Division 27
Telecommunications
DESIGN GUIDE

April 15, 2025

PREPARED BY:

Summit Engineering & Consulting
8350 W. Grandridge Blvd, Suite 200
Kennewick WA, 99336
(509) 457-6100

PREPARED FOR:

Central Washington University

Table of Contents

1 Preface

1.1 Introduction

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

B. Telecommunications distribution systems designed for CWU are expected to support and integrate telecommunications of voice, data, video, and other low voltage systems with common media; for example, fiber optic and unshielded twisted pair (UTP) copper cable.

C. It is the responsibility of the telecommunications infrastructure Designer to 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 infrastructure. It is critical to coordinate between disciplines during the design phase of a project, rather than adjusting in the field during construction.

1.2 Guiding Principles

The overall guiding principles for telecommunications infrastructure at CWU are:

- Telecommunications infrastructure should be robust, reliable, predictable, efficient and sustainable.
- Telecommunications infrastructure should support high performance communications throughout its life. CWU expects its cabling infrastructure lifecycle to exceed 25 years.
- Telecommunications infrastructure should be designed to support the expected future requirements.
- Telecommunications pathways and spaces should be designed to support cable replaceability.
- CWU's standards are established with the intent of being good stewards

of public resources. The high value of properly designed and constructed telecommunications infrastructure is considered to be an important contribution to wise resource stewardship.
- Continued technical development of CWU IT employees is essential to the mission of supporting high performance communications services to the University.

1.3 Standards and Guidelines

A. CWU has adopted all applicable industry standards and guidelines related to the design and construction of telecommunications infrastructure. Architectural and engineering consultants shall design applications for CWU that comply with industry standards, as well as with the requirements of this document.
- CWU Design and Construction Standards

B. The telecommunications industry is continually evolving and updating its standards, as well as developing new ones. The following is a non-comprehensive list of applicable industry standards that are current as of this writing. Compliance with new standards not listed here is required, as they become officially adopted by industry.

- 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
- TIA 568-D series – Commercial Building Telecommunications Cabling Standards
- TIA 569-E series –Telecommunications Pathways and Spaces
- TIA 606-D series – Administration Standard for Telecommunications Infrastructure
- TIA 607-D series – Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
- TIA 758-B series – Customer-Owned Outside Plant Telecommunications Cabling Standard
- TIA 862-C – Building Automation Systems Cabling Standard for Commercial Buildings
- TIA 942-B – Telecommunications Infrastructure Standard For Data Centers
- ANSI/BICSI 005-2013 - Electronic Safety and Security (ESS) System Design and Implementation Best Practices
- Fiber Optic Test Standards, TIA/EIA 455-C
- 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 Designer is required to incorporate only the manufacturers listed in this document into the design (unless otherwise directed by CWU) and to design systems that will be suitable for the use of products from these manufacturers. The construction documents shall require that the Telecommunications Contractor's installation workmanship fully comply with the current installation requirements from the manufacturers of these products.

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

- BICSI Telecommunications Distribution Methods Manual (TDMM) (14th Edition)
- BICSI Outside Plant Design Reference Manual (OSPDRM) (6th Edition)
- BICSI Information Technology Systems Installation Methods Manual (ITSIMM) (8th Edition)

The CWU TDG is the guide to the application of the TIA Standards, the BICSI TDMM, the BICSI OSPDRM and the BICSI ITSIMM to the unique circumstances present in CWU 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 CWU in writing or through a revised edition of the TDG.

E. The requirements in these documents apply to all permanent technology infrastructure installed in CWU facilities, including infrastructure serving non-CWU tenants.

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

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

H. The requirements contained in the TDG are considered to be in addition to those required under contract with the State of Washington. Where the

[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.

requirements differ, the issue shall be brought to the attention of the CWU Capital Planning Project Manager (CPPM) – otherwise the more stringent requirement shall apply.

1.4 Document Intent

A. The TDG is intended to be used in conjunction with the industry standards and guidelines listed above in order to reinforce selected content as well as highlight any restrictions and/or limitations that are specific to CWU's requirements.

B. The TDG 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 construction drawings and specifications for a project.

C. Any request to deviate from the requirements of the National Electrical Code will not be accepted. The Designer shall seek approval for designs that are not consistent with CWU TDG requirements. Requests to deviate from industry standards or CWU design solutions will be considered on a case-by-case basis by the CWU Information Services Manager (ISM). Designers shall contact the CWU ISM to discuss proposed alternatives before spending significant time pursuing the option.

1.5 Document Structure

The TDG is organized in the following sections:

1. Preface
2. Project Procedures
3. Design Criteria
4. Construction Document Content
5. Appendix

A. 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.

B. The **Project Procedures** section discusses the activities that should occur during each phase of a project.

C. The **Design Criteria** section serves two purposes. The first is to describe the general requirements for CWU 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, CWU 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 CWU facilities. Other practices are permitted in certain areas (residential halls, for example) but prohibited in other areas such as academic buildings.

D. The **Construction Document Content** section describes the content that is required in a complete set of drawings and specifications.

E. The **Appendix** section includes larger graphics that apply to multiple sections within the TDG.

1.6 CWU Personnel

There are several defined CWU personnel roles referenced in this document. The Designer shall interact with these individuals as direct points of contact:

- **Capital Planning Director (CPD)** – overall responsibility for project management, oversight and budget.
- **Capital Planning Project Manager (CPPM)** – assigned by the CPD to run and manage the project and administer the budget.
- **Electrical Power Lighting & Systems Manager (ELSM)** – assigned by the CPD to serve as the Owner's subject matter expert for the electrical power, lighting and systems aspects of the project.
- **Mechanical HVAC Manager (MHM)** – assigned by the CPD to serve as the Owner's subject matter expert for the mechanical heating and cooling system aspects of the project.
- **Space Allocation & Ergonomics Manager (SAEM)** – assigned by the CPD to serve as the Owner's subject matter expert for ergonomics and be responsible for space allocation decisions in coordination with the Program representatives who will use each space.
- **Room Numbering & Signage Manager (RNSM)** – assigned by the CPD to be responsible for room numbering and room signage for the project.
- **Information Services Manager (ISM)** – assigned by the CPD to serve as the Owner's subject matter expert for the information technology aspects of the project, including telecommunications/ICT features.

- **Audio Visual Manager (AVM)** – assigned by the CPD to serve as the Owner's subject matter expert for the telecommunications infrastructure for the project.

- **Security Systems Manager (SSM)** – assigned by the CPD to serve as the Owner's subject matter expert for the access control and video surveillance aspects of the project.

- **Life Safety Systems Manager (SAFM)** – assigned by the CPD to serve as the Owner's subject matter expert for the life safety systems aspects of the project.

- **Fire Protection & Suppression Manager (FPM)** – assigned by the CPD to serve as the Owner's subject matter expert for the fire alarm system and fire suppression system aspects of the project.

- **Cabinetry & Millwork Manager (CMM)** – assigned by the CPD to serve as the Owner's subject matter expert for the cabinetry and millwork features of the project.

- **Auxiliary Standards Manager (AUXM)** – assigned by the Director of Housing Facilities within Housing and Residence Life to serve as their representative for projects that serve their organization.

- **Record Drawing & Documentation Manager (RDM)** – assigned by the CPD to be responsible for managing the record drawings, as-built drawings, BIM content and operations & maintenance (O&M) content for the project.

1.7 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 CWU.

B. The copper infrastructure basis of design is defined as solutions comprised of products from CommScope:

- For copper cabling materials, CWU requires products from CommScope. CommScope provides 25-year warranties 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, CWU requires Corning products. Products from other manufacturers who incorporate Corning glass into their product are not acceptable. Corning provides 25-year warranties when installed by Corning Network of Preferred Installers contractors.

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 CWU) 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.

1.8 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

The Project Procedures section contains guidelines for architects, engineers and telecommunications infrastructure designers regarding the procedures that CWU requires for projects that include telecommunications infrastructure. This applies both to projects that entail primarily telecommunications work (such as classroom or conference room upgrade projects) as well as to architectural projects and other work (such as a new building or campus) that involve telecommunications design.

This section is not intended to supersede the requirements in the *State of Washington Conditions of the Agreement or the Instructions for Architects and Engineers*, but rather to complement them, providing additional requirements that apply specifically to telecommunications design projects at CWU facilities.

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. 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 CWU projects shall be produced by the RCDD. This means that the telecommunications design shall be produced by the Designer. CWU’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 CWU.

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

B. 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

C. 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 CWU 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 CWU 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 CWU telecommunications standards.

2.2 Design Review Process

As noted in Section 2.5 titled “Procedures Related to Project Phases”, the project documents will pass through the design review process at the end of each design phase plus follow-up reviews when necessary. These requirements are in addition to those contained in the *State of Washington Conditions of the Agreement and the Instructions for Architects and Engineers*.

Each time a review is required, the complete project documents set (drawings and specifications for all disciplines involved in the project) shall be provided to the ISM.

It is essential that adequate time be provided for the review process before proceeding to the next phase of the project. It is also important that any resulting review comments be addressed by the A&E Design Team.

The Designer shall work with the prime consultant, the CPPM and the ISM to ensure that adequate review time is provided.

The Prime Consultant shall be responsible for determining that the review process is conducted in accordance with CWU’s requirements and shall participate in the review process to determine that the review comments are satisfactorily addressed.

2.2.1 INDEPENDENT REVIEW CONSULTANT OR OWNER’S REPRESENTATIVE

CWU may elect to hire an independent review consultant or Owner’s Representative to assist with the review process or other consultation on the project. This consultant will not perform any design services. All resulting direction to the Design Team shall come from the CPPM through normal channels.

2.3 General Procedures

2.3.1 PROCUREMENT AND INSTALLATION

Early in the project the Designer shall inquire with the CPPM to determine which procurement method will be used for the project and receive guidance about the project document structure and content that will be appropriate for this method.

The Designer shall also inquire about whether the telecommunications scope of the project will be handled as a bid alternate. This is sometimes desired for budget accounting purposes and other times for bid protection purposes. It is important to consider whether the conduits and boxes to be installed by an electrician should remain in the base bid while telecommunications wiring and equipment can be designated as an alternate bid.

2.4 Architect/Engineer Teams

It is imperative that the telecommunications design be incorporated during the preliminary architectural design phase. To accomplish this, the architects and engineers on the Design Team shall work closely with the designated ISM, ISM and CPPM from the beginning of the project.

2.4.1 CROSS DISCIPLINE COORDINATION

Successful telecommunications projects require frequent, thorough design coordination between the disciplines involved in the project. The Designer shall be primarily responsible to coordinate the telecommunications requirements and design features with the designs produced by the other Designers on the project.

At a minimum, the following aspects of the design shall be coordinated:

2.4.1.1 OUTSIDE PLANT

- Ductbank routing around obstacles (trees, tunnels, buildings, existing ductbanks, etc.)
- Coordinate the locations of maintenance holes and hand holes to determine that they are not located in areas of water concentration. Site requirements, drainage, traffic, joint usage, utility requirements, etc.
- Proximity of ductbanks to sources of EMI, including power distribution feeders
- Proximity of ductbanks to steam piping
- Routing of entrance conduits through buildings

2.4.1.2 TELECOMMUNICATIONS ROOMS

- HVAC cooling requirements
- HVAC ductwork routing (avoiding TR ceiling spaces)
- Plumbing routing avoiding TR spaces
- Floor treatments in TRs
- Lighting requirements
- Power requirements

2.4.1.3 INSIDE PLANT DISTRIBUTION

- Power requirements for work areas (receptacle locations near telecommunications outlet locations)
- Proximity of cabling to sources of EMI
- Routing of telecommunications conduits through and location of telecommunications pullboxes in congested areas (HVAC ductwork, plumbing, electrical, etc.)

2.4.1.4 CEILING COORDINATION

- Routing of cable trays and conduits through hard-lid ceilings and plenum-rated ceilings.
- Routing of wire basket cable trays through ceiling spaces in congested areas (HVAC ductwork, plumbing, electrical, etc.)

2.4.1.5 SYSTEMS COORDINATION

- Telecom outlets serving audio visual systems.
- Telecom outlets serving the PML power monitoring system.
- Fiber optic cabling serving the fire alarm control panel.
- Proximity of microphone and speaker wiring to sources of EMI.
- Light fixture zoning to avoid undesirable light wash and reflections on projection screens and video panels.

2.4.2 CAD FILES

The Designer shall coordinate with the A/E to determine that the electronic CAD files used for backgrounds for the telecommunications design are consistent with the CAD file backgrounds used by the other disciplines on the project.

2.4.3 ALTERNATIVE DESIGN REQUEST (ADR)

A. It is not the intent of CWU to rigidly impose standards on every aspect of a design. Each design is unique and special requirements may lead to situations in which deviations from the standards are warranted.

B. This document identifies specific design solutions that are intended to meet the technical requirements at most CWU facilities. Design issues that are not consistent with the requirements in this document shall require prior approval through the CWU Alternative Design Requests (ADR) process. Requests to deviate from industry standards or CWU design solutions will be considered on a case-by-case basis. Any request to deviate from applicable code requirements or to deviate from manufacturer's warranty requirements will not be approved.

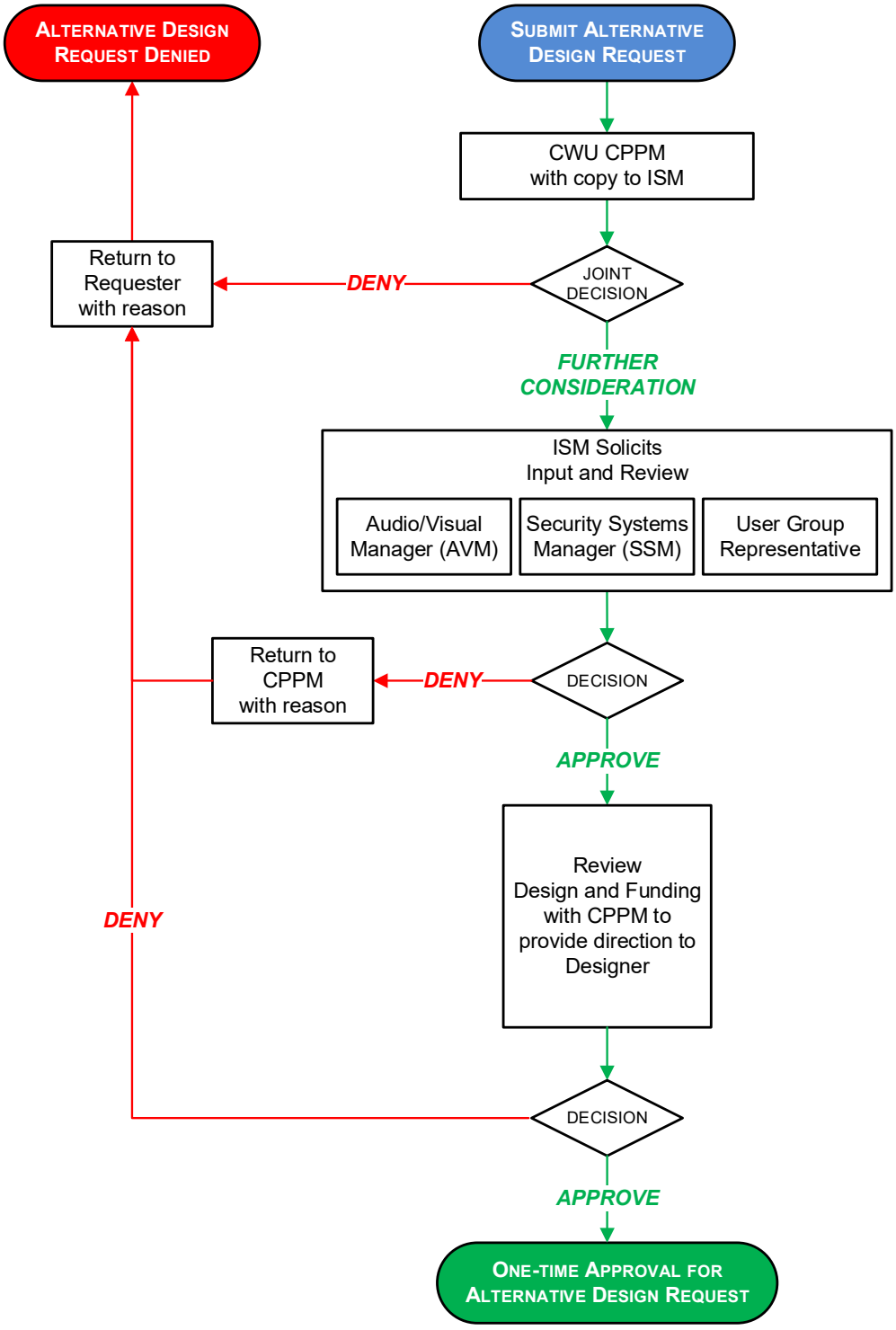
C. If the Designer feels that a solution that is different from a given standard is warranted, the Designer shall submit a written Alternative Design Request to CWU. The Designer may, upon written approval from CWU, incorporate the design deviation into the overall design. CWU approval is required on a project-by-project basis, and only for the designated instance(s) within that project. The Designer shall not assume that an approval for one project means that the practice is approved for use throughout that project or that it will necessarily be approved for a subsequent project.

   The request shall include a complete description of the proposed alternative design identifying:

   1. Background information;
   2. The approved design solution as described in this document or in applicable industry standards;
   3. The proposed alternative design;
   4. A list of the guidelines and standards referenced in this document with which the alternative design will not be in compliance, and the effect of non-compliance, both short and long term;
   5. The reason for wishing to use the alternative design;

D. The Designer shall be responsible for determining that the ADR process is properly conducted. For projects where the Designer is not the prime consultant, the prime consultant shall also be responsible for determining that the ADR process is properly conducted, and shall participate in the process (review, acknowledge and address issues) to determine that CWU's requirements are met.

Approval Process for Alternative Design Requests



2.5 Procedures Related to Project Phases

In addition to the requirements contained in the State of Washington *Conditions of the Agreement* and the *Instructions for Architects and Engineers*, Designers of telecommunications infrastructure for CWU facilities have the following responsibilities during each project phase:

2.5.1 SCHEMATIC DESIGN AND FIELDWORK

A. Some projects at CWU campuses may require the Designer to conduct preliminary fieldwork to document the existing equipment, cabling and applications into which new telecommunications infrastructure will integrate. CWU believes that this information is vital to a successful project.

During the Schematic Design phase where field work is required, the Designer shall document the information gathered while onsite:

- Take digital photographs of existing pathways, spaces, equipment and cabling that affect or are affected by the new project work.

B. The Designer shall also conduct a needs analysis (involving CWU personnel) to identify and describe the required features and functionality of the new telecommunications applications.

C. The information gathered during the fieldwork, combined with the results of the needs analysis shall be the starting point for Schematic Design of the proposed new work.

D. Upon completion of the Schematic Design documents, the standard Design Review Process shall be conducted prior to progressing to the Design Development phase.

2.5.2 DESIGN DEVELOPMENT

A. The Designer shall modify the design documents to address the review comments received during the Schematic Design Phase.

B. The Designer shall meet with the CWU ISM to review the telecommunications equipment and functionality described in this document and also specified in the TCGS to identify any changes that may have occurred since the documents were published. The design shall reflect the decisions from these discussions.

C. Upon completion of the Design Development documents, the standard Design Review Process shall be conducted prior to progressing to the Construction Document phase.

2.5.3 CONSTRUCTION DOCUMENTS

A. The Designer shall modify the design documents to reflect the accepted review comments received during the Design Development Phase.

B. It is expected that the Designer will expend considerable effort coordinating details between different disciplines during the design process. Non-coordinated pathway/raceway is not acceptable to CWU.

C. During the Construction Documents phase, the Designer shall obtain the assistance of manufacturer product representatives to review the project specification (adapted by the Designer from the CWU Telecommunications Construction Guide Specification) to determine that the correct part numbers have been included for each product in the specification.

D. Upon completion of the Construction Documents, the standard Design Review Process shall be conducted. The Designer shall then modify the documents to reflect the accepted review comments associated with the Construction Documents prior to the Bidding Phase.

E. Upon completion of the Final Construction Documents, the standard Design Review Process shall be again conducted as described above. The Designer shall modify the documents to address the review comments associated with the Final Bid Documents prior to the bidding phase rather than “by addendum.”

2.5.4 BIDDING

A. On projects where a pre-bid walkthrough is held, the Designer shall attend the walkthrough and shall discuss any materials and practice requirements that the bidders might find peculiar or which might affect the bids if such requirements were overlooked. Noteworthy items would typically be requirements that are more restrictive than practices considered acceptable for other commercial projects. The Designer shall consider the following items for inclusion on such a list, as well as any other items applicable to the project:

- The requirement that new telecommunications applications shall operate similarly to other existing telecommunications applications on campus so that instructors will not require re-training to use the systems.
- The fact that most of the materials specified for use in CWU’s telecommunications applications are not designated as “or equal, according to the judgment of the contractor.” Any material substitutions must be approved in advance by the Designer in counsel with the CWU ISM.

- The requirement that the telecommunications sub-contractor must be pre-approved prior to the bid, and that bids from telecommunications sub-contractors who have not been pre-approved will be considered to be non-responsive.
- The fact that CWU's telecommunications standards and specifications are more stringent than electrical installation requirements or the specifications on many other projects.

B. Approximately ten days prior to the date that bids are due, the Designer shall issue an addendum reiterating the requirement for telecommunications sub-contractors to have been preapproved. The addendum should also list the name and contact information for any sub-contractors who have been preapproved. The objective is that the bidders should receive this finalized list of preapproved sub-contractors not less than one week before the bids are due.

2.5.5 CONSTRUCTION OBSERVATION

A. The Designer shall review the Contractor's submittals that are required by the Construction Documents. When the Contractor's submittals include materials or methods that deviate from CWU standards, the Designer shall either:

- Reject the specific materials and methods that do not comply, when the Designer believes that they constitute undesirable solutions.
- Pursue the ADR process to seek separate approval for each specific material and method that the Designer believes would constitute a better solution.

B. The Designer shall visit the construction site frequently to observe the construction quality and status. The Designer shall confer with the CWU FP&CS Project Manager prior to proposing services for the project to determine an appropriate site-visit frequency for the project. The site visit frequency will likely change during the construction phase as the telecommunications related activity increases and decreases. At least every other month the Designer and the telecommunications contractor shall meet with the CWU ISM to review construction progress.

C. During the site visits, the Designer shall take digital photographs of existing and new pathways, spaces and cabling, both intra-building and outside plant that are related to the project. In particular, the Designer shall photograph infrastructure that will later be concealed during the course of construction.

D. It is the responsibility of the Designer to verify that the Contractor properly labels all cabling (both inside plant and outside plant) during construction. Inadequate or incomplete labeling is not acceptable.

E. Accurate as-built drawings are considered critical for the efficient long-term operation of CWU facilities. During construction observation visits, the Designer shall observe and report on the Contractor's progress toward staying current with the as-built drawing notations.

F. After each construction observation visit, the Designer shall submit a written report describing the observed construction progress. Observations shall be documented in the report with annotated digital photographs and a written description of any problems, a description of the requirements in the Construction Documents and the resolution to the issues. For each item requiring corrective attention, the report shall describe the following:

- A description of the issue
- Applicable requirements in the Construction Documents
- Applicable CWU standards, industry standards and codes
- Corrective options available to CWU
- Designer's recommendation

G. The Designer shall submit the construction observation reports via email to the CWU FP&CS PM and the CWU ISM as soon as possible following each site visit. The reports shall also be reviewed at the next construction meeting. A timely report submission will aid the Designer and CWU in identifying potential problems early in the construction process.

2.5.6 POST-CONSTRUCTION

A. The Designer shall review the Operation and Maintenance information provided by the Contractor for the telecommunications distribution system. The Designer shall verify that information is included for each component in the telecommunications system.

B. The Designer shall provide record drawings and record documentation to CWU (based on as-built documents that have been "red-lined" by the Contractor). Record documents shall be provided in electronic CAD format where applicable, in addition to requirements put forth by the Designer's contract with CWU.

C. The Designer shall verify that the telecommunications contractor provides the appropriate manufacturer warranty certification documentation to CWU.

3 Design Criteria

A. The CWU TDG is not intended to be a comprehensive design guide resource for telecommunications design at CWU 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 TIA standards or BICSI manuals offer multiple choices with a preferred method identified, and where the CWU TDG does not select one method over another or define specific requirements precluding use of the preferred method, the TIA or BICSI-preferred method shall be selected.

C. Where TIA 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 CWU ISM 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 CWU TDG requirements through the CWU Standards Variance Request (SVR) process. Requests to deviate from industry standards or CWU design solutions will be considered on a case-by-case basis by the CWU ISM. Designers may contact the CWU ISM to discuss proposed alternatives before spending significant time researching or preparing an SVR.

E. Telecommunications distribution infrastructure shall fully comply with the current CWU TDG, the current TIA 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 CWU facilities.

G. The following subsections are arranged to mirror the chapter sequence of the BICSI TDMM 14th Edition (the subsection numbers below are in the form of 3.x where x corresponds with the chapter number in the BICSI TDMM).

- Each TDG subsection contains commentary and requirements regarding the application of the BICSI TDMM to CWU 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 CWU 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 CWU facilities:

A. In CWU 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.

B. Access Control Panels shall be installed in TRs.

C. Lighting Control Panels might be acceptable in TRs if adequate space is available for these panels while preserving space for future wall-mounted equipment. The Designer shall inquire with the ISM for approval.

D. Fire Alarm Control Panels shall not be installed in TRs.

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 TDG 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 CWU ISM, 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.

Where TRs are located adjacent to an electrical room containing transformers, the electrical room shall be arranged with the transformers located on the far side of the electrical room (away from the TR). Telecommunications racks in the TR shall be located away from the shared wall with the electrical room. This is intended to maximize the distance between EMI-producing transformers and technology infrastructure.

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
21’ x 10’	6	864 CAT6A Cables	Only when specifically approved by the ISM
16’ x 13’	6	864 CAT6A Cables	Only when specifically approved by the ISM
18’ x 10’	5	864 CAT6A Cables	Only when specifically approved by the ISM
16’ x 10’	4	864 CAT6A Cables	Only when specifically approved by the ISM
16’ x 10’	4	864 CAT6A Cables	Only when specifically approved by the ISM
12’ x 10’	**3**	**624 CAT6A Cables**	**Standard MDF**

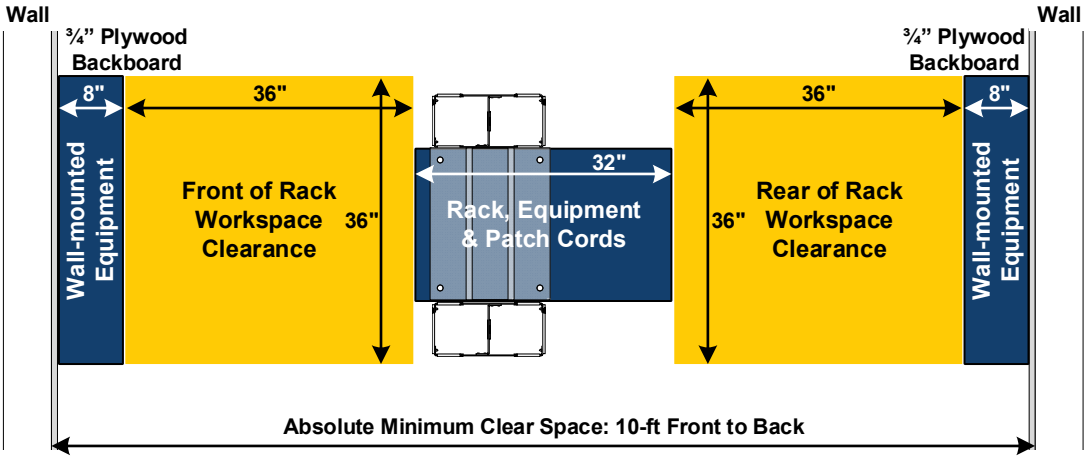
IDF Dimensions	# of Racks	Day 1 Design Limitations	IDF Comments
16’ x 10’	4	864 CAT6A Cables	Commonly used
16’ x 10’	4	864 CAT6A Cables	Commonly used
12’ x 10’	**3**	**624 CAT6A Cables**	**Standard IDF**
9’ x 10’	2	288 CAT6A Cables	Only when specifically approved by the ISM
6’ x 10’	1	144 CAT6A Cables	Only when specifically approved by the ISM
4’ x 10’	1	144 CAT6A Cables	Only when specifically approved by the ISM

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 5.2 of the TDG 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 CWU ISM:

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, lighting control panels, security system equipment, etc. The Designer shall seek input from the CWU ISM 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 for reviewing 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 CWU 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 CWU. 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 ¾” 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.

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 for determining 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 CWU 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, CWU 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 Capital Planning 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. CWU typically provides network electronics that provide Power-over-Ethernet. The Designer shall request power consumption data for the equipment that CWU 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. CWU prefers dry-type pre-action 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 or 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. Cabling shall be "pinstripe" groomed with an appropriate tool and well-managed on 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 5.1 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 TIA 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 CWU approval via the SVR process.

B. The rack arrangement shall be selected from the options shown in Appendix 5.1, 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 5.2 of the TDG 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 8” wide. Some applications, however, require 12” wide vertical cable management as shown in the rack elevation diagrams and floor plan diagrams in the Appendix.

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 CWU 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. Two layers of ladder racking shall be provided at heights of 7’-2” and 8’-2” above the finished floor, circling the room and crossing the room over the tops of the equipment racks, as shown in Appendix 5.2.

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. 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.

C. 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.

A. 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.

B. 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.

C. 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.

D. 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.

E. 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)*.

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

3.3.8 POWER REQUIREMENTS

A. The Designer shall be responsible for determining 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 CWU where additional power infrastructure is needed to meet the requirements.

B. CWU typically provides network electronics that provide Power-over-Ethernet. The Designer shall request power consumption data for the equipment that CWU 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. It is highly desirable to provide backup power to TRs from an Optional Standby Generator. The CWU campus has a centralized generator and campus backup power distribution infrastructure which may be available within the vicinity of a project. The Designer shall inquire with CWU about how to provide backup power to TRs for a given project.

B. All telecommunications rooms require backup power from an uninterruptible power supply (UPS), even when generator power is provided. 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.

C. The Designer shall work with the Electrical Engineer to appropriately size the backup power solutions for:

- All telecommunications rooms
- All mechanical cooling serving telecommunications rooms

D. CWU typically provides rack-mounted UPS equipment. Currently CWU uses the Eaton 9PX (5k or 6k) UPS with Double Conversion and Lithium-ion batteries.

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

E. 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.

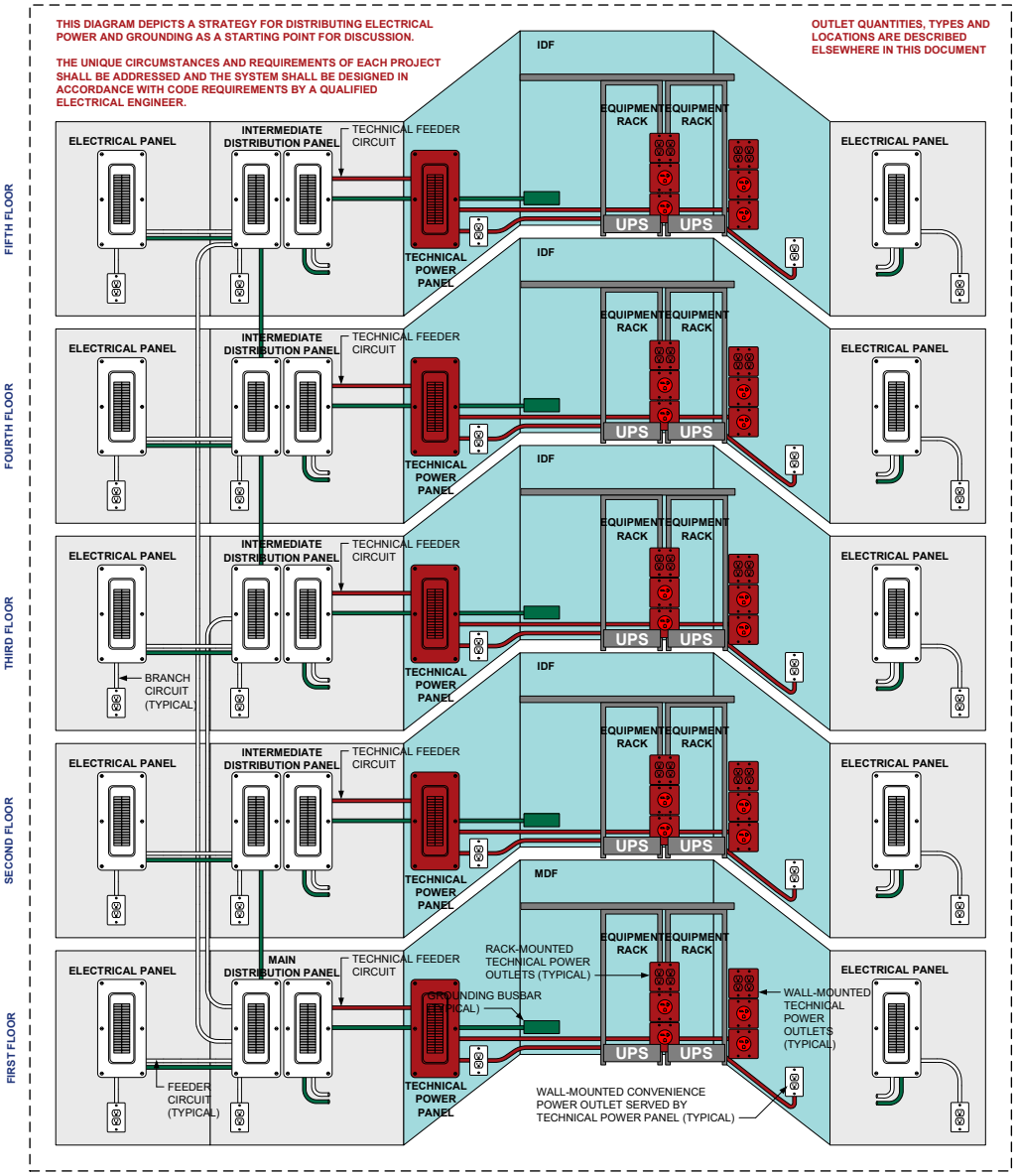
F. The Designer shall reserve sufficient space at the base of an equipment rack in each telecommunications room to hold the Owner-provided UPS equipment.

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 CWU'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 CWU for each piece of equipment and tabulate the information for review and confirmation by CWU. In addition to network electronics and UPS equipment, this may also include computers/servers, phone system equipment, audio

visual equipment and service provider equipment.

B. In TRs, CWU's technology power strategy requires two power sources:

- One with unconditioned utility power
- One with generator-backed (desired) and UPS-backed (required) power

C. For smaller rooms with 192 CAT6A cables or fewer, CWU will use up to four 1U "pizza box" network switches, each with two power supplies.

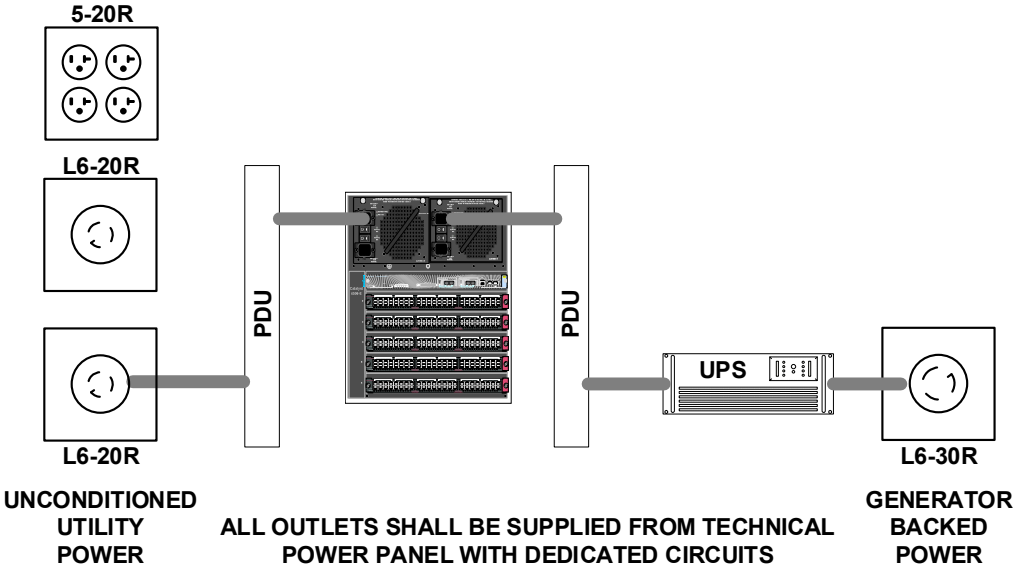
D. For rooms that will have more than 192 CAT6A cables, CWU will provide one or more chassis switches. Each 14U chassis switch can contain up to ten blades, eight of which can support 48 network connections, for a total of 384 cables per chassis switch.

E. Each chassis switch and each set of pizza box switches will require the following:

- A Power Distribution Unit (PDU) will be provided by CWU to distribute unconditioned utility power to one of the power supplies on each switch.
    - Provide a NEMA L6-20 receptacle to supply 208V/20A power to the PDU.
- A second PDU will be provided by CWU to distribute generator-backed UPS power to the other power supply on each switch.
    - Provide a NEMA L6-30 receptacle to supply 208V/30A power to the UPS. This circuit shall be served from a different phase than the 20A circuits. Each UPS shall have a dedicated circuit and L6-30 receptacle.
- Two additional power receptacles are required for future equipment:
    - Provide a NEMA L6-20 receptacle to supply 208V/20A power.
    - Provide a NEMA 5-20 quad receptacle to supply 120V/20A power.

The diagram below depicts the required power architecture:

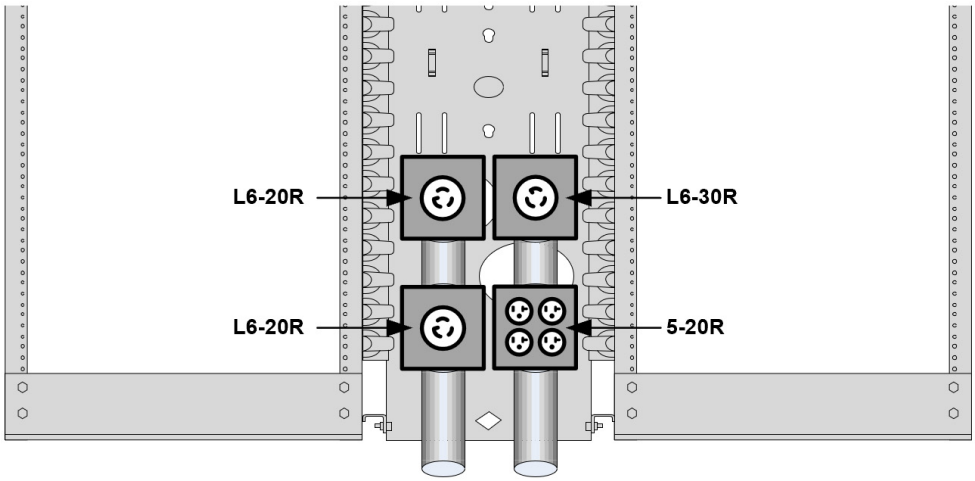
Rack Power Architecture



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

- 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.

G. Technical power outlets shall be mounted at the base of each rack inside the vertical cable management, on the rear side of the rack, as shown in the diagram below:



See the telecommunications room plan details in Appendix 5.2 of the TDG for technical power outlet types and locations.

H. The Designer shall specifically investigate the potential need to power other rack-mounted equipment. The Designer shall inquire with the CWU ISM to determine whether any dedicated or specialized circuit requirements exist.

I. 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 TDG 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 TIA J-STD-607-D.

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

3.3.12.2 ROOFTOP CONDUIT ENTRANCE

The topmost 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 FLOORING

Flooring materials have an anti-static finished surface, without carpet. Flooring 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 CWU ISM 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 Capital Planning 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 CWU ISM 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 CWU 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, CWU 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.

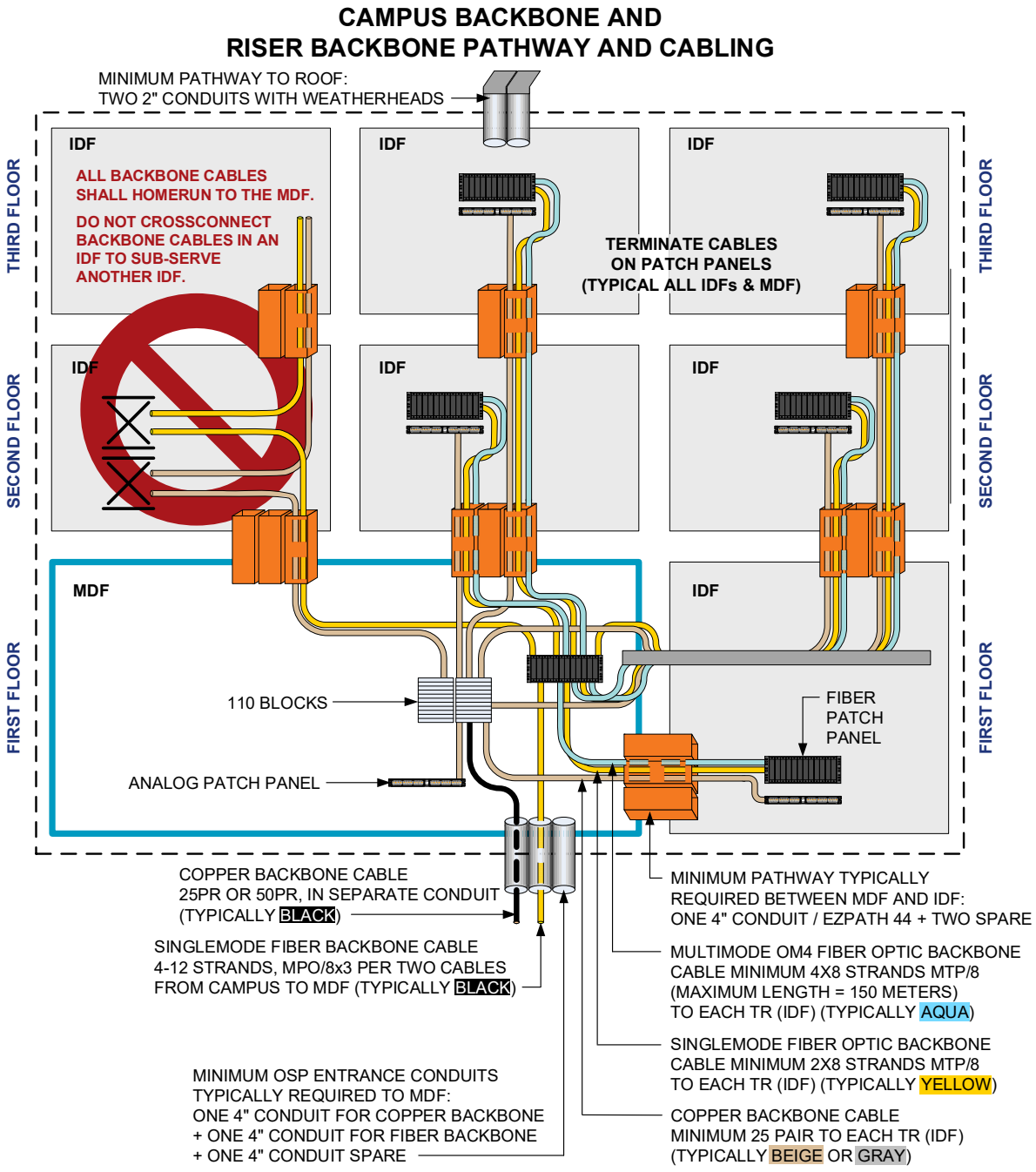
3.4.1.1.2 Multi-story buildings

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 CWU buildings:



3.4.2.1 INTRA-BUILDING BACKBONE CABLE TYPES

A. CWU uses three types of telecommunications cabling for intra-building backbone systems:

- Multipair copper voice backbone cable
- 8/125µm OS2 singlemode fiber optic cabling (yellow color)
- 50/125µm OM4 multimode fiber optic cabling (aqua color)

Indoor backbone cable shall be indoor rated (plenum or non-plenum as required) or Indoor/Outdoor (where circumstances permit).

B. Outdoor-rated or Indoor/Outdoor-rated cabling shall be used between buildings.

C. Splices are prohibited for backbone cabling.

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 CWU ISM and ISM 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 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.

3.4.3 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. CWU 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. CWU 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 Ellensburg, the frost zone reaches 24" below the surface, according to Kittitas 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.

[2] https://www.co.kittitas.wa.us/boc/countycode/title14.aspx

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. CWU 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 CWU ISM 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

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

A. Prior to concrete being poured, the CWU ISM 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 CWU facilities. The Designer shall inquire with the CWU ISM 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: multiple redundant entrances with 6 or more ducts at each entrance

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 CWU'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 CWU.

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 infrastructure 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 CWU ISM.

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 almost never used for fiber optic installations at CWU facilities. Historically a fair amount of innerduct was used, however with limited duct space at a premium, CWU has not installed innerduct in any significant amounts for many years. Inquire with the ISM when an application would appear to justify innerduct.

3.4.3.1.9 Coordination with Utility Service Providers

The Designer shall inquire with the CWU ISM 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. Maintenance holes and their covers shall be appropriately sized for the application.

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

B. 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.

C. 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.

- CWU 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.

D. 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.

E. 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).

F. 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. CWU 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 CWU 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 CWU ISM.

3.4.3.5 WIRELESS AND RADIO SYSTEM DISTRIBUTION

A. CWU 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

CWU 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. OSP cabling shall be labeled inside each maintenance hole in two locations: near where the cable enters the value and near its exit point.

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

3.4.4.1.1 Non-CWU Tenant Demarc

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

- CWU does not generally provide utility services to non-CWU tenants unless specified otherwise in the client's contract with CWU.

- Any utility services needed by a non-CWU 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 CWU 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 single gang mud rings that support a single gang faceplate. Double gang faceplates are not acceptable.

C. Category 6A (Augmented) cabling requires a larger bend radius than Category 6 or 5e cabling. As a result, the commonly used 4”x4” device boxes are too small to provide sufficient cable bend radius. Therefore, telecommunications outlet boxes shall be 5”x5” device boxes with reducing extension rings for single gang faceplates.

- As of this writing, there are several known sources of 5”x5” device boxes:
  - RANDL Industries, Inc. (www.randl-inc.com)
  - Hubbell
  - Thomas & Betts
  - CommScope (www.CommScope.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 ISM to achieve both telecommunications and audio-visual objectives. See the floor box requirements in the TDG.

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 associated accessories
- FSR FL-600P-x series with associated accessories
- Hubbell CFB7Gx series with associated accessories
- Poke-thru: Legrand Evolution xATC series with associated accessories

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

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 5”x5”x3-½” (where 3” is the depth of the box and ½” is the depth of the extension ring, with an overall depth of 3-½”). Device boxes shall be recess mounted.

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 CWU ISM 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 CWU ISM 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 5”x5”x3-½” (where 3” is the depth of the box and ½” is the depth of the extension ring, with an overall depth of 3-½”). Device boxes shall be recess mounted. Surface-mounted device boxes (if required) may be standard single gang (2” x 4”) and at least 2 ½” deep for a maximum of two Category 6A cables.

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

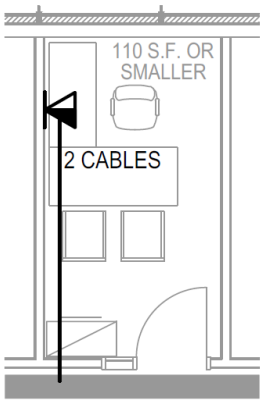
A. Each outlet shall have 2 jacks (ports) total, each served with a separate Category 6A cable. Do not split pairs on data jacks.

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)

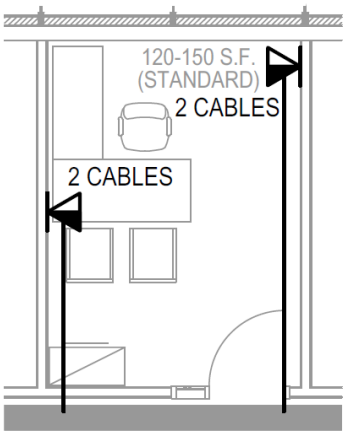
A. Provide one outlet in the corner opposite the door.



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.

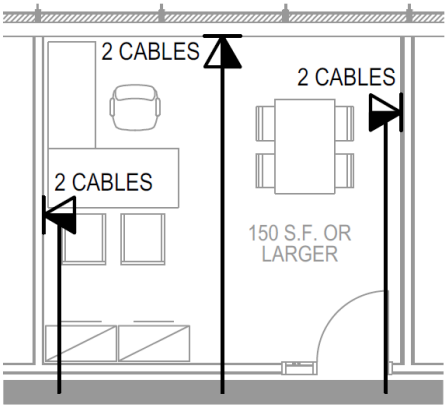
B. If an exterior wall will not support outlets due to windows, it is acceptable to place two outlets on a single wall if they are spread apart and one of the outlets is near the exterior wall.



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.



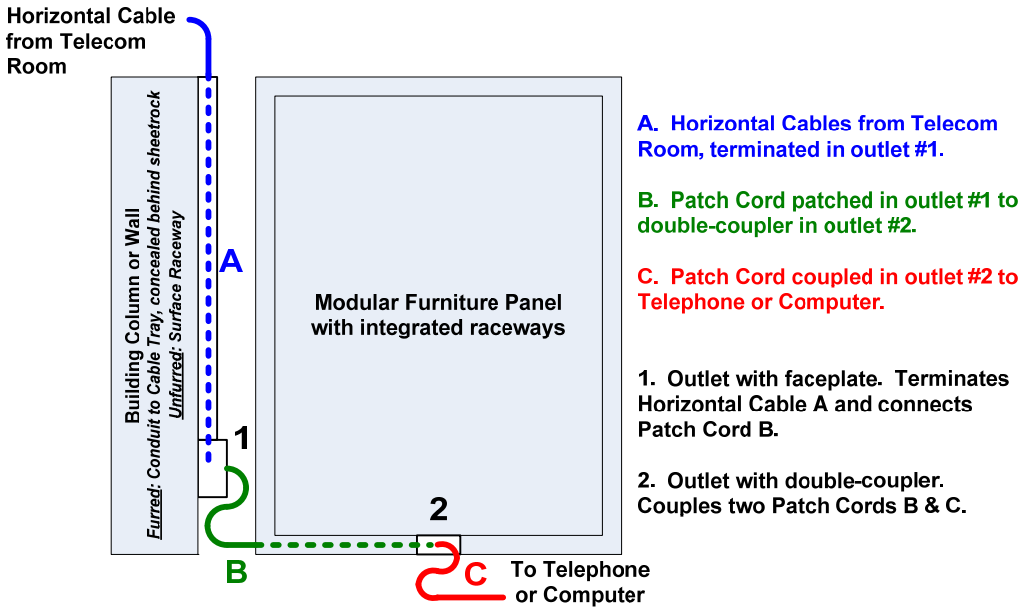
3.5.2.3 OPEN OFFICE / MODULAR FURNITURE

A. CWU prefers to serve open office areas using permanently mounted outlets in the wall nearest to 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 ISM 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. The following diagram depicts CWU'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. CWU currently uses Cisco wireless access point equipment in its buildings. This equipment operates with Power-over-Ethernet (POE) and requires one Category 6A cable 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 CWU ISM 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, CWU may request services to identify appropriate WAP locations and prepare associated coverage and signal strength maps.

3.5.2.4.1 Standard Provisions

A. 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. In addition to the labeling on the outlet above the ceiling, another label shall be applied to the ceiling directly below the outlet where the label can be viewed from below.

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

C. Each standard outlet (5-square box) shall have one Category 6A cable.

D. 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.

E. The Owner will furnish the WAP equipment and the Contractor shall provide the patch cords, install the WAP equipment, connect the patch cords and establish a live network connection to each WAP.

3.5.2.4.2 General Building Coverage

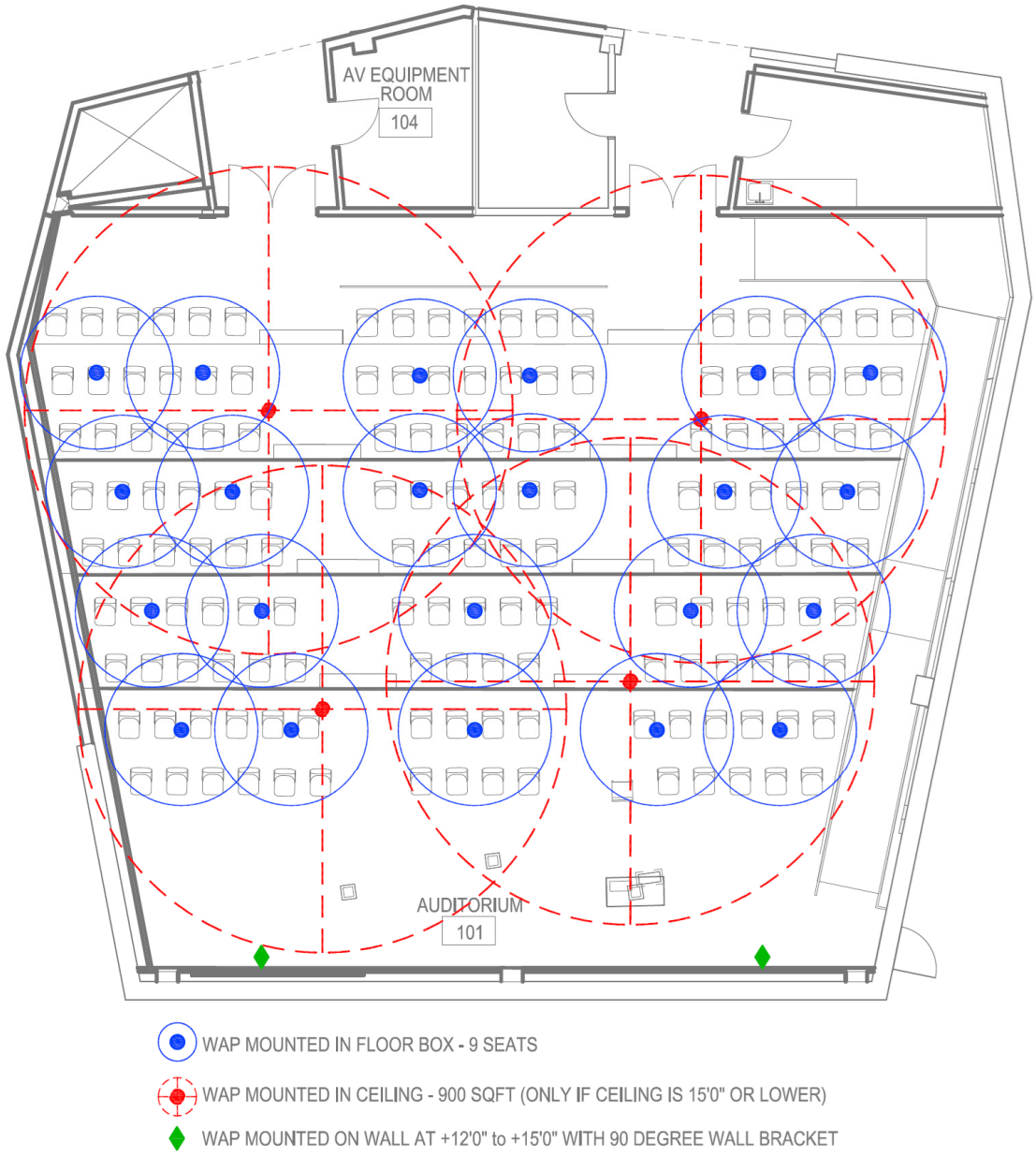
Outlets for WAPs shall be provided as needed to produce ubiquitous, uniform WiFi coverage throughout the building.

3.5.2.4.3 Areas of Higher WAP Concentration

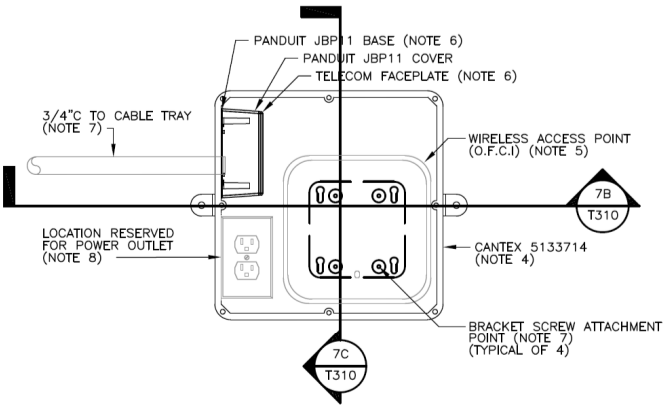
The following WAP outlets shall be provided in addition to the General Building Coverage WAPs described above.

Classrooms and Lecture Halls	Outlets and Cables
50 seats or less	• Two outlets with **one** data cable each above the ceiling at opposite corners of the room
51 to 100 seats	• Four outlets with **one** data cable each, distributed evenly around the ceiling
101 seats or more (See diagram below)	• For 9-seat circular area, one floor box 14”x14”x8” with **one** data cable in the center of the circle, directly beneath a fixed seat to avoid foot traffic load. See floor box detail below. • If the ceiling is 15’ high or lower, for every 900 square foot ceiling space, provide one outlet with **one** data cable in the ceiling. For ceilings that are higher than 15’, do not provide ceiling-mounted WiFi outlets. • At the front of the room in the height range of approximately 12’ to 15’, provide two outlets with **one** data cable each on the left and right sides of the room. Provide a 90-degree wall-mount bracket. • **One** data cable installed in every fourth seat in every third row (for student use with patch cords – not WAPs)

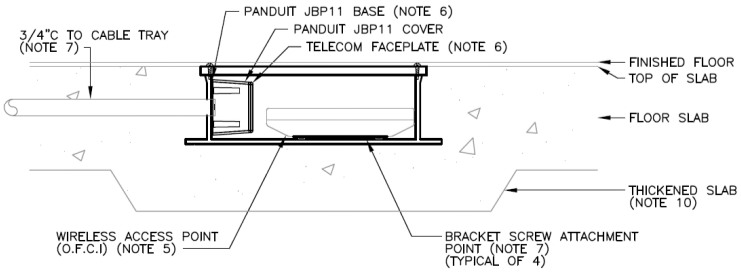
WAP Locations for Auditoriums with more than 101 Seats



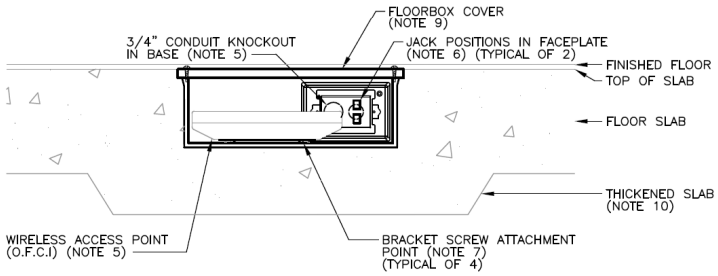
WAP Floor Box Detail for Auditoriums with more than 101 Seats



DETAIL 7A/T310
FLOOR BOX FOR WIRELESS ACCESS POINT
TOP VIEW
SCALE: 2"=1'-0"



DETAIL 7B/T310
FLOOR BOX FOR WIRELESS ACCESS POINT
SIDE VIEW (CONDUIT)
SCALE: 2"=1'-0"



DETAIL 7C/T310
FLOOR BOX FOR WIRELESS ACCESS POINT
SIDE VIEW (FACEPLATE)
SCALE: 2"=1'-0"

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 FLOOR BOXES THAT HAVE A POWER OUTLET (SEE NOTE 8) PROVIDE 2 CABLES AND JACKS. OTHERWISE PROVIDE ONE CABLE AND JACK. 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 with 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) inaccessible 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. Recent Code revisions (IBC 2012 1007.8) require that an elevator emergency communication device be located on each floor near elevator doors. CWU currently uses the device below for this application:

- Ramtel RR773 http://www.ramtel.com (877) 788-7881

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

Application	Conduits	Data	Power
Vending Machines	one 1¼”	1 cable per machine	1 single gang receptacle per 2 machines
Touch Screen Kiosks	one 1¼”	1 cable per machine	1 single gang receptacle per pair of kiosks
Instructor Console	See AVDG	See AVDG	See AVDG
Digital Signage (Flat Panel Display + Digital Media Player)	one 1¼”	2 cables	1 single gang receptacle
Ceiling-mounted Projectors	one 1¼”	1 cable	1 single gang receptacle
Active Door Signage / Room Scheduler	one 1¼”	1 cable	None (POE)
Conference Room A/V Junction Wall Box	See AVDG	See AVDG	See AVDG
Lighting Control System Main Panel	one 1¼”	1 cable	

D. Outlets shall be provided in electrical rooms to connect power monitoring equipment to the network.

E. 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.

F. The following applications require case-by-case direction. The Designer shall work with the CWU FPM, ISM and non-CWU 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

G. 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 CWU ISM.

H. 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 CWU 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.

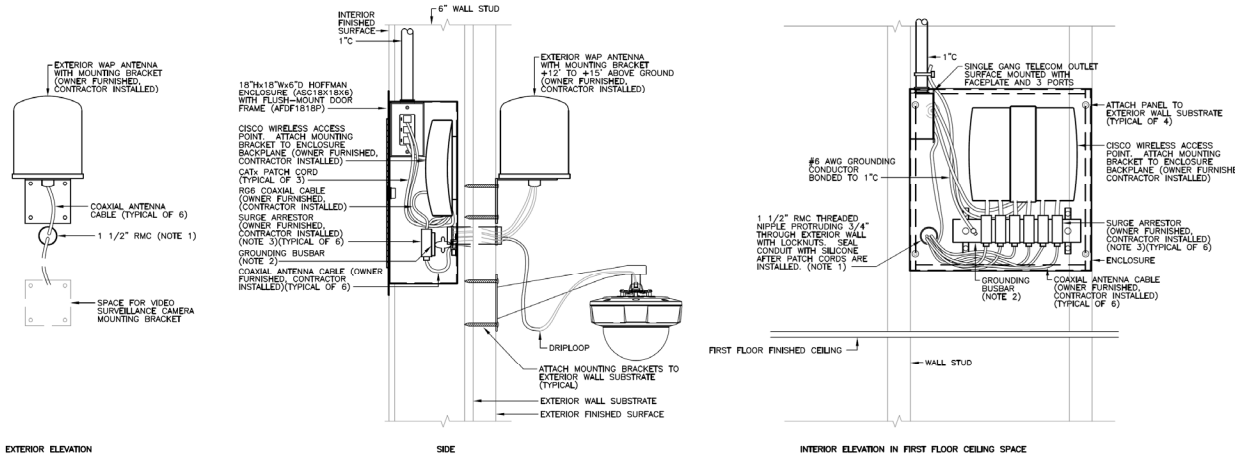
3.5.2.6.2 Pole-Mounted

If 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, CWU prefers to combine outdoor WAP locations with outdoor security camera applications. One possible solution to accomplish this is depicted below, where an outdoor WAP is mounted in the range of 12' to 15' above the ground, in the first-floor ceiling space:



3.5.2.7 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 CWU 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 CWU ISM 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 CWU FPM and the CWU ISM 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 TDG Section 1.7 *Required Manufacturers (Basis of Design)*, above.

C. All horizontal cabling shall be non-plenum rated. When cabling must pass through plenum air spaces, it is preferable to use metallic conduit to avoid the need for plenum-rated cabling. However, if it becomes necessary to route exposed cabling through a plenum-rated space, use plenum cabling for that application.

D. In addition to the manufacturers listed above, CWU 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

CWU 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 CWU 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. CWU requires 4-pair, 100-ohm, 23 AWG, unshielded twisted-pair (UTP) copper Category 6A-rated cabling for all horizontal data cabling applications.
   - HDBase-T audio-visual applications require the use of Category 6A shielded cabling.

- 600V-rated, shielded cabling is required when Category 6A cable must enter an electrical panel to serve a PML power meter.

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

1. CWU has standardized on the color white for horizontal data cabling.
2. The color of the modular jack shall be black.
3. Category 6A data jacks shall be straight (not angled) except for outlets in surface raceway which 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 CWU regarding whether to install Category 6 or Category 6A cabling. If the number of additional cables to be installed is very small compared to the installed base, CWU will likely wish to add new Category 6 cabling. If the number of new cables to be installed is relatively large, CWU will require Category 6A cable and matching components.
1. Category 5 and 5e 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. CWU uses VOIP telephones for voice applications in all 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.

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 CWU for consideration. These options shall comply with TIA 862-C – 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 CWU 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 instead of terminating 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 ISM.
- 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 voice, data and other applications shall be terminated on a rack-mounted patch panel.

3.5.3.7 GPON HORIZONTAL CABLING SOLUTION

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

3.5.3.8 PHYSICAL SEPARATION REQUIREMENTS

There are currently no CWU-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 CWU.

3.5.3.9 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 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.

B. The Designer shall quantify and specify the required patch cords in the Contract Documents to be provided (furnished and installed) by the Contractor for each particular project, as shown in Tables 3.3 and 3.4, below:

Table 3.2 Patch Cord Requirements for Telecommunications Rooms

Type & Color	Patch Cord Requirements, Quantities	Lengths Telecom Room (Patch Panel)
CAT6A **White**	Require patch cords to be provided by the Contractor for **each Category 6A cable terminated on a patch panel port**.	• 15% - 3 ft • 50% - 5 ft • 35% - 7 ft

Table 3.3 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**.	• 35% - 9 ft • 50% - 15 ft • 15% - 25 ft
CAT6A **White**	Require 1 patch cord to be provided by the Contractor **at each interior wireless access point**.	• 6 ft
CAT6A **White**	Require 3 patch cords to be provided by the Contractor **at each exterior wireless access point**.	• 3 ft
CAT6A **Violet**	Require 1 patch cord to be furnished by the Contractor **at each Audio Visual HDBaseT application**, for installation by the AV integrator.	• One – 6 ft • One – 12 ft
Silver satin	Require 2 silversatin patch cords to be provided by the Contractor **for each analog phone application**, including elevator phones, bluelight emergency phones, area of	• Two – lengths as required

	refuge 2-way communication devices, and hardened courtesy phones. One patch cord is for the endpoint application and the other patch cord is for the patch panel in the telecommunications room.	

C. CWU may wish to have the Contractor install some or all of the patch cords at workstations. This includes routing patch cords through modular furniture and connecting to telephones.

D. The Contractor will install all patch cords in telecommunications rooms. This includes the patch panel-to-switch connections.

Table 3.4 Fiber Optic Patch Cord Requirements

Lengths	Multimode Patch Cord Types, Lengths and Quantities 50/125 micron (OM4)		
	Aqua LC to LC Duplex	Blue (Power Meter) SC to LC Duplex	Blue (Power Meter) LC to LC Duplex
6 feet		2	
10 feet	6 (MDF) + 4 (for each IDF) + 2 (spare)		3
Totals	**20**	**2**	**3**

Lengths	Singlemode Patch Cord Types, Lengths and Quantities 8/125 micron		
	Yellow LC to LC Duplex	**Red (Fire Alarm) ST to LC Simplex**	**Red (Fire Alarm) LC to LC Simplex**
3 feet			2
6 feet		2	
10 feet	2 (for the MDF) + 2 (for the remote MDF)		
Totals	**4**	**2**	**2**

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 CWU ISM.

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. CWU 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 CWU ISM.

1. The Designer shall discuss the relative merits of the pathway options available and shall assist the CWU ISM 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 CWU ISM. 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 cables are 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 CWU 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, and for WiFi under seats in larger academic spaces are exceptions to this requirement.
- In any application (including Meeting Rooms and Classrooms) where telecommunications conduit passes in or under an on-grade slab, wet-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 except where specifically required to support computer lab types of spaces where high flexibility is required. In these cases, the surface raceway shall be designed in coordination with the architect for aesthetics. The Contractor is never given the option of using surface raceway as a Contractor-preference.

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 ISM.

B. Existing pathways shall be reused where existing raceways are 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 CWU ISM 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. CWU permission for this method is required on a project-by-project basis.

3.5.4.4 CABLE TRAY PATHWAY SYSTEMS

A. In general, cable tray systems shall be located in corridors 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.

B. CWU prefers that cable trays concealed above accessible ceiling be wire basket-type cable trays. Cable trays that are visible to the public shall be solid tray with C-channel sides and corrugated bottom.

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

C. 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.

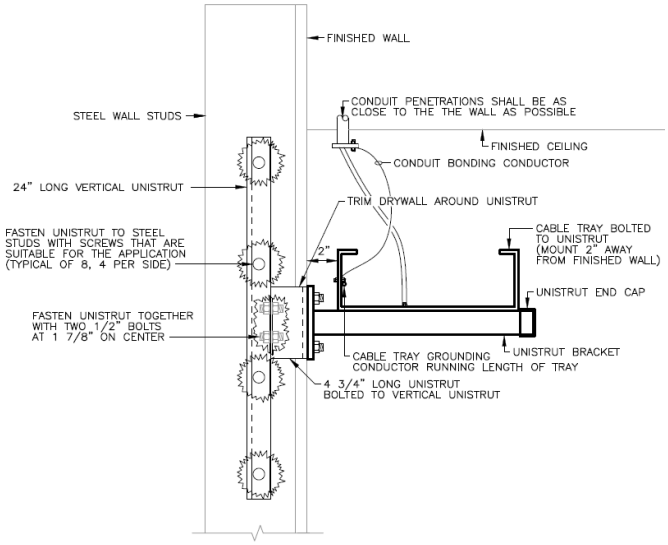
- For example, if a Category 6A cable has a 0.35 in O.D., a 12” x 4” tray could hold 200 such cables given a 40% allowable fill. The Designer could select a 12” x 4” cable tray if fewer than 100 Category 6A cables would be carried by this tray on Day 1. In other words, the Owner should be able to double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

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

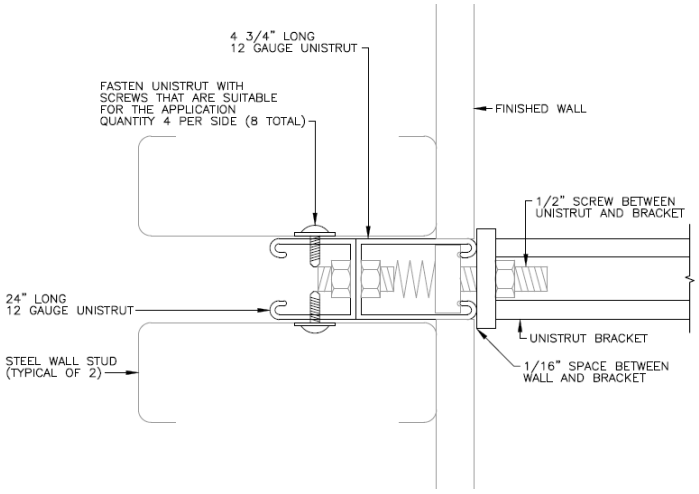
- CWU prefers a galvanized finish. The Architect may wish to paint the tray to blend it into its surroundings. Cabling in the tray shall not be painted.
- The Designer shall coordinate the selection of the cable tray materials with the design intent of the Architect or interior designer.

E. 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 CWU.

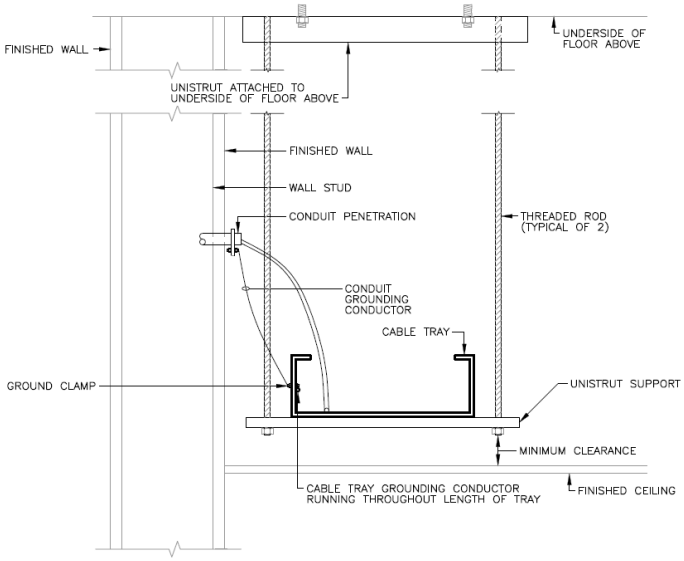
F. When cable tray is wall-mounted, the contact points for each mount shall be reinforced. The diagram on the right depicts a possible solution for reinforced wall mounts:



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



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



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

3.5.4.4.1 Cable Tray Clearances

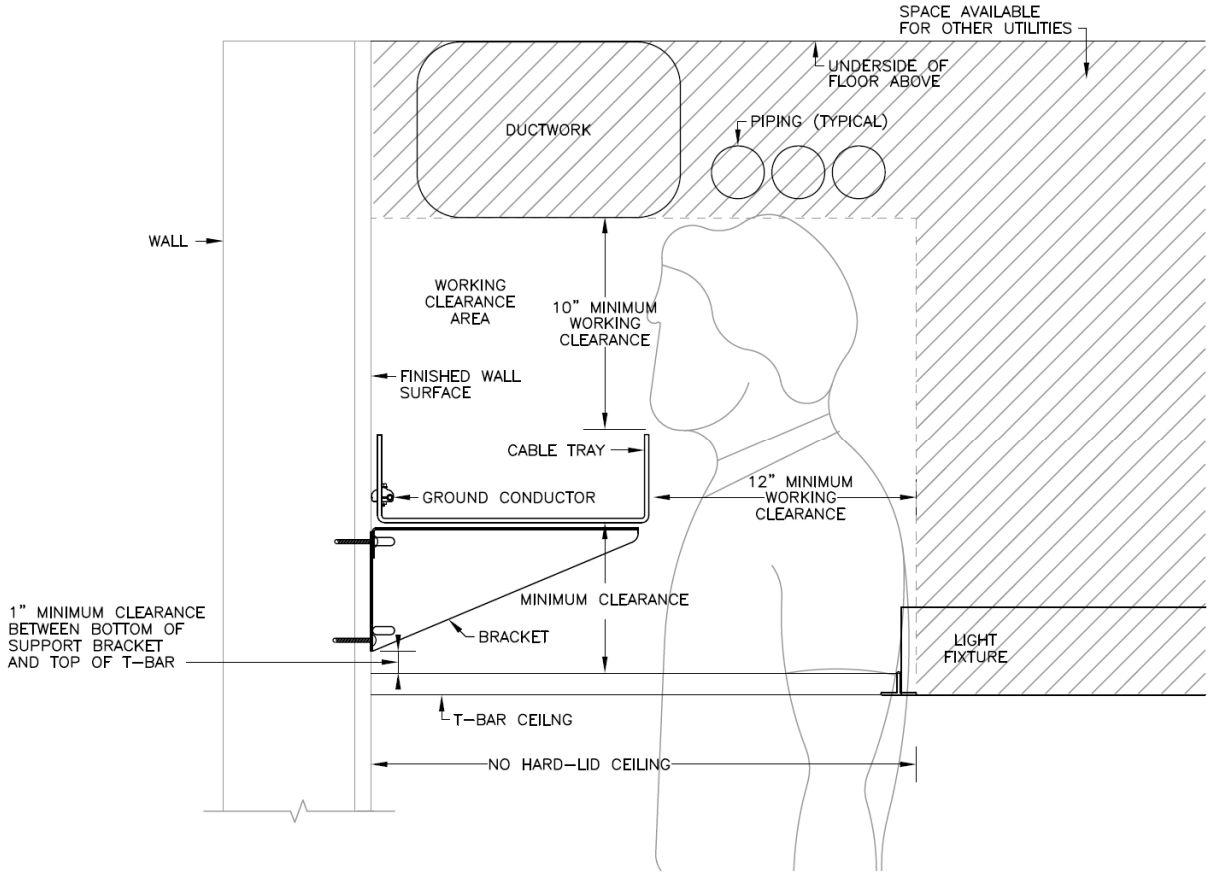
CWU uses cable trays to distribute cabling throughout its buildings. Cable trays shall be installed in corridors or other accessible spaces. Ceilings below cable trays must be accessible. Hard lid / gypboard ceilings prevent access to cable trays.

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 designing 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 1¼” 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 CWU when existing conditions prevent the use of 1¼” 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 1¼”.

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 CWU.

K. See the TDG for pathway requirements specific to telecommunications 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 CWU facilities:

3.6.1 COPPER CABLING

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

B. The design of new telecommunications infrastructure at CWU 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. CWU uses singlemode fiber optic cabling for all outside plant fiber applications. While there is some existing multimode fiber optic cabling on campus, no new outside plant multimode fiber shall be installed. Both singlemode and multimode are used for indoor backbone (riser) applications. Horizontal fiber type depends on the application (fire alarm uses singlemode while PML power metering uses multimode).

B. Fiber optic cabling shall be terminated at patch panels using LC-style connectors and/or MPO connectors. All other connector styles (including SC, ST, and MTRJ) are prohibited for new fiber optic patch panel terminations at CWU 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 CWU ISM on a case-by-case basis.

D. Where equipment does not support LC-style connectors, the Designer shall specify hybrid patch cords with LC 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 CWU 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. CWU 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 CWU facilities:

- Grounding and bonding conductors shall be sized according to the requirements in TIA J-STD-607-D.

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 CWU facilities:

A. The Designer shall be responsible for determining 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 CWU 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 TDG 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 TDG Section 3.3 *Telecommunications Spaces* for information on the power outlet requirements for TRs.

    - CWU typically provides network electronics that provide Power-over-Ethernet.
    - The Designer shall request power consumption data for the equipment that CWU 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 TDG Section 3.18 *Data Centers* for information on the power outlet requirements for data centers.

    - CWU 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 CWU 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.

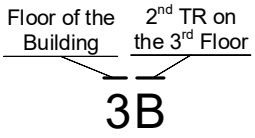
C. Telecommunications components shall ***not*** be labeled with an application-specific identifier. Ports shall ***not*** be labeled with the name or function of the device that is served by the port (server names, computer types. Also, the use of "V-#" and "D-#" are inconsistent with the industry standard-based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

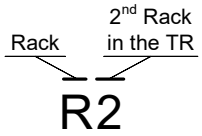
The items listed below shall be shown on the Construction Documents. The Designer shall assign the identifiers to the telecommunications components based on the following required identification strategy.

A. Telecommunications Rooms, Equipment Rooms and Data Centers shall have identifiers in the form of "F@", where "F" is the floor number on which the telecommunications rooms resides and "@" represents a sequentially assigned letter to distinguish between multiple rooms on the floor.



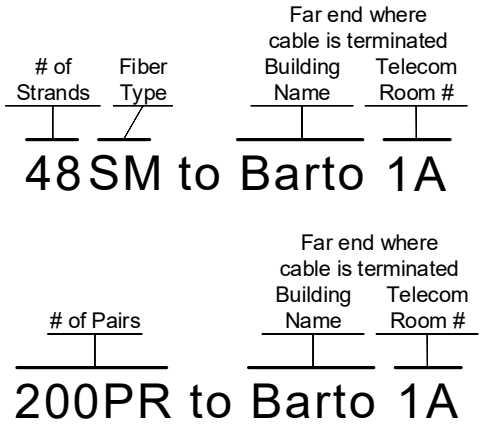
- For example: the second telecommunications room located on the third floor in a building would be identified as "3B".

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.

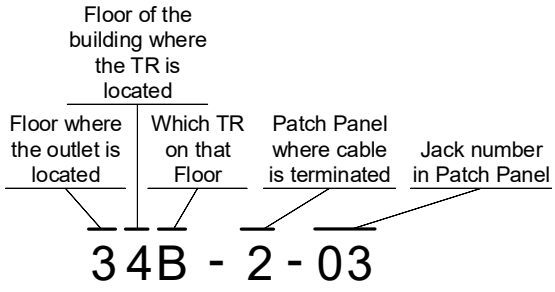
C. Backbone Cables (both fiber optic and copper) shall be labeled on both ends within 6 feet feet of entrance into a telecom room where they terminate, and also within 12" of the termination hardware.



- Fiber optic cables shall have identifiers in the form of "##SM to BB #@" where "##" is the number of strands, "SM" is the fiber type, "BB" is the building name and "#@" is the telecommunications room where the far end of the cable is terminated.
- Copper backbone cable cables shall have identifiers in the form of "###PR to BB #@" where "###" is the number of pairs, "BB" is the building name and "#@" is the telecommunications room where the far end of the cable is terminated.

D. Connector Panels and cassette modules in Fiber Optic Patch Panels shall be labeled identical to the fiber optic cable labeling. See paragraph C above.

E. Faceplates on Workstation Outlets shall be labeled as follows: Label content shall be in the form of "F#@-P-##" where "F" is the floor of the communications outlet where the horizontal cable terminates, "#" is the floor of the telecommunications room and "@" is the sequential letter of the telecommunications room where the cable terminates, P is the workstation patch panel number, and "##" is the two digit sequential port number (with a leading zero) on the patch panel that is used to terminate the cable.



- For example: if an outlet on the third floor has a faceplate with two copper cables (sequentially numbered 5 and 6) terminated on the third workstation patch panel in the second telecommunications room on the fourth floor, then the connectors would have the labels "34B-3-05" and "34B-3-06" respectively. Where labeling space is limited, it is permitted to combine labels, for example "34B-3-05 and 06".

F. Ports on Workstation Patch Panels are typically pre-labeled by the manufacturer with sequential numbers (i.e. 1 to 48).

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 cables, 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 CWU 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 CWU facilities:

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

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

G. CWU 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 CWU. Test results shall be submitted to CWU 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 and distributed paging systems at CWU facilities.

3.13.1 AUDIO-VISUAL SYSTEMS

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

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 CWU to determine whether a given project should include infrastructure to support a stand-alone paging system.

3.13.3 PRIVATE CATV DISTRIBUTION SYSTEMS

CWU 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 CWU 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 CWU facilities.

A. TIA-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. CWU requires that all telecommunications infrastructure 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 CWU's campus communicates via singlemode fiber optic rings.

B. The Designer shall include in the design singlemode fiber, patched through from the FACP in a new building through the nearest IDF or the MDF (splice) to an ISM designated point where it can intercept an established ring.

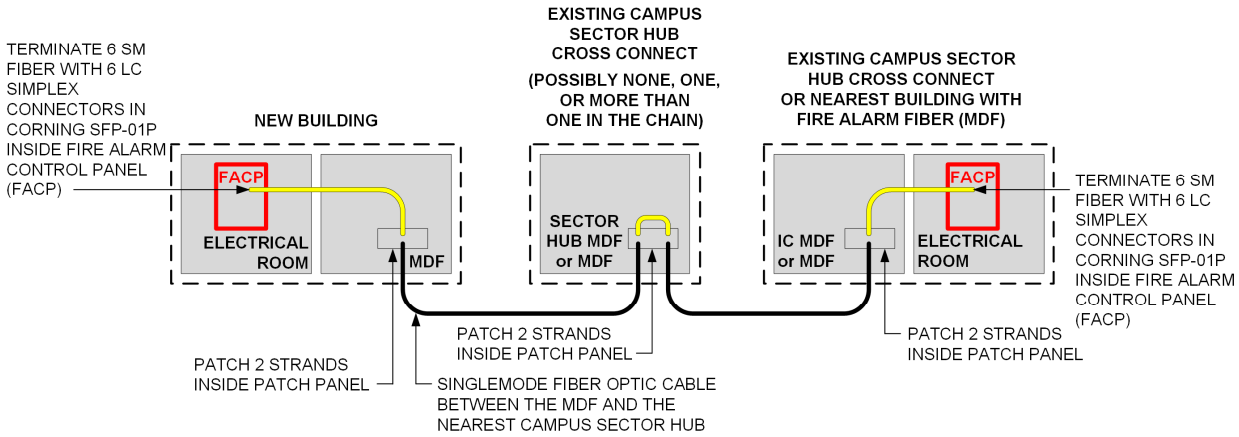
The fiber ring requires 2 strands of singlemode fiber. For the horizontal fiber segment (between the FACP and the splice panel in the nearest telecommunications room), provide a 6-strand cable. Terminate all 6 strands on a Corning SPH-01P mounted inside the FACP. In the telecommunications room, patch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

C. All fiber optic cabling serving fire alarm applications shall be installed by the telecommunications contractor. The construction scope of work shall include patching 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 in the Contract Documents.

D. The diagram below depicts the cabling and patching requirements for the fire

alarm system. The Designer shall work with the ISM to determine the best location on campus to insert a new link into an existing fiber loop.

SINGLEMODE FIBER OPTIC 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 CWU facilities:

A. All CWU facilities use the Ethernet LAN protocol. Telecommunications infrastructure for all CWU facilities shall be designed, installed, and tested to support the Institute of Electrical and Electronic Engineers (IEEE) Ethernet 802.3 standards. CWU 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 CWU and is outside the scope of work of the telecommunications Designer.

C. The Designer shall coordinate with the CWU ISM to determine the requirements for supporting the network electronics in each space. The design shall provide rack space to host CWU'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 infrastructure at CWU 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

CWU requires the services of an RF Distribution Engineer to properly design distributed antenna systems (DAS) for campus buildings. The Designer shall work with the ISM 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

CWU does not typically require Emergency Responder (Public Safety) DAS radio systems in its buildings due to the small-town nature of Ellensburg WA, where existing municipal radio systems successfully penetrate the buildings on campus. Historically, the local AHJ has not required CWU to include DAS in its projects. However, since Building Code requires such systems, it is prudent to inquire on a project-by-project basis to verify that the AHJ will continue to waive this Code requirement for CWU.

3.16.2.2 CELLULAR TELEPHONE SERVICE AUGMENTATION

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

3.17 Electronic Safety and Security

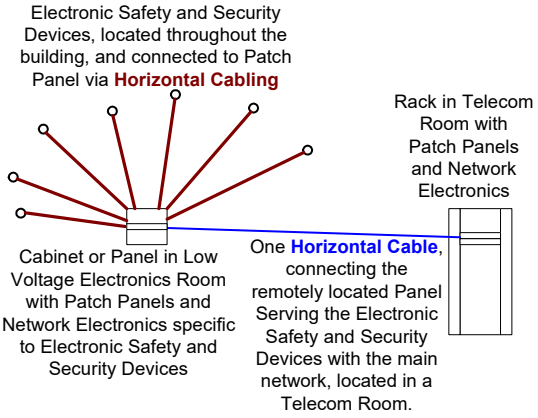
Please refer to Chapter 17, *Electronic Safety and Security* in the BICSI TDMM for general information regarding the design of telecommunications infrastructure for serving electronic safety and security systems.

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 telecommunications 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.

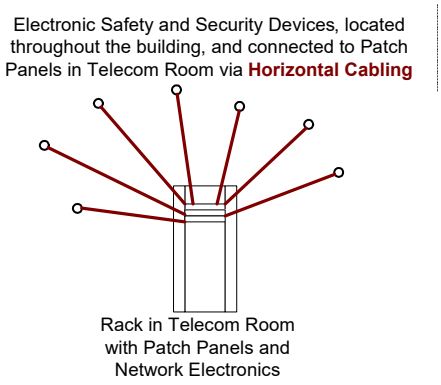
The diagrams at right depict the differences between these two solutions. The Designer shall inquire on a project-by-project basis which solution to apply to a given project. Non-technical issues will commonly affect which solution is used.



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, CWU follows the TIA-942-B 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 CWU 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 CWU ISM 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 CWU ISM 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 CWU ISM shall approve the final space requirements and design layout for the equipment and racks.

3.18.2 TIER CLASSIFICATION

CWU 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 ISM 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.

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.

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 CWU 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 CWU 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. CWU will consider the use of centralized UPS equipment as applications warrant, such as for Data Centers. However, if CWU 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 CWU ISM regarding project specific needs for increased runtime.
- 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.
- CWU 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. CWU typically uses network electronics that provide Power-over-Ethernet (POE).

G. The Designer shall request power consumption data for the equipment that CWU 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 TDG Section 3.3.8 *Power Requirements* (above).

B. The Designer shall obtain connection/load requirements from CWU for each piece of equipment and tabulate the information for review and confirmation by CWU. 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 TDG 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 TDG 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 TIA J-STD-607-D.

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.

CWU owns a single health care-related facility. 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 CWU facilities.

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

3.21 Project Administration and Execution

Please refer to Division 1 in the CWU Design and Construction Standards for Project Management requirements that are specific to CWU.

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.

3.22 Special Design Considerations

Please refer to Chapter 22, *Special Design Considerations* in the BICSI TDMM for information regarding the design of telecommunications infrastructure to address special design considerations at CWU facilities.

4 Construction Document Content

This section of the TDG describes the content requirements that the Designer shall include when creating the Construction Documents[3]. This content is in addition to the content found in some generally accepted document sets.

The documents produced by the Designer and the services provided by the Designer shall comply with the requirements in the Conditions of the Agreement and the Instructions for Architects and Engineers doing Business with Division of Engineering and Architectural Services. 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:

- 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.

[3] As of this writing, the Conditions of the Agreement and the Instructions for Architects and Engineers Doing Business with Division of Engineering and Architectural Services (both published by the Washington State Department of General Administration) make reference to the term "Construction Drawings." However, the Manual of Practice from the Construction Specifications Institute (CSI) defines "Construction Documents" as a subset of the "Construction Documents" and indicates that drawings, specifications and other written documentation are contained within the Construction Document subset. The TDG will use the term "Construction Documents" according to CSI's definition.

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

4.1.2 SITE PLAN DRAWINGS

Outdoor telecommunications applications may include:

- Outdoor speakers
- Broadcast vehicle connections for sporting events
- Power and network for outdoor gathering spaces

4.1.3 FLOOR PLAN AND REFLECTED CEILING 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 CWU.
- Approximate locations of junction boxes and conduit bends.
- The cable quantities and the raceway at any given point in the system.

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 CWU ISM 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.

4.1.4 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. CWU 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.

4.1.5 ELEVATION DIAGRAMS

A. The Designer shall provide scaled wall elevation details for each meeting space and instructional space affected by the project.

B. For remodel projects, the Designer shall take digital photographs of each wall depicting the existing conditions where future telecommunications equipment 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:

- Video panels
- Cameras
- Projection screens and control switches
- Assisted Listening radiators
- Touch panel docks

D. Elevation details shall be provided for each of the telecommunications Equipment Cabinets in each instructional space. Rack elevation details shall show the cabinets and any components that are mounted in or near the racks.

4.2 Project Manual

The *Instructions for Architects and Engineers Doing Business with Division of Engineering and Architectural Services* (published by the Washington State Department of General Administration) lists requirements for the Project Manual. The *State of Washington Conditions of the Agreement* (also published by the Washington State Department of General Administration) lists additional requirements for the Designer.

4.2.1 SPECIFICATIONS

4.2.1.1 CWU TELECOMMUNICATIONS CONSTRUCTION GUIDE SPECIFICATION

A. The CWU 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 project.

B. The TCGS is an example of a specification that shall be used for a telecommunications upgrade 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 CWU ISM where changes or additions to the specifications are desired. Edits to the documents shall be performed with the "Revision Tracking" features activated. At the various project milestones when the documents are submitted to CWU 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 TYPICAL SPECIFICATION SECTIONS

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

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

- 078400 – Firestopping
- 099100 – Painting

Sections typically provided by the Telecommunications Engineer, requiring telecommunications Designer input:

- 270500 – Common Work Results for Communications
- 270526 – Grounding and Bonding for Communications Systems
- 270529 – Hangers and Supports for Communications Systems
- 270533 – Conduits and Backboxes for Communications Systems
- 270536 – Cable Trays for Communications Systems
- 271100 – Communications Equipment Room Fittings
- 271300 – Communications Backbone Cabling
- 271500 – Communications Horizontal Cabling
- 271600 – Communications Connecting Cords, Devices, and Adapters

Sections typically provided by the Audio-Visual Designer:

- 115213 – Projection Screens
- 274100 – Audio-Video Systems

4.3 Record Drawings and Documentation

The *Instructions for Architects and Engineers Doing Business with Division of Engineering and Architectural Services* (published by the Washington State Department of General Administration) lists requirements for Record Drawings and submittals. The following requirements related to Record Drawings and submittals are **in addition** to the requirements listed in *Instructions for Architects and Engineers Doing Business with Division of Engineering and Architectural Services*:

4.3.1 RECORD DRAWING CONTENT

- The Record Drawings shall show the identifiers for the telecommunications equipment and cabling as constructed.

4.3.2 RECORD DRAWING DELIVERABLES

- 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 CWU Capital Planning.

5 Appendix

5.1 Sample Rack Elevation Diagrams

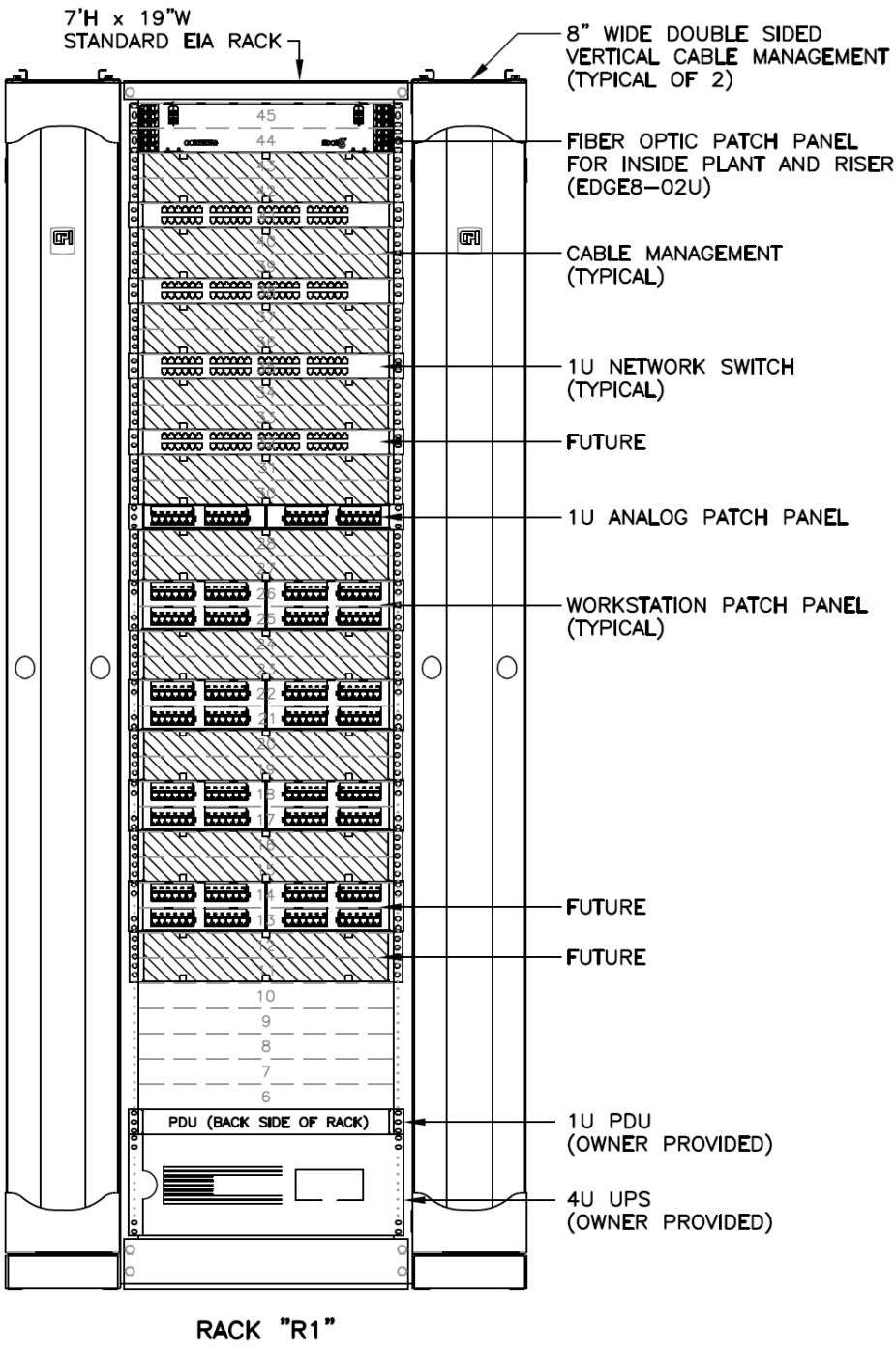
The Designer shall provide scaled rack elevation details in the project drawings (similar to the details below), and shall identify the racks, vertical and horizontal cable management, patch panels, shelves and drawers in each detail. The drawings below depict maximum Day-1 design capacity, with accommodations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

5.1.1 ONE RACK

This example is suitable for a full build out supporting a maximum of 192 horizontal cables and a **Day-1 design maximum of 144 cables** (leaving room for another patch panel for future growth).

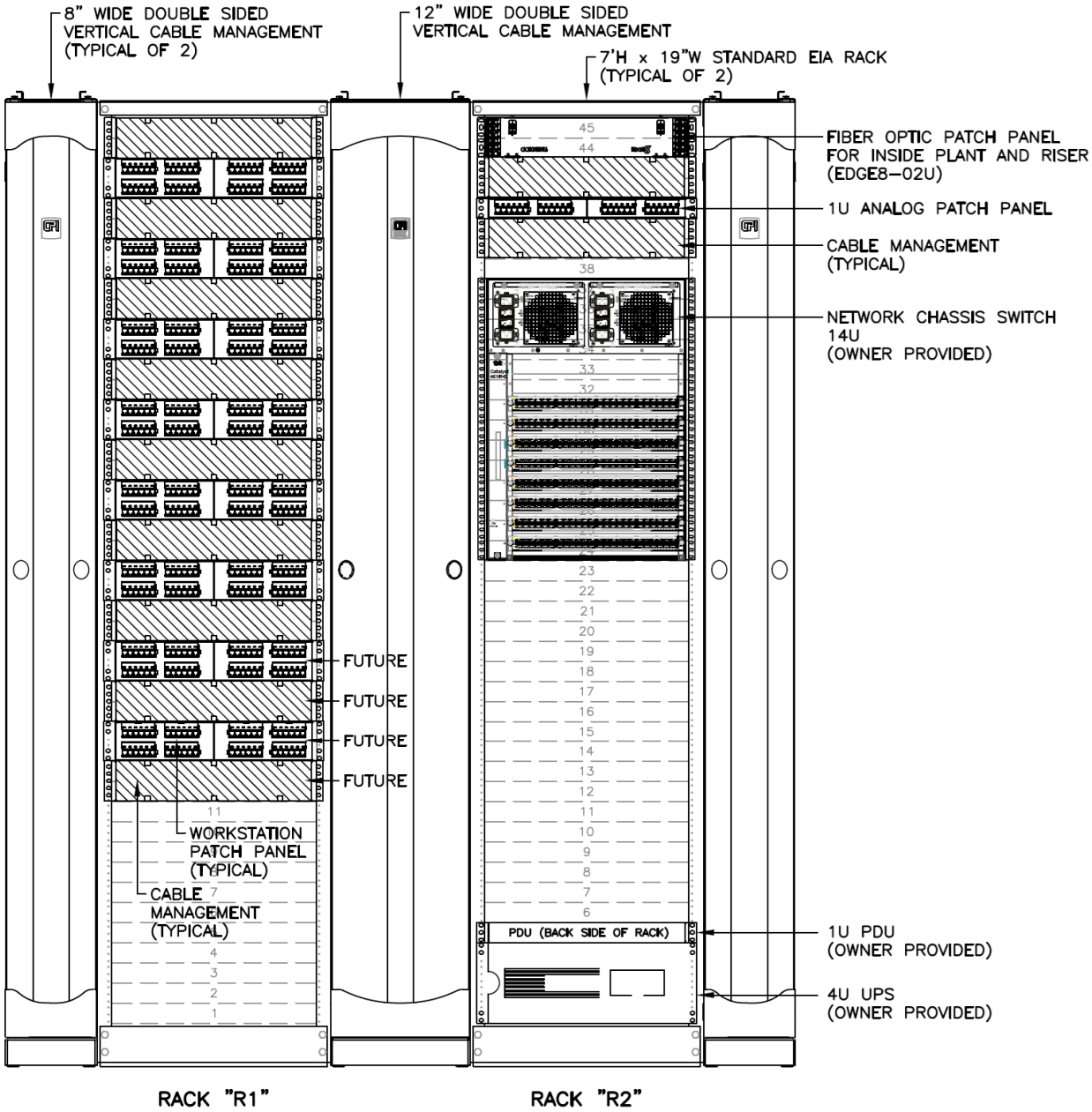
A one-rack room is rarely adequate, because it has very limited space for future equipment or cabling to be added. Therefore, it shall only be used as a last resort, and then only with the approval of the ISM.



5.1.2 TWO RACKS

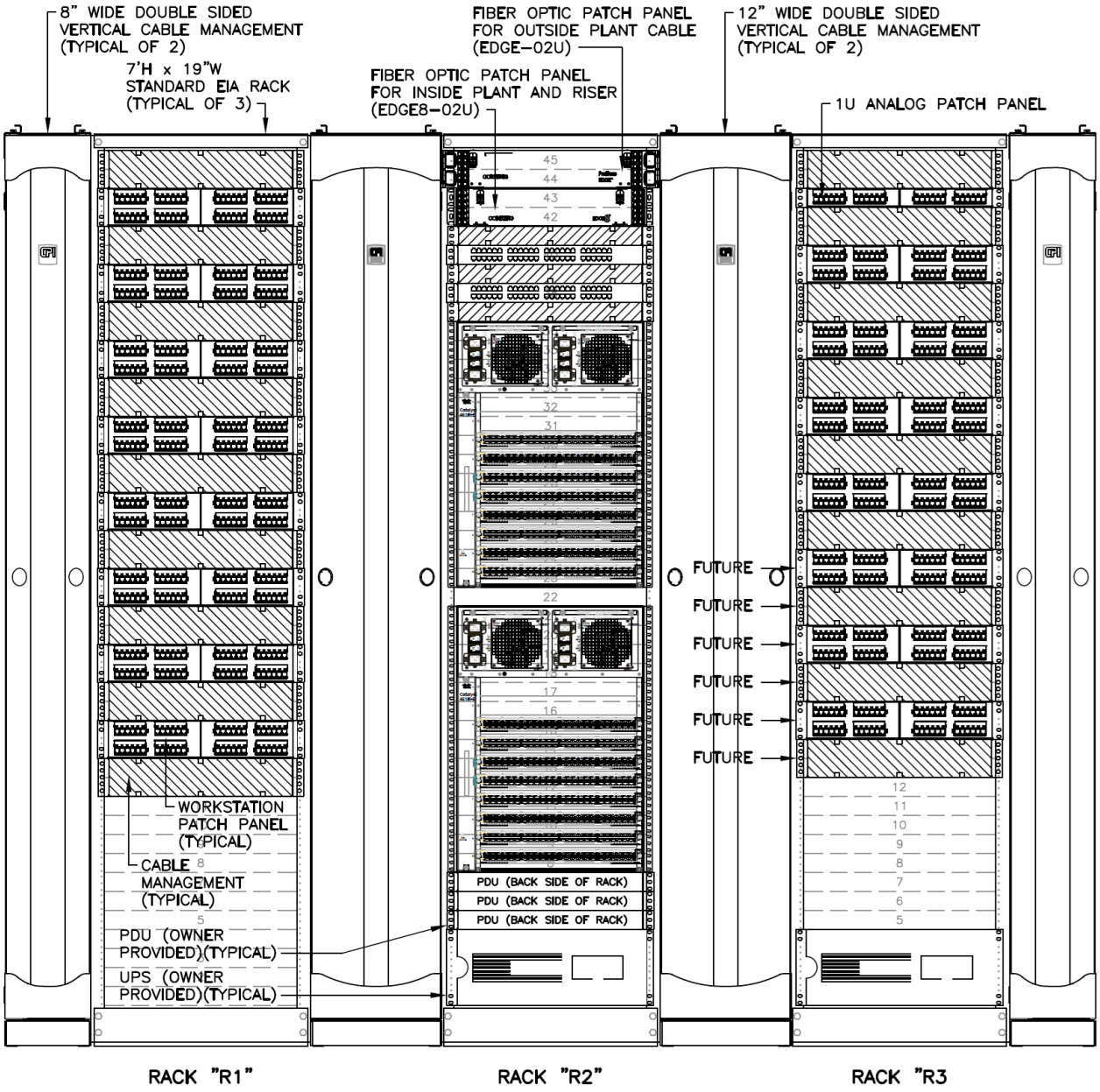
This example is suitable for a full build out supporting a maximum of 384 horizontal cables and a **Day-1 design maximum of 288 cables** (leaving room for two patch panels for future growth).

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 ISM.



5.1.3 THREE RACKS

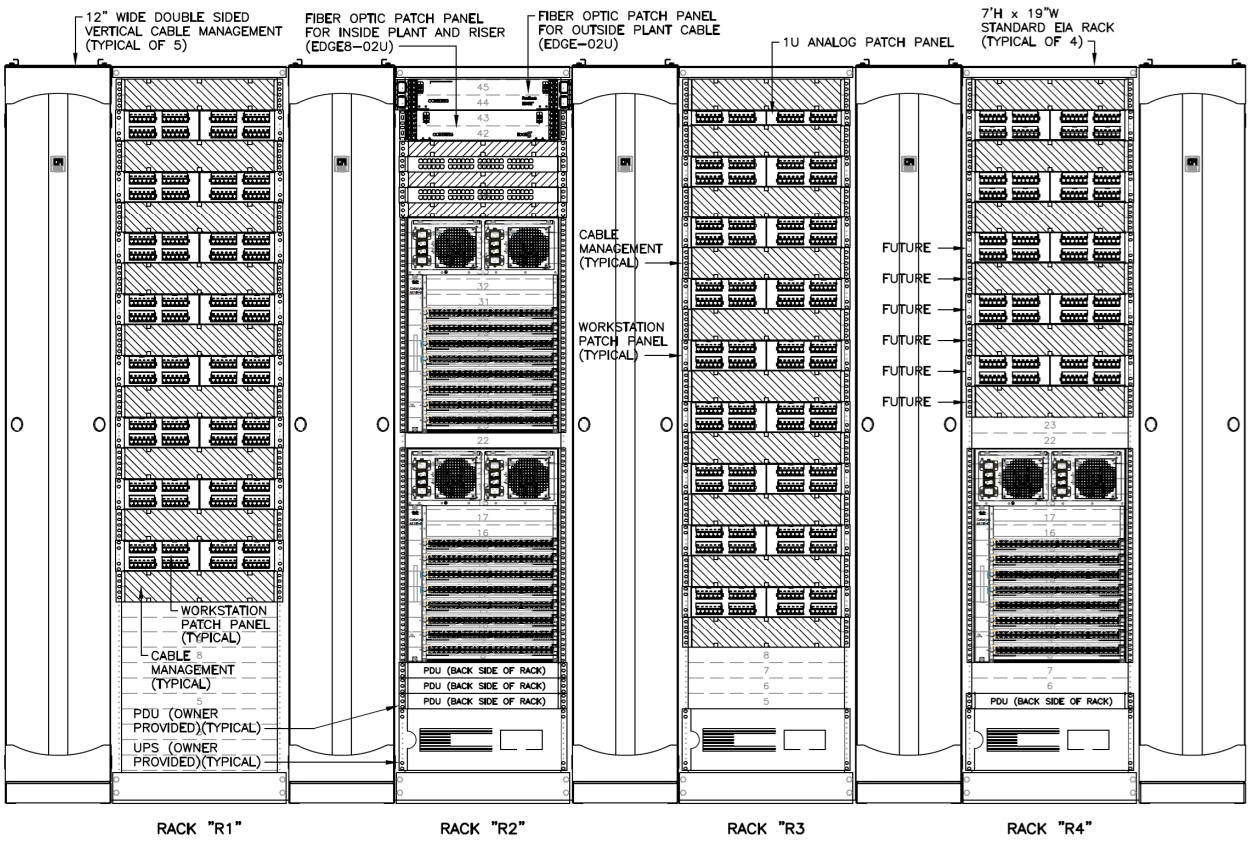
This example is suitable for a full build out supporting a maximum of 768 horizontal cables and a **Day-1 design maximum of 624 cables** (leaving room for three patch panels for future growth). This is the standard IDF application.



5.1.4 FOUR RACKS

This example is suitable for a full build out supporting a maximum of 1,008 horizontal cables and a **Day-1 design maximum of 864 cables** (leaving room for three patch panels for future growth). This is a standard large IDF application.

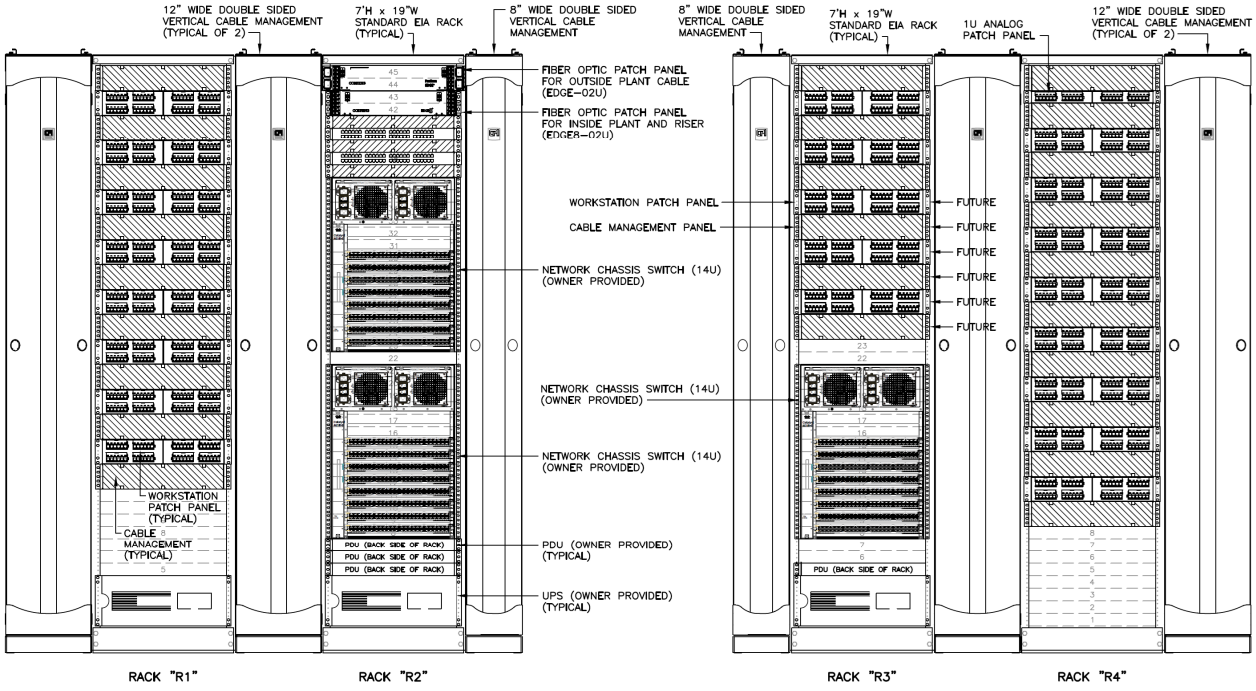
Note that this example shows four racks in a row. The next page shows an alternate arrangement of two rows facing each other with two racks each. There are subtle differences that apply.



This solution would be used in cases where the telecommunications room shape and door location would better fit the two-row arrangement. It supports the same cable counts as the normal solution with four racks in a single row.

The Designer shall inquire with the ISM to determine which method to implement.

When four racks are designed in a two-row arrangement, split the rows between racks 2 and 3. The chassis switches go in the racks adjacent to the wall where the power receptacles are mounted.



5.1.5 FIVE AND SIX RACKS

CWU anticipates that no more than four telecommunications racks will be required for most telecommunications rooms at its facilities. However, some rare applications may require telecommunications rooms supporting five or six racks.

These cases typically involve rack-mounted audio/visual or other systems sharing space in the telecommunications rooms. Therefore, the number of telecommunications cables for five and six rack rooms will still be the same numbers as intended for the 4-rack rooms. These rooms always require ISM approval.

5.2 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.

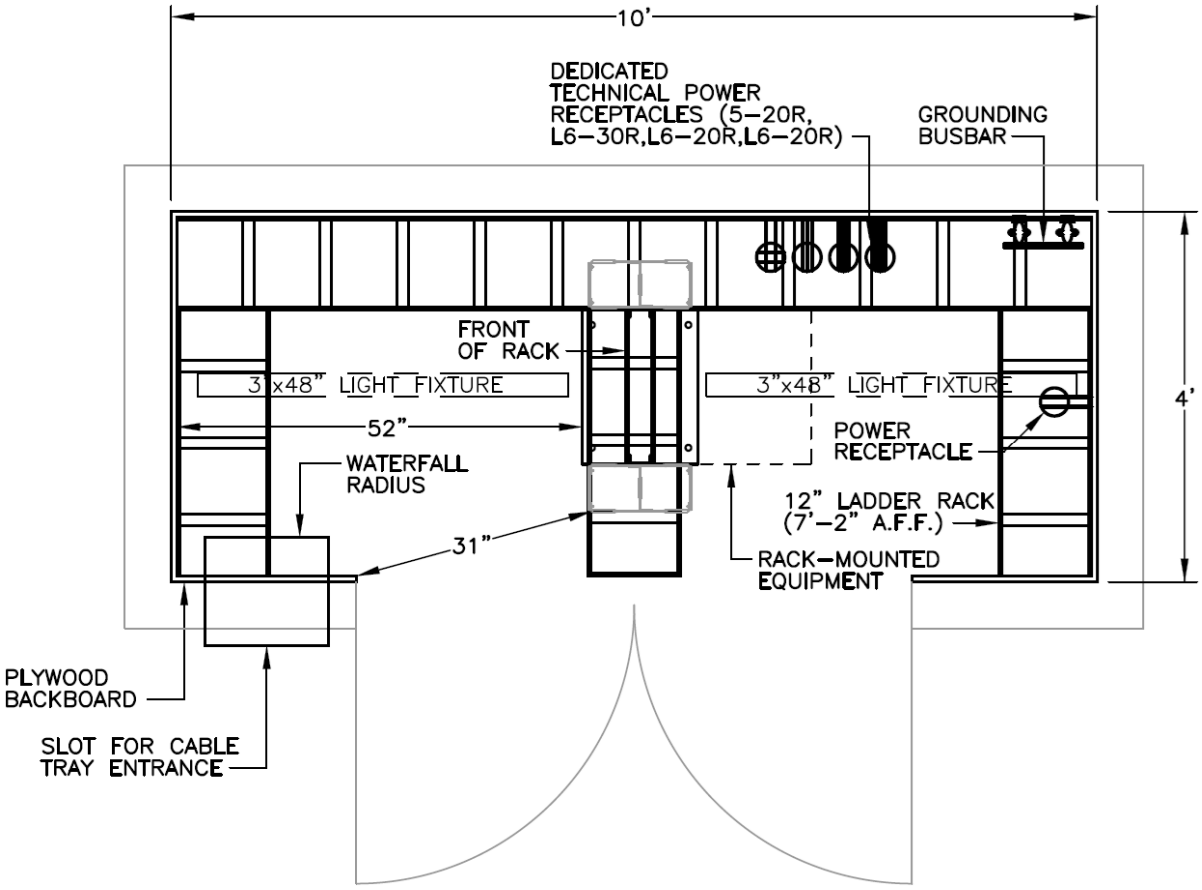
These sample plan details have been pre-approved for use at CWU. The Designer shall use this layout wherever appropriate and shall discuss project-specific alternatives with the ISM.

The room dimensions shown are considered to be acceptable minimums.

5.2.1 ONE RACK REACH-IN – 10’ X 4’ (INTERIOR CLEAR DIMENSIONS)

This example is suitable for a full build out supporting a maximum of 192 horizontal cables and a **Day-1 design maximum of 144 cables** (leaving room for future growth).

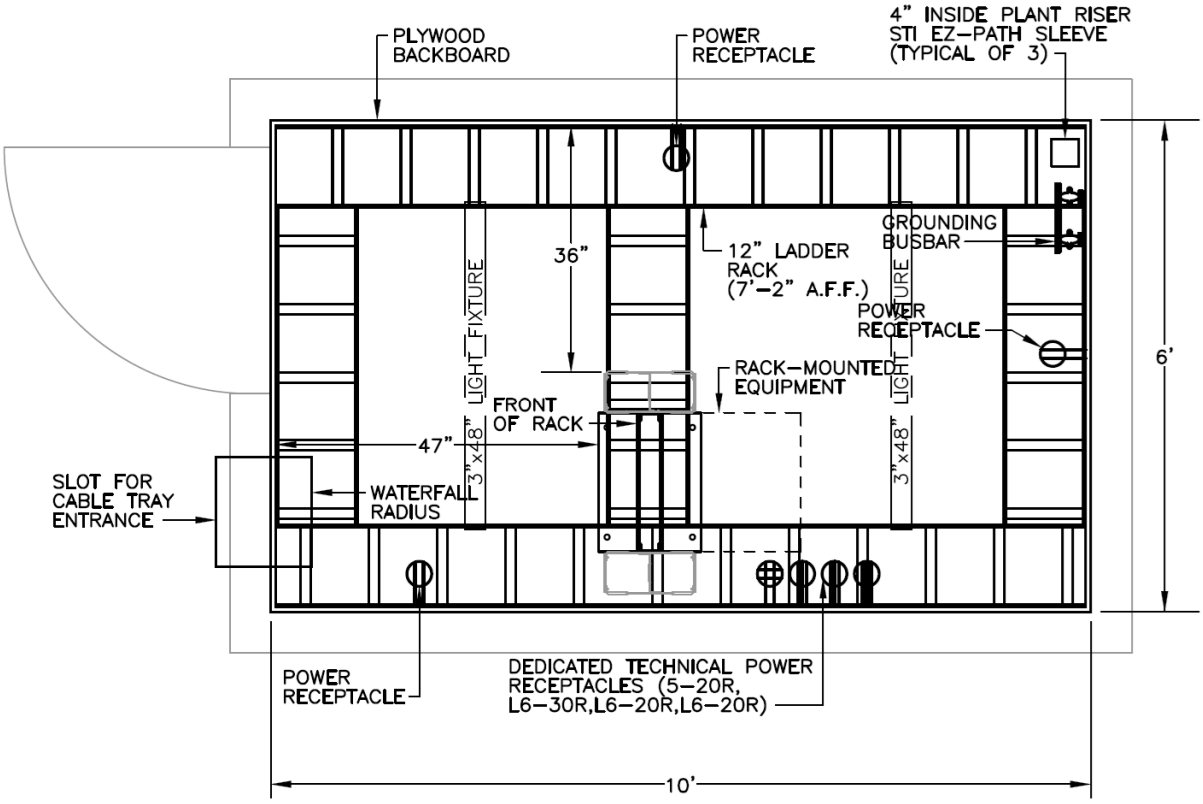
A one-rack room is rarely adequate, because it has very limited space for future equipment or cabling to be added. Therefore, it shall only be used as a last resort, and then only with the approval of the ISM.



5.2.2 ONE RACK – 10' X 6' (INTERIOR CLEAR DIMENSIONS)

This example is suitable for a full build out supporting a maximum of 192 horizontal cables and a **Day-1 design maximum of 144 cables** (leaving room for future growth).

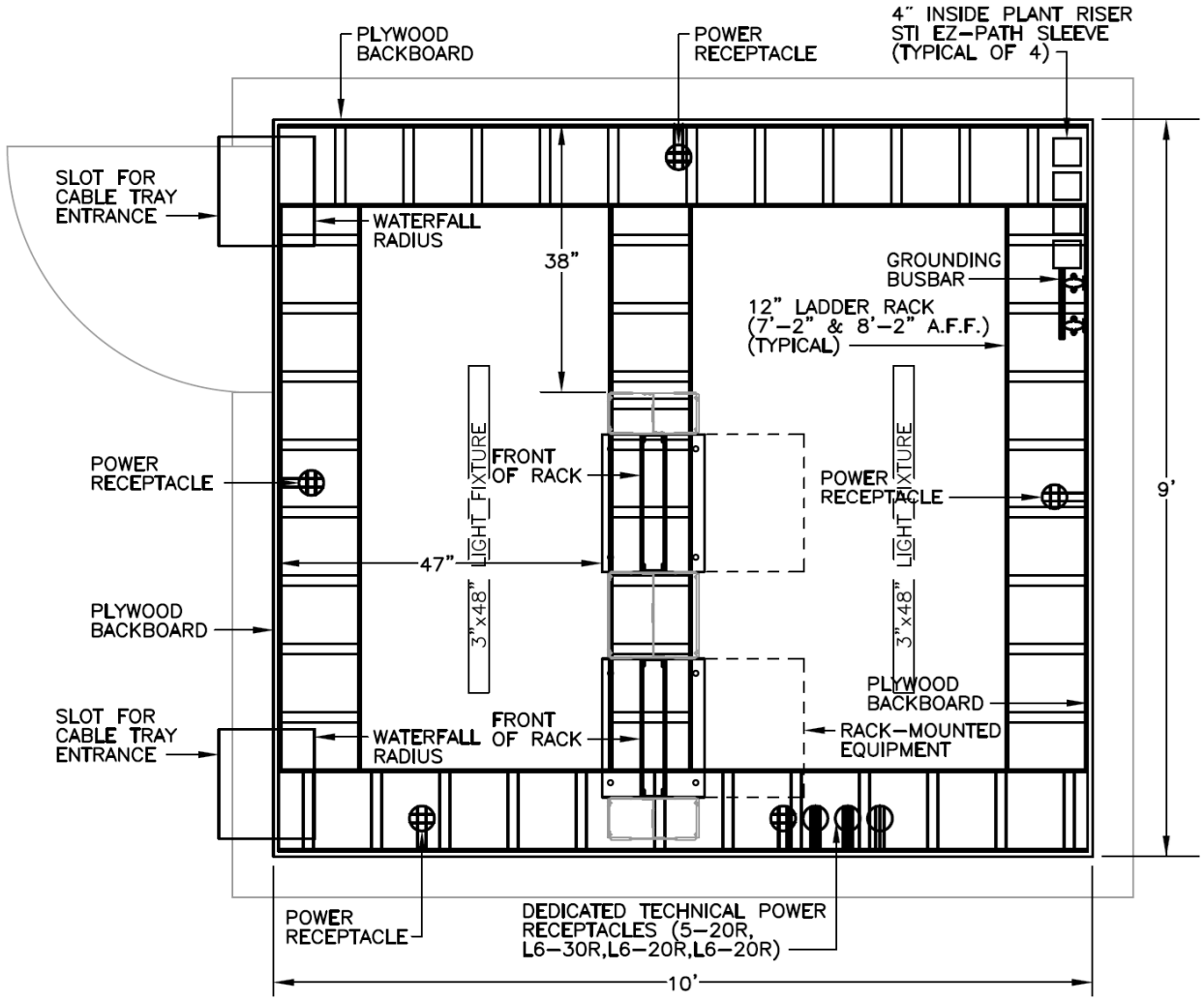
A one-rack room is rarely adequate, because it has very limited space for future equipment or cabling to be added. Therefore, it shall only be used as a last resort, and then only with the approval of the ISM.



5.2.3 TWO RACKS – 10’ X 9’ (INTERIOR CLEAR DIMENSIONS)

This example is suitable for a full build out supporting a maximum of 384 horizontal cables and a **Day-1 design maximum of 288 cables** (leaving room for future growth).

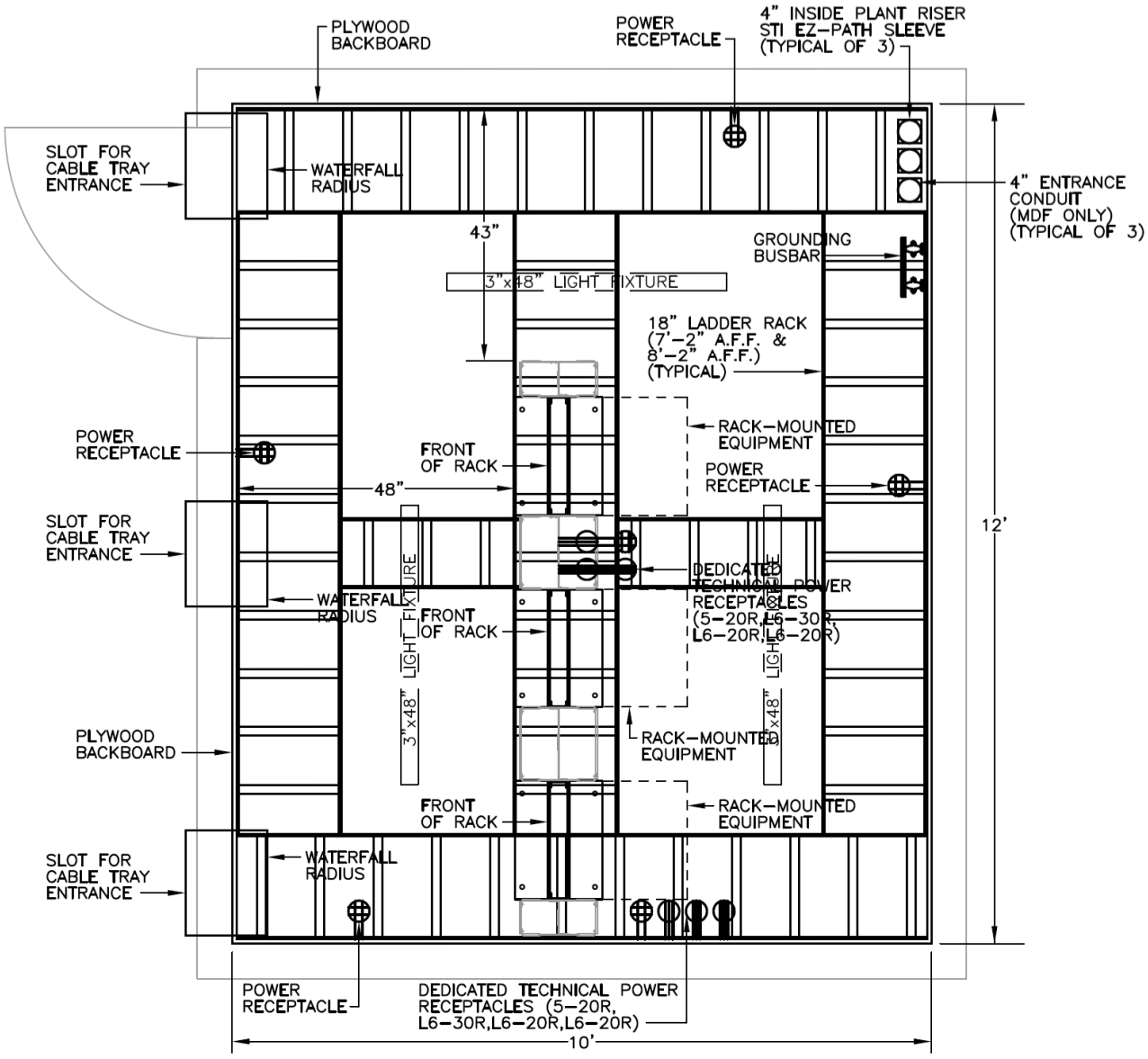
A two-rack room is rarely adequate, because it has very limited space for future equipment or cabling to be added. Therefore, it shall only be used as a last resort, and then only with the approval of the ISM.



5.2.4 THREE RACKS – 10' X 12' (INTERIOR CLEAR DIMENSIONS)

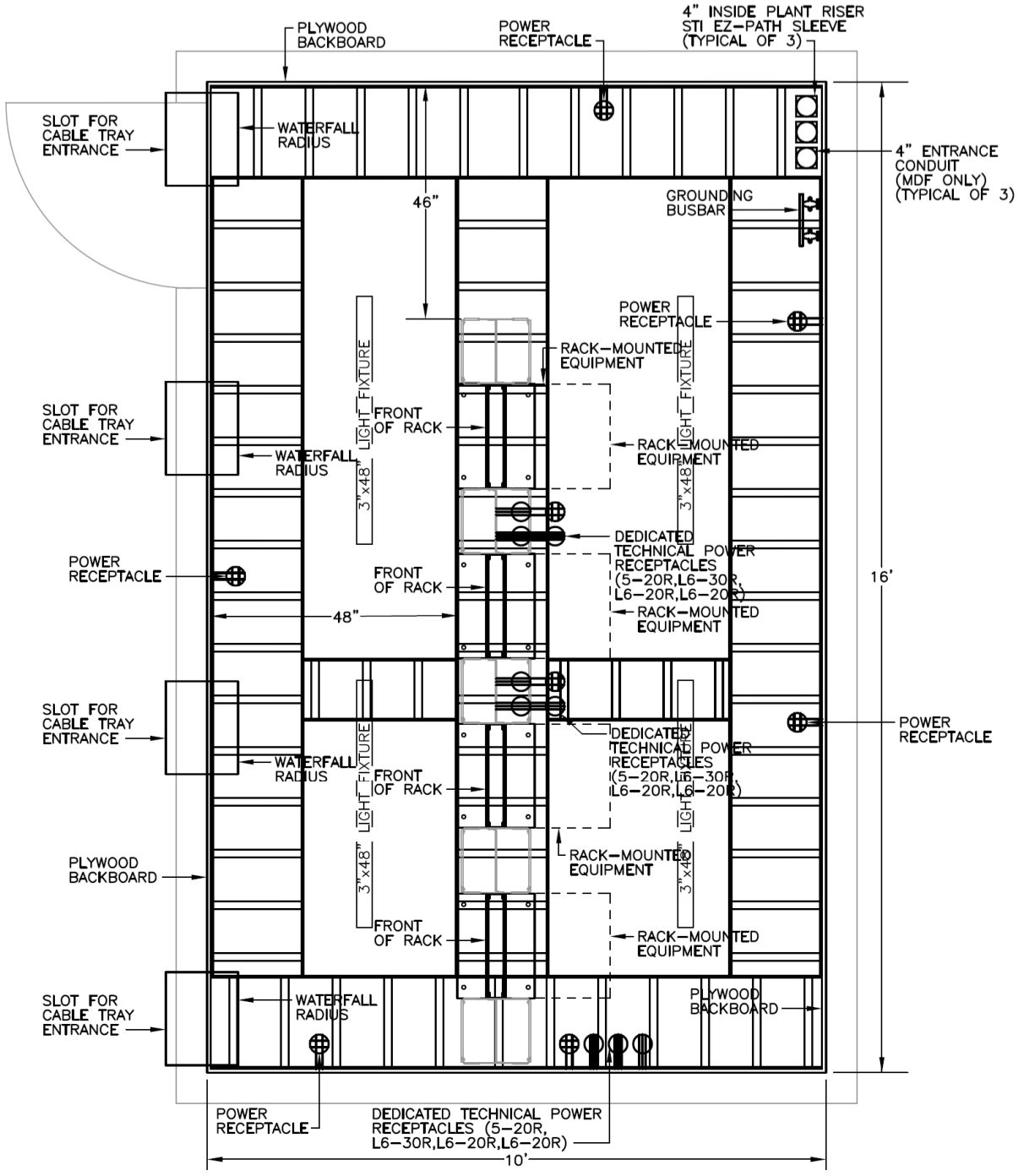
This example is suitable for a full build out supporting a maximum of 768 horizontal cables and a **Day-1 design maximum of 672 cables** (leaving room for future growth). This is the standard IDF application.

This is the standard IDF and standard MDF configuration.



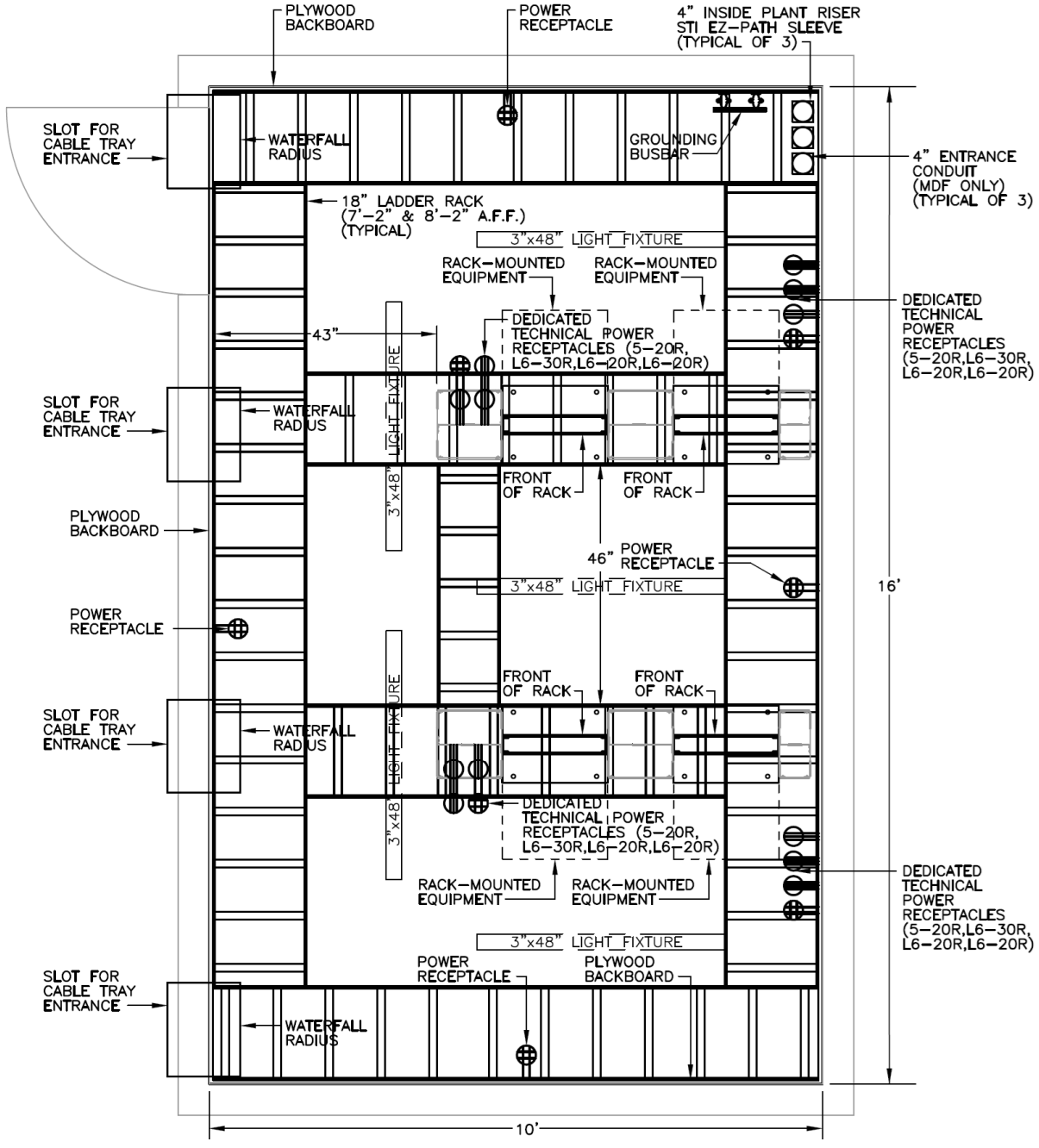
5.2.5 FOUR RACKS – 10' X 16' (INTERIOR CLEAR DIMENSIONS)

This example is suitable for a full build out supporting a maximum of 1,008 horizontal cables and a **Day-1 design maximum of 864 cables** (leaving room for future growth). This is a standard large IDF application.



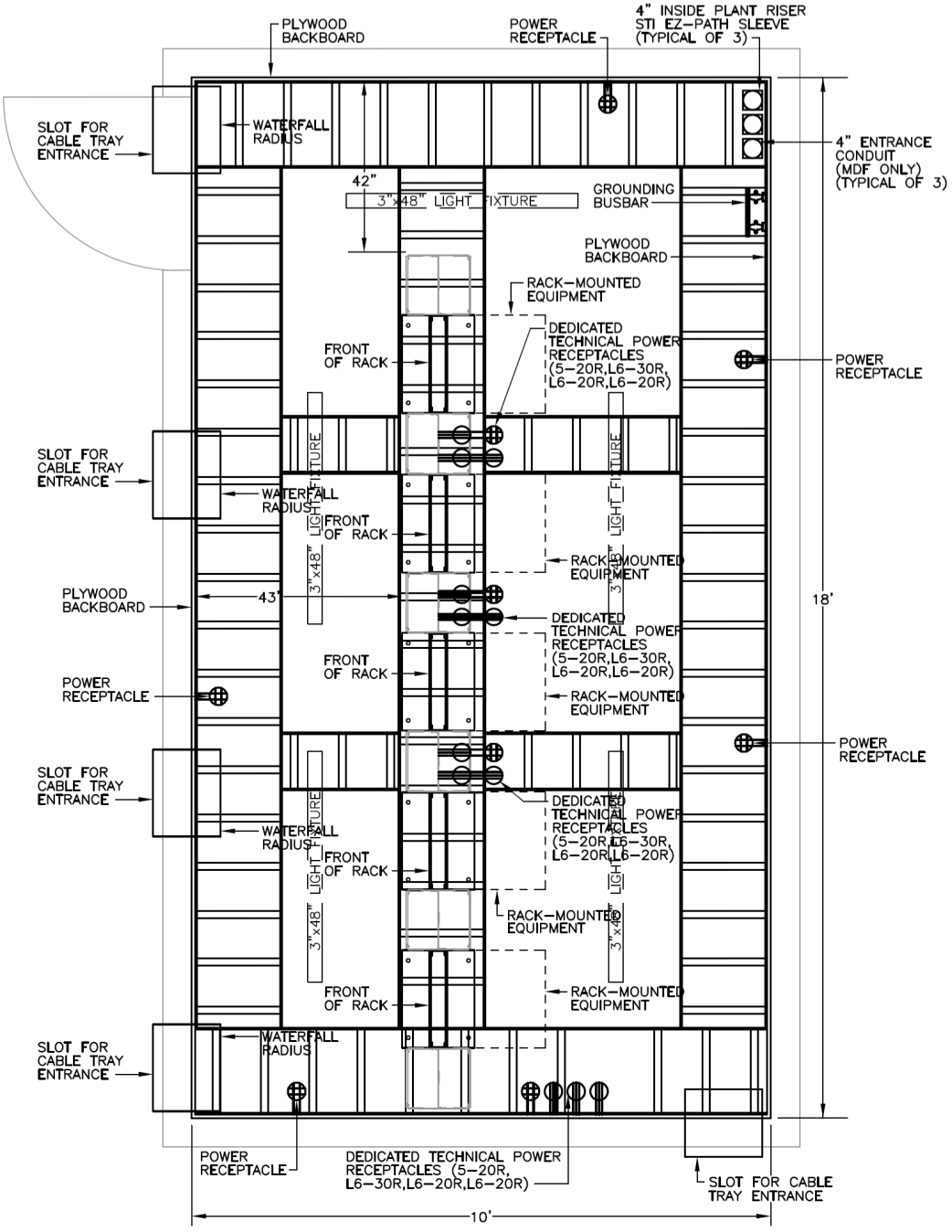
5.2.6 FOUR RACKS (2 ROWS) – 10' X 16' (INTERIOR CLEAR DIMENSIONS)

This example of a split four-rack solution is suitable for a full build out supporting a maximum of 1,008 horizontal cables and a **Day-1 design maximum of 864 cables** (leaving room for future growth).



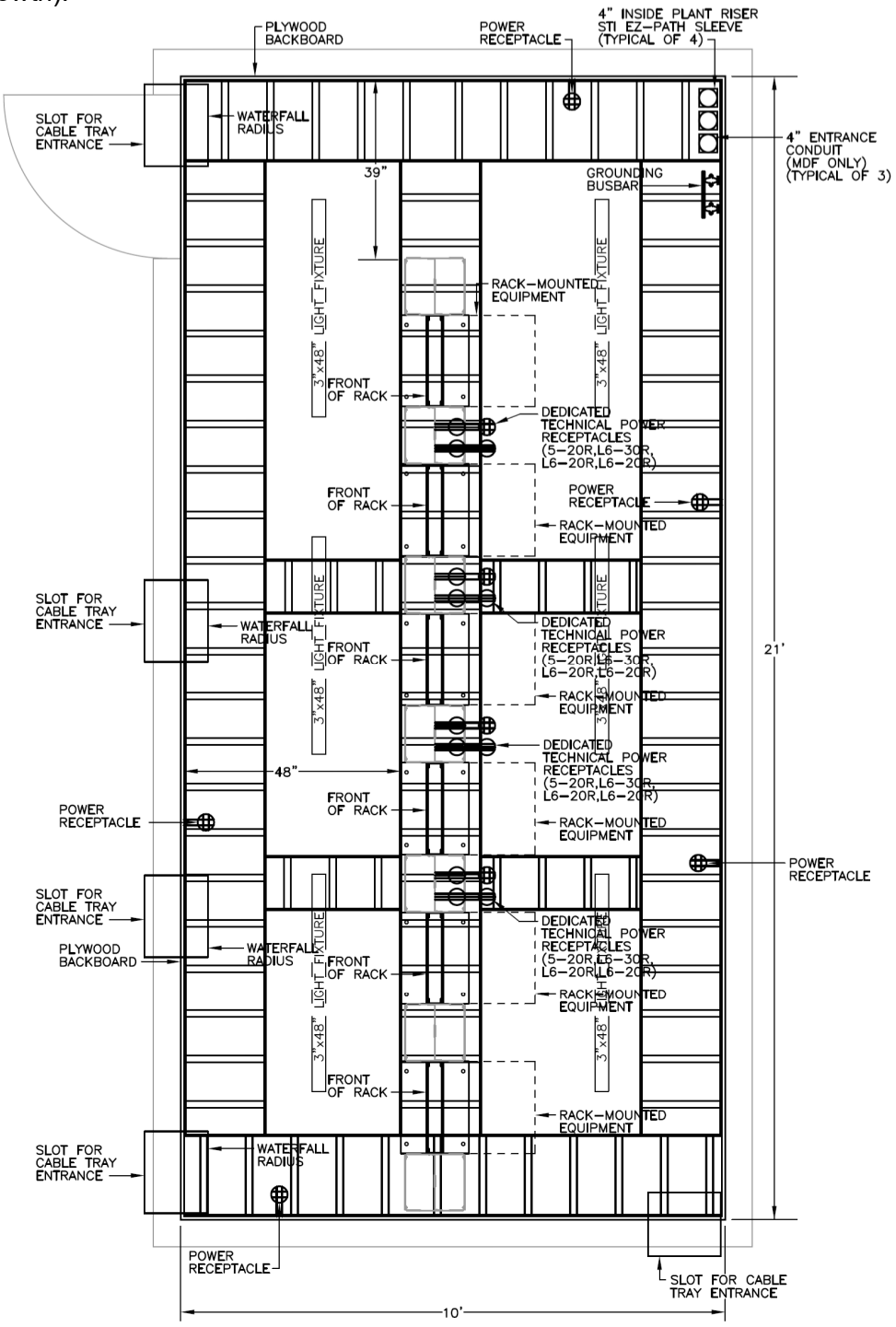
5.2.7 FIVE RACKS – 10' X 18' (INTERIOR CLEAR DIMENSIONS)

This example of a five-rack solution is suitable for a full build out supporting a maximum of 1,008 horizontal cables and a **Day-1 design maximum of 864 cables** (leaving room for future growth).



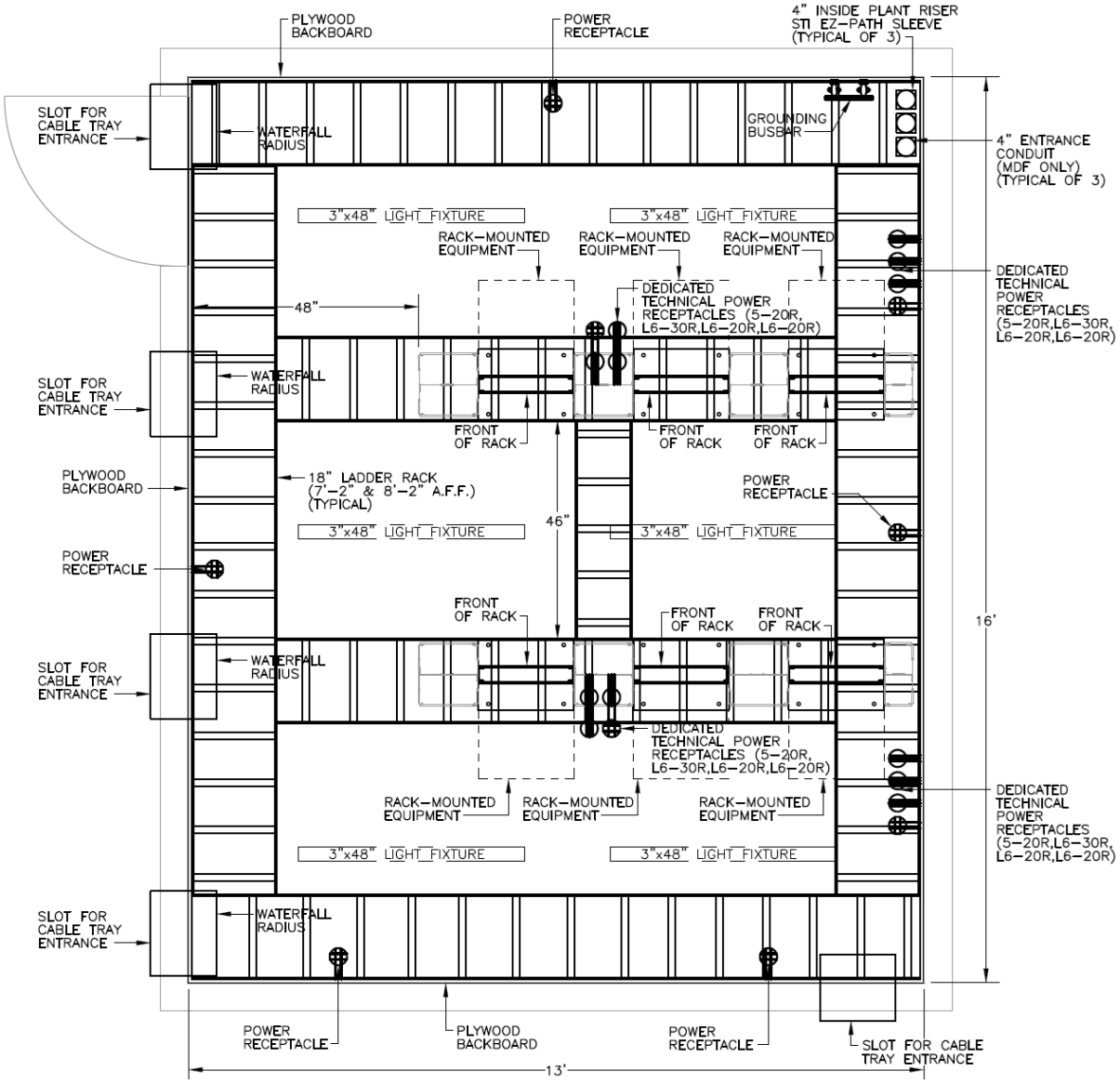
5.2.8 SIX RACKS – 10' X 21' (INTERIOR CLEAR DIMENSIONS)

This example of a six-rack solution is suitable for a full build out supporting a maximum of 1,008 horizontal cables and a **Day-1 design maximum of 864 cables** (leaving room for future growth).



5.2.9 SIX RACKS (2 ROWS) – 13' X 16' (INTERIOR CLEAR DIMENSIONS)

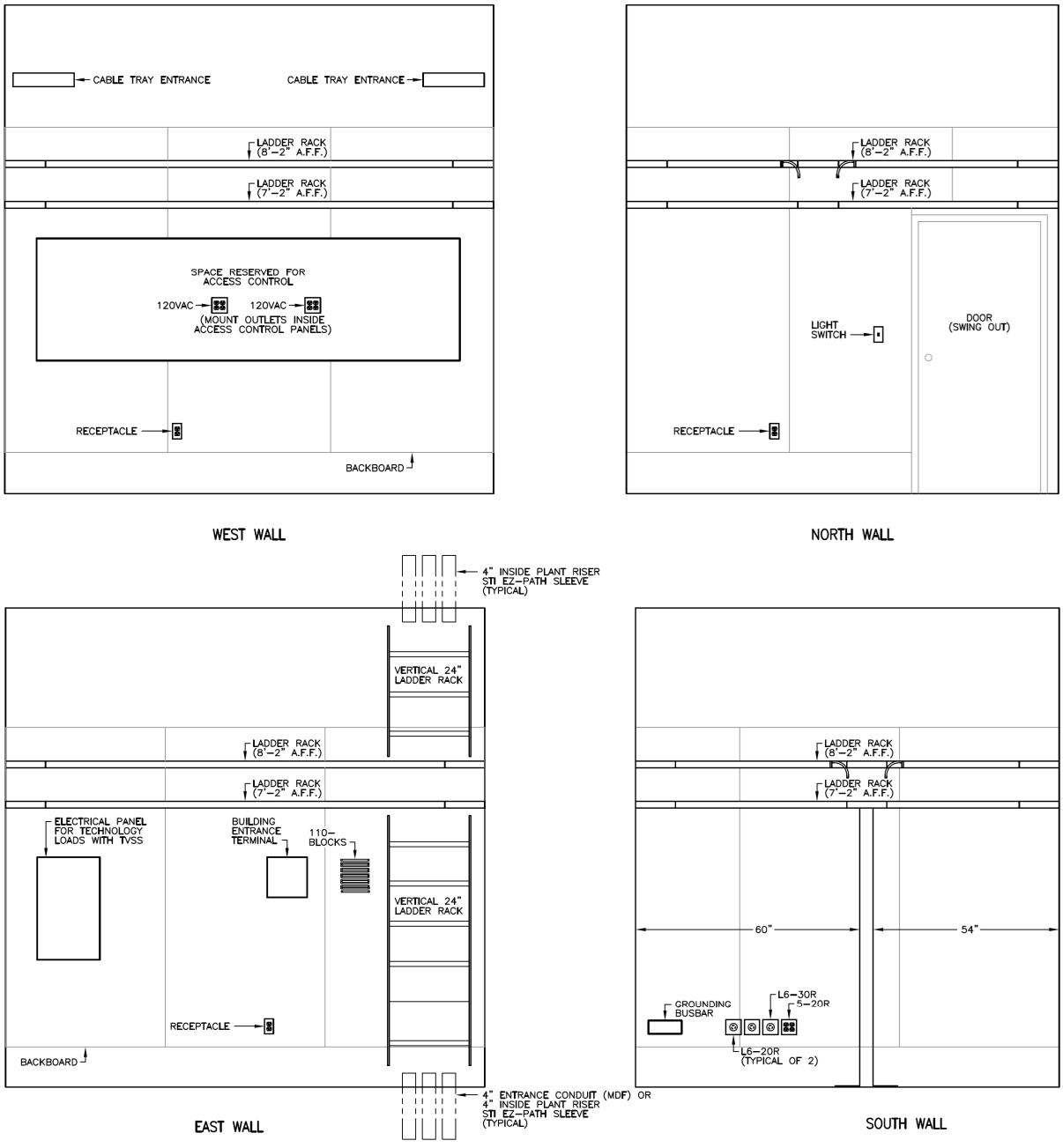
This example of a split six-rack solution is suitable for a full build out supporting a maximum of 1,008 horizontal cables and a **Day-1 design maximum of 864 cables** (leaving room for future growth).



5.3 Sample Wall Elevation Detail

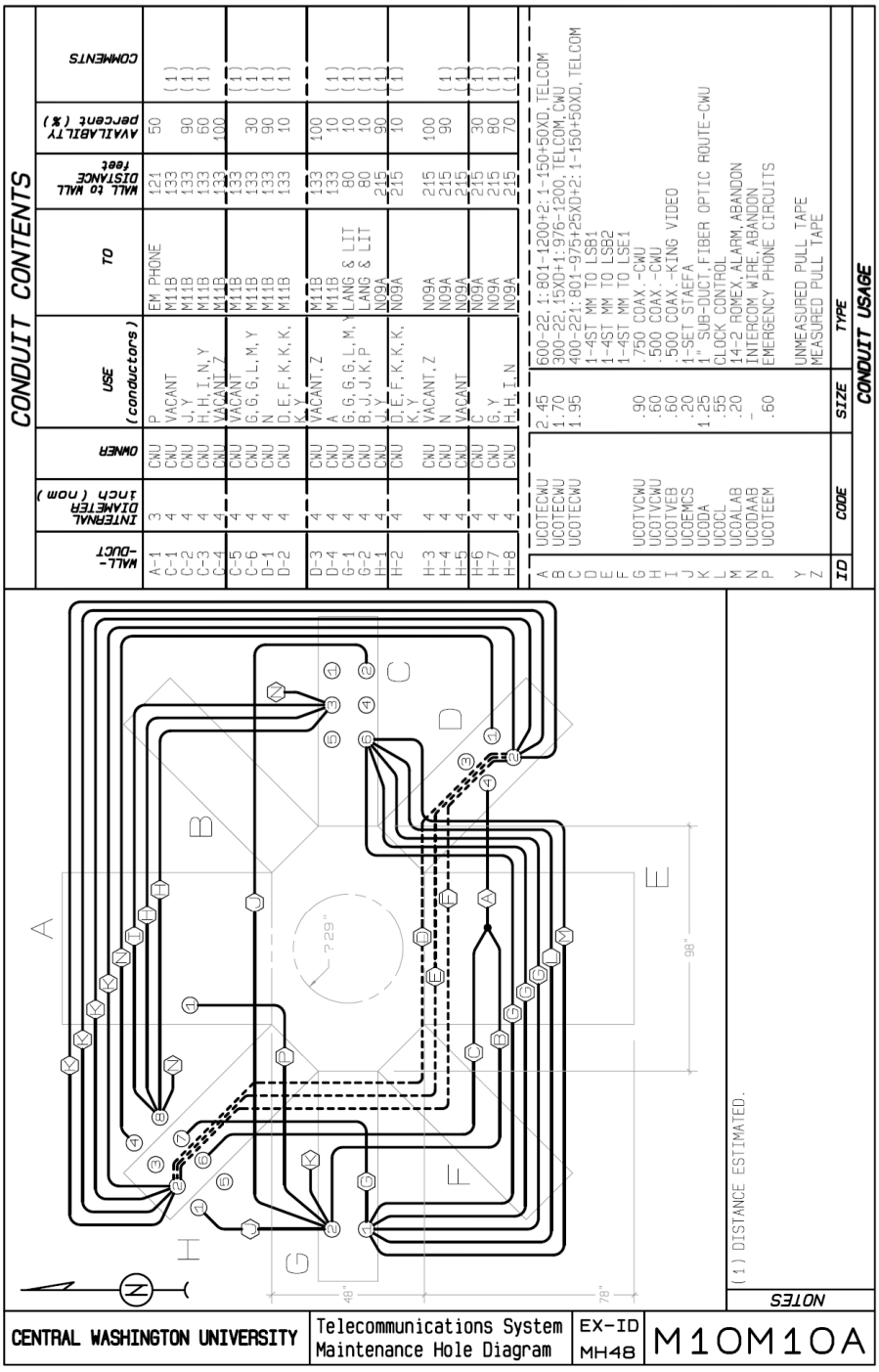
The Designer shall provide a scaled wall elevation detail, similar to the example below, for each new or existing telecommunications room wall affected by the project.

This information shall be provided in the Construction Documents.



5.4 Sample Maintenance Butterfly Detail

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.



5.5 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 CWU in both electronic and paper forms. Upon request, CWU 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 (Excluding Tx & Rx Connectors)	Number of Connector Pairs		2		2		2		2	pairs
	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.