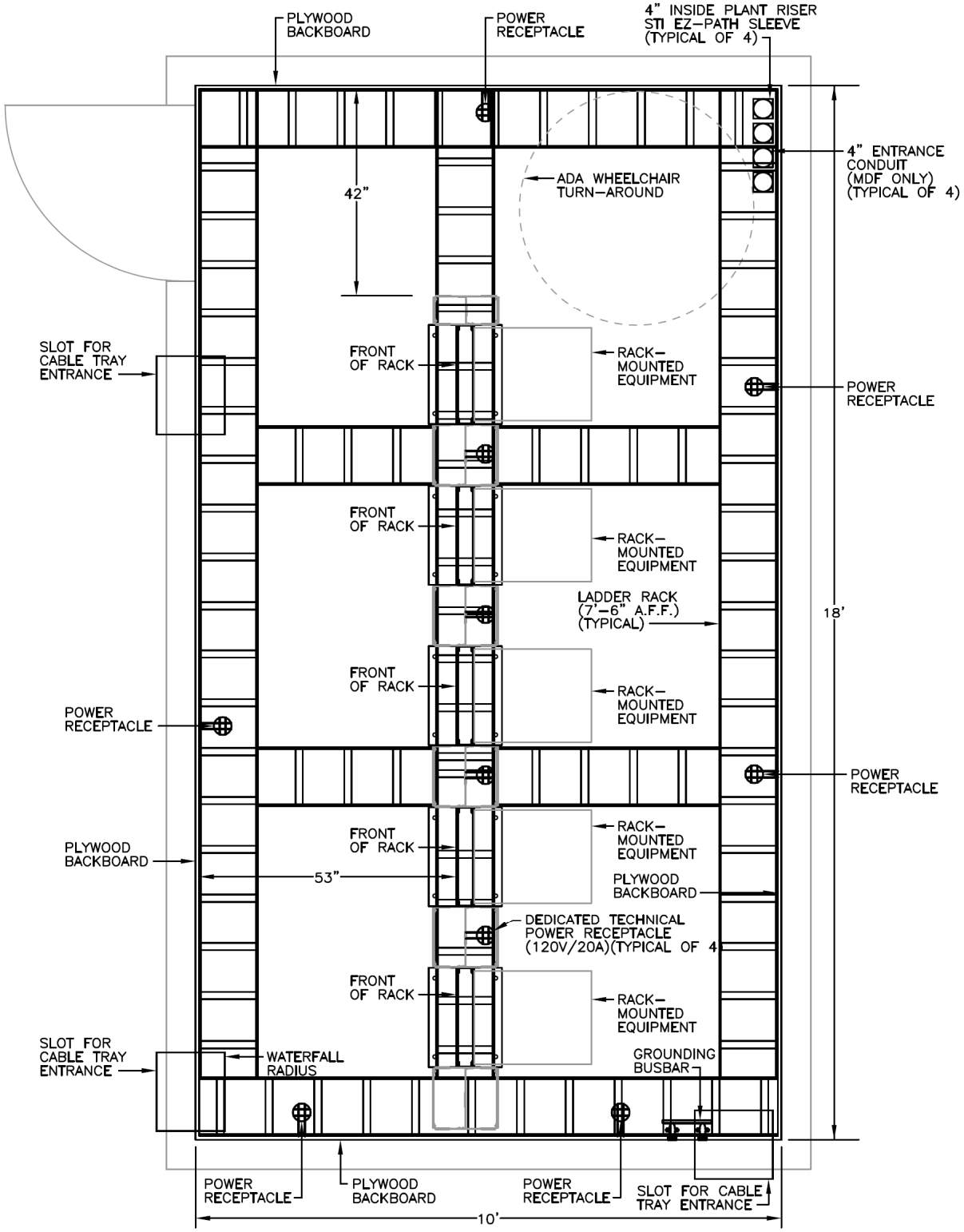
5.3.6 IDF / MDF: 4 RACKS (2 ROWS) – 9' X 16' (INTERIOR DIMENSIONS)

This example is suitable for a Day-1 design with a maximum of 336 horizontal cables and 6 fiber optic cables (leaving room for future growth).



5.3.7 MDF: 5 RACKS – 10' X 17' (INTERIOR DIMENSIONS)

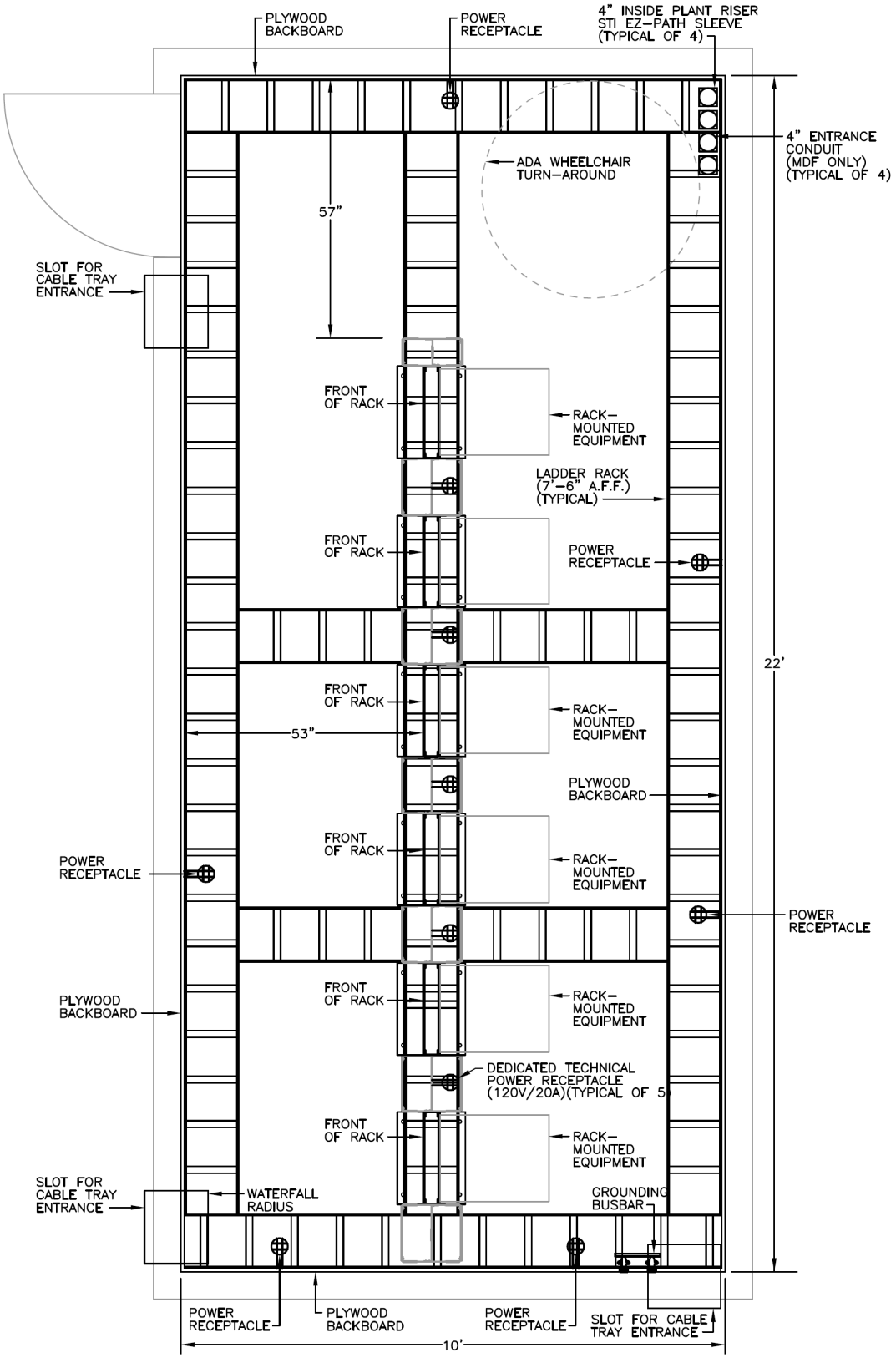
This example is suitable for a Day-1 design with a maximum of 336 horizontal cables and 8 fiber optic cables (leaving room for future growth).



5.3.8 MDF: 6 RACKS – 10' X 20' (INTERIOR DIMENSIONS)

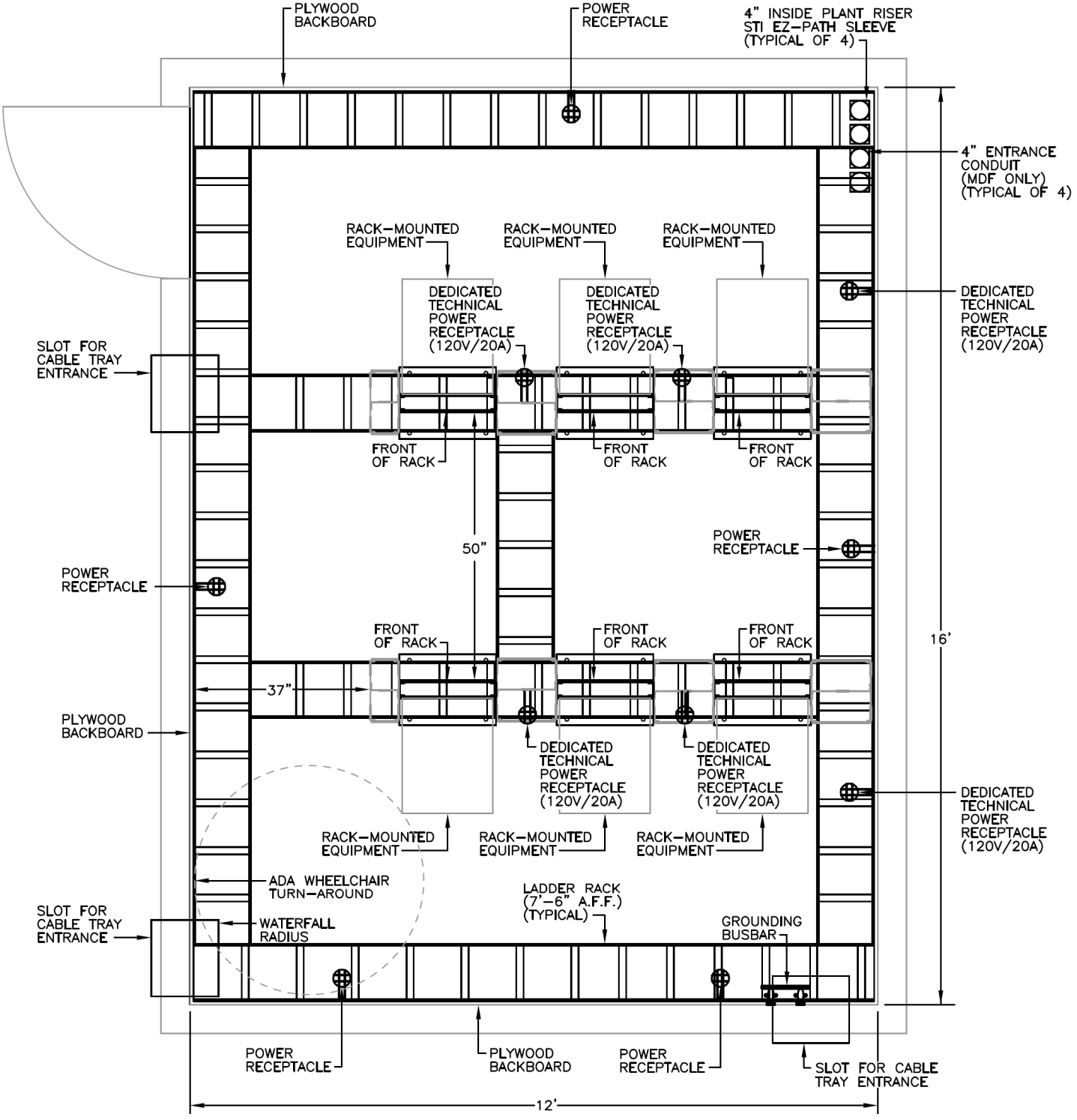
This example is suitable for a Day-1 design with a maximum of 336 horizontal cables and 13 fiber optic cables (leaving room for future growth).

This is the standard MDF configuration.



5.3.9 MDF: 6 RACKS (2 ROWS) – 12' X 16' (INTERIOR DIMENSIONS)

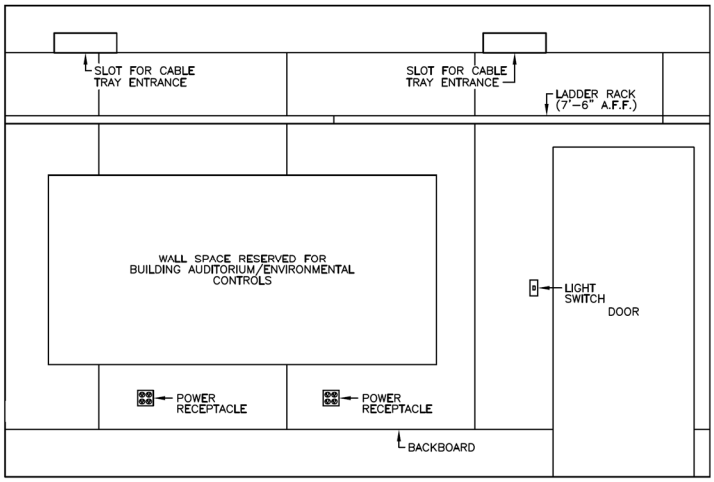
This example is suitable for a Day-1 design with a maximum of 336 horizontal cables and 13 fiber optic cables (leaving room for future growth).



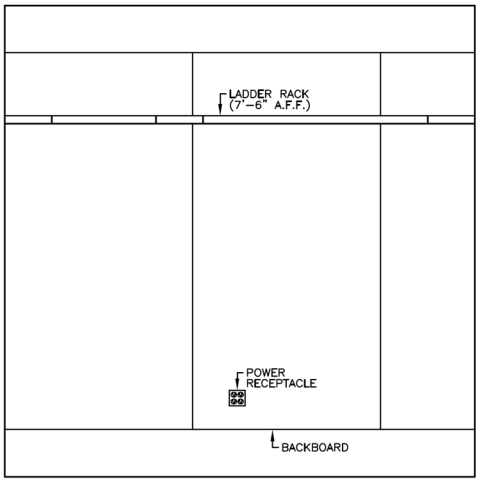
5.4 Sample Wall Elevation Detail

The Designer shall provide a scaled wall elevation detail, similar to the example below, for each new or existing telecommunications room wall affected by the project.

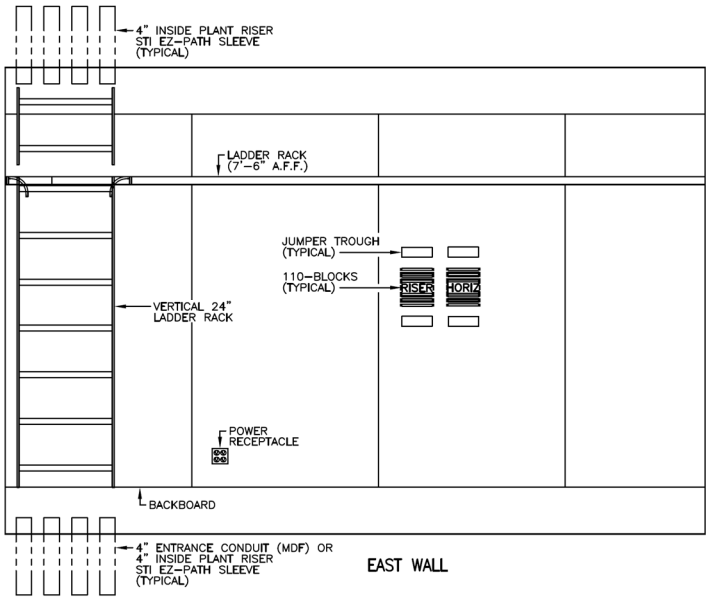
This information shall be provided in the Construction Documents.



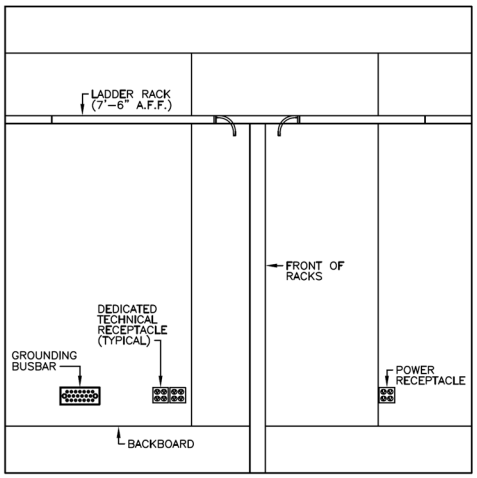
WEST WALL



NORTH WALL



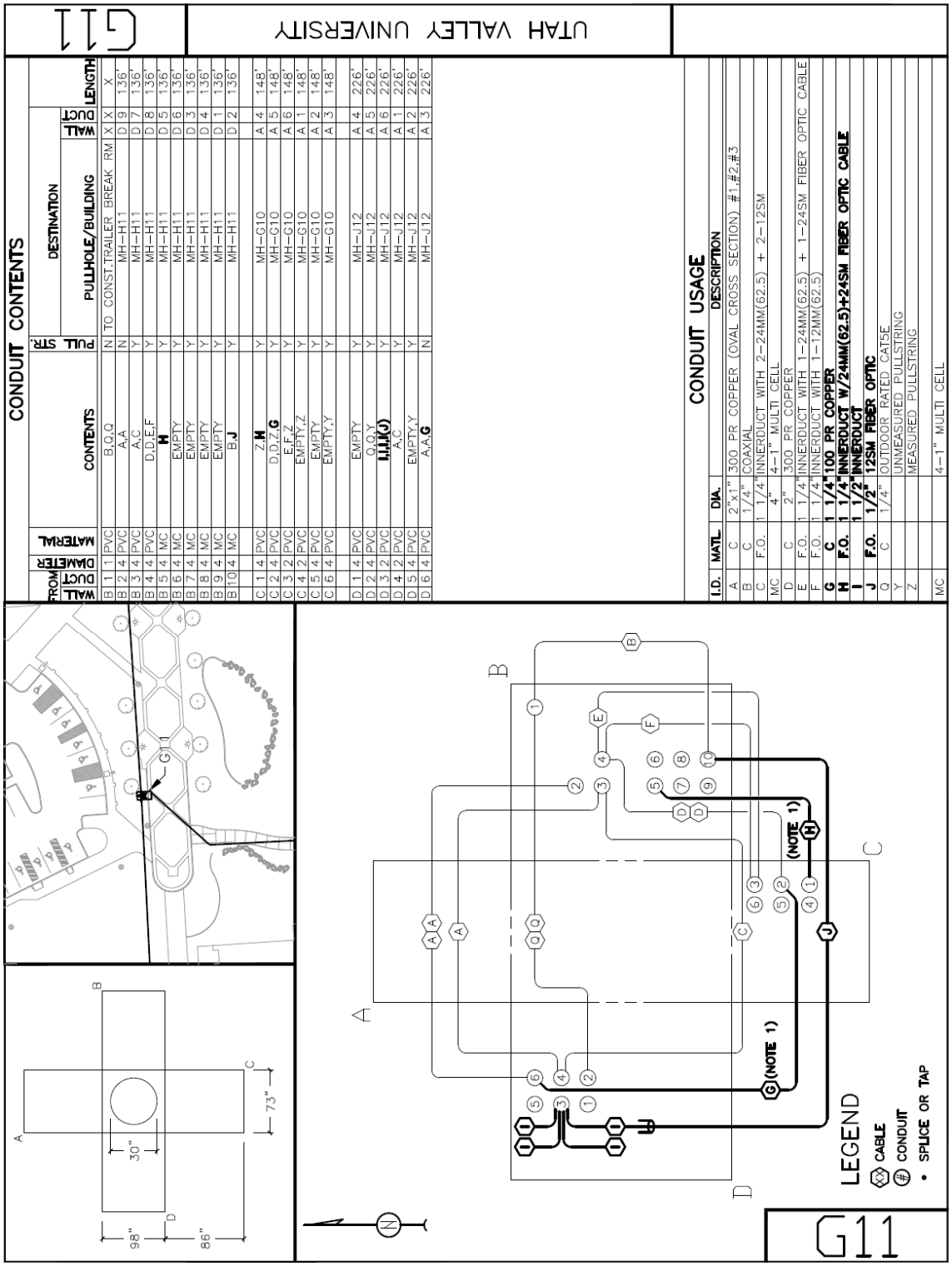
EAST WALL



SOUTH WALL

5.5 Sample Maintenance Hole Butterfly Diagram

For each outside plant handhole, pull hole and maintenance hole affected by a project (existing or new), the Designer shall provide a butterfly diagram similar to the example below:



5.6 Sample Fiber Optic Link-Loss Budget Analysis

The following is a sample Fiber Optic Link-Loss Budget Analysis that the Designer shall use for each new fiber optic cable designed in the project. The Designer shall submit the completed link-loss budget analyses to UVU in both electronic and paper forms. Upon request, UVU will provide an electronic spreadsheet of this form to be used as a template.

Cable ID: **Enter Cable ID Here**
From: **Enter MDF/Building Name Here**
To: **Enter IDF/Building Name Here**

	# of MM Strands
	# of SM Strands

			MM 850		MM 1300		SM 1310		SM 1550	
Passive Cable System Attenuation										
Fiber Loss at Operating Wavelength	Cable Length (in kilometers)									km
	x Attenuation per km	x	3.75	x	1.5	x	0.5	x	0.5	dB/km
	= **Total Fiber Loss**		0.00		0.00		0.00		0.00	dB
Connector Loss	Number of Connector Pairs		2		2		2		2	pairs
(Excluding Tx & Rx Connectors)	x Individual Connector Pair Loss	x	0.5	x	0.5	x	0.5	x	0.5	dB/pair
	= **Total Connector Loss**		1.00		1.00		1.00		1.00	dB
Splice Loss	Number of Splices									splices
	x Individual Splice Loss	x	0.3	x	0.3	x	0.3	x	0.3	dB/splice
	= **Total Splice Loss**		0.00		0.00		0.00		0.00	dB
Other Components Loss	**Total Components Loss**									dB
Total Passive Cable System Attenuation	Total Fiber Loss		0.00		0.00		0.00		0.00	dB
	+ Total Connector Loss	+	1.00	+	1.00	+	1.00	+	1.00	dB
	+ Total Splice Loss	+	0.00	+	0.00	+	0.00	+	0.00	dB
	+ Total Components Loss	+	0.0	+	0.0	+	0.0	+	0.0	dB
	= **Total System Attenuation**		1.00		1.00		1.00		1.00	dB

			MM 850		MM 1300		SM 1310		SM 1550	
Link Loss Budget										
From Manufacturer's Specifications	Average Transmitter Output		-18.0		-18.0		-18.0		-18.0	dBm
	Receiver Sensitivity (10^{9} BER)		-31.0		-31.0		-31.0		-31.0	dBm
System Gain	Average Transmitter Power		-18.0		-18.0		-18.0		-18.0	dBm
	- Receiver Sensitivity	-	-31.0	-	-31.0	-	-31.0	-	-31.0	dBm
	= **System Gain**	=	13.00	=	13.00	=	13.00	=	13.00	dB
Power Penalties	Operating Margin		2.0		2.0		3.0		3.0	dB
# of Fusion Splices: 2 x Loss per Splice: 0.3 =	+ Receiver Power Penalties	+	0.0	+	0.0	+	0.0	+	0.0	dB
	+ Repair Margin	+	0.6	+	0.6	+	0.6	+	0.6	dB
	= **Total Power Penalties**	=	2.60	=	2.60	=	3.60	=	3.60	dB
Link Loss Budget	System Gain		13.00		13.00		13.00		13.00	dB
	- Power Penalties	-	2.60	-	2.60	-	3.60	-	3.60	dB
	= **Total Link Loss Budget**	=	10.40	=	10.40	=	9.40	=	9.40	dB

			MM 850		MM 1300		SM 1310		SM 1550	
Performance										
System Performance Margin	Link Loss Budget		10.40		10.40		9.40		9.40	dB
	- Passive Cable System Attenuation	-	1.00	-	1.00	-	1.00	-	1.00	dB
	= **System Performance Margin**	=	9.40	=	9.40	=	8.40	=	8.40	dB

Users of this spreadsheet shall verify prior to use that the parameters and calculations are appropriate for the project, equipment and materials that are used.

5.7 Acronym Glossary

A/E	Architect / Engineer
ACPM	Access Control Project Manager
AVCGS	Audio/Visual Construction Guide Specification
AVDG	Audio/Visual Design Guide
AVPM	Audio/Visual Project Manager
BAPM	Building Automation Project Manager
BIM	Building Information Model
CDF	Controlled-density fill
CGS	Construction Guide Specification
CGSP	Construction Guide Specification Preface
CMU	Concrete masonry unit
DFCM	(State of Utah) Division of Facilities Construction & Management
EMI	Electromagnetic interference
ESS	Electronic Safety and Security
FF&E	Furniture, fixtures and equipment
FPM	Facilities Project Manager
GC/CM	General Contractor/Construction Manager
HC	Horizontal cross-connect
HCP	Horizontal connection point
IC	Intermediate cross-connect
IDF	Intermediate Distribution Frame (secondary telecommunications rooms)
ISP	Inside plant
ITPM	Information Technology Project Manager
MC	Main cross-connect
MAC	Moves, adds or changes
MDF	Main Distribution Frame (main telecommunications room in the building)
O.D.	Outside Diameter
OSP	Outside plant
PDU	Power distribution unit
PII	Personally identifiable information
POE	Power over Ethernet
RCDD	Registered Communications Distribution Designer

RFI	Radio frequency interference
SVR	Standards Variance Request
TCGS	Telecommunications Construction Guide Specification
TDDG	Telecommunications Distribution Design Guide
TGB	Telecommunications grounding busbar
TIDG	Technology Infrastructure Design Guide
TPM	Telecommunications Project Manager
TR	Telecommunications room
UTC	Undercarpet telecommunications cabling
UTP	Unshielded twisted pair
WAP	Wireless access point