21 NOVEMBER 2024

ADDENDUM NO. 4

Modifications described herein shall be incorporated into the Project Manual and the Drawings. All other Work described in the Project Manual and Drawings shall remain unchanged. Acknowledge receipt of this Addendum by inserting its number on the Bid Form. This Addendum is a part of the Contract Documents.

ATTACHMENTS

A. Specifications
   1. 00 01 10 – Table of Contents
   2. 07 42 16 – Metal Plate Wall Panels
   3. 27 00 00 – Communications
B. Drawings
   1. E120 EXISTING SELB CONDUIT PLAN
   2. E502 SINGLE LINE DIAGRAM – EMERGENCY POWER – NEW WORK

QUESTIONS / ANSWERS

Q: American Institute of Steel Construction (AISC) certification requirement is called out in specification section 05 12 00 section 1.5.B.1 and 2. Would this project consider waiving the requirement for this certification?

A: Non-AISC certified steel fabricator could be allowed, provided that all "QA" tasks listed in chapter N of AISC 360-16 are performed by a 3rd party special inspection agency. This alternate approach is acceptable based on the text of chapter N, section 6. For specifics of the additional shop inspections to be performed by the 3rd party special inspection agency reference chapter N, section 5.

CHANGES TO DRAWINGS

- E120 EXISTING SELB CONDUIT PLAN – remove transfer switch replacement from this phase of the project.
- E502 SINGLE LINE DIAGRAM – EMERGENCY POWER – NEW WORK – further clarification to the generator scope, removing future work from sheet for clarity.

CHANGES TO SPECIFICATIONS

A. 00 01 10 – Table of Contents
   A. Re-issued in its entirety, sections noted with changes.
B. 07 42 16 – Metal Plate Wall Panels
   A. Clarified metal panel thickness to match manufacturer's standard system at 1/8" thick.
C. 27 00 00 – COMMUNICATIONS
   1. Revised the part number of the hard ceiling wireless access point mount indicated in the IU Building Telecommunications Design Guidelines (page 33 of the guidelines).

END OF ADDENDUM #4

[THIS PAGE LEFT INTENTIONALLY BLANK]

SECTION 00 01 10 - TABLE OF CONTENTS

VOLUME 1 of 5: DIVISIONS 00-01

VOLUME 2 of 5: DIVISIONS 02-08

DIVISION 10 – SPECIALTIES

DIVISION 11 — EQUIPMENT

DIVISION 12 — FURNISHINGS

DIVISION 13 — SPECIAL CONSTRUCTION

DIVISION 14 — CONVEYING EQUIPMENT

DIVISION 21 – FIRE SUPPRESSION

DIVISION 22 – PLUMBING

VOLUME 4 of 5: DIVISIONS 23-32

SECTIONS **ISSUE DATE**

DIVISION 23 – HEATING VENTILATING AND AIR CONDITIONING

SECTION 074216 - METAL PLATE WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Provide the work of this Section in accordance with requirements of the Contract Documents.

B. This Section includes but is not limited to

1. Metal plate wall panels.
2. Metal plate canopy and soffit panels.
3. Exterior Column Covers.

C. Related Sections:

1. Division 05 Section "Metal Fabrications" for secondary framing support of ceiling suspension attached to steel beams that support interior metal soffit systems.
2. Division 06 Section "Sheathing" for sheathing support.
3. Division 07 Section "Membrane Air Barriers" for continuous air barrier systems.
4. Division 07 Section "Thermal Insulation" for building insulation.
5. Division 07 Section "Flashing" for high temperature sheet waterproofing under plate metal roofing panels, field-formed flashings and other sheet metal work not part of metal wall panel assemblies.
6. Division 07 Section "Joint Sealants" for installation of joint sealants between metal panel system and adjacent exterior wall systems.
7. Division 08 Section "Louvers" for louvers.

1.2 DEFINITION

A. Metal Plate Panel Assembly: Metal plate panels, attachment system components, miscellaneous metal framing, and accessories necessary for a complete rainscreen system.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site;

1. Attendees: Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of doors, windows, and louvers.
2. Agenda: Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
    a. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
    b. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
    c. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal panels.

d. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
e. Review temporary protection requirements for metal panel assembly during and after installation.
f. Review procedures for repair of metal panels damaged after installation.
g. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.
h. Coordinate the work of this Section with the work of other Trades.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Sustainable Design Action Submittal:

1. Building Product Disclosure and Optimization - Sourcing of Raw Materials:
   a. Leadership Extraction Practices
      1) Extended Producer Responsibility (EPR): Submit documentation indicating that manufacturers have a take back or recycling program for the product purchased.
      2) Recycled Content: For products having recycled content, indicate percentages by weight of post-consumer and pre-consumer recycled content.
         a) Include statement indicating costs for each product having recycled content.
   b. Sourcing of Raw Materials: For products that are responsibly sourced within 100 miles of project site, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material.
      1) Include statement indicating distance to Project, cost for each regional material and the fraction by weight that is considered regional.

2. Indoor Environmental Quality, Low Emitting Materials:
   a. Laboratory Test Reports: For adhesives, sealants, paints, coatings wet applied on site, indicating testing and compliance with the California Department of Public-Health (CDPH) Standard Method V1.2-2017, using the applicable exposure scenario.
   b. For paints, and coatings, wet applied, include printed statement of VOC content, showing compliance with the applicable VOC limits of the California Air Resources Board (CARB) 2007, Suggested Control Measure for Architectural Coatings or the South Coast Air Quality Management District (SCAQMD) Rule 1113, effective February 5, 2016.
   c. Alternative tests for VOC include ASTM D2369-10, ISO 11890, ASTM D6886-03; or ISO 11890-2.
   d. Methylene Chloride and perchloroethylene may not be added to paints, coating, adhesive or sealants

C. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; interfaces with other systems and components, details of edge conditions, joints, panel profiles, corners, anchorages, attachment assembly, trim, flashings, closures, and accessories; and special details.
   a. Distinguish among factory-, shop, and field assembled work.
2. Accessories: Include details of the flashing, trim, and anchorage, at a scale of not less than 1-1/2 inches per 12 inches.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.
2. Trim and Closures: 12 inches long. Include fasteners and other exposed accessories.
3. Accessories: 12-inch-long Samples for each type of accessory.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Exterior elevations, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Metal plate panels and attachments.
2. Penetrations of by pipes and utilities.
3. Details of gutter, flashing, roofing, air/water barrier systems.
4. Interface with other systems and components.

B. Qualification Data: For Professional Engineer, Installer, fabricator, testing agency.

C. Sustainable Design Informational Submittals:

1. Building Product Disclosure and Optimization - Environmental Product Declarations
   a. Submit product specific type III EPDs or Industry wide (generic) EPDs, USGBC approved program declaration or products with a publicly available, critically reviewed life-cycle assessment conforming to ISO 14044 that have at least a cradle to gate scope.

2. Building Product Disclosure and Optimization - Material Ingredients
   a. Material Ingredient Optimization: Submit manufacturer's Environmental Product Declaration (EPD) and at least one of the following:
      1) GreenScreen V1.2 Benchmark: Third party report prepared by a licensed GreenScreen List Translator, or a full GreenScreen Assessment.
      2) Cradle to Cradle: Manufacturer's published literature for the product bearing the Cradle to Cradle logo.
      3) International Alternative Compliance Path - REACH Optimization
      4) Declare: Manufacturer's completed Product Declaration Form
      5) Other programs approved by USGBC

D. Fabrication Engineering and Design: Submit comprehensive engineering analysis and Shop Drawings signed and sealed by a qualified Professional Engineer licensed to practice in the project jurisdiction, responsible for their preparation, indicating compliance with performance requirements specified. Submission shall include:

1. Analysis for applicable loads on framing members including backup cold formed metal wall.

2. Analysis for applicable loads on anchors and support system for the project.
3. Structural calculations and details of anchoring system, including type, size, and spacing of fasteners.

E. Product Test Reports: For each product, based on evaluation of compressive tests performed by a qualified testing agency.

1. Provide lab test data (performed within 4 years prior to the date of submission) on structural air and water penetration tests per AAMA 509, evidencing compliance with requirements for exterior metal panel rainscreen systems to control water flow within the exterior envelope.

F. Certification for High Performance Organic Finishes: Manufacturer's and fabricator's certification indicating that PVDF coating complies with the Contract Documents and AAMA 2605.

G. Field quality-control reports.

H. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

B. Warranty Documentation:

1. Manufacturers' special warranties.
2. Installer's special warranties.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum 5 years' experience.

B. Fabricator Qualifications: Approved by plate metal panel manufacturer.

C. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for installation of specified metal plate wall panels, column covers and metal soffit and canopy systems.

D. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated, who is acceptable to authorities having jurisdiction.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for design and installation of metal wall panel assemblies that are similar to those indicated for this Project in material, design, and extent

F. Mockups: Prior to installing exterior wall systems, build mockups as part of composite mockup indicated on Mockup Elevation Drawing Sheets. Incorporate exterior wall construction and finish to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installationand for preconstruction testing.

1. Provide materials in this section to create the composite testing mockup indicated.

2. Build mockup of typical metal panel assembly as shown on Drawings, including corner, soffits, canopies, supports, attachments, and accessories.
3. Build mockup of typical metal panel assembly as shown on Drawings, including corner, soffits, supports, attachments, and accessories.
    a. Include four-way joint for metal panels, with finish for Architect's selection.
    b. Include exterior metal panel soffit.
    c. Column cover, including base/bumper and finish.
4. Water-Spray Test: Conduct water-spray test of metal panel assembly mockup, testing for water penetration according to AAMA 501.2.
5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
6. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

G. Repair procedure: Provide a sample panel of minimum 36” x 36” size. Demonstrate repair procedure for scratches, dents and discoloration. Review with Architect and make determination which repair procedures will be acceptable on the project. Repairs will be viewed in natural light, 8 feet from panel and viewed at 60-degree angle.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal panels during installation.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

B. Field Measurements: Verify locations of structural members and opening dimensions by field measurements before metal plate panel fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish framing and opening dimensions and proceed with fabricating metal wall panels without field measurements. Coordinate wall construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.

1.10 COORDINATION

A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including rupturing, cracking, or puncturing.
b. Deterioration of metals and other materials beyond normal weathering.
c. Damage to panel surface that cannot be repaired in the field successfully.

2. Warranty Period: Five Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Metal plate panel assemblies shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.

B. Fabrication Engineering and Design: Engineer metal plate panel assembly, including cold formed steel framing supports, as well as sheathing, air/water barrier and insulation to comply with performance requirements specified. Provide a comprehensive engineering analysis by a qualified professional engineer licensed to practice in the State of the project and responsible for preparation of the design, using performance requirements and criteria indicated.

C. Structural Performance: Provide metal panel systems, column covers, soffits and canopies capable of withstanding the effects of the following loads, based on testing according to ASTM E330:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/240 of the span.

D. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft..

E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

F. Thermal Performance: Provide metal panel exterior Rainscreen assemblies (including Insulation, air space, and air barriers within cavity) with total Composite U factor of 0.048 Btu/sq. ft x h x deg F, and a minimum insulation R value of 21 or as shown on specific wall sections types whichever is greater, when tested according to ASTM C1363 or ASTM C518.

G. Single Source Responsibility: Use one manufacturer for each type of metal panel system used on the project, so that there is single source responsibility.

2.2 MATERIALS, GENERAL

A. Recycled Content:

1. Aluminum: Provide aluminum products with an average recycled content such that so post-consumer recycled content plus one-half of pre-consumer recycled content is not less than 12 percent.
2. Steel: Provide steel products with an average recycled content such that so post-consumer recycled content plus one-half of pre-consumer recycled content is not less than 50 percent.

B. Aluminum Plate: ASTM B209. Alloy and temper as recommended by manufacturer for application.

C. Aluminum Extrusions: ASTM B221, alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Horizontal Joint Accent: 3/8 inch x 4 inch continuous aluminum bar shape, for use at ground floor panels; profiles shown on Drawing A-508.

D. Stainless-Steel Sheet: ASTM A240/, Type 304, fully annealed.

E. VOC and Emissions Requirements: Paints and Coatings, adhesives and sealants, wet applied on site shall comply with:

1. VOC limits (g/L) found in tables in Division 01 Section "Sustainable Design Requirements."
2. Emissions testing criteria of CHPH Standard v1.2-2017.

2.3 METAL PLATE WALL PANELS <MTP-01>

A. Metal Plate Wall Panels: Provide factory-formed, metal plate wall panels fabricated from single sheets of metal formed into profile for installation method indicated. Include attachment assembly

components, panel stiffeners, and accessories and air barriers specified in Division 07 Section "Membrane Air Barriers" as required for weathertight system.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Sobotech SL-2000P Dry Joint Pressure Equalized Rainscreen System or comparable product by one of the following:

    a. Alply Insulated Panels LLC;
    b. AMNA; AM3000
    c. LINEL;.
    d. Metalwerks Div Armstrong;
    e. Pohl USA;

B. Aluminum Plate: Tension-leveled, smooth aluminum plate, ASTM B209~~, 0.1875 inch thick;~~ **Addendum #4** except that canopy panels shall be a minimum of 1/4 inch thick or greater as required to support the load of workman equal to 300 lbs point load distributed over a 4 inch square at any point of a uniform load of 30 lbs. per linear foot, whichever is the more severe.

1. Panel Depth: As indicated on Drawings.
2. Exterior Finish: Two-coat fluoropolymer.

    a. Color: As indicated on Drawings
        1) **MTL-01A:** UC5195XL Medium Gray.
        2) **MTP-01B:** UC51568XL Champagne Gold

C. Metal Panel Types:

1. **MTP-01:** ~~3/16~~-1/8”inch-thick metal plate panels with **MTL-01** finish; **Addendum #4**

D. Attachment Assembly: Manufacturer's standard.

E. Attachment System Components: Formed from extruded aluminum.

1. Provide internal drainage system that allows individual panels to be installed and removed without disturbing adjacent panels.
2. Include aluminum subgirts, perimeter extrusions, tracks, and drainage channels, panel stiffeners, panel clips, and anchor channels.
3. Alignment Pins: Stainless steel.

F. Fabricate metal plate wall panel system to profiles and dimensions shown, using metal plate wall panels specified in a dry-open joint plate system installation as shown on drawings.

2.4 METAL SOFFIT AND EXTERIOR CEILING CLOSURE PANELS

A. Flush-Profile Metal Soffit Panels Provide 1/8-inch-thick plate metal soffit and ceiling closure panels, designed to be installed by interconnecting side edges of adjacent panels and mechanically attaching through panel supports using concealed fasteners, inside laps. Fabricate from plate aluminum to profiles and dimensions shown with framing structure required to suitably reinforce panels to withstand imposed structural loads specified. Include accessories required for weathertight installation.

B. Solid panels formed with vertical panel edges and a flat pan between panel edges; with gasketed flush joint between panels.

C. Provide aluminum fascia and ceiling panels matching metal soffit panels.

D. Provide structural supports to building structure to withstand imposed structural loads including wind uplift and suction. Pay particular attention to enhanced loads at automobile and ambulance pass-through areas.

E. Provide removable soffit panels at locations where required to access mechanical equipment. Secure panels with hidden fastenings. No visible access holes (for panel removal) or visible fasteners will be permitted in the finish work.

F. Coordinate with Section "Thermal Insulation". Provide thermal insulation at space above soffits and exterior metal ceiling panels to maintain thermal envelope complying with Indiana State Energy Conservation Code and requirements of LEED requirements.

G. For support of interior metal soffit panels from steel beams, coordinate with Division 05 Section "Metal Fabrications" and secure panels to support framing with slotted channel to hanger rod clips specified in that section.

H. Manufacturers: Same as for Metal Plate Panels.

2.5 MISCELLANEOUS MATERIALS

A. Reference Division 07 Section “Thermal Insulation” for Thermal Isolation Clips and spacers for support girt system of exterior wall cladding material that maintains continuous insulation requirements for the exterior wall.

B. Miscellaneous Metal Subframing and Furring: ASTM C955, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 coating designation or ASTM A792/A792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

C. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

D. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, end walls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

E. Panel Fasteners: Self-tapping series 300 stainless steel screws with bimetallic heads equal to Bi-Flex "300 series Stainless Steel Self Drilling Fasteners" bolts and nuts; self-locking rivets and bolts, end welded studs or other suitable series 300 stainless steel fasteners designed to withstand design loads. Do not used exposed fasteners. Provide EPDM or PVC sealing washers for exposed fasteners.

F. Panel Sealants: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer. Provide sealant types that are compatible with panel materials, are nonstaining, and do not damage panel finish.

2.6 FABRICATION

A. General: Fabricate and finish metal panels and accessories at the factory to the greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Graffiti Resistant Coatings: Incorporate graffiti resistant Kynar coatings in production of metal panels to be installed in the first 10 ft. above finish flooring. Graffiti Resistant Coatings shall be specially formulated to be applied to metal panel as a finish paint system and shall not alter the color of metal panels in wet or dry state from panels without graffiti resistant coatings. Coatings and shall prevent spray paint from penetrating surface of metal panels and staining, and shall allow removal of spray paint with basic soap and water.

C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
    a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.7 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not

acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

1. Physical damage to panels including dents and scratches are not acceptable.

D. Finishes Application: Apply high performance organic coatings to exposed exterior surfaces of exterior enclosure system components. Apply thermosetting acrylic enamel coatings to exposed and concealed interior surfaces of exterior enclosure system components.

1. During production, maintain large size color range samples for use in comparing against production material.
2. Adhesion and Compatibility Testing: Test samples of high-performance coatings on aluminum shall be provided for compatibility and adhesion testing of joint sealants proposed for use on exterior enclosure system components prior to installations. Refer to Section Division 07 Section "Joint Sealants.'

E. Aluminum Panels and Accessories: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat, with a minimum dry film thickness of 1.2 mils..
2. Graffiti Resistant Fluoropolymer: "Duranar GR" (PPG) graffiti resistant coatings specifically formulated to work with Duraprep Prep 400 graffiti remover to achieve graffiti resistant paint combination systems. Color and gloss to match color and gloss of metal panels. Performance to comply with the following:
    a. Dry film thickness: 0.45-0.55 mils (ASTM D7091)
    b. Gloss: 10-35 (ASTM D523 at 60 degrees)
    c. Pencil Hardness: HB-H (ASTM D3363)\
    d. Flexibility: 0T-1T; No pick-off (T-Bend, ASTM D4145)
    e. Chemical Resistance: No Discoloration when tested with 10% Muriatic Acid for 15 minutes, and No effect when tested with 25% NaOH for 1 hour per ASTM D1308.
    f. Reverse Impact: 3 times metal thickness on steel with no adhesion loss and 1.5 times metal thickness with no adhesion loss per ASTM D2794.
3. Exterior Exposure: Maximum 5 NSB unit color change and less than 0.01 mils per year film erosion per ASTM D2244, 10 years at 45 deg. south Florida exposure
4. Exposed Anodized Finish:
    a. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
    b. Color Anodic Finish: AAMA 611, [AA-M12C22A42/A44, Class I, 0.018 mm] [AA-M12C22A32/A34, Class II, 0.010 mm] or thicker.

F. Stainless-Steel Panels and Accessories:

1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
    a. Run grain of directional finishes with long dimension of each piece.
    b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
    c. Directional Satin Finish: No. 4.

3. Unpolished Finish, Bright, Cold-Rolled: No. 2B.

2.8 SOURCE QUALITY CONTROL

A. Subcontractor's Quality Control: Inspect metal wall panels at fabrication plant to verify that panels comply with performance and aesthetic requirements.

1. Panels shall be subject to inspection by the Exterior Wall Subcontractor.
2. Subcontractor shall make fabrication facility available for inspection upon request.
3. Panels shall be inspected by Manufacturer's Representative before leaving the fabrication plant and upon arrival at the site.

B. Do not release panels that exhibit damage or do not have labeling required by code marked on the back of each panel. Do not send such panels to the site.

C. Periodically perform inspection. Refer to Indiana Building Code requirements and article "Field Quality Control" for source quality control periodic inspection. Reports no older than 6 months.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.
    a. Maximum substrate and framing deviations from flat plane acceptable:
        1) 1/4-inch in 20 feet vertically or horizontally.
        2) 1/2-inch across building elevation.
        3) 1/8-inch in 5 feet).
    b. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

C. Examine panels to verify that panel surfaces are unmarred, smooth, and free from discoloration and scratches. Do not install panels that have been damaged.

D. Examine for out-of-tolerance work and other deficient conditions prior to starting installation of metal panels.

E. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Attachment Assembly: Install attachment assembly required to support metal wall panels, including subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C955 and metal panel manufacturer's written recommendations.

1. Soffit Framing: clip and fasten furring channels to supports, as required to comply with requirements for assemblies indicated.

3.3 INSTALLATION

A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Commence metal plate panel installation and install minimum of 300 sq. ft. in presence of factory-authorized representative.
2. Shim or otherwise plumb substrates receiving metal panels.
3. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
4. Install screw fasteners in predrilled holes.
5. Locate and space fastenings in uniform vertical and horizontal alignment.
6. Install flashing and trim as metal panel work proceeds.
7. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
8. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
9. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
2. Stainless-Steel Panels: Use stainless-steel fasteners.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

D. For panels with metallic finish, orient panels so that metallic flake lays in the same direction so that panels do not appear as a patchwork quilt. Any panels installed that do not orient correctly will be subject to removal and replacement.

E. Attach thermal clips and spacers against air barrier with sealant compatible with water resistive air barrier. Shim as required to maintain tolerances for exterior wall system. Position thermal clips and spacers and install specified stainless-steel fasteners through clips and spacers, securing to cold formed metal channels in horizontal and vertical spacing grid in accordance with clip and spacer manufacturer's written recommendations and specifications.

1. For clips, install no less than 1 clip per 4 sq. ft. of area. Use no less than two screws per block in accordance with manufacturer's standard details or as required by engineering analysis. Install clips plumb, level, in alignment across elevation and at locations required to support girts that will provide securement for attachment assembly
2. For thermal spacer channels, install wall panel support system in accordance with manufacturer's installation instructions. shim and align units with installed tolerances of 1/4 inch in 20 ft. non-cumulative on level, plumb and location lines. Secure angle and channel spacers to cold formed metal framing with stainless steel fasteners.
3. Fit insulation tightly around clips and spacers in accordance with manufacturer's instructions and requirements specified in Division 07 Section "Thermal Insulation". Do not compress insulation, install continuously without voids. Place insulation in clip recess to maintain continuity of insulation.

F. Attachment Assembly, General: Install attachment assembly required to support metal plate wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.

1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.
2. Do not begin installation until air barrier and flashings that will be concealed by metal panels are installed and tested.

G. Installation: Attach metal plate wall panels to supports at locations, spacings, and with fasteners recommended by manufacturer to achieve performance requirements specified.
1. Rainscreen Systems: Do not apply sealants to joints unless otherwise indicated.

H. Rainscreen-Principle Installation: Install using manufacturer's standard assembly with vertical channel that provides support and secondary drainage assembly, draining at base of wall. Notch vertical channel to receive support pins. Install vertical channels supported by channel brackets or adjuster angles and at locations, spacings, and with fasteners recommended by manufacturer. Attach metal plate wall panels by inserting horizontal support pins into notches in vertical channels and into flanges of panels. Leave horizontal and vertical joints with open reveal.

1. Install metal plate wall panels to allow individual panels to be installed and removed without disturbing adjacent panels.
2. Do not apply sealants to joints unless otherwise indicated.

I. Joint Sealers: Install gaskets, and joint fillers where indicated and where required for weathertight performance of metal plate panel assemblies. Provide types of gaskets, and fillers indicated or, if not indicated, types recommended by panel manufacturer.

1. Coordinate with adjacent exterior wall systems to prepare joints and apply sealants where shown, to comply with requirements in Division 07 Section "Joint Sealants."

3.4 ACCESSORY INSTALLATION

A. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal panel manufacturer; or, if not indicated, provide types recommended in writing by metal panel manufacturer.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

1. Install exposed flashing and trim that is without buckling and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
3. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.5 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal plate wall panel units within installed tolerance of 1/4 inch in 20 feet, non-accumulative, on level, plumb, and location lines as indicated, and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

B. Align joints vertically and horizontally across entire elevation. Do not vary by more than 1/8 inch in 20 ft. noncumulative, in level, plumb, or offset greater than 1/8 in in adjoining panel surfaces.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Metal plate wall panel subcontractor shall coordinate with Division 08 Section "Exterior Enclosure System Requirements" for other required laboratory and field testing, including air barrier testing prior to installation of metal plate wall panels.

B. Manufacturer's Field Service: Metal plate panel subcontractor shall engage a factory-authorized service representative to test and inspect metal wall panel installation, including accessories and write reports at the startup, midpoint and completion of exterior wall work.

1. Be responsible for carrying out all recommendations of the manufacturer to ensure a total and complete exterior wall finish system.

2. Manufacturer's final inspection report shall be made directly to the Owner Architect, Commissioning Agent, prior to the acceptance of the work.

C. Remove and replace metal wall panels where tests and inspections indicate that they do not comply with specified requirements. Remove and replace metal panels where field applied repairs are not acceptable.

1. Scratches longer than 2” and located in the center of the panel are not acceptable for field repairs.

D. Additional tests and inspections, at Subcontractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

E. Prepare test and inspection reports and submit to the Owner, Architect.

3.7 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 42 16

DIVISION 27 00 00 - COMMUNICATIONS

27.00.00 COMMUNICATIONS
v.05012019

27**.00.01 SCOPE OF WORK**

1. This specification covers the furnishing and installation of materials for telecommunications system structured cabling, complete and in operating condition as indicated on drawings and/or as described herein, applicable to new building construction projects and major renovations on all Indiana University campuses. For smaller renovations, exceptions *may* be required, but only if approved by the appropriate UITS representative on a case-by-case basis. Potential exceptions are noted in this document and in the UITS document "IU Building Telecommunications Design Guidelines".
    1.1. The telecommunication systems herein specified provides for Information outlets and other low voltage signaling functions (such as for energy management and security systems) through twisted pair, fiber optic, and coaxial cable.
    1.2. The system shall provide acceptable outlets for any telecommunication device, which requires connection to other devices, networks or information services serving general university needs.

2. Products shall be as listed in this document or as directed by the Owner.

3. Installation procedures shall be in accordance with industry acceptable practices, product manufacturer's recommendations, federal, state and local codes and standards, and shall include demolition and removal of materials as required to support the work.

4. This section includes tools, materials, equipment and labor necessary to complete a turnkey installation, including but not limited to the following items, which will be supplied by contractor unless otherwise noted by the University:
    4.1. Cable trays, hangers, and mounting hardware
    4.2. Conduit
    4.3. Connecting blocks
    4.4. Cross connect cable
    4.5. Cross connect rings or spools
    4.6. Equipment racks, mounting hardware and wire management
    4.7. Labels for cables and receptacles
    4.8. Modular station receptacles
    4.9. Mounting brackets
    4.10. Fire Retardant plywood (preferred) or Fire Retardant Painted backboards
    4.11. Riser cable
    4.12. Station blocks
    4.13. Station cables
    4.14. Velcro Tie wraps, bushings, and miscellaneous

27.01.00 OPERATION AND MAINTENANCE

As a project nears Substantial Completion, telecommunications services must be ordered in a timely manner by the appropriate Indiana University representatives authorized to charge to the appropriate University accounts. The following is a representation of an average schedule for new construction on the Bloomington campus, to be adjusted as needed for individual projects. Other campuses should create a similar schedule that reflects their individual processes and contacts.

EXAMPLE: **BLOOMINGTON CAMPUS - Telecom Service Orders Schedule**

ORDERS & SERVICE ACTIVATION	WHO	TO	LEAD TIME	** Cable test results are required before circuits will be activated* NEEDED *
Provide updated port counts	Tel Consultant	UITS Construct Rep	6 weeks	before Substantial Completion
Analog (Voice) Line Activations	User	telecom.iu.edu/services	4 weeks	User specified date(s), Jack IDs, Test Results
Elevator Phone Voice Line(s)	IU Construct Mgr	telecom.iu.edu/services	3 weeks	before State Inspection, Jack ID(s), Test Results
Fire Alarm Voice Line(2)	IU Construct Mgr	telecom.iu.edu/services	3 weeks	before State Inspection, Jack ID(s), Test Results
**** Network switching equipment will NOT be installed until IDFs are secured**				
Telecom Room Locks & Cores	IU Construct Mgr	Facility Operations Lock Shop	1 week	before turnover of IDFs to UITS **
User Data Line Activations	IU Construct Mgr	telecom.iu.edu/services	3 weeks	User specified date(s), Jack IDs, Test Results
Emergency Phones Voice	IU Construct Mgr	telecom.iu.edu/services	3 weeks	before Building Occupancy
Emergency Phone Data/Camera	IU Construct Mgr	telecom.iu.edu/services	3 weeks	before Building Occupancy
Data based V-LAN Data Circuits, including:	IU Construct Mgr	phypltbl@indiana.edu *who will contact* bms-uiso@iu.edu	3 weeks	before needed, Jack ID(s), Test Results
MDF and IDF Door Control				
Lighting Control Circuits				
Fire Alarm Circuit				
Climate Controls				
Security Cameras				
Card Readers				
(for each, specify if a Static IP is required)				

27.02.00 REFERENCES

27.02.10 APPLICABLE CODES and STANDARDS

Telecommunication design shall comply with Federal and State codes, regulations, and standards with variances adopted as standards by Indiana University and the State of Indiana. Applicable state and national standards include the latest editions of:

1. ANSI/NFPA 70 National Electrical Code with Indiana Amendments, latest edition
2. BICSI CO-OSP Customer Owned Outside Plant Manual
3. BICSI Telecommunications Distribution Methods Manual
4. BICSI Customer Owned Outside Plant Design Reference Manual
5. TIA Standard TIA-230 Color Marking of Thermoplastic Wire
6. FCC Rules and Regulations
7. Indiana Administrative Code, Title 675, Article 22, Indiana Fire Prevention Codes
8. Joint Commission Accreditation of Hospitals Code
9. J-STD-607 Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
10. UL 467 Standard for Grounding and Bonding Equipment
11. National Electrical Code

12. National Electrical Safety Code
13. NFPA 101: Life Safety Code
14. RUS Standards for Engineering, Construction, and Installation
15. TIA 526-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant – OFSTP-7
16. TIA 526-14 Optical Power Loss Measurements for Installed Multimode Fiber Cable Plant – OFSTP-7
17. TIA 568 Commercial Building Telecommunications Cabling
18. TIA 569 Commercial Building Standard for Telecommunications Pathways and Spaces
19. TIA 598 Optical Fiber Cable Color Coding
20. TIA Standard ANSI/TIA-607 Commercial Building Grounding and Bonding Requirements for Telecommunications
21. TIA 604 Standards on Fiber Optic Connector Intermateability
22. TIA 606 Administration Standard for Commercial Telecommunications Infrastructure
23. TIA 758 Customer Owned Outside Plant Telecommunications Cabling Standard
24. TIA Telecommunication Systems Bulletin TSB67 - Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling Systems
25. TSB-140 Additional Guidelines for Field Testing Length, Loss and Polarity of Optical Fiber Cabling Systems
26. The "IU Building Telecommunications Design Guidelines" is part of the Division 27 specification

27**.03.00 DEFINITIONS**

1. OUTSIDE PLANT: Transmission facilities used in the distribution of voice, data, or video from point where it leaves one building and enters another, including copper, coax, fiber optics, and microwave.

2. ENTRANCE CABLE: The outside plant cable(s) that enter the building from the campus outside plant communication distribution network.

3. ENTRANCE FACILITY (telecommunications): An entrance to a building for both public and private network service cables (including antennae) including the entrance point at the building wall and continuing to the entrance room or space.

4. BACKBONE: A facility (e.g. pathway, cable or conductors) between telecommunications rooms, or floor distribution terminals, the entrance facilities, and the equipment rooms within or between buildings.

5. BACKBONE CABLE (Riser Cable): Cabling from the Building Telecommunication Equipment Room (see below) to each Floor Telecommunication Equipment Room (see below), including copper, coax, and fiber optics cabling.

6. MAIN BUILDING TELECOMMUNICATION EQUIPMENT ROOM (IDF-1/Building MDF): The main telecommunication room located where the university outside plant cabling and university backbone cabling (risers) are interconnected; in other words, the Entrance Facility for university network cabling.
    - 6.1. This room may also serve as a telecommunication equipment room (IDF-2, see below).
    - 6.2. For new construction and major renovations, the telecommunications equipment rooms shall not house systems other than telecom systems. Excluded systems include:
        - 6.2.1. non UITS servers
        - 6.2.2. security system monitors
        - 6.2.3. fire alarm monitors
        - 6.2.4. building IP camera monitoring systems
        - 6.2.5. audio systems
        - 6.2.6. mechanical systems conduit and components
        - 6.2.7. plumbing systems pipe, conduit and components

6.2.8. HVAC ducting and components
6.2.9. electrical equipment
6.2.10. door controller equipment other than that for IDF rooms 6.2.11. or any other systems requiring access by non-UITS personnel.

6.3. For smaller renovations, refer to "27.04**.50 GENERAL INSTALLATION"** section, to the Appendix "IU Building Telecommunications Design Guidelines", and special instructions provided in the specifications and plans.

7. TELECOMMUNICATION EQUIPMENT ROOM (IDF-2): A centralized space where telecommunications network equipment connects to backbone cable and station horizontal cabling.
   7.1. Telecommunication equipment rooms are normally provided a minimum of one per floor of a building.
   7.2. Floor equipment rooms must be located such that the cable length of any horizontal cable run shall not exceed 295 feet, wire length, termination to termination, and thus may require more than one telecommunication equipment room per floor.
   7.3. see also requirements listed under Item 6 (MDF) above.

8. STATION OUTLET BOX: The standard outlet box for telecommunications terminations shall be a double gang 5"x5"x2-7/8" minimum depth box, with mud ring sizes as required.

9. INFORMATION OUTLET: An assembly of interface ports for copper (data), coaxial (campus television), and fiber terminations (data); variations of arrangements are describe elsewhere in this document.

10. GROUNDING: See **27.05.26**

27**.04.00 EXECUTION**

27.04**.10 QUALITY ASSURANCE**

1. Contractor's management team shall have demonstrated compliance with all applicable Indiana University UITS installation requirements as a prime contractor or subcontractor on no less than three (3) Indiana University projects.
   1.1. The Contractor bears the burden of installing the telecommunications infrastructure described in the University specifications in such a manner that the final product is fully usable in the manner for which it is intended; that an installation merely meets the letter of the specifications is neither sufficient nor acceptable.
   1.2. The telecommunications contractor/subcontractor must be capable to and must perform all work on the telecommunications systems for which they are responsible, including testing and corrections, but excluding pathways which fall under the responsibilities of a separate electrical contractor/subcontractor.
   1.3. The University may, at its discretion, require the names, previous project list, and references for the Contractor's management team and field personnel assigned to this project prior to the start of the work.
   1.4. The University maintains the right to ask for replacement of management or field staff at any time during the project.

2. All cabling shall meet ANSI/TIA-568.

3. Termination and testing of the telecommunication cabling shall be performed by a certified BICSI ITS Installer 2 Optical Fiber or ITS Technicians. It is required for technicians to be BICSI certified and have experience with Category 6 (e or A as applicable) installation.
    3.1. At the initial award of this contract and onsite during construction and installation, at least one technician must be an ITS Installer 2 Optical Fiber and or ITS Technician.
        3.1.1. Prior to final award of apparent low bidder, first and last name of certified personnel with appropriate certificates will be required as documentation.
        3.1.2. Contractor shall provide certified personnel for the duration of the project, if substitution is required, the appropriate certificates shall be supplied.
    3.2. All work shall follow NEC 2011, TIA Standards and follow BICSI installation practices.
        3.2.1. Short cuts to any BICSI installation practices or NEC requirements will not be accepted unless previously authorized by a designated University representative in writing and shall be reworked at the contractor's expense.
        3.2.2. This will include installing racks, overhead runway, patch panels, horizontal cable, fiber cable, grounding, termination blocks, and removal of dead and abandoned cabling and equipment. The cabling will include horizontal voice and data, thick net, thin net, coax, IBM cabling, fiber and any other dead or abandoned cables within the work area.
    3.3. The contractor shall employ on onsite Building Industry Consulting Service International (BICSI) certified project manager for the telecom work.
    3.4. Vendors and contractors shall employ a BICSI Registered Communications Distribution Designer (RCDD).
        3.4.1. The Vendor shall provide the name and stamp number of the RCDD assigned to this project to the appropriate UITS representative.
        3.4.2. The RCDD shall approve construction design and upon completion of installation, certify compliance with the standards and installation practices as specified by this document.

4. Prior to commencing the work of this section, the telecommunication contractor shall convene a meeting with Construction Manager, University Information Technology Services representative, and the consulting design engineer's representative.
    4.1. The meeting will cover Project Specifications, Addendum, Change orders, IDF layouts, labeling, and other project work, documents and site conditions.
    4.2. System testing procedures and requirements shall be confirmed at this time.
    4.3. Test report forms and schedules shall be provided for University review.
    4.4. Inspection milestones will be set and notifications scheduled.
    4.5. Meeting minutes will be distributed and will include agreements, action items and responsible party(s), for this meeting and for future meetings when required.

5. Store materials and equipment in dry, environmentally controlled space. Do not install equipment and materials until spaces are enclosed, watertight, and dry. Protect equipment from dust and other airborne materials.

6. Contractor's regular job progress meetings with the Construction Manager and other university representatives shall include a University Information Technology Services telecommunications representative.

7. The Contractor shall perform all work according to University plans and specifications, manufacturers' specifications where given, and according to best industry practices otherwise.

8. University *Inspect*ion: Indiana University will provide advising as requested.
    8.1. The Office of University Information Technology Services *may inspect* the job as it progresses.
    8.2. Prior to final acceptance of the work, the Contractor (electrical/telecom) shall make arrangements with the appropriate authorized University personnel to *inspect* the construction areas, both to

ensure satisfactory completion of the work and to ensure complete cleanup and restoration of areas affected by the work.

8.3. Temporary protection, coverings, and structures must be removed at or before time of *inspect*ion.

8.4. Examine areas and conditions with the Installer present for compliance with requirements and other conditions affecting the performance of telecommunication transmission media.

8.5. Areas such as ceilings, which will be enclosed permanently (ie, drywall) or accessible (ie, lay-in ceilings), and which contain telecommunications cabling, **must** be inspected by the appropriate University UITS representative before enclosure; if not, enclosing materials will be removed and replaced for inspection at no extra cost to the University.

8.6. Do not proceed with work until unsatisfactory conditions are corrected in a manner acceptable to the appropriate University personnel.

27.04**.20 SUBMITTALS**

1. Submit **shop drawings** and/or **manufacturer's product data** for telecommunications equipment, including termination equipment, copper cables, fiber optic cables, cable routing devices, and associated equipment and materials.
    1.1. Include cut sheets with rated capacities, operating characteristics, electrical characteristics and other measurements and descriptions that describe these items in detail.

2. Submit **manufacturer's test reports** and **test data** for each of the fiber optic cables installed.
    2.1. The test reports must clearly identify which fiber corresponds with the respective test measurement data so that the results can be verified prior to installation of the cable.

3. Submit a **schedule of material** and an **installation schedule** based on the construction schedule and construction phasing, to the Architect/Engineer, within three (3) weeks after contract award.

4. Submit qualifications data for material installers, supervisors, and the project RCDD (Registered Communications Distribution Designer).

5. Submit completed **cable records**, including floor plans, riser diagrams, manhole diagrams, footages on any cable other than horizontal cabling, and jack id's by location.

6. Submit **test reports** to the Owner's Representative for approval.
    6.1. Include in the test reports the test data taken and converted values.
    6.2. Prior to submittal for approval, have test reports signed by authorized witnesses present at tests.
    6.3. Submit electronic final copies of approved test reports in tester native format to the Owner's representative.
    6.4. No telecommunications services will be provided until verified reports are submitted, reviewed, and found to be acceptable by the appropriate University Information Telecommunication Services (UITS) representative.

7. *In addition to UITS, submit electronic copies of the submittal to the prime consultant (i.e. architect) in order to process and track the submittals properly in accordance with Division 1 and 26 submittal requirements. Architects and consultants are to submit all submittals and RFI's to consultant electronically. Send to:*
    7.1. *Constuctionadministration@kbsoconsulting.com*

27.04**.30 DELIVERY, STORAGE and HANDLING**

1. Deliver wire and cable properly packaged in factory-fabricated type containers, or wound on NEMAspecified type wire and cable reels.

2. Store wire and cable in clean dry space in original containers, following manufacturer's storage guidelines. Protect products from weather, damaging fumes, construction debris and traffic.

3. Handle wire and cable carefully to avoid abrading, puncturing, kinking, and tearing wire and cable insulation and sheathing. Ensure that dielectric resistance and characteristic impedance integrity of transmission media are maintained.

27.04**.40 SEQUENCING and SCHEDULING**

1. Coordinate installation of wires/cables with installation of electrical boxes and fittings, cable trays, and raceways.

2. Sequence installation of optical-fiber cabling systems with other work to minimize possibility of damage during construction.

3. Interruptions to existing voice, data and video systems should be avoided where at all possible.
    - 3.1. If it becomes necessary to interrupt voice and/or data network services, then such interruptions must be approved by and scheduled with UITS Change Management.
    - 3.2. Approval is gained by submitting an MOP (Method of Procedure) to the UITS project contact person, containing the following information:
        - 3.2.1. Detailed account(s) of the work to be performed
        - 3.2.2. Proposed outage time(s)
        - 3.2.3. Estimated service restoral time(s)
        - 3.2.4. A contingency plan in case the work takes longer than anticipated, or doesn't go as scheduled.
    - 3.3. Change Management meetings are held on Wednesday of each week
        - 3.3.1. The MOP should be submitted to the UITS project contact person no later than 4:00 pm on the Tuesday of the week in which the work is to be performed.
        - 3.3.2. Outages and associated work should be performed outside of peak hours, such as on weekends, or after 5:00 pm and before 7:00 am during the week.
        - 3.3.3. Actual time(s) first should be approved by the parties affected by the outage(s).
        - 3.3.4. No outages may be scheduled during the first two weeks of a fall or spring semester, during which time there is a "Change Freeze" period.
    - 3.4. Approval from UITS Change Management must be granted before any scheduled outages can be performed.
        - 3.4.1. If the outage is disapproved, then an updated MOP will need to be resubmitted on the following Tuesday, to be reviewed the following day.
    - 3.5. Contractors are solely responsible for:
        - 3.5.1. making all necessary access arrangements in ample time before the work begins.
        - 3.5.2. notifying the affected parties of the scheduled outage(s).
        - 3.5.3. notifying repair@indiana.edu
    - 3.6. Interruptions to video systems should be coordinated with the IU Building Systems division at http://www.indiana.edu/~phyplant/building_systems.html and reported to repair@indiana.edu.

4. When new IDF's are constructed as part of the project, communications work must be completed, tested and accepted four (4) weeks in advance of the substantial completion date, to ensure that necessary communications circuits will be available for required building systems such as elevator phones, environmental systems monitoring and security systems.
    4.1. This includes all IDF associated electrical, HVAC, and door lock systems, as well as riser and outside plant copper and fiber cables, as necessary to allow the permanent installation of voice grade circuits and data network equipment.

27.04**.50 GENERAL INSTALLATION**

1. In new construction and major renovations, telecom rooms must be clear of mechanicals such as ventilation ducts, water, sewer, or steam pipes, and high voltage electric.
    1.1. In smaller renovations and older construction, where it is not possible to remove any or all of these systems, work should be coordinated with the University Architect's Office in order to meet all requirements necessary to ensure safety, security, and proper network system operation.

2. No cable shall be installed in any facilities other than those intended for that use.
    2.1. Gas pipe and water pipes must not be used for conduit under any circumstances.

3. Install telecommunication transmission media as indicated, in accordance with manufacturer's written instructions, in compliance with applicable requirements of NEC, and in accordance with recognized industry practices.

4. CMP (Plenum) type cable will be used for all telecommunications cables.

5. Coordinate transmission media installation work, as necessary to properly interface installation of media with other work.

6. Do not install compressed, kinked, scored, deformed or abraded cable, or allow such damage to occur.
    6.1. Damaged materials shall be removed from the job site immediately.

7. Use extreme care in handling, fishing, and pulling-in transmission media to avoid damage to conductors, shielding and jacketing/cladding.
    7.1. Use pulling means including fish tape, cable, rope, and basket weave wire/cable grips, which will not damage media or raceway.
    7.2. If power equipment is used to pull cable, the pull speed must not exceed 30 meters per minute.
    7.3. Use water based lubricant approved by the cable manufacturer to ensure manufacturer's pulling tensions are not exceeded.
        7.3.1. Compound used must not deteriorate conductor or insulation.
    7.4. Cable bending radii must not be exceeded.
    7.5. Pulling methods must not cause cable to twist.
    7.6. Cables pulled through pull boxes shall be hand assisted to prevent the cable from being crushed, kinked, or scraped.

8. Provide pull strings in telecommunication conduit.
    8.1. To facilitate future cable installations, install a nylon pull cord in each conduit simultaneously with the pull-in of cable.

9. Pull conductors simultaneously where more than one is being installed in same raceway.

10. Splices in building media runs are **NOT** permitted.
    10.1. Building wiring must be continuous and undamaged from outlet to connecting block or connecting block to connecting block.

11. Terminations shall be made with the manufacturer's stated tools and in accordance with manufacturer's instructions and guidelines.

12. Tighten connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque-tightening values. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals to comply with tightening torque specified in UL Std.

13. When necessary within IDFs, horizontal Station cables shall be secured with Velcro tie wraps. Outside Fiber and Copper Entrance shall be secured with standard tie wraps. Observe the manufacturer's recommendations for distances between tie wraps and tightening tension from tie wraps and as specified in ANSI/TIA-568.
    13.1. Outside of IDFs, horizontal cabling, entrance cables, and riser cables must be installed within industry standard pathways, such as cable tray, J hooks, and rigid metal conduit or EMT.

14. Cables shall be permanently identified at each end with an industry approved label.

15. All wall penetrations for telecommunications cabling must be firestopped, either sleeved with bushings at each end and plugged with removable/reusable firestopping material that has a minimum 2 hour rating, with EZ Path Fire-Rated Pathway, or in accordance with other architectural details, unless otherwise noted.
    15.1. Cables must not be installed through unsleeved holes drilled through walls.
    15.2. Comply with Division 07 requirements for Firestopping.
    15.3. Comply with TIA 569 on Firestopping.
    15.4. Comply with UL1479 or ASTM E814, and label with the UL1479 or ASTM E814 reference number.
    16.1. The 2017 NEC, Article 770, Article 800, and Article 820 warns that paint, plaster, cleaners, abrasives, corrosive residues, or other contaminants may result in the alteration of communications cable properties, and therefore must under no circumstances be purposefully or inadvertently applied to communications cables.
    16.2. If any such contaminants are applied to communications cables, then without exception either during construction or as a warranty repair, the affected cables must be removed and replaced immediately with new cables according the specifications of this document, and at no cost to the University.

17. For remodels and renovations in which jacks and/or station wire are to be removed or abandoned:
    17.1. The jack/ports must be removed from the station end and the outlet covered with a blank plate,
    17.2. The station wire/cabling must be removed in its entirety from the jack location to the telecommunications equipment room (IDF), and
    17.3. The jack/port label(s) must be removed from the jackfield(s); if the associated jack/port is less than the current standard station wire Category rating, then the jack/port should also be removed from the jackfield.

27.04**.60 TESTING and DOCUMENTATION**

1. **General**
    1.1. Acceptance testing shall be completed and documentation provided to the University as soon as possible in order to permit the installation of networking equipment necessary to bring the building online for security and equipment monitoring systems.

2. **Testing**
   - 2.1. Acceptance testing by the University shall not occur until all work in the telecommunication closet area is completed, including but not limited to mounting and installation of fiber OSP and riser cables, backboards, terminating boxes and cabinets, and grounding blocks, and termination of fiber riser cables, copper backbone cables, station wires, or any other work necessary for the completion of the installation.
   - 2.2. The University shall have the right to schedule acceptance testing at its convenience.
   - 2.3. A University representative, at the option of the University, shall be present during testing.
   - 2.4. Such acceptance testing shall in no way reduce the Contractors' obligations regarding restoration, cleanup, or warranty.
   - 2.5. The telecommunications contractor/subcontractor shall perform tests necessary prior to acceptance testing to ensure that the installed cables will pass acceptance testing performed in conjunction with University representatives.
     - 2.5.1. Acceptance testing includes verifying that each cable and conductor is properly labeled and in agreement at each end, also known as continuity testing.
     - 2.5.2. As such, the telecommunications contractor/subcontractor's personnel must perform their own testing; subcontracting testing to an outside entity is not permitted.
   - 2.6. Contractor shall be responsible for performing, tracking, and recording the results of tests.
   - 2.7. Contractor shall be responsible for providing equipment and materials necessary for as long a period of time as necessary to complete testing to the satisfaction of the University.
   - 2.8. The University must agree to test record forms and methods prior to the commencement of acceptance testing.

3. **Documentation**
   - 3.1. Provide record plant documentation, including jack type (Information outlet), jack location, circuit length, fiber riser cable lengths, and copper backbone cable lengths and any other information deemed to be useful.
     - 3.1.1. Additionally, provide a list of all existing jacks removed during project demolition phase(s).
   - 3.2. The documentation format(s) will be agreed upon between the campus telecommunication coordinator and the contractor.
     - 3.2.1 Provide all documentation in University approved electronic format.
     - 3.2.2. If it is agreed to use proprietary software to provide testing results, the contractor will be required to furnish licensed system software to run it unless the University already has a licensed version of the contractor's software.

27.04**.70 RECORD DRAWINGS**

1. Provide updated drawings of telecommunications systems in CAD format.

2. As a minimum, the data provided must include the following elements, where applicable:
   - 2.1. **Inside Plant**
     - 2.1.1. Cable routing.
     - 2.1.2. Riser and OSP cable, pair (count), locations, and final cable lengths.
     - 2.1.3. Supporting structures.
     - 2.1.4. Terminal locations and IDs.
     - 2.1.5. Telecommunications Room and terminal details.
     - 2.1.6. Conduit and cable tray routing, elevations installed at and section lengths.
     - 2.1.7. Pull box locations, elevations installed at and sizes.
     - 2.1.8. Information Outlet locations, label ID's, types, and serving Telecommunications Room

2.1.9. For each change reflected on the Record Drawings, the Change Order Request number shall be shown.

2.2. **Substantial Completion Requirement**

2.2.1. One month before the contractual Substantial Completion date, Contractor shall provide updated floor plans showing all known Information Outlets in contractually affected areas to be working at time of Substantial Completion, with actual jack label IDs and port counts.

2.2.2. These floor plans are for use by University groups for coordinating FF&E, employee location assignments and telecommunications service orders, as well as testing documentation and verification.

2.3. **Outside Plant** (provide on an accurate and scaled site plan)

2.3.1. Location of underground routes, indicating type (conduit, direct buried, etc.) and quantities.

2.3.2. Location of manholes and handholes.

2.3.3. Deviations from minimum depth requirements.

2.3.4. XYZ coordinates from 'permanent' landmarks.

2.3.5. Footages of conduit between maintenance holes.

2.3.6. Crossings of other utilities uncovered, including type and size of utility.

2.3.7. Location of outdoor emergency phone with conduit routing

27.04**.80 WARRANTY**

1. The warranty on labor and material installed by the Contractor shall be in effect for Five (5) years from the date of acceptance of the work.

2. Contractor shall repair, adjust, and/or replace, whichever the University determines to be in Its best interests, any defective equipment, materials, or workmanship, as well as such parts of the work damaged or destroyed by such defect, during warranty period, at the Contractor's sole cost and expense.

3. In the event that any of the equipment specified, supplied, and/or installed as part of the work should fail to produce capacities or meet design specification as published or warranted by the manufacturer of the equipment involved or as specified in this document, the Contractor shall, in conjunction with the equipment manufacturer, remove and replace such equipment with equipment that will meet requirements without additional cost to the University.

4. In the event that the Contractor does not affect repair within seven (7) days from the date of notification of such defect, the University may secure repair services from other sources and charge the Contractor for such costs without voiding the warranty.

5. Guarantees of material, equipment, and workmanship running in favor of the Contractor shall be transferred and assigned to the University on completion of the work and acceptance of said work by the University.

27**.05.00 COMMON WORK RESULTS**

27.05**.05 SELECTIVE DEMOLITION**

Not Applicable

27.05**.09 RELATED SECTIONS**

Section 26 – Common Work Result for Electrical

Section 26 – Low-Voltage Electrical Power Conductors and Cables

Section 26 – Grounding and Bonding for Electrical Systems Section 26 – Hangers and Supports for Electrical Systems

Section 26 – Raceway and Boxes for Electrical Systems Section 26 – Cable Trays for Electrical Systems

27.05**.26 GROUNDING and BONDING**

1. Products specified in this Section shall be manufactured by a company with a minimum of three years' documented experience specializing in manufacturing such products.

2. **DEFINITIONS** (additional–see also **27.03.00**)
    - 2.1. **Bonding**: The permanent joining of metallic parts to form an electrically conductive path that will assure electrical continuity and the capacity to conduct safely any current likely to be imposed. All exposed metal parts of the telecommunications system which are not intended to carry current must be bonded to the CBN (Ground Electrode System).
    - 2.2. **Common Bonding Network (CBN)** (Ground Electrode System): Per ANSI T1.333-2001, a CBN is the principal means for effecting bonding and grounding inside a telecommunication building. It is the set of metallic components that are intentionally or incidentally interconnected to form the principal bonding network (BN) in a building. These components include structural steel or reinforcing rods, plumbing, alternating current (ac) power conduit, ac equipment grounding conductors (ACEGs), cable racks, and bonding conductors. The CBN always has a mesh topology and is connected to the grounding electrode system.
    - 2.3. **EMI** (Electromagnetic Interference) - The interference in signal transmission or reception resulting from the radiation of electrical or magnetic fields.
    - 2.4. **Exothermic Weld**: A method of permanently bonding two metals together by a controlled heat reaction resulting in a molecular bond.
    - 2.5. **Ground**: A conducting connection, whether intentional or incidental, between an electrical circuit or equipment and the earth, or to some conducting body that serves in place of the earth.
    - 2.6. **Grounding Electrode Conductor**: The conductor used to connect the grounding electrode to the equipment grounding conductor, to the grounded conductor, or to both, of the circuit at the service equipment, or at the source of a separately derived system.
    - 2.7. **Mesh Bonding Network (Mesh-BN)**(Ground Electrode System): A bonding network to which all associated equipment (e.g., cabinets, frames, racks, trays, pathways) are connected using a bonding grid, which is connected to multiple points on the common bonding network.
    - 2.8. **Primary Protector**: A surge protective device placed on telecommunications entrance conductors in accordance with ANSI/NFPA 70 and ANSI/ATIS 0600318. and listed under ANSI/UL 497.
    - 2.9. **Telecommunications Main Grounding Busbar (TMGB)**: A busbar placed in a convenient and accessible location within the Building Telecommunication Main Equipment Room (IDF-1) which is in compliance with J-STD-607, and serves as a common point of connection for telecommunications system and equipment bonding to ground, as well as the common point of connection between other major building grounds and the Mesh Bonding Network (Ground Electrode System).
        - 2.9.1. shall be pre-drilled copper or electro-tin plated busbar with holes to accommodate lug mounting holes, listed by a nationally recognized testing laboratory (NRTL).

2.9.2. shall be 0.25” thick x 4” wide with length sized for current applications and future growth.
2.9.3. shall be located to minimize ground wire lengths.
2.9.3.1. The TMGB mounting location shall be coordinated with University Information Technology Services representative and University electrical engineer.
2.9.4. shall be mounted at 18 inches above the floor in a location out of the way of other equipment.
2.9.5. shall be mounted to maintain a two (2) inch minimum clearance from the wall, using stand-off insulators that comply with UL 891 for use in switchboards, 600V, made of Lexan or PVC impulse tested at 5000V.
2.9.6. shall be installed with clearances as required by applicable codes.
2.9.7. shall be mounted as close as practical to an electrical power panel if located in the same room, but no closer than 36” to a power panel or active electronics.
2.9.8. Unplated busbars shall be cleaned and have antioxidant applied before attaching grounding conductors. 2.9.9. shall have connections made with exothermic welding or two-hole compression lugs with a two-crimp minimum.
2.9.10. shall be bonded the building ground system ground or building structural steel with a copper ground wire of not smaller gauge than that used for the Telecommunications Bonding Backbone (TBB).
2.9.11. shall be bonded to the Alternating Current Electrical Ground (ACEG) with a copper ground wire of not smaller gauge than that used for the Telecommunications Bonding Backbone (TBB).
2.9.12. shall be bonded to any electrical panelboards that occupy the same room using a minimum #6 AWG copper conductor with a maximum length of 13 feet.
2.9.13. All ungrounded telecommunications racks and metallic raceways in the same room as the TMGB shall be bonded to the TMGB (see TEBC).
2.9.14. Telecommunications equipment racks shall have a grounding busbar connected to the TMGB.
2.9.15. Other connections to the TMGB include:
2.9.15.1. Primary protector
2.9.15.2. Outside plant cables
2.9.15.3. Backbone cables which contain a shield or metallic member
2.9.15.4. All metallic pathways for the telecommunications cabling located within the same room or space as the TMGB.
2.9.15.5. Cable tray
2.9.15.6. Ladder rack
2.9.15.7. Telecommunications equipment
2.9.15.8. TBB
2.9.15.9. TEBC
2.9.15.10. Primary protector grounding conductor, maintaining a minimum of 1 foot separation between this insulated conductor and any dc power cables, switchboard cable, or high frequency cables, even when placed in rigid metal conduit or EMT.

2.10. **Telecommunications Grounding Busbar** (**TGB**): A busbar placed in a convenient and accessible location within a Floor Telecommunication Equipment Room (IDF-2) that is in compliance with J-STD-607, and serves as a common point of connection for telecommunications system and equipment bonding to ground.
2.10.1. shall be pre-drilled copper or electro-tin plated busbar with holes to accommodate lug mounting holes, listed by a nationally recognized testing laboratory (NRTL).
2.10.2. shall be 0.25” thick x 2” wide with length sized for current applications and future growth.
2.10.3. shall be located to minimize ground wire lengths.
2.10.3.1. The TGB mounting location shall be coordinated with University Information Technology Services representative and University electrical engineer.

2.10.4. mount at 18 inches above the floor in a location out of the way of other equipment.
2.10.5. shall be mounted to maintain a two (2) inch minimum clearance from the wall, using stand-off insulators that comply with UL 891 for use in switchboards, 600V, made of Lexan or PVC impulse tested at 5000V.
2.10.6. shall be installed with clearances as required by applicable codes.
2.10.7. shall be mounted as close as practical to an electrical power panel if located in the same room, but no closer than 36" to a power panel or active electronics.
2.10.8. Unplated busbars shall be cleaned and have antioxidant applied before attaching grounding conductors.
2.10.9. shall have connections made with exothermic welding or two-hole compression lugs with a two-crimp minimum.
2.10.10. shall be bonded to any electrical panelboards that occupy the same room using a minimum #6 AWG copper conductor with a maximum length of 13 feet.
2.10.11. All ungrounded telecommunications racks and metallic raceways in the same room as the TGB shall be bonded to the TGB (see TEBC).
2.10.12. Telecommunications equipment racks shall have a grounding busbar connected to the TGB.

2.11. **Telecommunications Equipment Bonding Conductor** (**TEBC**): A conductor or conductors that connect the telecommunications main grounding busbar (TMGB) or telecommunications grounding busbar (TGB) to equipment racks and cabinets.
2.11.1. shall be a continuous copper conductor sized according to the conductor table under TBB.
2.11.2. shall be separated from ferrous materials by 2 inches, or be bonded to the ferrous material.
2.11.2.1. may be routed within cable trays, or suspended 2 inches under or off the side of a cable tray or ladder rack.
2.11.3. shall be supported every 3 feet.
2.11.4. shall be installed with a minimum of 8-inch bend radii of no more than a 90 degree bend.
2.11.5. may contact other cable groups at a 90 degree angle only.
2.11.6. Metallic cable shields may not be used as a TEBC.
2.11.7. Includes RBCs and UBCs.

2.12. **Telecommunications Bonding Backbone** (**TBB**): A conductor that interconnects the Telecommunications Main Grounding Busbar (TMGB) in the MDF/IDF-1 to Telecommunications Grounding Busbars (TGBs) in the IDF-2(s).
2.12.1. The intended function of a TBB is to reduce or equalize potential differences between telecommunications systems; while the TBB will carry some current under ac power ground fault conditions, it is not intended to provide the only ground fault return path.
2.12.2. The TBB shall be constructed with copper ground wire solid or stranded, insulated or uninsulated as approved the University, and sized according to length, as detailed in J-STD-607, shown below:

WIRE LENGTH	WIRE SIZE (AWG)
<4 m / < 13 ft	6
4-6 m / 14-20 ft	4
6-8 m / 21-26 ft	3
8-10 m / 27-33 ft	2
10-13 m / 34-41 ft	1
13-16 m / 42-52 ft	1/0
16-20 m / 53-66 ft	2/0
> 20 m / > 66 ft	3/0

2.12.3. As sized above, a continuous ground wire shall be run from the TMGB in the outside plant cable entrance telecommunications room (MDF/IDF-1/BDF) to the TGB in the highest/last IDF in each of any stacks of IDFs; the TGB in each intermediate IDF in a given stack shall be H-tapped to the continuous grounding riser/TBB.

2.12.3.1. Connections to the Conductor shall be made with irreversible compression connectors.

2.12.3.2. Taps shall be UL & CSA listed.

2.12.3.3. Taps shall be able to accept 6 AWG to 3/0 AWG.

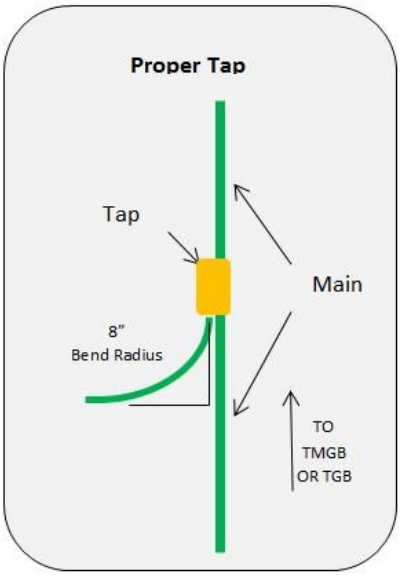
2.12.3.4. Taps shall have a traceable feature to ensure proper die size was used to make the crimp.

2.12.3.5. Taps require a minimum of (2) crimps for C Tap and H Tap, 1 crimp for I-Beam and busbar Tap.

2.12.3.5.1. Crimp according to manufacturer's recommendation.

2.12.3.6. Minimize the amount of insulation removed for installing the compression connector.

2.12.3.7. Taps shall be installed as shown in the following diagram:



2.12.4. TBB conductors should be installed in metal conduit for protection and ease of replacement everywhere inside the building, except as follows:

2.12.4.1. inside MDF/IDF rooms.

2.12.4.2. between stacked MDF/IDF rooms where the sleeve through the floor is less than three (3) feet.

2.12.5. TBB conductors in metal conduit must utilize grounding bushings at both conduit ends.

2.12.6. Multiple TBB runs may be required as dictated by building size and layout.

2.12.7. Metallic cable shields may not be used as a TBB.

2.13. **Grounding Equalizer (GE)**: A bonding conductor that interconnects TGBs on the same floor, top floor, and every third floor of a multistory building (formerly TBBIBC).

2.13.1. The GE shall be sized according to the conductor table under TBB.

2.13.2. Metallic cable shields may not be used as a GE.

2.14. **Rack Bonding Conductor (RBC)**: A bonding conductor used to connect the rack/cabinet directly to the TMGB/TGB/Mesh.

2.14.1. Metallic enclosures, including telecommunications cabinets and racks, shall be bonded to the meshBN, TGB, or TMGB using a minimum sized conductor of No. 6 AWG.

2.14.2. Cabinets, racks, and other enclosures in computer rooms must not be bonded serially; each shall have their own dedicated bonding conductor to the mesh-BN, TGB, or TMGB

2.15. **Unit Bonding Conductor** (**UBC**): A bonding conductor used to connect a rack/cabinet mounted equipment unit to the grounding structure (i.e. conductor, busbar) utilized in that rack/cabinet.

2.16. **Electrical Distribution Panel (EDP**): In existing room installations only; new construction must not have EDPs located in the same room as telecommunications equipment.

2.16.1. When located in the same room as the TMGB/TGB the EDP's equipment grounding bus or the panel board enclosure shall be bonded to the TMGB/TGB.

2.16.2. Using a bonding conductor for telecommunications (BCT) minimum 6 AWG to a maximum of 3/0 AWG depending on the length of cable required.

2.16.2.1. BCT should be installed in metal conduit for protection and ease of replacement everywhere inside the building, except as follows:

2.16.2.1.1. inside MDF/IDF rooms.

2.16.2.1.2. between stacked MDF/IDF rooms where the sleeve through the floor is less than three (3) feet.

2.16.2.2. BCT in metal conduit must utilize grounding bushings at both conduit ends.

2.16.3. Use same AWG as TBB.

2.16.4. A qualified electrician shall make all connections within an ac electrical panel.

2.16.5. Outside of the scope of ANSI/TIA-607B.

2.17. **Conductive Cables** contain metallic components that are capable of transmitting current.

2.17.1. Conductive cables should be bonded and grounded as specified in NEC Article 770.100.

2.17.2. Fiber optic cables may be conductive or non-conductive.

2.17.3. Telecommunications cables with metallic sheath members shall be bonded together at splices with a #6 solid or stranded copper ground wire and bonded to the TMGB or TGB.

2.17.4. Cable shields (of cables not installed in ferrous metal conduit elsewhere grounded) shall be grounded to a tested and proven earth ground within 50 feet of entering any building with an independent #6 solid or stranded copper ground wire or other electrically equivalent method as approved by the University.

2.18. **Ladder Rack and/or Cable Tray Potential Equalization** is achieved when all cable runway sections are bonded together and bonded back to the TMGB or TGB in a Telecommunications Room.

2.18.1. Maintain an 8” Bend Radius on the TEBC

2.18.2. Keep a 2” separation from other cables, power and telecommunications

2.18.3. Remove any paint, oxidation, etc. from the runway surfaces that are being bonded

2.18.4. Drill two holes as required to accommodate the 2-hole compression lug

2.18.5. Apply a thin coat of antioxidant around the holes and on the surface where the lug will be in contact.

2.18.6. Attach straps to the runway using stainless steel hardware sized for the lug holes.

2.18.7. Tighten the hardware

2.18.8. Wipe off any excess antioxidant after installation of the lug.

3. **Labeling of Telecommunication Grounding System**

3.1. The format for the telecommunications main grounding busbar shall be FS-TMGB, while the format for the TGBs shall be FS-TGB.

3.1.1. FS is the TS identifier for the space containing the busbar; Floor & space

3.1.2. TMGB is the portion of an identifier designating a telecommunications main grounding busbar;

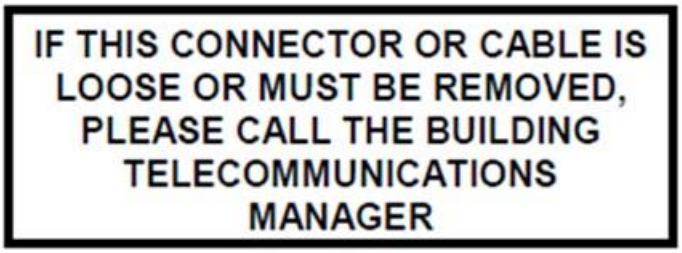
3.1.3. TGB is the portion of the identifier designating a telecommunications grounding busbar.

3.2. Each telecommunications space or room shall be assigned an identifier unique within the building.

3.2.1. The TS shall be labeled with the TS identifier inside the room so as to be visible to someone working in that room.

3.2.2. The TS identifier shall have a format of FS.

3.3. All busbars and cables will have the following label attached in a visible location and in a readable format:



4. **Testing of Telecommunication Grounding System**

4.1. Testing shall be performed with an earth ground resistance tester, and not a standard Volt-Ohmmultimeter.

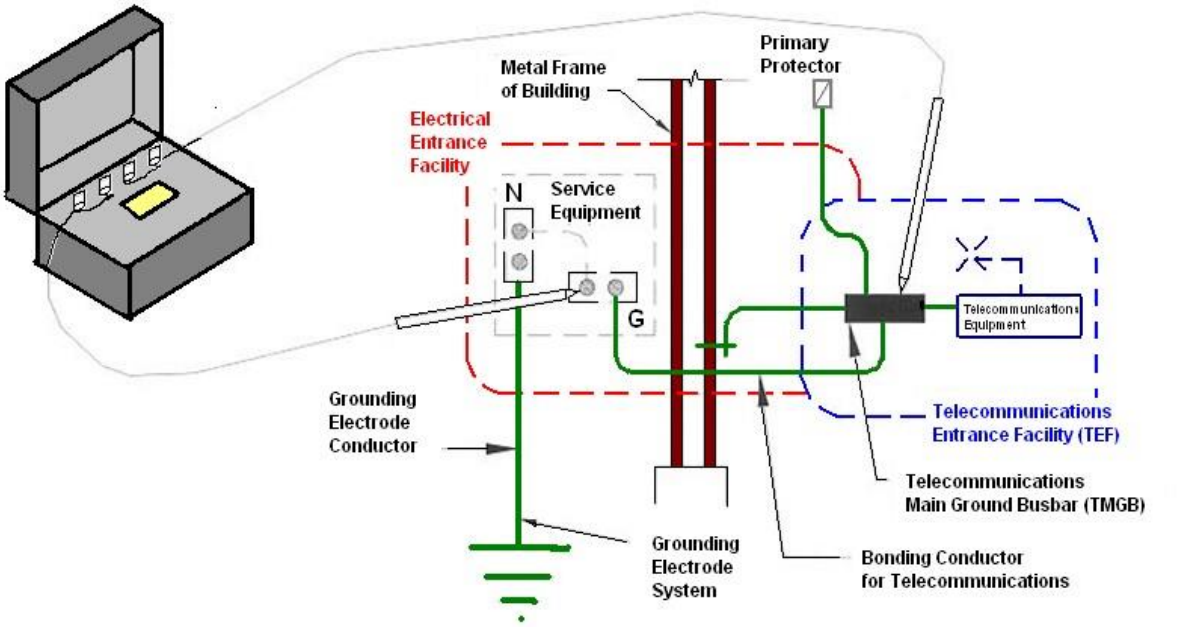
4.1.1. Perform two-point ground continuity testing.

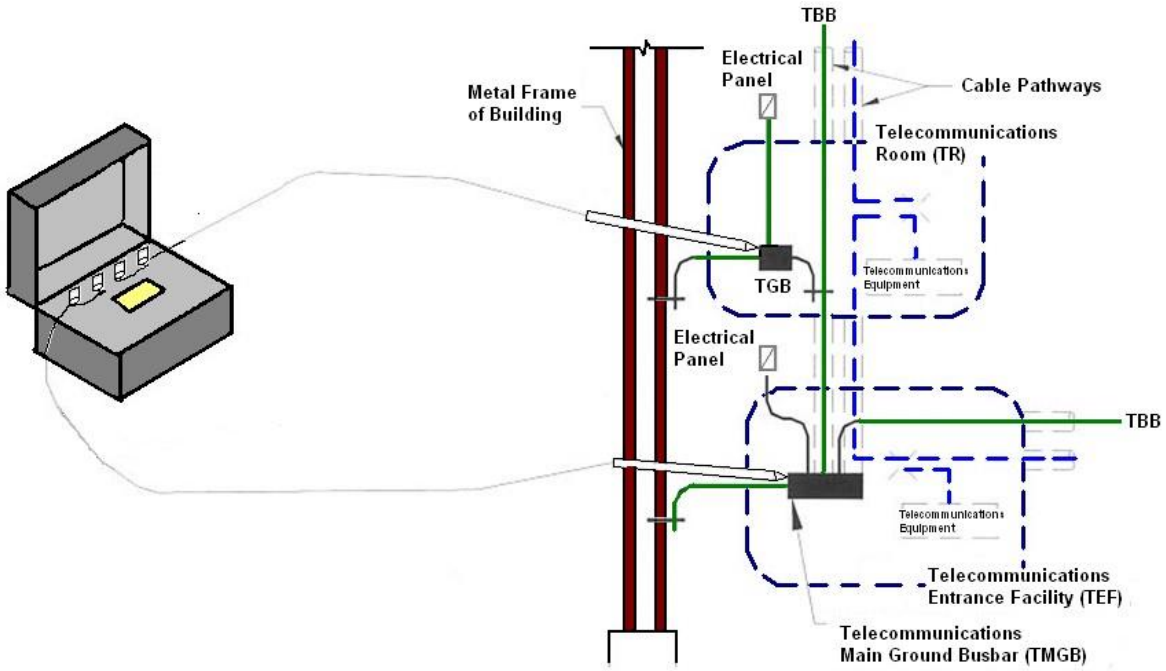
4.1.2. Maximum value 100 milliohms.

4.1.3. Follow manufacture instructions on setup and how to perform the test.

4.1.4. Care should be taken and safety precautions in place.

4.1.5. Record and submit ground test results.





27.05.**28 PATHWAYS**

1. **Cable paths must be designed and installed in a manner which allows reasonable access to add or remove cables for future demand and maintenance purposes, including capacity for future growth.**
    1.1. It is the financial responsibility of the contractor to install sufficient pathway capacities to meet the requirements stated in the following sections 27.05.**33,** 27.05.**36,** 27.05.**39** and 27.05.**43.**
    1.2. It is the responsibility of the contractor to install pathways which upon project completion will remain readily accessible by telecommunication cable installers.

2. **Separation from EMI sources:**
    1.3. Open cables and cables in nonmetallic raceways and unshielded power:
        1.3.1. Electrical less than 2 kVa 5 inch minimum
        1.3.2. Electrical 2 to 5 kVa 12 inch minimum 2.1.3. Electrical greater than 5 kVa 24 inch minimum
    1.4. Cables in grounded metallic raceways and unshielded power:
        1.4.1. Electrical less than 2 kVa 2-1/2 inch minimum
        1.4.2. Electrical 2 to 5 kVa 6 inch minimum
        1.4.3. Electrical greater than 5 kVa 12 inch minimum
    1.5. Cables in grounded metallic raceways and shielded power:
        1.5.1. Electrical less than 2 kVa 1 inch minimum
        1.5.2. Electrical 2 to 5 kVa 3 inch minimum 2.3.3. Electrical greater than 5 kVa 6 inch minimum
    1.6. Cables and electrical motors and transformers 5 kVa or larger 48 inches
    1.7. Cables and fluorescent fixtures 5 inches

27.05.**29 HANGERS and SUPPORTS**

1. Hanger and supports must be NRTL (Nationally Recognized Testing Laboratories) labeled for support of Category 6A cabling.

2. J-hooks shall be installed where no provisions for cabling runways.

3. J-hooks shall be installed per ANSI/TIA 569 Commercial Building Standards for Telecommunications Pathways and Spaces, including a maximum distance between j-hooks of fiver (5) feet, but with varied spacing to avoid the production of electrical harmonics in the high-speed data cabling.

27.05.**33 CONDUITS and BACKBOXES**

1. Horizontal distribution conduit shall be installed from junction box joining each station conduit box to the floor telecommunications equipment room, assuming worst allowable case of 180° of conduit bend from pull point to pull point, to be sized per the following table:

EMT Conduit Trade Size	Category 6A Station Cables
1"	2
1-1/4 "	4
1-1/2 "	6
2"	12
2-1/2 "	18
3"	26
3-1/2 "	38
4"	48

The conduit fill table is based on BICSI's recommended 40% derated fill recommendation as calculated in the following table for horizontal station cables.

NEW CONSTRUCTION

----------(inches)----------					NEW CONSTRUCTION			90 Degrees of Bend			180 Degrees of Bend		
EMT Conduit Trade Size	Cat 6A Cable Diameter	Conduit Area	Cable Area	100% Fill	Bends (NONE)	40% Fill	Cables	Bends	40% Fill Derated	Cables	Bends	40% Fill Derated	Cables
1.00	**0.275**	0.7850	0.0594	13.223	0	5.289	4	1	4.496	4	2	3.702	2
1.25	0.275	1.2266	0.0594	20.661	0	8.265	8	1	7.025	6	2	5.785	4
1.50	0.275	1.7663	0.0594	29.752	0	11.901	10	1	10.116	10	2	8.331	8
2.00	0.275	3.1400	0.0594	52.893	0	21.157	20	1	17.983	16	2	14.810	14
2.50	0.275	4.9063	0.0594	82.645	0	33.058	32	1	28.099	28	2	23.140	22
3.00	0.275	7.0650	0.0594	119.008	0	47.603	46	1	40.463	40	2	33.322	32
3.50	0.275	9.6163	0.0594	161.983	0	64.793	64	1	55.074	54	2	45.355	44
4.00	0.275	12.5600	0.0594	211.570	0	84.628	84	1	71.934	70	2	59.240	58

----------(inches)----------					NEW CONSTRUCTION			90 Degrees of Bend			180 Degrees of Bend		
EMT Conduit Trade Size	Cat 6A Cable Diameter	Conduit Area	Cable Area	100% Fill	Bends (NONE)	40% Fill	Cables	Bends	40% Fill Derated	Cables	Bends	40% Fill Derated	Cables
1.00	**0.300**	0.7850	0.0707	11.111	0	4.445	4	1	3.778	2	2	3.111	2
1.25	0.300	1.2266	0.0707	17.361	0	6.945	6	1	5.903	4	2	4.861	4
1.50	0.300	1.7663	0.0707	25.000	0	10.000	10	1	8.500	8	2	7.000	6
2.00	0.300	3.1400	0.0707	44.444	0	17.778	16	1	15.111	14	2	12.444	12
2.50	0.300	4.9063	0.0707	69.444	0	27.778	26	1	23.611	22	2	19.444	18
3.00	0.300	7.0650	0.0707	100.000	0	40.000	40	1	34.000	32	2	28.000	26
3.50	0.300	9.6163	0.0707	136.111	0	54.445	54	1	46.278	46	2	38.111	38
4.00	0.300	12.5600	0.0707	177.778	0	71.111	70	1	60.444	60	2	49.778	48

2. Junction boxes shall be sized according to NEC 314.28, NEC 314.54, Article 770, and to accommodate bending radiuses as discussed in NEC 300.34 and related TIA documents.
    2.1. In any case, all methods employed for the installation of interior communication cables should not subject the cables to a bend radius less than the following minimums:
        2.1.1. Copper riser communication cables, bending radius not smaller than 8 times the cable diameter.
        2.1.2. Copper station communication cables:
            2.1.2.1. In conduit, bending radius not smaller than three (3) inches, or 8 times the cable diameter, whichever is greater.
            2.1.2.2. In furniture, where the cable is not subject to high pulling tensions, bending radius not smaller than 4 times the cable diameter.
        2.1.3. Fiber optic cables, during pulling operations, should not exceed a bending radius smaller than 20 times the cable diameter, or as recommended by the cable manufacturer; after pull is complete, the final cable bend radius should not exceed 10 times the cable diameter.

3. Conduits for copper and fiber riser cables shall be sized to no greater than 40% derated fill.

4. Conduits for interior grade telecommunication cables, such as riser rated and horizontal station cables, may be placed in a slab-on-grade or in a slab above crawl space, but must never be placed below the slab for any reason. Likewise, horizontal station cables must not be placed in conduit which is exposed to outside weather conditions. Inside building rated cables are not designed to withstand the moisture and condensation which

can occur in underground and exterior conduits, which will render the cable(s) unusable in a short period of time. Although such conduits may be placed in the slab as a last result, whenever possible conduits should be placed above slab, but never below.

27.05.36 CABLE TRAYS

1. **Horizontal distribution**: Cable trays are to be installed as low as possible above the finished ceiling.
    1.1. A clearance of 12" shall be maintained above the trays.
    1.2. 90º turns shall be made by two (2) 45º turns.
    1.3. Cable trays shall not be installed using center point mounts.
    1.4. Cable tray outside the IDFs shall be large enough that all of the telecommunication cabling installed as part of a project will not produce a fill ratio greater than 70% of the manufacturer's stated capacity.

2. **Telecommunication Rooms (IDFs)**: In IDFs, ladder type cable tray shall be sized as indicated in the following table, based on the Chatsworth Cable Fill Capacities chart for their 10250-Xnn products:

CABLE TRAY CAPACITIES & ROOM SIZES			
Racks	**Category 6A Cables**	**Tray Width**	**Minimum Room Size**
One	1-250	12-inch	10'x11'
Two	251-382	18-inch	10'x11'
Two	383-500	24-inch	10'x11'
Three	501-637	30-inch	14'x14'
Three	638-792	36-inch	14'x14'

    2.1. Install ladder tray one size larger above the equipment rack(s), secured and braced as necessary to stabilize the end of the rack(s). (See diagrams)
    2.2. Mount ladder tray at a minimum 7' height.
    2.3. Install cable tray systems such that cables will transition to the ladder rack runway without damage to or strain on the cables.
    2.4. Use additional ladder rack where necessary to stabilize equipment racks in the room or as needed to provide reasonable and shortest distance routing of cables.

3. Refer to Division 26.

27.05.39 SURFACE RACEWAYS

1. Cables must not be subjected to sharp or binding edges.

2. Surface raceways must be large enough to accommodate all intended telecommunications cables as well as allow for 30% growth.

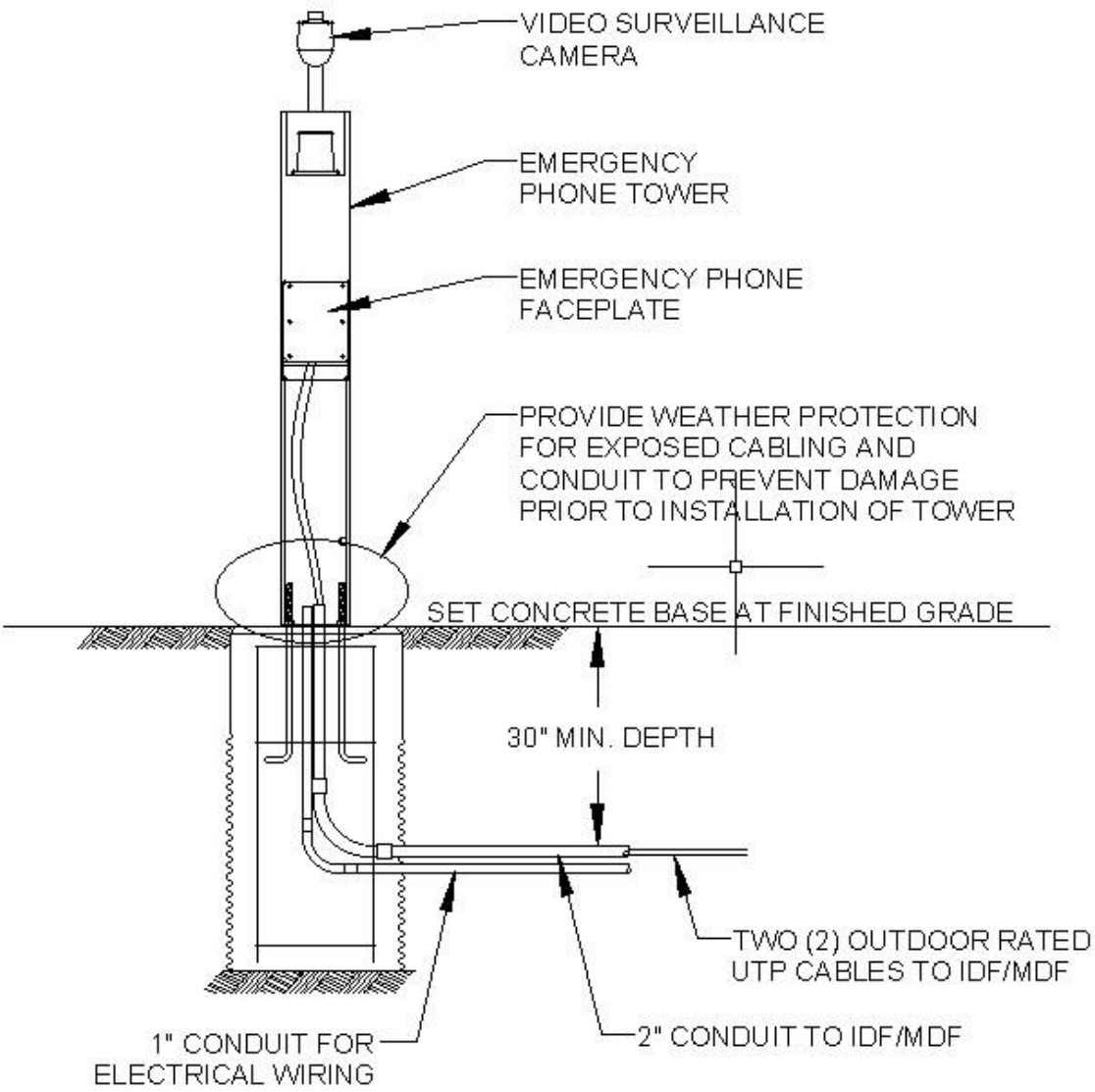
3. Such raceways and pathways shall installed to support horizontal cabling in accordance with the requirements of ANSI/TIA-569-C.

4. Refer to Division 26.

27.05**.43 UNDERGROUND DUCT SYSTEMS and RACEWAYS**

Not Applicable

6. **Outdoor Emergency Phone Detail**



NOTE: Current as of 10/2/2018. Log in to https://app.e-builder.net to retrieve latest version, under "zIUResources – BL", "Standard Front End Docs", "IU Standards", "Electrical Standards", "20XX – IU Electrical Design Standards.pdf"

Additional cable and/or electronic treatments may be necessary, depending on cable distance (copper data cables not to exceed 295 feet) or other situational requirements.

27.05**.53 IDENTIFICATION**

1. Comply with Section 27.15.43

2. Otherwise, identify system components according to TIA 606-B.

27.06.00 SCHEDULES for COMMUNICATIONS

See 27.04.50 GENERAL INSTALLATION

Firestop (non-hardening compounds only)

FIRE-STOP	3M MP+1.4”x11”
FIRE-GRMT2PC	Specified Technologies RFG2
FIRE-PILL941	Specified Technologies SSB14
FIRE-PILL942	Specified Technologies SSB24
FIRE-PILL962	Specified Technologies SSB26
FIRE-PILL963	Specified Technologies SSB36
Firestop, 36 ci tube	Specified Technologies SSP100

See 27.05.26 GROUNDING

Grounding Busbars — Comply with J-STD-607-B

TMGB

4” X 20” Copper	Hubbell HBBB14420J	or equivalent
4” X 20” Tin Plated Copper	Hubbell HBBB14420JTP	or equivalent

TGB

2” X 10” Copper	Hubbell HBBB14210A	or equivalent
2” X 10” Tin Plated Copper	Hubbell HBBB14210ATP	or equivalent

Horizontal Cabinet or Equipment Rack Busbar – 19”

Grounding busbar kit, 19” — Panduit RGRB19_ (shown in drawings)
0.75”x19” x 0.25” Copper — Hubbell HBBBHR19KT or equivalent
0.75”x19” x 0.25” Tin Plated Copper Hubbell HBBBHR19KTTP or equivalent

Vertical Cabinet or Equipment Rack Busbar – 36” to 72”

0.75” x 36”x0.25” Copper Hubbell HBBBVR36KT or equivalent 0.75”x36”x0.25” Tin Plated Copper Hubbell HBBBVR36KTTP or equivalent

Compression Lugs

0.250” holes X 0.625” spacing

0 degrees	Hubbell HGBLXXD	or equivalent
45 degrees	Hubbell HGBLXXD45	or equivalent
90 degrees	Hubbell HGBLXXD90	or equivalent

0.250” holes x 0.750” spacing

0 degrees	Hubbell HGBLXXDA	or equivalent

0.375” holes x 1.000” spacing

0 degrees	Hubbell HGBLXXDB	or equivalent
90 degrees	Hubbell HGBLXXDB90	or equivalent

C Tap

Main Run 6-4 AWG - Tap 6 AWG	Hubbell HYC4C6	or equivalent
Main Run 6-4 AWG – Tap 4 AWG	Hubbell HYC4C4	or equivalent
Main Run 2 AWG – Tap 8-4 AWG	Hubbell HYC2C4	or equivalent
Main Run 2 AWG – Tap 2 AWG	Hubbell HYC2C2	or equivalent
Main Run 1/0-2/0 AWG–Tap 8-2 AWG	Hubbell HYC26C2	or equivalent
Main Run 1/0-2/0 AWG–Tap 1/0-2/0 AWG	Hubbell HYC26C26	or equivalent

H Tap

Main Run 4/0-2 AWG - Tap 2-8 AWG	Hubbell HYH292C	or equivalent
Main Run 2-8 AWG – Tap 2-8 AWG	Hubbell HYH2C2C	or equivalent
Main Run 6-10 AWG – Tap 6 AWG	Hubbell HYH6C6C	or equivalent

I-Beam Tap

I-Beam steel with a Standard Flange	Hubbell HYGIBS####	or equivalent
I-Beam steel with a Wide Flange	Hubbell HYGIBW####	or equivalent

Busbar Tap

Busbar thickness 0.25”, Main Run 2 AWG - Tap 6 AWG
Hubbell HYG14B2TC2C6C or equivalent

Busbar thickness 0.25”, Main Run 2 AWG – Tap 2 AWG
Hubbell HYG14B2TC2C2C or equivalent

Busbar thickness 0.25”, Main Run 4/0 – 1/0 AWG
Hubbell HYGBTC28 or equivalent

Ladder Rack Bonding Conductors

Stranded THHN, green	Hubbell HGRKTD12D	or equivalent
Stranded THHN, green	Hubbell HGRKTKA9KA5	or equivalent
Stranded THHN, green	Hubbell HGRKTKLU9KLU5	or equivalent
Braided Jumper	Hubbell HGBBD12	or equivalent

Basket Tray Conductors	Hubbell HGBKS17	or equivalent
	Hubbell HGRKTWC45	or equivalent
	Hubbell HGRKTWB5	or equivalent

Wrist Strap ESD Port	Hubbell HGBESDKT10	or equivalent

Raised Floor Grounding Clamp

Grid or Parallel	Hubbell HGBGXP1828RF	or equivalent
Parallel	Hubbell HGBGP1526G1	or equivalent
Parallel	Hubbell HGBGRF4C3	or equivalent
Stringer 0.75”-1.5” Round or Square	Hubbell HGBGXP1828RF	or equivalent
Stringer 1.0”-1.25” Round	Hubbell HGBGP1526G1	or equivalent
Stringer 0.75”-1.0” Round or Square	Hubbell HGBGRF4C3	or equivalent
Wire Range 6 – 4/0 AWG	Hubbell HGBGXP1828RF	or equivalent
Wire Range 4 – 2/0 AWG	Hubbell HGBGP1526G1	or equivalent
Wire Range 8 – 2 AWG	Hubbell HGBGRF4C3	or equivalent

See 27.05.29 **HANGERS**

Horizontal Cable Hangers	Panduit J-Pro Series (preferred)
Horizontal Cable Hangers	Panduit J-Mod series
Horizontal Cable Hangers	Erico Caddy CAT J-Hook: Cat32
Horizontal Cable Hangers	Erico Caddy CableCat Wide Base Cable Support Clips

See 27.05.33 **CONDUITS and BACKBOXES**

Refer to following section on Information Outlets, referencing “***See 27.15.43***”

See 27.05.36 **CABLE TRAY**

Cable Tray through building (Not in IDF)	Comply with NEMA VE 2 and TIA-569 cable tray or cable basket 12” or larger as required by manufacturer’s specifications

See 27.05.43 **UNDERGROUND DUCTS and RACEWAYS**

Not Applicable

See 27.11.13 **ENTRANCE PROTECTION**

Solid-state 4-pair protector unit for Outdoor Devices:

For POE circuits (power over Ethernet) minimum 48V (*cameras, WAPs, for instance*) For Analog circuits minimum 96V (*dial tone circuits*)

For both OSP Entrance Cables and Outdoor Devices:

Circa Building Entrance Terminal Module 110 Connector Series, by pair count Circa Gas Tube Circa 3B1E

See 27.11.16 **EQUIPMENT RACKS**

7'x19" Equipment Rack	Panduit CMR19x84
Wire Management Horizontal	Panduit WMPH2E
Wire Management Intermediate 12"	Panduit Patchrunner PR2VD12
Wire Management End Panel	Panduit PREPB1
Tie bracket	

See 27.11.19 **TERMINATIONS**

Copper backbone Termination Block	Panduit Pan-Punch 110 Category 5e system
Horizontal Copper Cabling Patch Panel	
MDF/IDF	Panduit CPPLA24WBLY
Equipment Cabinet (small bldgs.)	Panduit CPPL24M6BLY
Voice Patch Panel	Panduit VP24382TV25Y with RJ21 connector

Patch Panel Jack Modules:

For 6A station wire	Panduit CJ6X88TGVL TX6 PLUS, Violet, Cat 6A

Corning Fiber Terminations for Outside Plant Terminations Only

Not Applicable

Sumitomo Fiber Terminations (for Sumitomo cables only):

1U Termination Unit (requires prior UITS approval)	Sumitomo FT01RU3P Rack Mount Panel
2U Termination Unit (requires prior UITS approval)	Sumitomo FT02RU4P Rack Mount Panel
4U Termination Unit (standard / preferred)	Sumitomo FT04RU12P Rack Mount Panel
PrecisionFlex OM4 LC 12F cassette universal	FTLC-MP12COM4-L-U
PrecisionFlex SM LC/APC 12F cassette universal	LGX FTLC-MP12COS2-LA-U
Splice Tray, 12 Mass/24 Single	ST-01

See 27.11.23 **CABLE MANAGEMENT and LADDER RACK**

Ladder Rack (in IDF)	Chatsworth 10250-712* (12" or wider, as required) for up to 180 Cat 6A cables**
	Chatsworth 10250-718* (18" or wider, as required) for up to 270 Cat 6A cables**

* associated parts, as required

** based on the Chatsworth "Estimated Cable Fill Capacities" chart, under "Recommended Fill" for Cat 6A wiring since IU does not use the "cable retaining posts" on new installs. Refer to chart for other sizes of Chatsworth "Universal Cable Runway".

See 27.13.13 **BACKBONE COPPER** (Riser)

Category 3 Copper Backbone Cable	OFS Type CMP, #24 AWG, twisted pair, solid copper Category 3, suitable for placement in a plenum
Category 3 Copper Backbone Cable	Belden Corporation equivalent
Category 3 Copper Backbone Cable	General Cable, Guardian Products, equivalent
Category 3 Copper Backbone Cable	Mohawk Wire and Cable Corporation equivalent
Category 3 Copper Backbone Cable	Commscope, General Instrument, equivalent
Riser Cable to Patch Panel Tie Cable	Type CMP 25-pair amphenol style cable, #24 AWG twisted pair, solid copper Category 3

See 27.13.23 **BACKBONE FIBER**

Sumitomo 12 fiber 50 micron Multimode OM4 Plenum Riser Cables, MPO/MPO

CB-4012IUUXYY020M-P1R	Cable, pulling eye one end only, 20 **meters**
CB-4012IUUXYY030M-P1R	Cable, pulling eye one end only, 30 **meters**
CB-4012IUUXYY040M-P1R	Cable, pulling eye one end only, 40 **meters**
CB-4012IUUXYY050M-P1R	Cable, pulling eye one end only, 50 **meters**
CB-4012IUUXYY060M-P1R	Cable, pulling eye one end only, 60 **meters**
CB-4012IUUXYY070M-P1R	Cable, pulling eye one end only, 70 **meters**
CB-4012IUUXYY080M-P1R	Cable, pulling eye one end only, 80 **meters**
CB-4012IUUXYY090M-P1R	Cable, pulling eye one end only, 90 **meters**
CB-4012IUUXYY100M-P1R	Cable, pulling eye one end only, 100 **meters**
CB-4012IUUXYY110M-P1R	Cable, pulling eye one end only, 110 **meters**
CB-4012IUUXYY120M-P1R	Cable, pulling eye one end only, 120 **meters**
CB-4012IUUXYY150M-P1R	Cable, pulling eye one end only, 150 **meters**
CB-4012IUUXYY160M-P1R	Cable, pulling eye one end only, 160 **meters**

CB-4012IUUXYY275M-XXA	Cable, pulling eye one end only, 275 **meters**

Sumitomo 12 fiber Singlemode Plenum Riser Cables, MPO/MPO

CB-9012IUUXYY020M-P1R	Cable, pulling eye one end only, 20 **meters**
CB-9012IUUXYY030M-P1R	Cable, pulling eye one end only, 30 **meters**
CB-9012IUUXYY040M-P1R	Cable, pulling eye one end only, 40 **meters**
CB-9012IUUXYY050M-P1R	Cable, pulling eye one end only, 50 **meters**
CB-9012IUUXYY060M-P1R	Cable, pulling eye one end only, 60 **meters**
CB-9012IUUXYY070M-P1R	Cable, pulling eye one end only, 70 **meters**
CB-9012IUUXYY080M-P1R	Cable, pulling eye one end only, 80 **meters**
CB-9012IUUXYY090M-P1R	Cable, pulling eye one end only, 90 **meters**
CB-9012IUUXYY100M-P1R	Cable, pulling eye one end only, 100 **meters**
CB-9012IUUXYY110M-P1R	Cable, pulling eye one end only, 110 **meters**
CB-9012IUUXYY120M-P1R	Cable, pulling eye one end only, 120 **meters**
CB-9012IUUXYY150M-P1R	Cable, pulling eye one end only, 150 **meters**
CB-9012IUUXYY160M-P1R	Cable, pulling eye one end only, 160 **meters**
CB-9012IUUXYY275M-XXA	Cable, pulling eye one end only, 275 **meters**

See 27.13.33 **BACKBONE COAX**

Not Applicable

See 27.15.13 **HORIZONTAL COPPER CABLING**

Horizontal Station Cable, **6A** Plenum	Superior Essex 10 Gain XP 6A Plenum P/N 6H-272-7B Purple, .275 inches, bend radius 1.20 inches
Horizontal Station Cable, **6A** Plenum	General Genspeed 10UTP6A Plenum P/N 7141825, Purple, .250 inches, bend radius 1.00 inches
Horizontal Station Cable, **6A** Plenum	Bertek LANmark-XTP 6A Plenum P/N 11085661 Violet, .275 inches, bend radius 1.12 inches
Horizontal Station Cable, **6A** Plenum	Belden 10GXS13 6A Plenum P/N 0071000 Violet, .265 inches, bend radius 1.10 inches
Horizontal Station Cable, **6A** Plenum	Panduit PUP6AM04VL-UG 6A Plenum Violet, .275 inches, bend radius 1.10 inches

For **Outside Emergency Phones**, and **Conduits in Slab-On-Grade**:

Horizontal Station Cable, **6A** filled	Superior Essex 04-001-A5 OSP BBDG
Horizontal Station Cable, **6A** filled	Superior Essex 04-001-A4 OSP BBDN
Indoor/Outdoor Cable, 6A	GenSPEED 7141007 UTP CAT-6A

See 27.15.33 **HORIZONTAL COAXIAL CABLING**

Not Applicable

See 27.15.43 **INFORMATION OUTLET**

Standard Information Outlet, Single Gang face

Double Gang Electrical Box ….	5”x5” minimum x 2-7/8” deep double gang box
Mud Ring	5” square Double Gang to Single Gang mud ring
Faceplate ……	Panduit CFPE4IWY Executive Series, 4-port, off-white faceplate
Jack module: Cat **6A**	Panduit CJ6**X**88TGVL TX6 PLUS, **Violet**
Blank module ……..	Panduit CMBIW-X Mini-Com blank module insert, off-white

Standard Information Outlet, Double Gang face

Double Gang Electrical Box ….	5”x5” minimum x 2-7/8” deep double gang box
Mud Ring	5” square Double Gang mud ring
Faceplate ……	Panduit CFPE10IW-2GY Executive Series, 4-port, off-white
Jack module: Cat **6A**	Panduit CJ6**X**88TGVL TX6 PLUS, **Violet**
Blank module ……	Panduit CMBIW-X Mini-Com blank module insert, off-white

Wall Phone Outlet

Single Gang Electrical Box …….	5”x5” minimum x 2-7/8” deep double gang box
Mud Ring	5” square Double Gang to Single Gang mud ring
Wall Plate ……	Panduit KWP6PY stainless steel plate with Category 6 Keystone module

(see also below for Security Phone Wall Plate)

Wireless Access Point Outlet (WAP) – Ceiling Mount

Tile Ceiling Mount ……	Acceltex ATS-03879
Hard Ceiling Mount……	Acceltex ATS-04080
Jack module: Cat **6A**……	Panduit CJ6**X**88TGVL TX6 PLUS, **Violet**

Wireless Access Point Outlet (WAP) – Wall Mount

Double Gang Electrical Box ….	5”x5” minimum x 2-7/8” deep double gang box
Mud Ring	5” square Double Gang mud ring
Faceplate ……	Panduit CFPL2IW-LY Executive Series, 2-port,
Jack module: Cat **6A**……	Panduit CJ6**X**88TGVL TX6 PLUS, **Violet**

Biscuit Jack

Interior Wall Security Phone

Wall Phone Plate	Hubbell P630S
Wall Phone Set	Cortelco Trendline 815047-VOE-21F

Top of mounted set must be below 48” aff; therefore the installed top of the Wall Phone Plate should not be higher than 45” aff.

27**.08.00 COMMISSIONING**

Intentionally blank

27.**10.00 STRUCTURED CABLING**

27**.11.00 EQUIPMENT ROOM FITTINGS**

27.11.**03 WALLS**

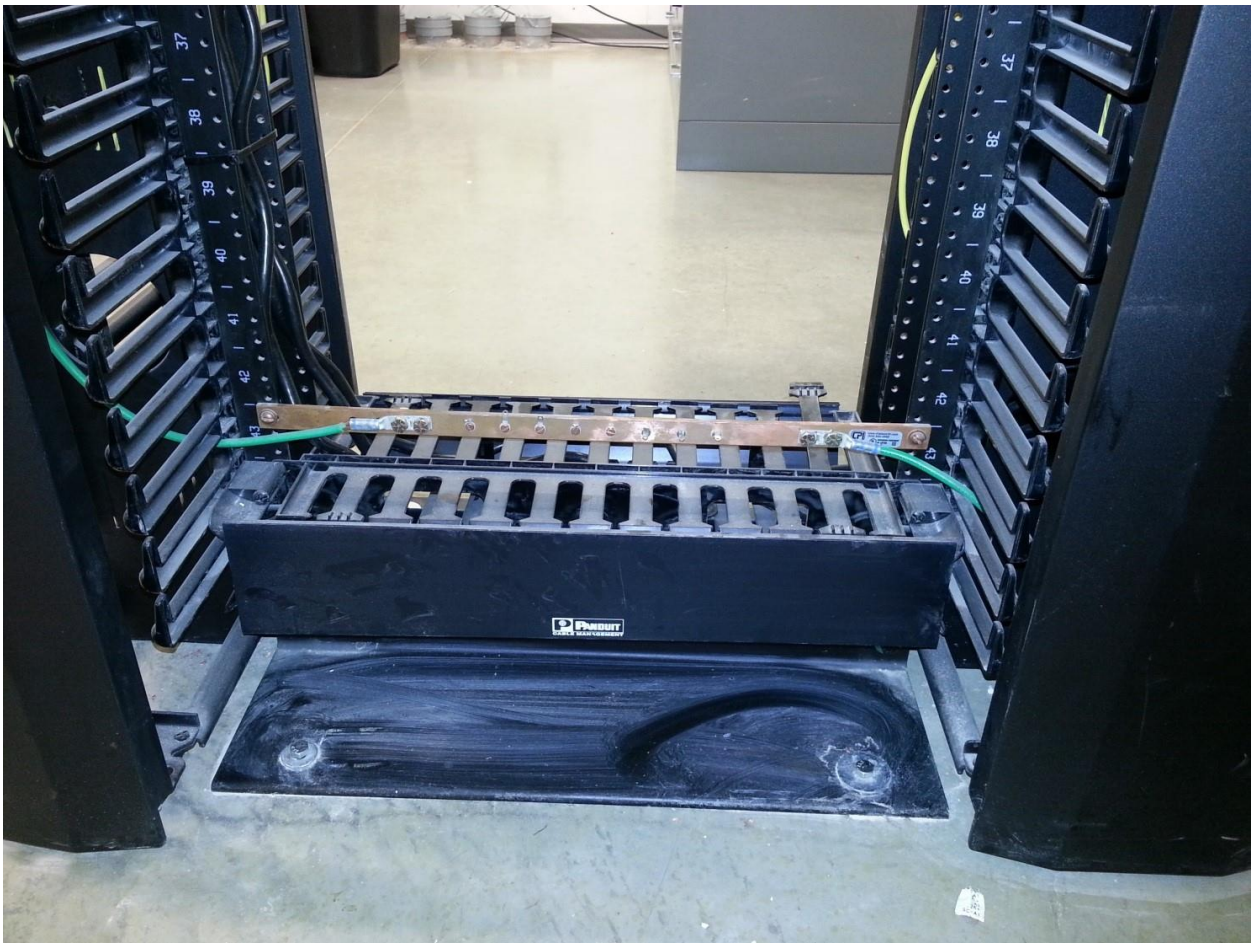
1. All walls shall be covered with 4' x 8' x 3/4" plywood, mounted 0'-6" above the finished floor with the 8'0" dimension vertical.
    1.1. Backboards shall either be painted with two (2) coats of fire retardant paint on all sides, or fireretardant treated and painted.
    1.2. Backboard paint color shall be a light gray / off-white.

27.11.**13 ENTRANCE PROTECTION**

1. Entrance cable protection shall be provided by the installer of outside plant cables in accordance with all applicable codes and standards.
    1.1 On the IUB and IUPUI campuses, UITS provides outside plant cables and terminations to the building IDF-1 (MDF).
        1.1.1. Any station cable which leaves the envelope of the building must be OutSide Plant rated and be electrically protected.
    1.2 On the regional campuses, outside plant facilities must be included in the project; the work must be performed by a qualified telecommunications contractor.

27.11.**16 CABINETS, RACKS, FRAMES and ENCLOSURES**

1. **Equipment Racks**
    1.1. The equipment rack shall be installed in the Telecommunication Equipment Rooms (IDFs) according to layout and communication media requirements
    1.2. Telecommunication Equipment Room (IDF) layouts shall be coordinated with the appropriate University Information Technology Services representative
    1.3 The rack shall be anchored to the floor and braced overhead with ladder racking and grounded to the ground busbar location in the IDF with a #6 solid or stranded ground wire.



2. **Wire management**
    2.1. **Vertical**: Open ends of racks shall have 12” vertical wire management with hinged doors on the front.
    2.2. Between each of multiple racks use 12” a vertical wire manager with a hinged door on the front.
    2.3. **Horizontal**: On the top and bottom of each rack, install one horizontal wire manager with covers.

27.11**.19 TERMINATION BLOCKS and PATCH PANELS**

1. **Copper** Equipment
    1.1. Unshielded Twisted Pair Riser
        1.1.1 Amphenol style cables shall be terminated on 110 type blocks with 110A wiring blocks.
        1.1.2 Terminal blocks shall be located so as to be easily cross-connected to feeder pair and the voice cable stations and plugged into the analog voice patch panel.
    1.2. Horizontal Cabling Patch Panels
        1.2.1 Use Panduit modular 6 port face plate angled patch panels filled with yellow TX-6+ modules
        1.2.2 Use a Panduit voice patch panel installed in the rack for analog voice with a 50 pin, 25 pair female amphenol connector
        1.2.3 All patch panels, termination panels, and cable managers should be installed so that their fronts, and the front of the networking equipment later provided by owner, shall be visible from the telecommunications room open doorway.

2. **Fiber** Equipment
    2.1. Use cable clamps, breakout kits, mounting bracket(s) and other miscellaneous hardware as necessary to complete a proper installation.
    2.2. Breakout kits will be required to terminate all loose tube 250 micron fibers (outdoor rated cables).
        2.2.1 NOT needed for 900 micron fiber.

3. **Coaxial** Equipment
    3.1. *Not Applicable*

27.11**.23 CABLE MANAGEMENT and LADDER RACK**

1. A minimum 18" ladder rack shall be installed from the top of and perpendicular to the equipment rack(s) to 4' x 8' wall mounted plywood board, as needed to stabilize equipment racks, and according to room layout and field conditions. See also illustrations.

2. Bond all ladder rack segments and connect to telecom grounding bar with minimum #6 ground wire.

3. Transition station cables and bundles from room entrances to ladder rack with large radius bends (following illustration).

4. Preserve bundles as defined by conduit and cable tray entrances into the IDF room; do not combine station cable bundles as defined by entrances into IDF room into larger bundles. If exceptionally large bundles enter the IDF room by cable tray, divide into manageably sized bundles.

5. Use vertical ladder rack for distances greater than three (3) feet from conduit or cable tray to IDF ladder rack.

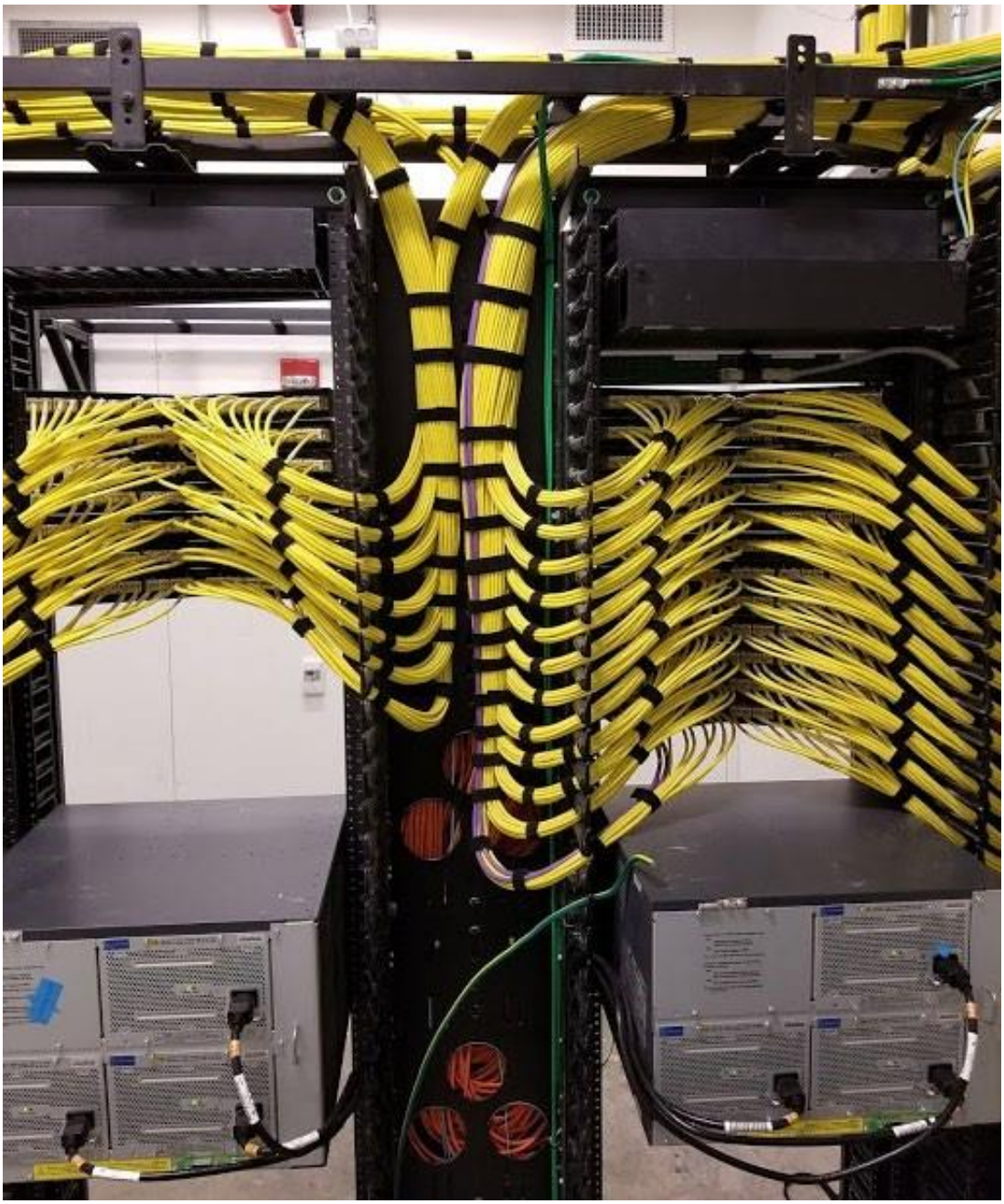
6. Neatly bundle station cables and secure bundles with Velcro tie wraps (following illustration).

7. Transition station cables and bundles from ladder rack to wire managers with large radius bends (following illustration).

8. Keep station cables and bundles to the side from which they transition. (following illustration) Eg, do not block wire manager by arcing cables from one side to the other. Maintain proper bend radius.

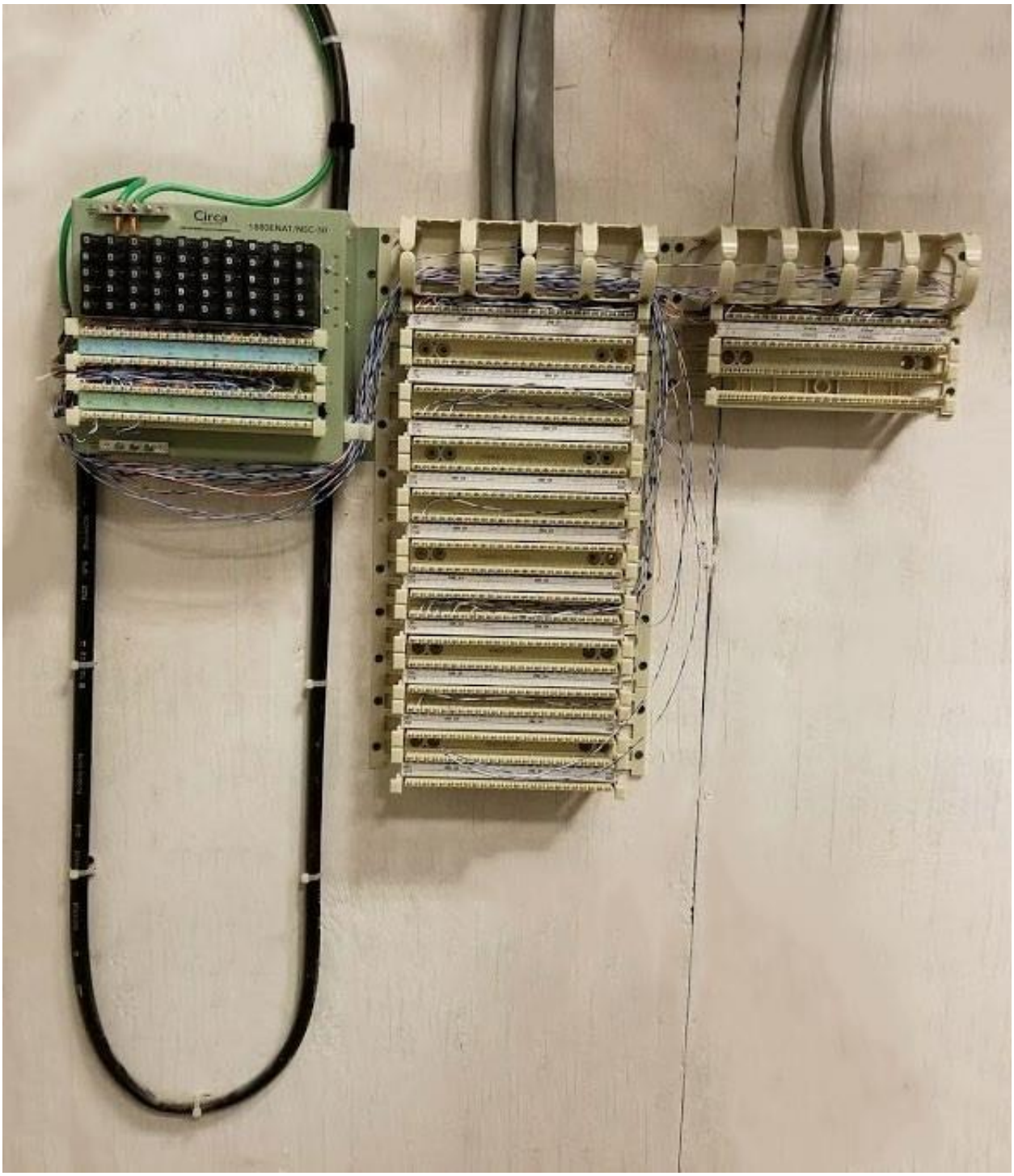
9. Preserve cable bundles; do not combine bundles.

10. Neatly bundle station cables and secure bundles with Velcro tie wraps (following illustration).



11. Mount top of protector block(s) and riser block jumper rings at 5 feet (60 inches). (following illustration)

12. Riser blocks and protector block must be mounted adjacent to one another.

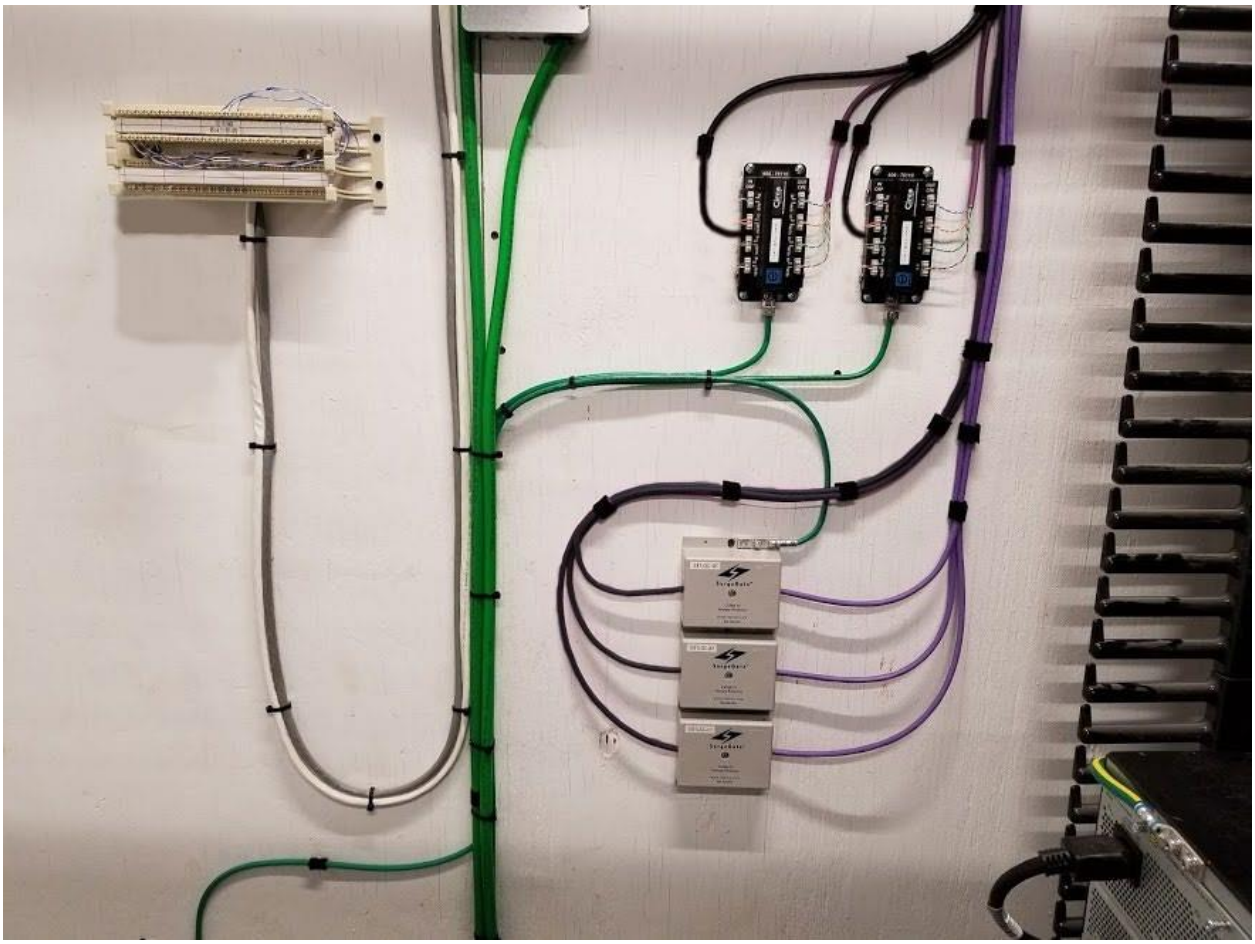


13. Mount 110 block for connections between riser cable and voice patch panel. (Left side of following illustration.) In MDF, this block should be physically separated from riser cable blocks next to outside plant protector block(s). .

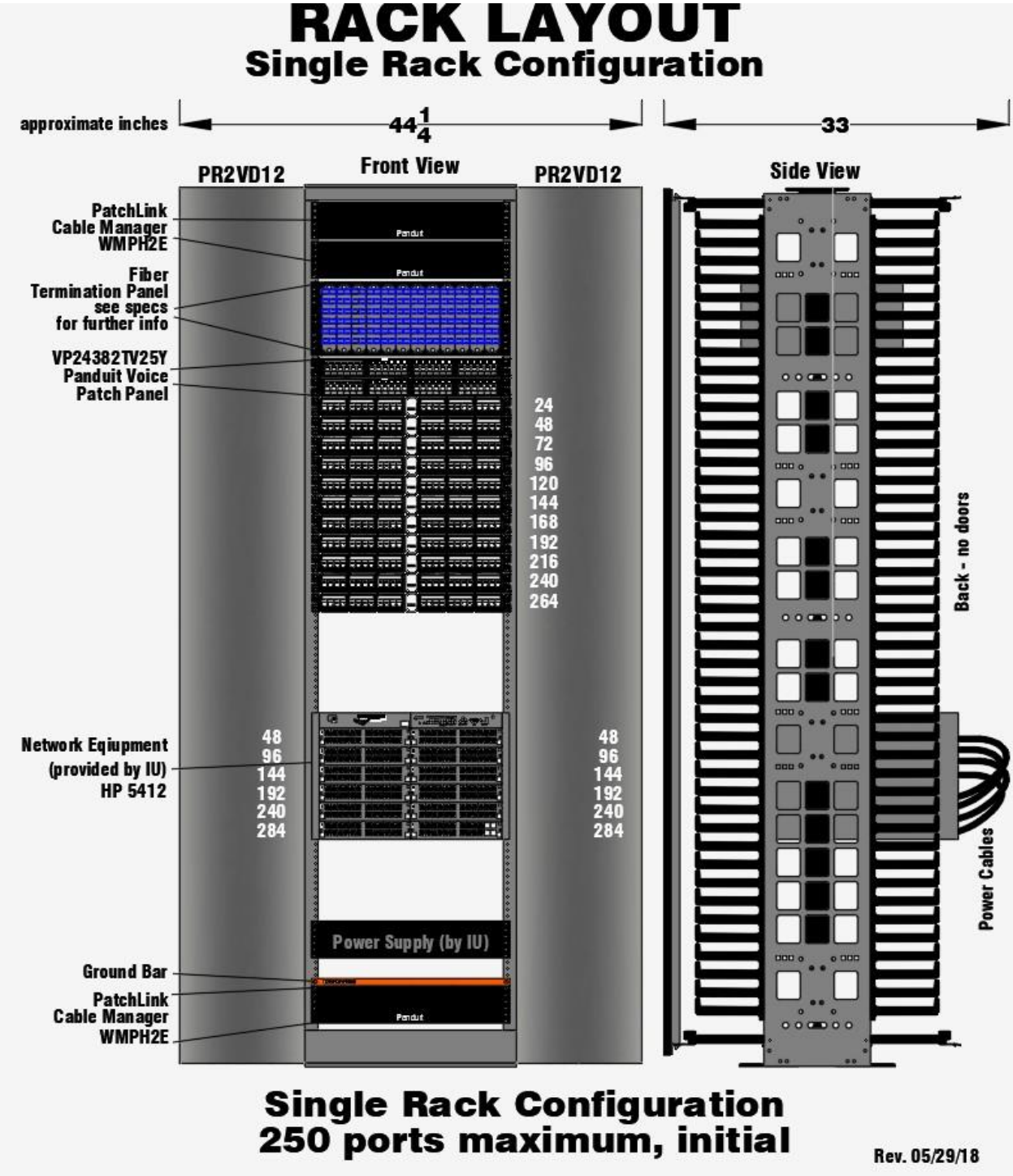
14. Mount 4-pair protector units for individual outdoor station cables in a configuration similar to below. Provide proper grounding from telecom grounding bus bar to each protector unit according to manufacturer's instructions.

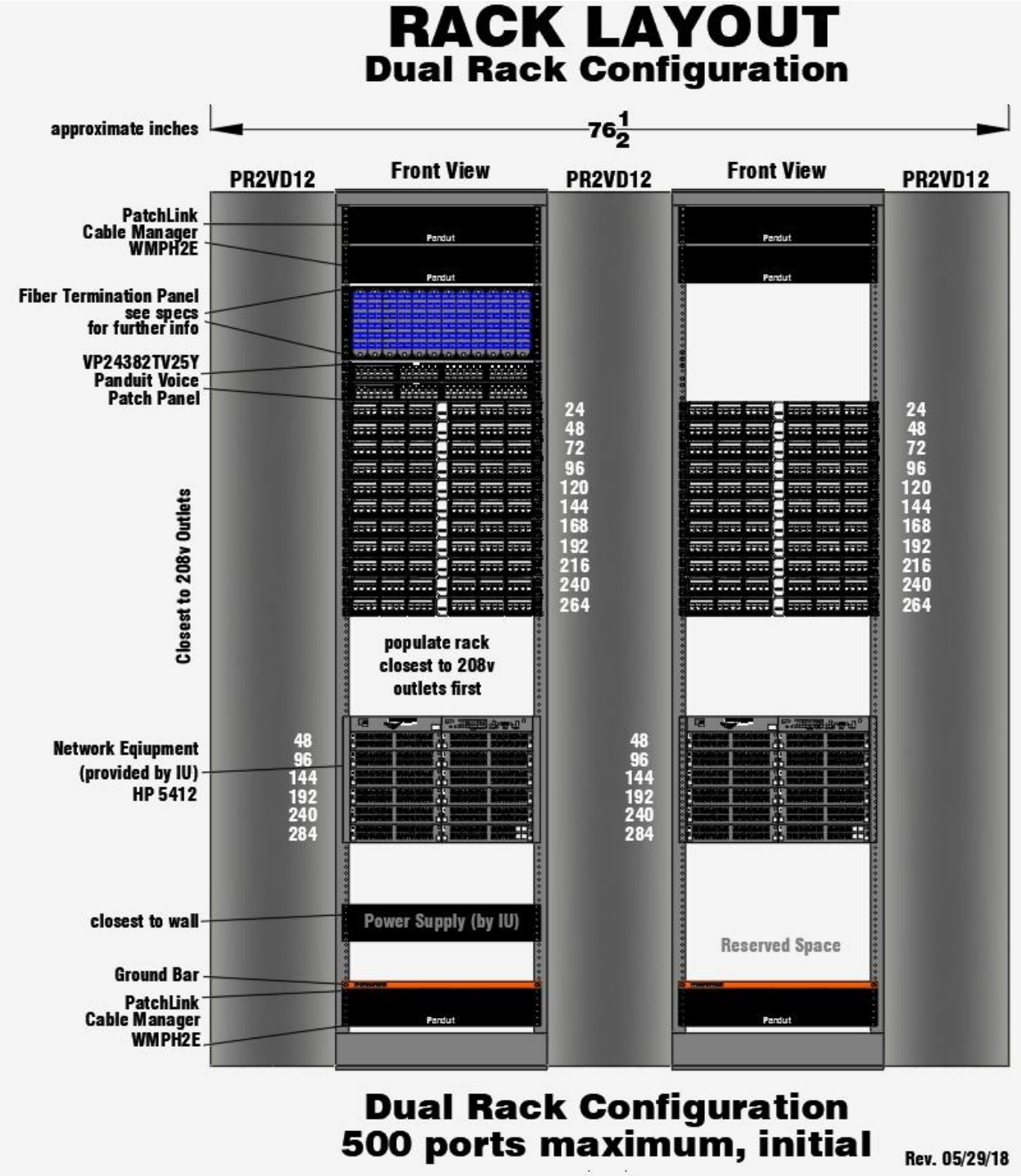
15. Use only shielded station cable from outside mounted security phones and security cameras to the individual 4-pair protector unit(s) in accordance with NEC grounding practices for outside telecom cables entering a building envelope. Connect shields to the 4-pair protector unit grounding device according to manufacturer's instructions.

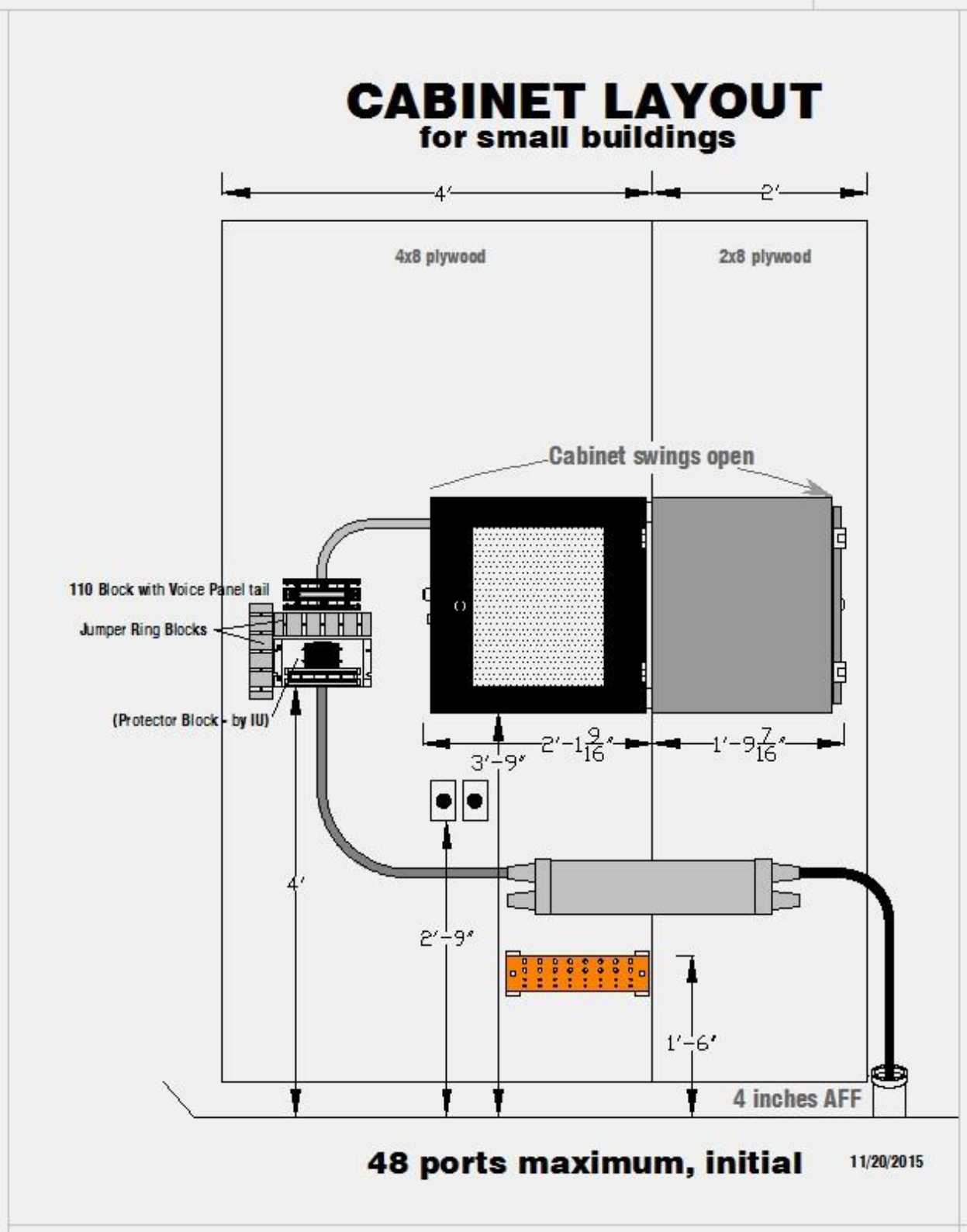
16. In all cases, housekeeping counts. Use tie wraps and Velcro straps as necessary to provide neat, traceable and maintainable wire and cable paths.

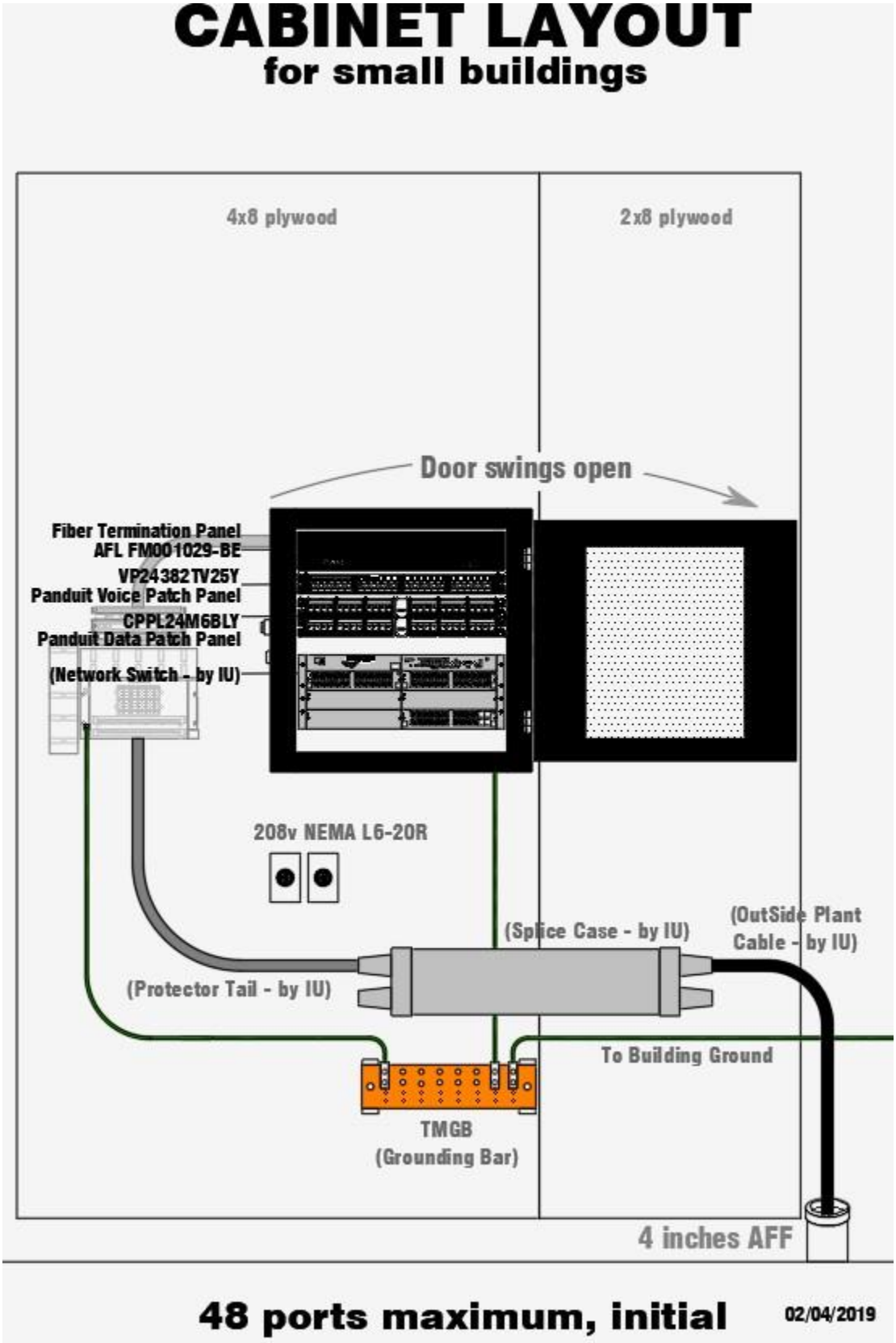


27.11**.36 EQUIPMENT RACK LAYOUTS**

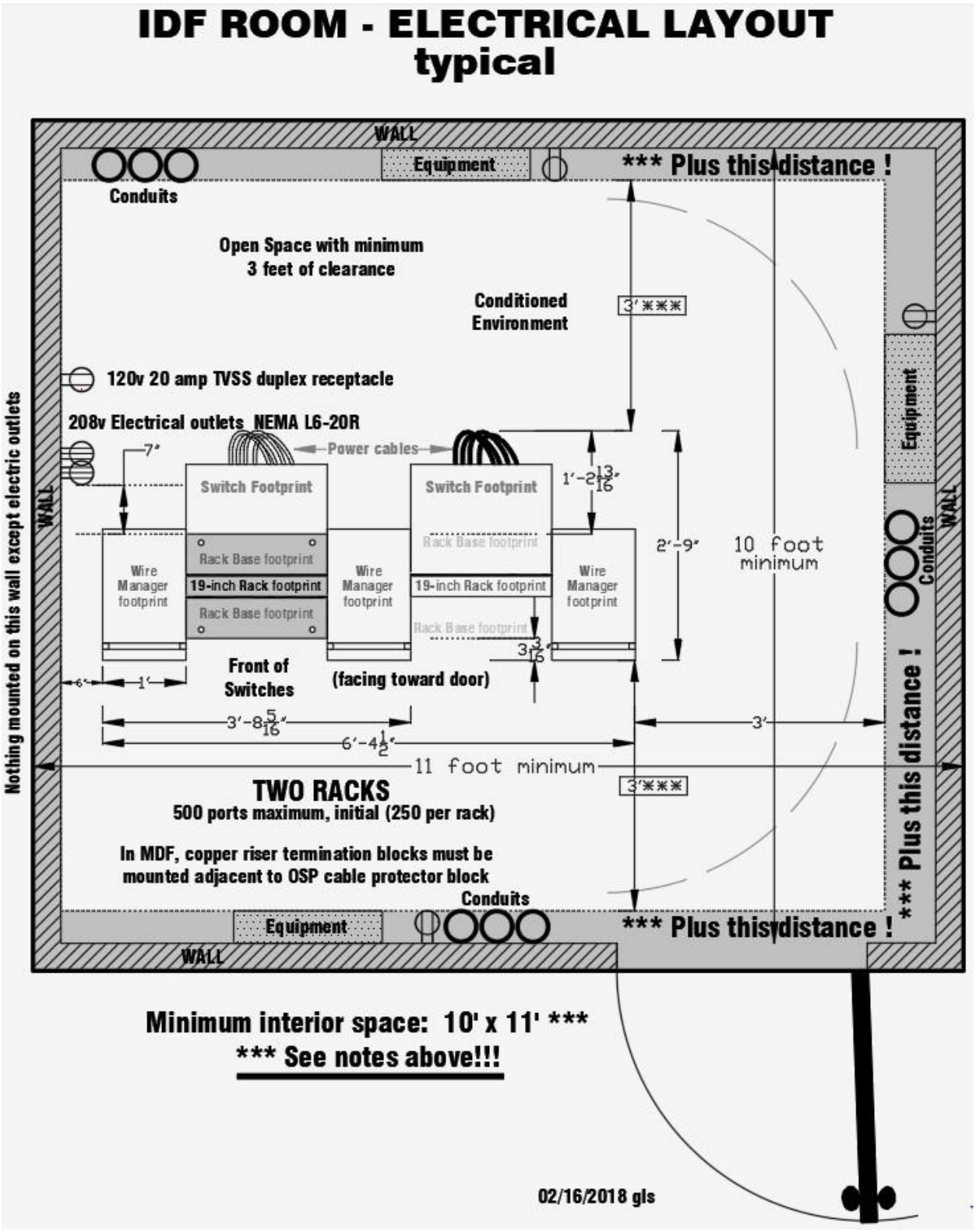



RACK LAYOUT
Dual Rack Configuration
approximate inches
76 1/2
PR2VD12
Front View
PR2VD12
Front View
PR2VD12
PatchLink Cable Manager WMPH2E
Fiber Termination Panel see specs for further info
VP24382TV25Y Panduit Voice Patch Panel
Closest to 208v Outlets
24 48 72 96 120 144 168 192 216 240 264
populate rack closest to 208v outlets first
Network Eqiupment (provided by IU) HP 5412
48 96 144 192 240 284
closest to wall
Power Supply (by IU)
Reserved Space
Ground Bar
PatchLink Cable Manager WMPH2E
Dual Rack Configuration
500 ports maximum, initial
Rev. 05/29/18


CABINET LAYOUT
for small buildings
4'
2'
4x8 plywood
2x8 plywood
Cabinet swings open
110 Block with Voice Panel tail
Jumper Ring Blocks
(Protector Block - by IU)
3'-9"
2'-1 9/16"
1'-9 7/16"
4'
2'-9"
1'-6"
4 inches AFF
48 ports maximum, initial
11/20/2015


CABINET LAYOUT
for small buildings
4x8 plywood
2x8 plywood
Door swings open
Fiber Termination Panel
AFL FM001029-BE
VP24382TV25Y
Panduit Voice Patch Panel
CPPL24M6BLY
Panduit Data Patch Panel
(Network Switch - by IU)
208v NEMA L6-20R
(Splice Case - by IU)
(OutSide Plant
Cable - by IU)
(Protector Tail - by IU)
To Building Ground
TMGB
(Grounding Bar)
4 inches AFF
48 ports maximum, initial
02/04/2019

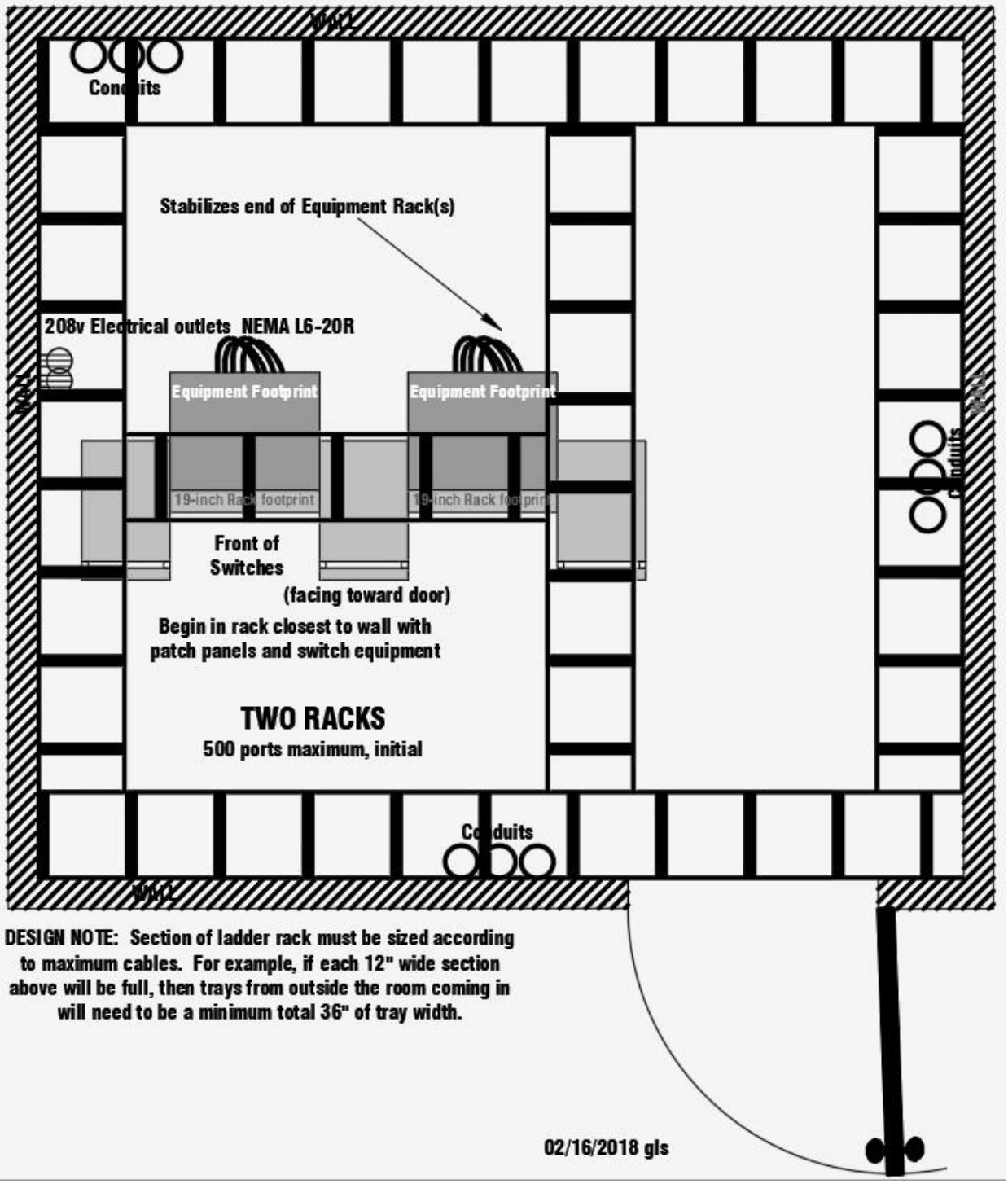
27.11**.46 EQUIPMENT ROOM LAYOUT**



IDF ROOM - LADDER RACK LAYOUT

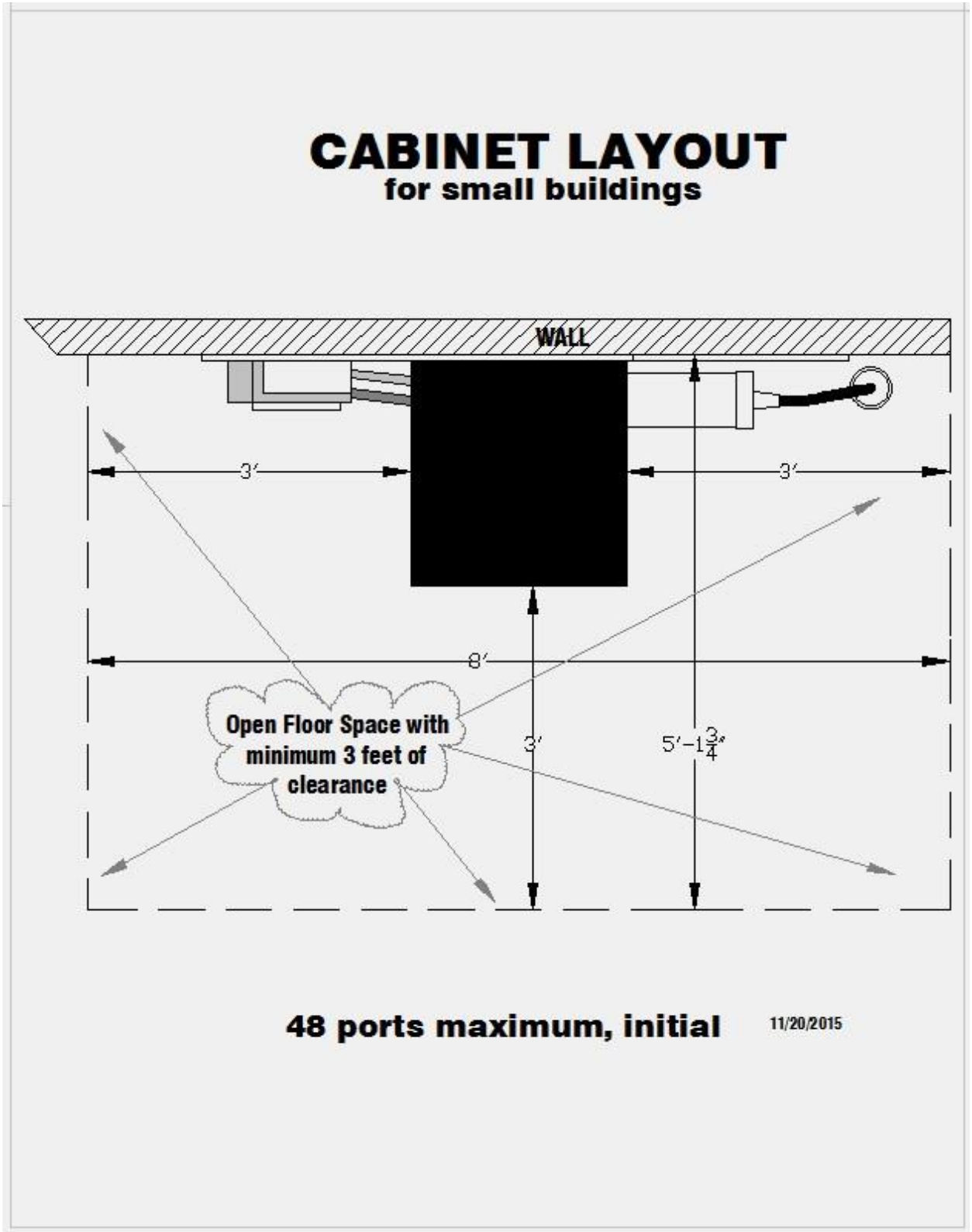
Chatsworth Universal Cable Runway
Chatsworth 10250-7xx **

** where xx = 12, 15, 18, 24, etc.



DESIGN NOTE: Section of ladder rack must be sized according to maximum cables. For example, if each 12" wide section above will be full, then trays from outside the room coming in will need to be a minimum total 36" of tray width.

02/16/2018 gls


CABINET LAYOUT
for small buildings
WALL
3′
3′
8′
Open Floor Space with minimum 3 feet of clearance
3′
5′–1¾″
48 ports maximum, initial
11/20/2015

27.12.00 TRANSMISSION MEDIA

1. General: Provide telecommunication transmission media of manufacturer's standard materials, as indicated by published product information; designed and constructed as recommended by manufacturer, for a complete installation, and for applications indicated. Except as otherwise indicated, provide copper conductors with conductivity of not less than 98% at 20ºC (68ºF).

2. Cable Labeling: The National Electrical Code (NEC) requirements dictate that telecommunication cables used within a building are classified as to their use and smoke and flame requirements. Underwriters Laboratories (UL) provides certification that a cable meets the NEC requirements.

3. All cables shall be clearly marked with the proper NEC classification as follows:

RISER CABLES

CABLE TYPE	NEC CLASSIFICATION CODES
Fiber Optic	OFNP, OFNR
Copper UTP	CMR & CMP, Category 3
Coaxial	CL2R & CL2P, CATVR & CATVP

HORIZONTAL CABLES

CABLE TYPE	NEC CLASSIFICATION CODES
Fiber Optic	OFN, OFNR & OFNP
Copper UTP	CMG, CMR & CMP, Category 6A
Coaxial	CL2, CL2R & CL2P

27.13.00 BACKBONE CABLING

27.13.13 COPPER BACKBONE CABLING

1. Terminating blocks mounted to the wall.

2. Copper backbone cables shall be extended to the equipment rack with 25 pair male amphenol style cables, terminated at the wall on 110 blocks on one end, with the amphenol end plugged into the analog voice patch panels.

3. Cable pairs and 25-pair binder groups shall be cut down in standard color code order.

4. UTP riser cable will have cable ID and pair count clearly marked on building equipment room and punch down blocks.
    - 4.1. Copper backbone cabling will be labeled in both the building telecommunications equipment room and the floor telecommunications equipment rooms.
    - 4.2. Cable ID's will be building number + an underscore + an incremental two digit cable number.
        - 4.2.1. For example, the cable to IDF-2 would be 023_01, while the cable to IDF-3 would be 023_02.
    - 4.3. Counts shall start from the lowest IDF number and increment with IDF numbers.
        - 4.3.1. For example, the cable to IDF-2 would count 023_01, 1-50, while the cable to IDF-3 would count 023_02, 51-100.
    - 4.4. All labeling must be approved by the appropriate IU UITS personnel.

27.13.13.**23 TESTING of COPPER BACKBONE CABLING**

1. Perform visual inspection to ensure that all cables are terminated on the punch down block in proper color code order.

2. Test all pairs for continuity and tip and ring polarity.

3. Test results shall meet or exceed the appropriate tests requirements as specified in the ANSI/TIA-568 specifications.

4. Bad pairs shall be limited to a maximum of 1% of the total number of pairs, and with a maximum of two

5. (2) bad pairs per binder group.

6. Test results shall be posted to the University project management website, emailed to the appropriate UITS representative (depending on whether it is AV or telecom test results) in a timely fashion, and stored on a CD and delivered to the University Information Technology Services representative upon request.

7. Test results shall be verified by the designated University personnel as part of the inspection and acceptance procedure.

27.13.**23 OPTICAL FIBER BACKBONE CABLING**

1. **Qualifications**
    1.1. Bidders will supply documentation of verified experience splicing the proposed type(s) and size(s) of cable, splice cases, and where applicable cutting over live fiber circuits with minimal down time.

2. **Cable Installation**
    2.1. Install FO cables and devices in accordance with industry standards and manufactures written instructions.
        2.1.1 Fiber riser cables must be separated from horizontal station wires and station wire bundles.
        2.1.2. Fiber riser cables must be kept to the side of cable trays and not be placed under station wires.
    2.2. Install fiber optic cable without damage to fibers, cladding, or jacket.
        2.2.1. Ensure that media manufactures recommended pulling tensions are not exceeded.
    2.3. Do not bend cables to smaller radii than minimums recommended by manufacturer.
    2.4. Use a pulling means, including fish tape, rope, and basket-weave grips, that will not damage media or raceway.
        2.4.1. Install FO cable simultaneously where more than one cable is being installed in the same raceway.
    2.5. Use pulling lubricant where necessary; compound used must not deteriorate cable materials. Do not use soap.
    2.6. NO splices are allowed. Cable runs to be continuous.
    2.7. Install a spare fiber loop of between 50 and 100 feet in each IDF for each fiber cable.
        2.7.1. Secure fiber loop(s) in a location which will not interfere with the installation of other cables, conduits and devices in the IDF room.
        2.7.2. For outside plant fibers, install spare fiber loops in every third manhole.

2.8. Provide grounding connections for FO cable and other system components as required by specifications and applicable codes and regulations, according to manufacturer's written instructions.

2.9. Fiber optic cable will have cable ID and strand count clearly marked on the fiber cabinet in the IDF, on the cable in the fiber cabinet, and on at least one visible point along its racking route within the IDF.

2.9.1. Outside plant fiber optic cable shall be labeled likewise in every manhole with stamped stainless steel tags.

27.13.23.13 SPLICING and TERMINATIONS

1. **Execution**

1.1. The Contractor is responsible for performing work in compliance with OSHA 1910.146 (Permit Required Confined Spaces) and OSHA 1910.268 (Telecommunication Installation Practices.

1.2. All fiber splicing will be done in a well-lighted secured controlled environment (climate controlled splicing trailer or vehicle built specifically for fiber cable splicing, IDF closet or approved room, or equivalent wherein dust or and other contaminants are minimized), with splice case and cables properly secured.

1.2.1. Splicing on outside plant fiber cables should not occur in manholes unless no other approved option is possible, and then requires specific approval and monitoring by appropriate UITS personnel.

1.2.2. In any case, splicing location must be away from electrical or other utility dangers and clear of vehicular and pedestrian traffic.

1.3. Perform all work according to University plans and specifications, manufacturers' specifications and recommended practices where given, and best industry practices otherwise, including workspace and fiber hygiene.

1.4. Provide termination of cables.

1.4.1. Use AFL fiber optic connectors on singlemode cables.

1.4.2. Use preterminated MTP/MPO connectors on 50 micron multimode cables with pre-connectorized modules with and AFL cabinets.

27.13.23.23 TESTING of FIBER CABLES

1. **General**

1.1. Maintenance of working circuits is critical. Cutover of live circuits require prior approval of UITS Change management as described in "27.04.40 SEQUENCING and SCHEDULING".

1.2. It will be the contractor's responsibility to provide the test equipment necessary and document the campus telecommunication coordinator the test equipment available for testing and the last date of certification.

1.3. Cables will have connectors installed on fiber cables prior to testing.

1.4. Tests shall be performed on inter-building and riser fiber cables.

1.4. **Testing equipment**:

1.4.1. Continuity tester

1.4.2. Visible fault detector

1.4.3. Power meter and light source

1.4.4. OTDR (Optical Time Domain Reflectometer)

1.4.5 Appropriate types of fiber jumpers 1.4.6. Equipment for two testers to communicate

1.4.7. Fluke DSP 4000 or equivalent.

1.4.8. Other equipment as approved by designated University personnel and as required to complete the testing to the satisfaction of the University

1.5. Prior to usage, test equipment and components in accordance with manufactures published test procedures.

1.6. All fibers will be tested bi-directionally per TIA-526-7 (singlemode) and TIA-526-14 method A-2 (multimode).

1.7. Bi-directional attenuation figures in decibel (dB) will be documented.

1.7.1. Before testing, verify with the University Information Technologies representative if raw or referenced readings are preferred.

1.8. All strands shall test good and meet current ANSI/TIA-568 specifications. Dark fibers and excessive attenuation due to breaks, bends, bad splices, defective connectors and bad installation practices will not be accepted and must be corrected.

1.9. Replacement fiber cables shall be subject to tests and criteria as described in this document.

1.10. All fiber cables shall have NO bad fibers. Fiber cables tested to have bad fibers, and determined to be non-repairable by practices acceptable to the University, shall be replaced at no additional cost to the University.

1.11. Any and all measures taken to correct unacceptable test results will be recorded, along with loss measurements taken before and after corrective measures.

1.12. Documentation will include cable ID, from and to points, strand ID, bi-directional attenuation figures in dB, per TIA Method A-2.

1.13. Use of an OTDR may require that a "launch reel" be used to overcome the OTDR's dead zone, if needed for fault location if the bi-directional tests fail.

1.14. Fiber jumpers used with the OTDR, light source and power meter must be of the same size and type of the fiber being tested.

1.15. Clean all connections according industry recommended practices each time when installing connectors for testing and circuit connections.

1.16. Fiber jumpers used with the light source and power meters shall be zeroed out by attaching the jumper from the light source via a coupler to the jumper from the power meter.

1.16.1. This reading noted, will become the reference level to obtain a true attenuation reading (some power meters can be zeroed to allow reading the attenuation level direct).

1.16.2. TIA-526-7 and TIA-526-14 Method A-2 should be used to zero OLTS.

2. **Loss Budgets**

2.1. Average splice loss shall not exceed 0.35 dB attenuation for multi-mode, 0.25 dB attenuation for single mode, measured from both directions.

2.2. No individual splice, multimode or single mode, shall exceed 0.50 dB attenuation, measured from both directions.

2.3. No termination shall exceed 0.40 dB attenuation for multimode, 0.30 dB attenuation for single mode.

d. No single mode OSP fiber shall exceed 0.000091436 dB attenuation per foot at 1550 nm. (0.25 dB attenuation per kilometer at 1550 nm).

2.4. Acceptable maximum allowable attenuation per spliced and terminated fiber will be determined by the following formula:

MAX = (S*MS) + (E*ME) +(F*MF)

Where S = number of splices in fiber between end termination points
MS = dB maximum average allowable attenuation per splice
E = number of endpoint terminations (namely, 2)
ME = dB maximum allowable attenuation per endpoint termination

F = number of feet of fiber from endpoint termination to endpoint termination
MF = maximum allowable fiber attenuation per foot of fiber
Manufacturer's specifications (converted from dB/km by formula (dB per km / 3280.8))

3. **Riser Fiber Cable Testing**
   - 3.1. Test multimode riser fiber at 850 nm and 1300 nm in both directions.
   - 3.2. Test singlemode riser fiber at 1310 nm and 1550 nm in both directions is to be used.
   - 3.3. No multimode riser fiber shall exceed 0.00021336 dB attenuation per foot at 1300 nm, 400 Mhz bandwidth. (0.70 dB attenuation per kilometer at 1300 nm, 400 Mhz bandwidth).

4. **Entrance / Outside Plant Fiber Cable Testing**
   - 4.1. Test entrance fiber with an OLTS per TIA-526-7 method A-2, Option 1.
     - 4.1.1. Test with an optical time domain reflectometer (OTDR) if needed per Option 2.
     - 4.1.2. ORL should be -30 dB or higher.
   - 4.2. Test singlemode entrance fiber at 1310 nm and 1550.
   - 4.3. Test cable segments for faulty connectors and terminations, and for the integrity of the cable and its component parts.
   - 4.4. Replace malfunctioning of damaged items with new materials, then retest until satisfactory performance is achieved. Test cable in both directions using the wavelengths described above.

27.13**.33 COAXIAL BACKBONE CABLING**

Not Applicable

27**.15.00 HORIZONTAL CABLING**

27.15**.00.23 COMMUNICATIONS AUDIO-VISUAL HORIZONTAL CABLING**

See following addenda

27.15**.16 VOICE COMMUNICATIONS HORIZONTAL CABLING**

1. All telecommunications horizontal copper cabling materials and installation shall be data grade as described in 27.15.19 and elsewhere, and shall NOT be referenced as "Voice" cable or wire.

27.15**.19 DATA COMMUNICATIONS COPPER HORIZONTAL CABLING**

1. Before the installation of Horizontal Cabling will be allowed to begin, the telecommunications subcontractor must provide a mock-up of the labeling and wiring to a sample face-plate and patch panel. 1.1. The mock-ups must be reviewed by an appropriate representative of UITS and approved prior to performing any final wiring required by the project documents.

2. Installation of Horizontal Copper Cabling
   - 2.1. 4-pair UTP cables should withstand 25 foot-pounds of pulling pressure. This number shall be verified by the wire manufacturer.
     - 2.1.1. Maximum cable length is limited to 90 meters (295 feet) from the jack to the patch panels.

2.1.2. Comply with ANSI/TIA-569 standard regarding the requirements and recommendations for separation of copper telecommunication cabling from sources of electromagnetic interference.
2.1.3. The Contractor shall replace any damaged cable at no expense to the University. No repair will be allowed on damaged cables.

2.2. Cabling shall be terminated at the station jack and at the equipment room as indicated in ANSI/TIA568, wiring configuration T568A.
2.2.1. The modular faceplate at the user end shall be equipped with inserts for communication services as indicated on plans.
2.2.2. Station cable in the IDF shall be terminated on Category 6A patch panels located in the equipment racks.
2.2.3. The minimum bend radius of Category 6A UTP cable shall not be smaller the manufacturer's recommended minimum at any time during installation or after completion, and shall not cause the cable jacket to buckle.
2.2.4. Station cables supported by j-hooks shall have no more than 12 inches of sag between j-hooks.
2.2.5. Route cables from the back of the patch panel through its coupler openings and loosely attach them to the wire manager with Velcro cable ties, leaving enough slack for re-termination at a future date.
2.2.6. Remove only as much jacketing as needed to terminate properly to the connecting hardware, keeping the amount of jacketing removed to an absolute minimum.
2.2.7. Do not untwist pairs more than 0.5 inches.
2.2.8. Visually *inspect* cable pairs for bare wire and other defects before terminating wires.
2.2.9. Once all of the cables have been terminated, dress the cable slack behind the panel with Velcro tie wraps tightened to a snug but not compressing fit.

2.3. Telecommunication cabling for elevator emergency phones shall be provided as follows:
2.3.1. Cabling for the elevator telephone to the elevator control room is by the elevator installer.
2.3.2. Cabling from the elevator control room to the telecommunication equipment room is by the electrical contractor.
2.3.2.1. <u>Jack must be mounted adjacent to, but outside of the elevator electrical panel.</u>
2.3.3. The electrical contractor shall notify campus personnel of the elevator service date.
2.3.3.1. This notification for request of services shall be provided no fewer than **21** days prior to service.

3. **Testing of Horizontal Copper Cabling**

3.1. Perform visual inspection to ensure that all cables are terminated on the eight position station jacks on both ends in proper color code order.

3.2. All station cables attached between information outlets and floor equipment room patch panels will be link tested with a cable analyzer to ensure compliance with current ANSI/TIA-568.

3.3. All pairs shall test good and meet Category 6A parameters for the respective type of cable.
3.3.1. Open, split, miss-terminated pairs, deviations from the manufacturer's installation specifications, defective connections and bad installation practices will not be accepted and must be corrected.

3.4. Test 100% of station wire in both directions with a certified handheld tester appropriate testing Category 6A installations, such as the Fluke OmniScanner or the Fluke DSP 4000 and other test equipment as necessary to assure proper termination sequences, continuity, and Category 6A compliance. Station wire shall have **<u>NO</u>** bad pairs.

3.5. When all station wire is determined to be acceptable, University Information Technology Services will spot test the plant using a certified handheld tester, such as the Fluke OmniScanner or Fluke DSP 4000.

3.6. Test results shall meet or exceed the appropriate tests requirements as specified in the ANSI/TIA-568 specifications.
3.7. The approved handheld tester will have the capability to be programmed with current Category 6A requirements as specified in ANSI/TIA-568 standards.
3.8. Documentation will include cable ID (same as jack ID) to be marked on the punch down blocks and patch panels in the telecommunication closet, station jack ID to be marked on the station jack and results of the testing done with the cable analyzer.
3.9. Analyzer documentation test result must be provided in the **native format** such as *.flw (not PDF) of the testing equipment used.
3.9.1. Results must be labeled using the information outlet labeling scheme for the project.
3.10. Test results shall be stored on a CD and delivered to the University Information Technology Services representative, or transmitted electronically to both the appropriate UITS representative and to the appropriate University Architect's Office representative.
3.11. Test results shall be verified by the designated University personnel as part of the inspection and acceptance procedure.

4. **Submission of test results**
4.1. In order to facilitate quicker turn-around for ordering and activating new information outlets in the building, the Telecommunications Subcontractor shall submit partial jack lists that are tested and approved rather than submitting the lists and test results of the entire building.
4.1.1. The details of how the partial lists are created will be determined in the field through coordination between the Telecommunications Subcontractor and the UITS Technical Staff.
4.1.2. As an example, test results may be submitted by IDF as work in an IDF is completed.
4.1.3. Special care must be taken to assure that telecommunications outlets for Fire Alarm systems and Elevator, which will be required for state inspections, be installed, tested and verified with sufficient lead times to meet the project construction and occupancy schedule.

27.15**.23 OPTICAL FIBER HORIZONTAL CABLING**

Not Applicable

27.15**.33 COAXIAL HORIZONTAL CABLING**

1. Not Applicable

27.15**.43 FACEPLATES and CONNECTORS**

1. **Termination equipment**
1.1. All station cables in the IDF shall be terminated on rack mounted patch panels.

2. **Information Outlet Rough-In**
2.1. Standard Information Outlets (single gang or double gang) shall be located at the same height as 120 volt AC outlets (normally 18" above finished floor).
2.2. Wall mounted telephones require a double gang box with a single gang plaster ring, positioned 40" A.F.F. to the center of the outlet box.
2.3. Information Outlets above counter tops should be installed so that the center of the outlet box will be a minimum of 12" above the counter top.

2.3.1. A counter top with a splash back may require different outlet box locations.

2.4. Wall mounted telephones require a special wall telephone jack that provides mounting lugs for the telephone and an eight position jack.

2.5. Information Outlets for wall mounted wireless Access Points must be located to accommodate mounting the Access Point equipment, which is 8.0”(W) x 8.0”(D) x 2.2”(H), centered on the box.

2.6. No Information Outlet will be installed such that workstations or devices served from it cannot be reasonably reached by a 16 ft cord.

3. **Finishing of Information Outlets**

3.1. Information Outlet faceplates and jack modules must not be modified in any manner, including being painted.

3.2. Jack labeling must remain visible.

4. **Labeling of Horizontal Copper Cabling**

4.1. The telecommunications contractor’s onsite representative(s) shall schedule a meeting with the UITS representative through the IU Project Manager prior to the permanent labeling of Information Outlets and IDF patch panels.

4.2. Information Outlet receptacles, cables, and terminations shall be labeled with a standard identification tag at both the Information Outlet and on the jackfields in the IDF/Wire Closet.

4.2.1. Tags shall be preprinted or computer printed with indelible waterproof ink and mechanically secured in a permanent fashion; for example, such as using an appropriate label maker with 3/8” tape.

4.2.2. Handwritten labels are NOT acceptable.

4.2.3. Labels shall be mounted in a manner which permits easy access and viewing.

4.2.4. The station cable serving each receptacle must be labeled at the room receptacle and the IDF rack.

4.3. Information Outlet receptacles in rooms are to be labeled -A through -ZZ in each room beginning with the first receptacle to the left of the main entrance to the room and continuing clockwise around the room.

4.3.1. All labeling will be done in all capital letters.

4.3.2. For example, a jack labeled 246A-A would be because:

4.3.2.1. Room 246A is the room number

4.3.2.2. The Information Outlet designation is “A” (first receptacle in room from the left of the door)

4.3.2.3.. Station cables from a given room shall be terminated in sequential order, i.e. – 246A-A, 246A-B, 246A-C, 246A-D, etc. If double letters are needed, the progression would be –AA, -AB, AC, … -AZ, -BA, BB, etc.

4.4. Information Outlets for special purposes shall have a unique identifier listed with the jack ID.

4.4.1. The identifier shall be inserted into the Outlet ID, between the room number and the Outlet designator as indicated in following drawings.

4.4.2. Identifiers are listed below:

4.4.2.1. Building Automation	"100+BA-A1" and “100+BA-A2”
4.4.2.2. Fire Panel	"100+FP-A1" and “100+FP-A2”
4.4.2.3. Wireless Access Point (WAP)	"100+WD-A1" (and “100+WD-A2” if applicable)
4.4.2.4. Elevator Phone	“100+EL-A1” and “100+EL-A2”
4.4.2.5. Interior Emergency Phone	“100+EM-A1” and “100+EM-A2”

4.4.2.6. Outdoor Emergency/Blue Light “OUT**x**+EM-A1” and “OUT**x**+EM-A2” where “**x**” is “N”, “E”, “S”, or “W” for direction from serving building or in extreme cases, “NE”, “NW”, “SE”, or “SW”

4.5. ALL LABELING SHALL BE COORDINATED WITH AND APPROVED BY AN APPROPRIATE UITS REPRESENTATIVE.

4.5.1. Schedule a meeting with the UITS representative through the IU Project Manager prior to the permanent labeling of Information Outlets and IDF patch panels.

4.5.2. In cases where the telecommunications (sub)contractor installs Wireless Access Point equipment, the equipment installer must provide a cut sheet of installed access equipment IDs and its associated data jack ID. An example of this cut sheet follows:

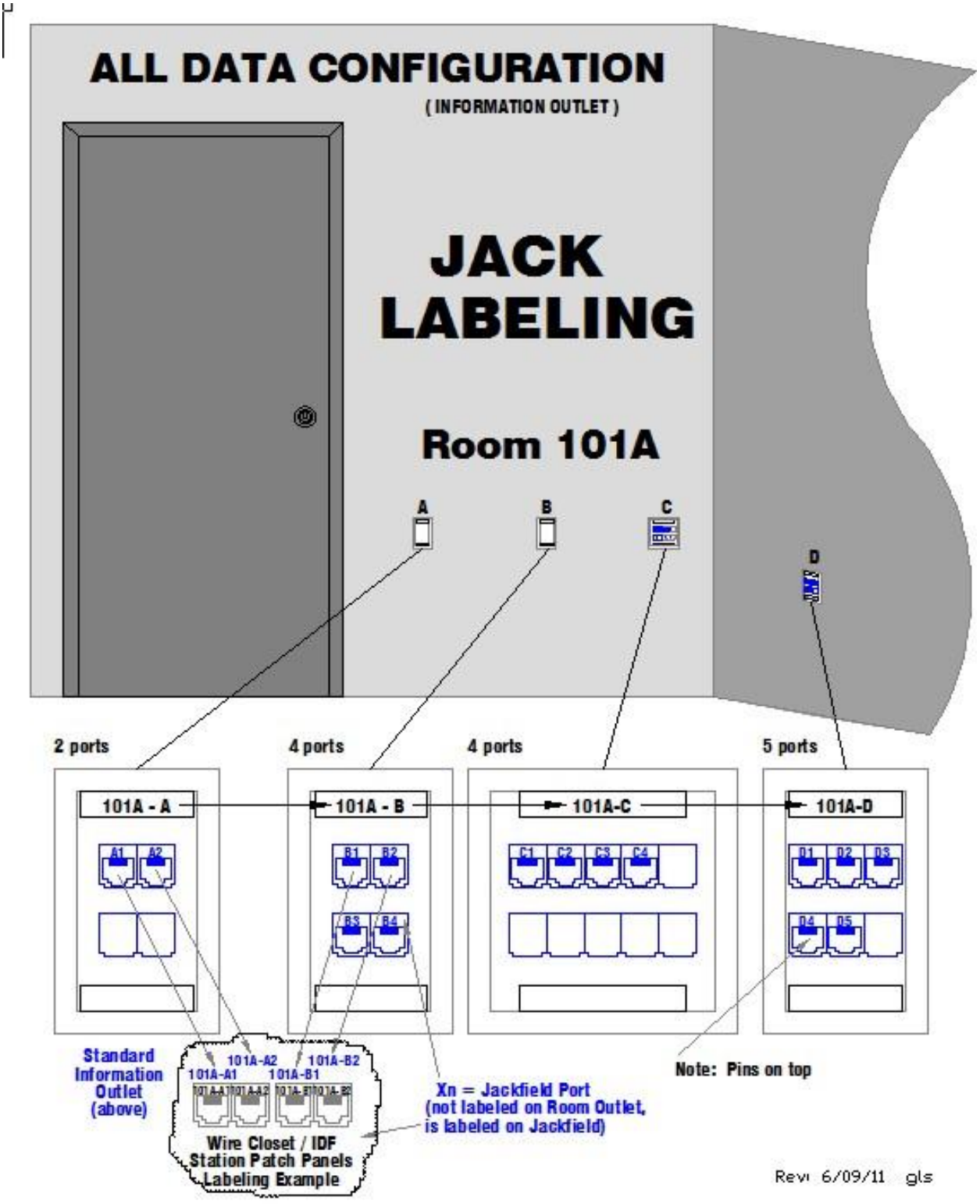
WIRELESS ACCESS PONT CUT SHEET example

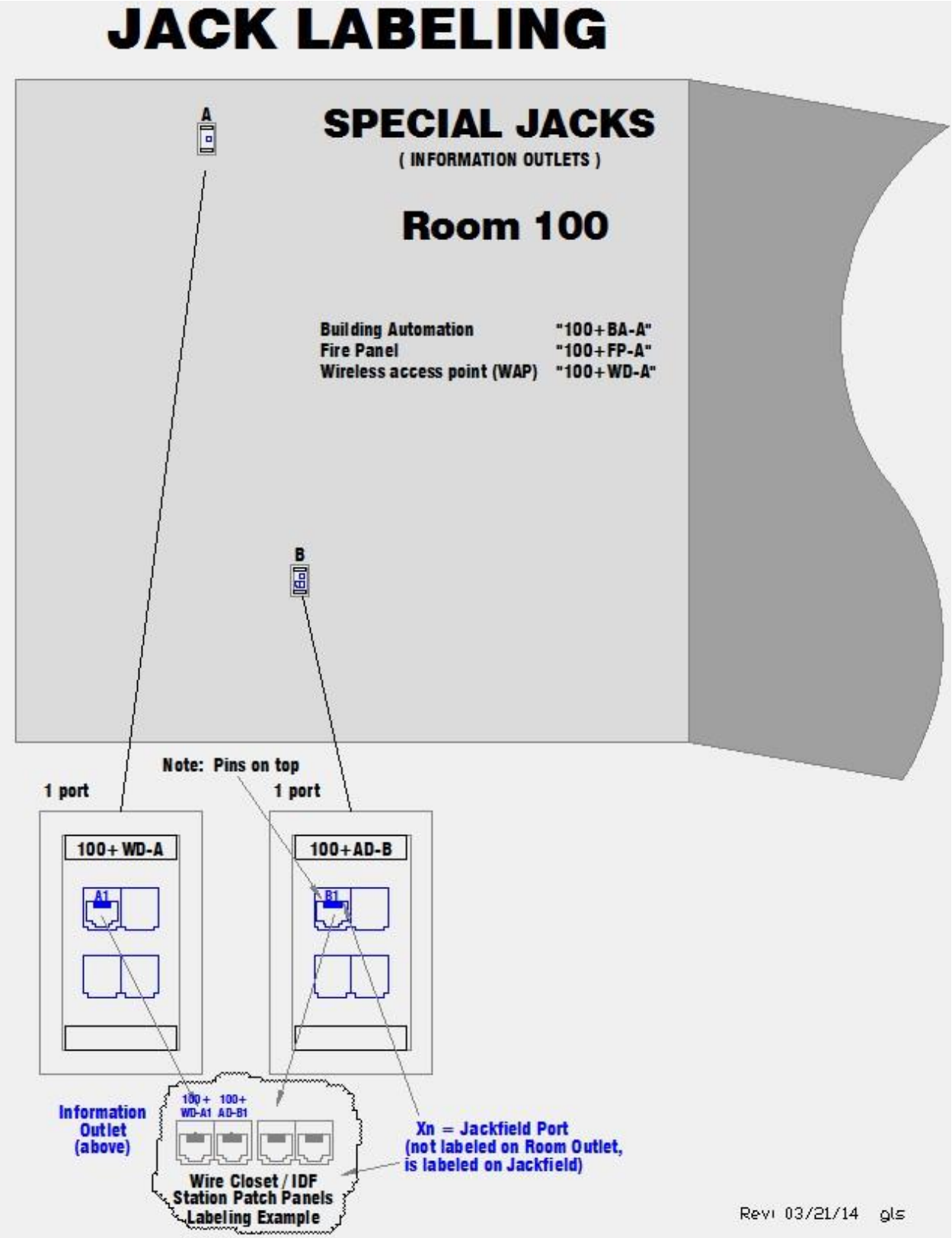
- Place the AP sticker on a sheet
- Write the Jack ID next to the sticker

Marching 100	
<PLACE AP STICKER HERE>	<WRITE JACK ID HERE>

Once complete, deliver cut sheet to UITS Wireless engineering.

LABELING EXAMPLES


ALL DATA CONFIGURATION
(INFORMATION OUTLET)
JACK LABELING
Room 101A
A
B
C
D
2 ports
4 ports
4 ports
5 ports
101A - A
101A - B
101A-C
101A-D
A1
A2
B1
B2
B3
B4
C1
C2
C3
C4
D1
D2
D3
D4
D5
Standard Information Outlet (above)
101A-A2
101A-B2
101A-A1
101A-B1
Wire Closet / IDF Station Patch Panels Labeling Example
Xn = Jackfield Port (not labeled on Room Outlet, is labeled on Jackfield)
Note: Pins on top
Revi 6/09/11 gls



27**.20.00 DATA COMMUNICATIONS**

User End Equipment and IDF Network Equipment provided by IU

27**.30.00 VOICE COMMUNICATIONS**

User End Equipment provided by IU

27**.40.00 AUDIO-VIDEO COMMUNICATIONS**

27**.41.16 INTEGRATED AUDIO-VISUAL SYSTEMS and EQUIPMENT**

User End Equipment provided by IU

27**.50.00 DISTRIBUTED COMMUNICATIONS and MONITORING SYSTEMS**

Not Applicable

27**.60.00 WIRELESS TRANSCEIVERS**

Equipment provided by IU

27**.99.99 APPENDIX: Design Guide**

See IU Building Telecommunications Desing Guidelines on next page

IU Building Telecommunications Design Guidelines
v.11092018

COMMUNICATIONS (Includes Information Outlets and Telecommunications Rooms)

Telecommunications equipment rooms are an increasingly critical part of building systems in today's highly technical world. As such, adequate space and proper location for the equipment rooms as well as adequately size cable paths should be part of initial Schematic and Design Development drawings and not be "squeezed in" to the floor plans during later design stages.

This guideline is a reference for architectural, mechanical and electrical design as it pertains to UITS (*University Information Technology Services*) telecommunications infrastructure on all Indiana University campuses. The telecommunications system specified herein provides for voice, data, video and other low voltage signaling functions (such as for energy management and security systems) through twisted pair, fiber optic, and coaxial cable. The system shall provide acceptable information outlets for any telecommunication device, which requires connection to devices, networks or information services serving general university needs.

Please note that for all new construction or major renovations, the only equipment that may be housed in telecommunications rooms will be equipment for UITS data network and voice services, door controllers for the telecommunications room(s) only, and non-intrusive cooling units, which serve the telecommunications room only. Coaxial television equipment and cabling, other door controller systems equipment and cabling, other security systems equipment and cabling, and any other equipment, ducting, piping, and cabling shall not be installed in or routed through telecommunications equipment rooms. Under no circumstances are liquid carrying structures to pass through telecommunication room spaces for even the slightest distances. Control cables shall not be installed in telecommunications conduits or cable tray, except in very small quantities and with verifiable approval by the appropriate UITS representative. The purpose of these restrictions is to:

(1) eliminate the need for non UITS employees to access these spaces in order to maintain the security of telecommunications systems which are defined as critical infrastructure by the USA Patriot Act, as well as protect sensitive institutional data, and
(2) maintain a vertical minimum of nine (9) feet aff working space for cable routing and associated hardware above equipment racks.

For renovations in older buildings, some exceptions must be made for some of the items banned in newer construction. During renovation projects in these older telecommunications rooms, particular items will be addressed on a case-by-case basis. Examples of some exceptions are addressed throughout this document. It is critical that ALL telecommunications components and installations will follow ALL state and national codes where safety is concerned.

For remodels and renovations in which jacks and/or station wire are to be removed or abandoned: (1) the jack/ports must be removed from the station end and the outlet

covered with a blank plate, (2) the station wire/cabling must be removed in its entirety from the jack location to the telecommunications equipment room (IDF), and (3) the jack/port label(s) must be removed from the jackfield(s); if the associated jack/port is less than the current standard station wire Category rating, then the jack/port should also be removed from the jackfield. In some cases, empty jack/port slots in the existing jackfield may be repopulated with the current station wire Category rated station wire and jack/port modules; such instances must be approved by the appropriate UITS representative.

Some requirements may be stated generally because of rapid changes in technology. University Information Technology Services Telecommunications and Networks staff must be actively involved in a review and advisory capacity from project inception through construction with contacts available through the University Capital Planning & Facilities office and through https://telecom.iu.edu/services. Greater detail with additional information is provided in the Division 27 Communications construction specifications document, available for download from the University Capital Planning & Facilities office website at https://app.e-builder.net/da2/Documents/Explorer.aspx?PortalID=0e145392-dfbd-4a91-877b-16a096b764f8&FolderID=9c1f5436-1504-45c7-9129-bff4a06ec5de. Access to IU's e-Builder is required.

GENERAL

Design architects, engineers, and eventually, contractors are expected to propose designs and build in accordance with the guidelines and requirements stated herein. Exceptions to the Design Guideline or the Division 27 specifications must be approved in written or email form by the appropriate UITS personnel, but such exceptions should not be considered until all other specification conforming solutions have been exhausted.

Telecommunication rooms not only need to accommodate initial equipment and services requirements, but provide ample facilities for future UITS equipment requirements, most especially where unfinished "shell spaces" are part of the overall space design. Each generation of networking equipment housed in the rooms produces more heat than the previous; therefore, adequate room size is not only necessary to house equipment, but also plays an important role in managing and dissipating heat loads.

The design architect shall schedule regular design progress meetings with the UITS Telecommunication Plant representative, a UITS Network representative, and a university Engineering Services representative. These linkages shall be made through the University Capital Planning & Facilities office (preferred) or through https://telecom.iu.edu/services/.

Telecommunications design shall comply with Federal and State codes, regulations, and

standards with variances adopted as standards by Indiana University and the State of Indiana. In order to achieve compliance with BICSI telecommunications standards, the design architects/engineers must employ the services of an RCDD (Registered Communications Distribution Designer) if one is not already on staff. Applicable university, state and national standards include the latest editions of:

1. ANSI/NFPA 70 National Electrical Code with Indiana Amendments, latest edition
2. BICSI CO-OSP Customer Owned Outside Plant Manual
3. BICSI Telecommunications Distribution Methods Manual
4. BICSI Customer Owned Outside Plant Design Reference Manual
5. TIA-230 - Color Marking of Thermoplastic Wire
6. FCC Rules and Regulations
7. Indiana Administrative Code, Title 675, Article 22, Indiana Fire Prevention Codes
8. Joint Commission Accreditation of Hospitals Code
9. J-STD-607 Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
10. UL 467 Standard for Grounding and Bonding Equipment
11. National Electrical Code
12. National Electrical Safety Code
13. NFPA 101: Life Safety Code
14. RUS Standards for Engineering, Construction, and Installation
15. TIA 526-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant – OFSTP-7
16. TIA 526-14 Optical Power Loss Measurements for Installed Multimode Fiber Cable Plant – OFSTP-7
17. TIA 568 Commercial Building Telecommunications Cabling
18. TIA 569 Commercial Building Standard for Telecommunications Pathways and Spaces
19. TIA 598 - Optical Fiber Cable Color Coding
20. TIA Standard ANSI/TIA-607 Commercial Building Grounding and Bonding Requirements for Telecommunications
21. TIA 604 Standards on Fiber Optic Connector Intermateability
22. TIA 606 Administration Standard for Commercial Telecommunications Infrastructure
23. TIA 758 Customer Owned Outside Plant Telecommunications Cabling Standard
24. TIA Telecommunication Systems Bulletin TSB67 - Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling Systems
25. TSB-140 Additional Guidelines for Field Testing Length, Loss and Polarity of Optical Fiber Cabling Systems
26. Indiana University Division 27 Communications specifications for construction

TOPOLOGY

Horizontal cabling shall be installed in a star topology, with each work area Information Outlet terminated via horizontal station cable to a horizontal cross-connect in a telecommunications room.

Floor telecommunications rooms (which may include the building MDF) should be located on the same floor as, and centrally located to the work areas served. In a large building, if the number of stations would require a significantly larger room, or if

necessary to keep horizontal cabling runs within the specified lengths, more than one telecommunications room on some floors may be required; in such cases, the serving area of each telecommunications room must be clearly defined and strictly adhered to during cabling installation. In small buildings, a telecommunications room may serve multiple small floors if approved on a case-by-case basis by the appropriate UITS design representative, with the requirement that all other design criteria are met.

Where at all possible, telecommunications rooms should be vertically stacked within multi-floor buildings.

Telecommunications room doors must open into public spaces, preferably hallways. Doors should be oriented to open outward to provide easy egress from the room in case of emergency.

Station communications design is based on 'one Information Outlet per workstation', to be implemented as defined under "Information Outlet Types at IU". Each Information Outlet must be sized with port counts by type and quantity for the needs of intended and possible future users of each Information Outlet location.

Horizontal (station) cabling extends from the work area Information Outlet/connector to the horizontal cross-connect in the telecommunications room. The maximum horizontal data cable length shall be 90 m (295 ft). The maximum horizontal cable link length is based on a maximum length of 5 m (16 ft) of work area line cord; therefore, no Information Outlet will be installed such that the intended workstation or device cannot be reasonably reached by a 16 ft cord.

Due to the need to maintain a secure and manageable campus network, as well as the need to maintain location records of Information Outlets and equipment associated with them for E911 response databases, all equipment connected to a given Information Outlet must be located in the same room as the outlet. Likewise, a local switch may not serve equipment in more than one room.

In certain circumstances, such as laboratory settings or temporary work clusters, communications data switching can be supplied from an in-room switch to individual stations, or run back to a wiring closet via horizontal cabling (preferred). Any application of an in-room switch must be approved prior to design and implemented by the Indiana University Technology Services (UITS) Network group. Those not approved will not be connected to the University data network. Further information on this topic may be obtained the Indiana University Bloomington Network Operations Center at noc@indiana.edu.

Large classrooms should be routed to Telecommunications Rooms and have wireless service, or be served with only wireless facilities where practical. Such decisions should be coordinated with a UITS wireless system representative.

TELECOMMUNICATIONS ROOMS, GENERAL

Architects/engineers must submit detailed layout diagram/drawing(s) for each telecommunications equipment room in each building in a project. Such drawings must be included in bid and construction documents. Drawings should include room locations and footprints; identification of all telecom related and non-telecom related materials, equipment, devices, and structures which occupy space in the telecommunications equipment rooms; and high voltage electrical gear adjacent to the telecommunications equipment rooms, with clearance measurements of telecom items from all such objects. A simple example of a layout drawing is included in this document and indicates minimum clearance requirements for equipment.

In smaller renovations, any deviations from these general requirements should be corrected where feasible and practical. Many remodels will not fall under either of these situations; however, the IDF which serves the remodel area must be reviewed by the appropriate UITS representative for cabling and network equipment capacities in order to determine if charges and construction beyond individual station cabling costs are necessary.

All telecommunications rooms should be designed to the two rack standard, with the exception of small buildings where the installation of large quantities of wiring and devices is not possible. In such small buildings, design would be handled on a case by case basis, with design approval required by the appropriate Indiana University UITS representative.

Telecom rack layout drawings must be included in bid and construction documents. The rack layout drawings provided in this document, and in the Division 27 document provided on the University Capital Planning & Facilities website, illustrate the specified arrangement of components in the telecom equipment racks. With nearly 1300 telecommunications rooms to manage on the largest IU campus, and 200 more on regional campuses, uniform equipment arrangement is an important step in efficiency for those who provide ongoing service orders, repair, and upgrades to University telecommunications systems. Examples of rack layout drawings are included in this document, and may be requested in CAD form.

Very small buildings with fewer than 40 stations may have another option than a large telecom room. Such option may be discussed with the appropriate UITS representative during design.

In order to maintain network security, all telecommunications rooms must be able to be locked with a (1) telecommunications key core and (2) a cardkey system separate from all other building cardkey systems, so that such rooms will not be accessible to other trades or individuals who are not granted access to telecommunications equipment rooms.

Telecommunications rooms shall not house systems or equipment other than those related directly to telecom systems. Systems requiring access by non-UITS personnel must be

located in spaces entirely outside of the telecommunications rooms. Examples of systems and equipment that are not appropriate for placement in UITS telecommunications rooms include:

- Servers
- Security system monitors
- Fire alarm monitors
- IP camera monitoring systems
- Audio systems
- CATV systems
- DVR racks
- Computer workstations
- Storage shelving

Mechanical systems conduits and components, plumbing systems conduits and components, HVAC ducting and components, CaTV cables and equipment, and other mechanical and electrical systems conduits, cabling, and ducting shall not pass through telecommunications rooms. Access panels for other building systems must not be located in telecommunications room. (*Note: At the IUPUI campus only, UITS Telecommunications is in charge of CATV, so that system is allowed in the telecom rooms.*)

Thus, telecommunications rooms are not catch-all spaces in which to add forgotten utility chases or unrelated equipment at a later date, typically during construction. As noted above, **anything not directly serving the functionality of a telecommunications room simply does not belong in a telecommunications room**.

Conduit placement, as well as other items installed in telecommunications rooms, must not interfere with working space clearances. Conduits should not be placed near the equipment racks in order to prevent damage to electronic equipment during future cable pulls as well as to allow for proper cable racking. Horizontal conduit penetrations should enter rooms near ceiling height. Vertical conduits should penetrate floors or ceilings within four (4) inches of walls. Conduits penetrating floors should be placed in or near room corners and away from equipment rack locations.

Where possible, rack installations should be oriented so that the front of patch panels and switches are visible from the opened door of the room.

The design must comply with the ANSI/TIA-569 standard regarding the requirements and recommendations for separation of copper telecommunication cabling from sources of electromagnetic interference.

Signage for MDF/IDF rooms shall **not** contain any text listing of the use of the room, only the correct room number.

MAIN BUIDING TELECOMMUNICATIONS ROOM (MDF/IDF-1/BDF)

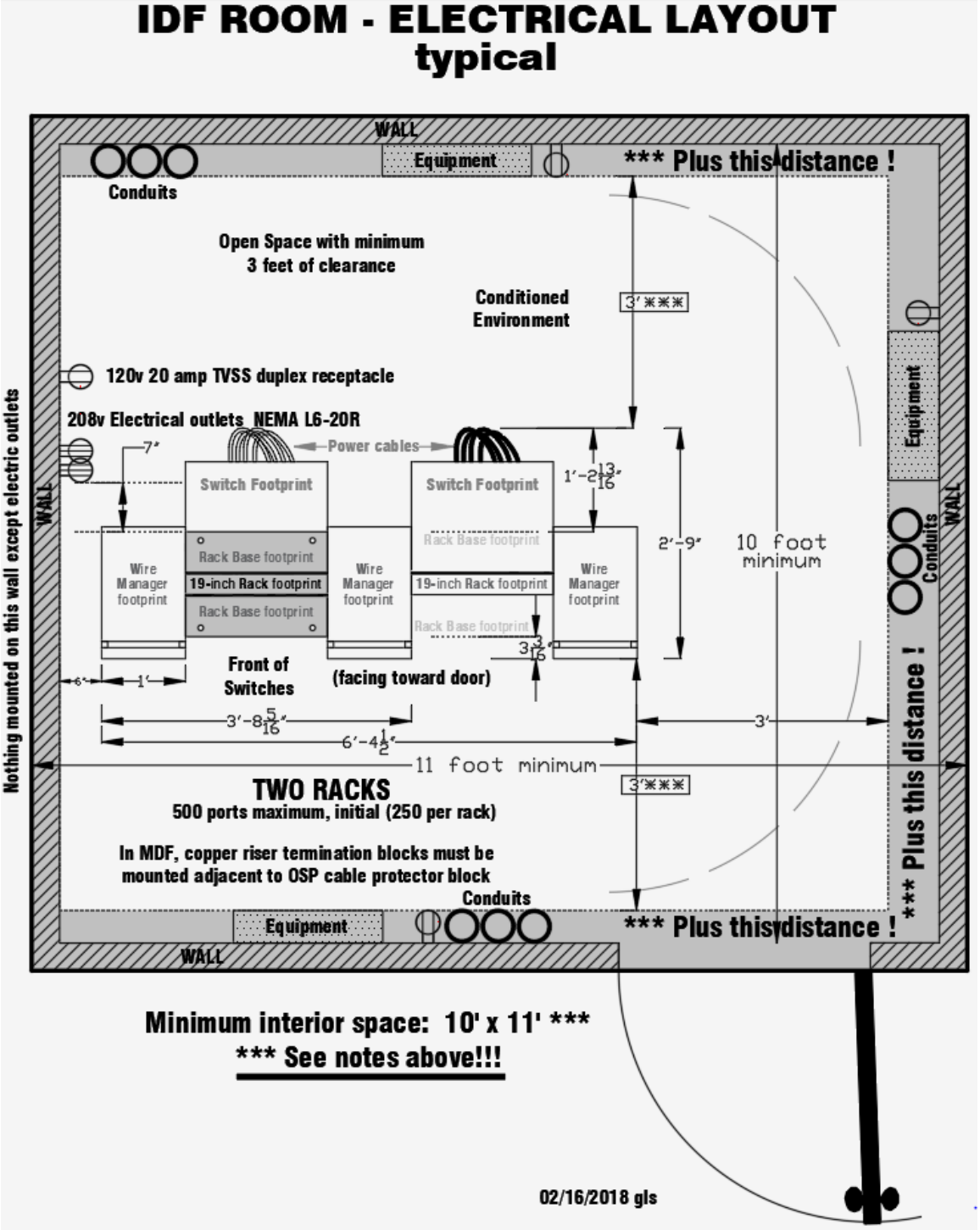
The primary functions of the main building telecommunications room are to:
(1) house the necessary hardware to provide electrical protection for outside plant cables,
(2) house splice closures and grounding and bonding facilities,
(3) allow for cross connection between the outside plant cables that enter the building from the campus communication distribution network and the inside backbone cabling or data network switching equipment, and
(4) allow for riser cable and station cable connection to the data network switching equipment.

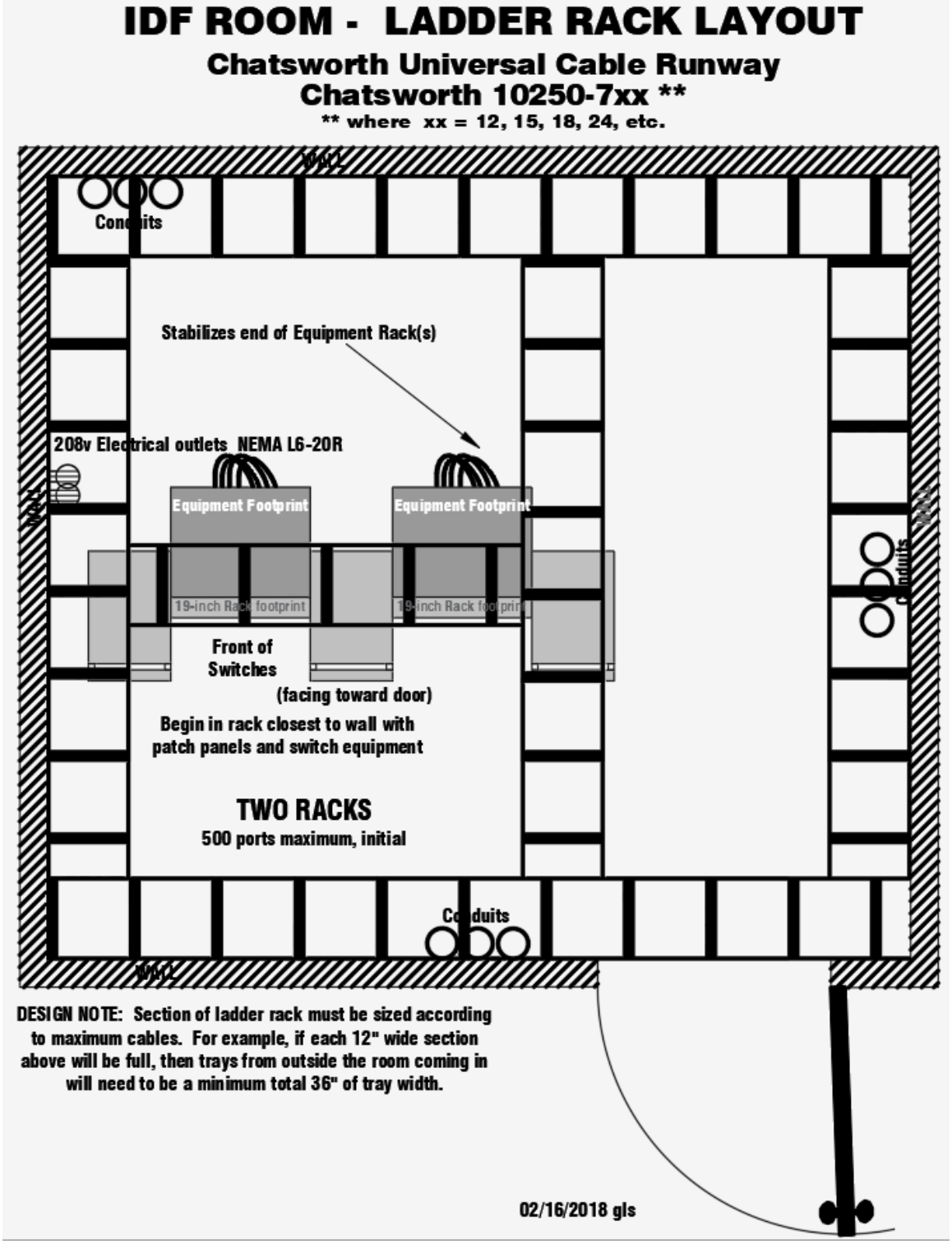
Except for very small buildings, the room should be sized at a bare minimum of 110 sf with dimensions no less than 10' x 11' (see illustrations in this document); this minimum space requirement is not negotiable. Additional space must be added for wall-mounted equipment of any type as illustrated on the "IDF ROOM – RACK LAYOUT" drawing elsewhere in this document and in the Division 27 specification; this minimum space requirement is no longer negotiable; actual space will be determined by the initial number of data ports plus foreseeable future growth.

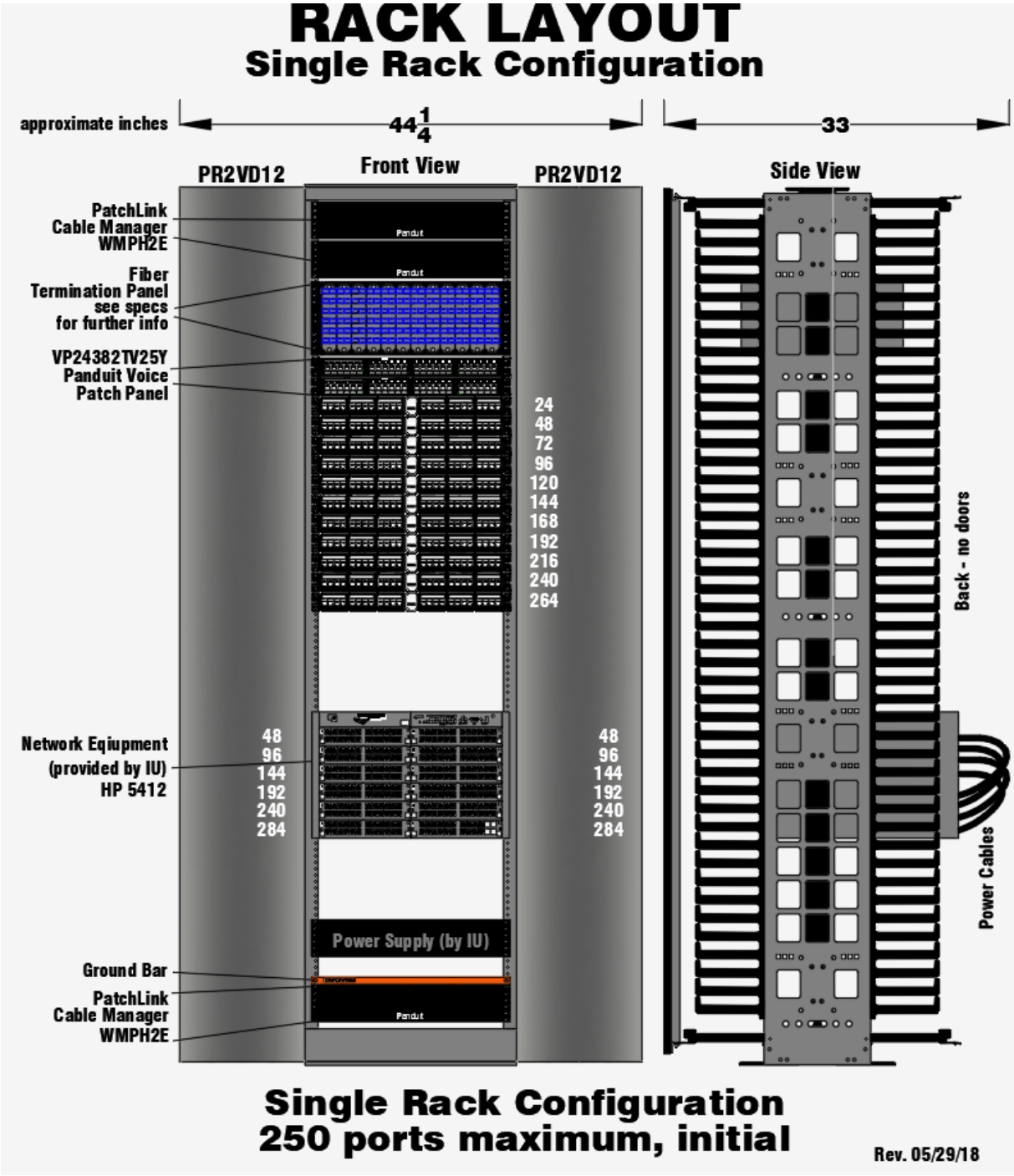
The main telecommunications room will likely serve as a floor telecommunications room (IDF, or IDF-2) as well. If so, then the room should be sized by appropriate UITS Telecommunications personnel on a case-by-case basis, but with no dimension less than required to allow for the aforementioned clear floor space solely dedicated to telecom equipment racks and personnel movement. If future additional equipment racks are expected, then additional floor and necessary wall space must be added to the size of the room according to the space requirements of that equipment as well as any associated cabling and mechanical requirements.

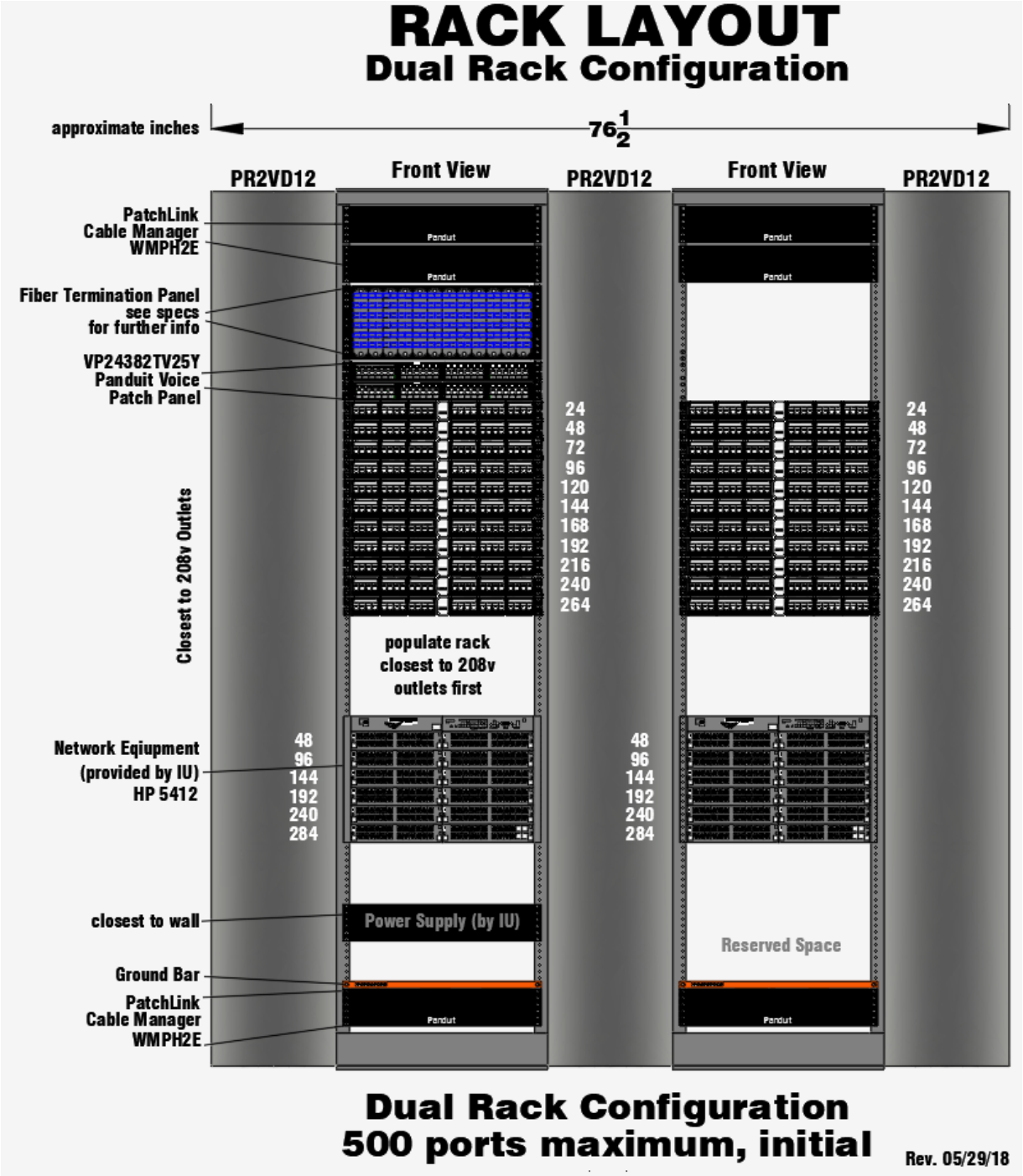
In either case, the main telecommunications room will contain electronic network equipment necessary for service to the entire building and so must be environmentally controlled for both temperature and humidity as described elsewhere in this document.

The design must comply with the ANSI/TIA-569 standard regarding the requirements and recommendations for separation of copper telecommunication cabling from sources of electromagnetic interference.


IDF ROOM - ELECTRICAL LAYOUT
typical
WALL
Equipment
*** Plus this distance !
Conduits
Open Space with minimum
3 feet of clearance
Conditioned
Environment
3'***
120v 20 amp TVSS duplex receptacle
208v Electrical outlets NEMA L6-20R
7"
Power cables
Switch Footprint
Switch Footprint
1'-2 13/16"
Rack Base footprint
19-inch Rack footprint
Rack Base footprint
Wire
Manager
footprint
Wire
Manager
footprint
Wire
Manager
footprint
Rack Base footprint
19-inch Rack footprint
Rack Base footprint
2'-9"
10 foot
minimum
3 3/16"
Front of
Switches
(facing toward door)
6"
1'
3'-8 5/16"
6'-4 1/2"
3'
11 foot minimum
3'***
TWO RACKS
500 ports maximum, initial (250 per rack)
In MDF, copper riser termination blocks must be
mounted adjacent to OSP cable protector block
Conduits
Equipment
*** Plus this distance !
WALL
Nothing mounted on this wall except electric outlets
Equipment
Conduits
WALL
*** Plus this distance !
Minimum interior space: 10' x 11' ***
*** See notes above!!!
02/16/2018 gls


IDF ROOM - LADDER RACK LAYOUT
Chatsworth Universal Cable Runway
Chatsworth 10250-7xx **
** where xx = 12, 15, 18, 24, etc.
WALL
Conduits
Stabilizes end of Equipment Rack(s)
208v Electrical outlets NEMA L6-20R
WALL
Equipment Footprint
Equipment Footprint
19-inch Rack footprint
19-inch Rack footprint
Conduits
WALL
Front of
Switches
(facing toward door)
Begin in rack closest to wall with
patch panels and switch equipment
TWO RACKS
500 ports maximum, initial
Conduits
WALL
DESIGN NOTE: Section of ladder rack must be sized according to maximum cables. For example, if each 12" wide section above will be full, then trays from outside the room coming in will need to be a minimum total 36" of tray width.
02/16/2018 gls


RACK LAYOUT
Single Rack Configuration
approximate inches
44 1/4
33
PR2VD12
Front View
PR2VD12
Side View
PatchLink
Cable Manager
WMPH2E
Fiber
Termination Panel
see specs
for further info
VP24382TV25Y
Panduit Voice
Patch Panel
24
48
72
96
120
144
168
192
216
240
264
Network Eqiupment
(provided by IU)
HP 5412
48
96
144
192
240
284
48
96
144
192
240
284
Power Supply (by IU)
Ground Bar
PatchLink
Cable Manager
WMPH2E
Back - no doors
Power Cables
Single Rack Configuration
250 ports maximum, initial
Rev. 05/29/18


RACK LAYOUT
Dual Rack Configuration
approximate inches
76 1/2
PR2VD12
Front View
PR2VD12
Front View
PR2VD12
PatchLink
Cable Manager
WMPH2E
Fiber Termination Panel
see specs
for further info
VP24382TV25Y
Panduit Voice
Patch Panel
Closest to 208v Outlets
24
48
72
96
120
144
168
192
216
240
264
populate rack
closest to 208v
outlets first
Network Eqiupment
(provided by IU)
HP 5412
48
96
144
192
240
284
closest to wall
Power Supply (by IU)
Reserved Space
Ground Bar
PatchLink
Cable Manager
WMPH2E
Dual Rack Configuration
500 ports maximum, initial
Rev. 05/29/18

FLOOR TELECOMMUNICATIONS ROOM (IDF-2)

The primary function of a floor telecommunications room is to allow for riser cable and station cable connection to the data network switching equipment.

A floor telecommunications room must provide an environmentally controlled environment as described elsewhere in this document in order to house electronic equipment necessary to connect to the campus data network. The telecommunications room also provides for the administration and routing of equipment cables/cords from the horizontal cross-connect to the telecommunications equipment.

A floor telecommunications room (IDF) should be sized at a bare minimum of 110 sf and no smaller than 10' x 11' (see illustrations in this document) and in the Division 27 specification; this minimum space requirement is not negotiable.

The design must comply with ANSI/TIA-569 standard regarding the requirements and recommendations for separation of copper telecommunication cabling from sources of electromagnetic interference.

SMALL BUILDING TELECOMMUNICATIONS MDF/IDF-1/BDF

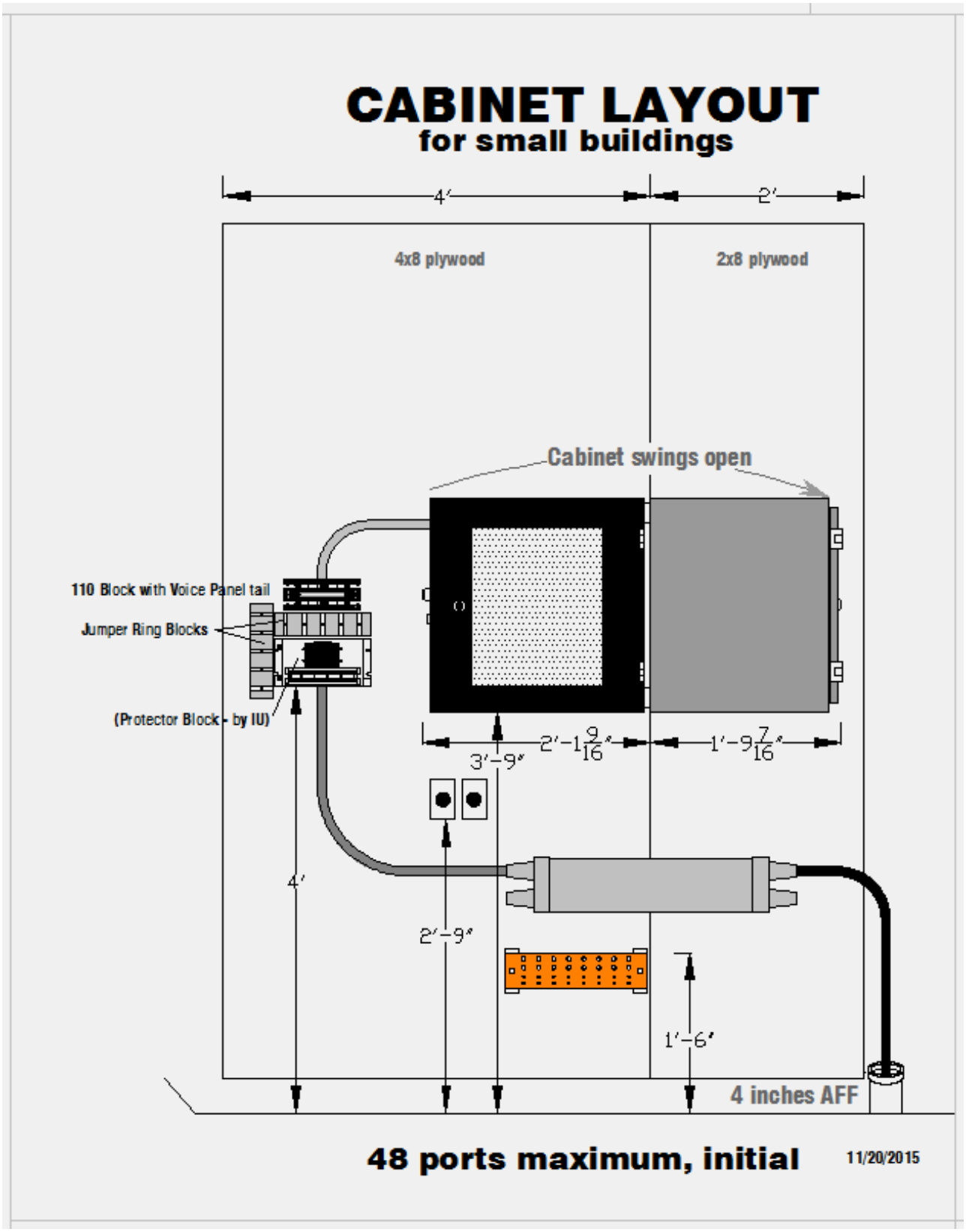
Certain small buildings are not large enough in either size or number of stations to warrant a room dedicated to only telecommunications equipment.

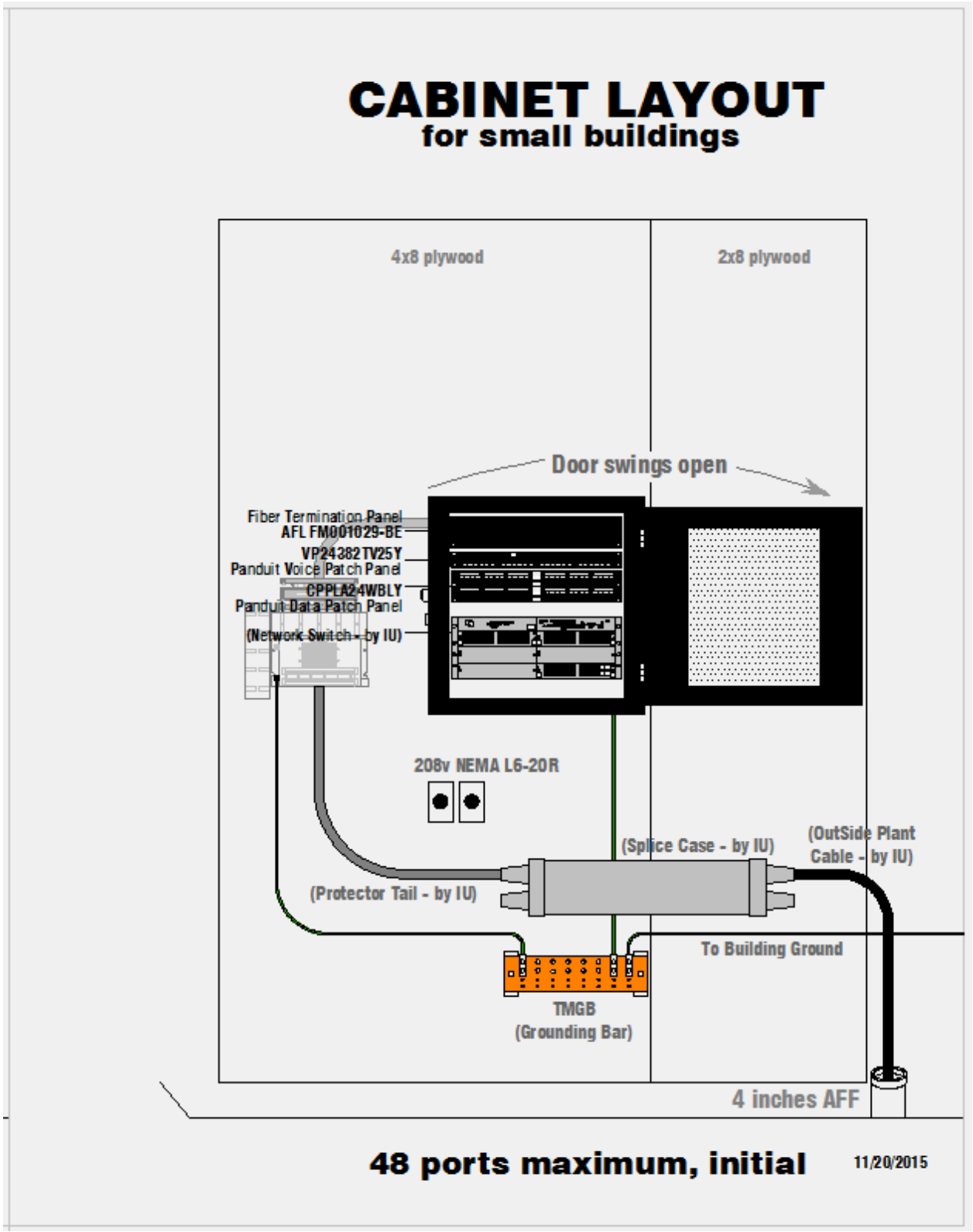
In UITS approved situations, a lockable cabinet solution may be used which minimizes space utilization while maintaining essential university network security.

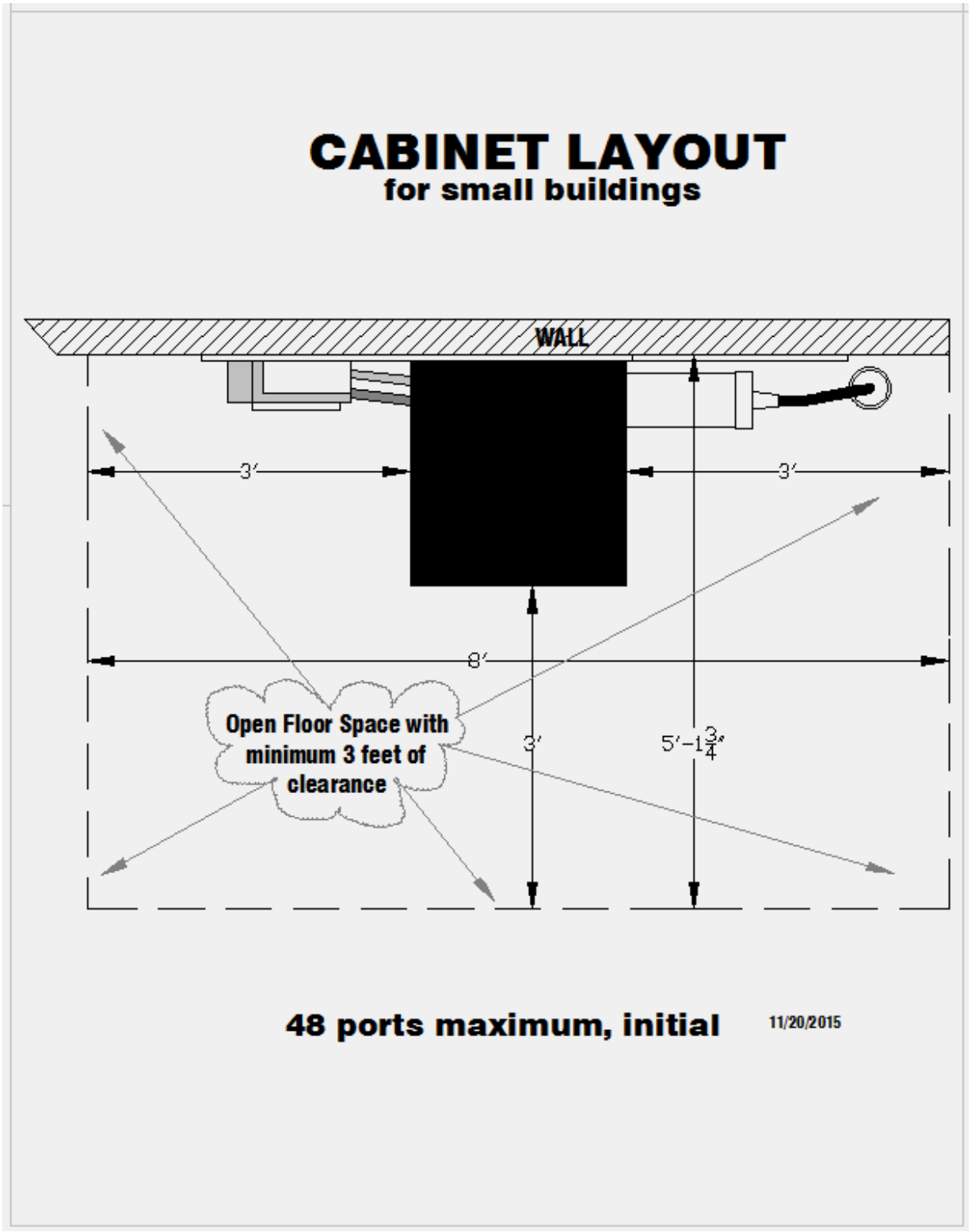
The number of network ports may not exceed 48 for this arrangement; 49 or more ports will require a dedicated telecommunications room as previously described, regardless of the stage of construction at which the 48 maximum ports is exceeded.

The cabinet will contain electronic network equipment; therefore, the room in which it is mounted must be environmentally controlled for both temperature and humidity as described elsewhere in this document.

This design also must comply with ANSI/TIA-569 standard regarding the requirements for minimal separation of copper telecommunication cabling from sources of electromagnetic interference and to meet electrical safety requirements.


CABINET LAYOUT
for small buildings
4′
2′
4x8 plywood
2x8 plywood
Cabinet swings open
110 Block with Voice Panel tail
Jumper Ring Blocks
(Protector Block - by IU)
3′-9″
2′-1 9/16″
1′-9 7/16″
4′
2′-9″
1′-6″
4 inches AFF
48 ports maximum, initial
11/20/2015


CABINET LAYOUT
for small buildings
4x8 plywood
2x8 plywood
Door swings open
Fiber Termination Panel
AFL FM001029-BE
VP24382TV25Y
Panduit Voice Patch Panel
CPPLA24WBLY
Panduit Data Patch Panel
(Network Switch - by IU)
208v NEMA L6-20R
(Splice Case - by IU)
(OutSide Plant
Cable - by IU)
(Protector Tail - by IU)
To Building Ground
TMGB
(Grounding Bar)
4 inches AFF
48 ports maximum, initial
11/20/2015


CABINET LAYOUT
for small buildings
WALL
3′
3′
8′
Open Floor Space with minimum 3 feet of clearance
3′
5′–1¾″
48 ports maximum, initial
11/20/2015

SECURITY for TELECOMMUNICATIONS ROOMS

Telecommunications rooms will utilize the following security devices to provide controlled access and video/audio monitoring. Complete design should be coordinated with the appropriate UITS representative. Associated costs of infrastructure as well as hardware listed below are both project costs and are to be provided as part of the project. The control system for this equipment must be located in the telecommunications rooms, e.g., separate from any other building access control systems, and will be activated by UITS (University Information Technology Services) after all associated infrastructure, wiring, hardware and network equipment are installed and tested.

Access Control

The following devices support multiple card formats:

Option, Inc. SSP-D2 Intelligent Two Door Controller
Open Option, Inc. RSC-1 Single Reader
Open Option, Inc. RSC-2 Dual Reader

ACCESS CONTROL READER: Allegion MT15 reader

Door access hardware

LOCK: Stanley Best Lock 45HW-7DEU14H **L/C RQE RH 626**
The part number can vary to allow for finish and handling of the door; however, the RQE (request to Exit) switch must be built into the lockset.

DOOR CONTACT: One (1) inch recessed door position contact
(for example, Sentrol 1078)

See the IU Division 28 specification for details.

Network Cameras

As a general guideline, a network based security camera will not be mounted inside Telecommunications Rooms unless specifically requested on a case-by-case basis. If a network security camera is requested, then the Telecommunications Rooms shall have a Category 6A station wire terminated on a single port Information Outlet, mounted at ~7'2" aff unless noted otherwise, located on the ceiling or wall in a location such that a camera mounted to it can monitor persons entering and leaving the room.

Cameras may be requested for other locations within the building as well. Only cabling for campus network based cameras may be terminated within telecommunications equipment rooms.

Should it be deemed necessary to install one or more devices at a later date, examples of acceptable cameras are:

Axis 216FD/216FD-V Network Cameras (power over Ethernet)
For use in normal lighting conditions

Axis P3301/-V Fixed Dome Network Cameras (power over Ethernet)
For use in areas where extreme light changes can cause picture wash out, such as might be experienced around glass entryways or opened overhead doors

Axis 225FD Network Camera (power over Ethernet)(outdoor camera)
An environmental mini-dome camera for outdoor use

See the IU Division 28 specification for other model details and options.

Exterior cameras mounted within 6 feet of a lightning ground or mounted on metal that can conduct lightning must be served by electrically protected OSP rated station cable.

PATHWAYS

Cable paths must be designed and installed in a manner which allows reasonable access to add or remove cables for future demand and maintenance purposes, including capacity for future growth. It is the responsibility of the design consultant to indicate the quantities and sizes clearly on the construction documents.

The sizes of station device boxes are defined in the Division 27 specifications available on the UAO website.

The telecommunications raceway system must be specified such that during installation, cable is not subject to sharp or binding edges. All newly installed cable tray systems and surface raceway shall be large enough that all of the telecommunication cabling installed as part of a project will not produce a fill ratio greater than 70% of the manufacturer's stated capacity.

Conduits shall be sized to a 40% fill ratio for telecommunications cabling installed as part of a project and as recommended by BICSI; detailed information is available in Division 27. Where conduit is used for wall penetrations between sections of cable tray, the minimum conduit capacity must be equal to the cable tray maximum capacity.

The capacity for other systems cabling such as CATV, controls, access, and alarm systems, capacity must be calculated separately and added to the overall tray size in a

separate channel, or be planned for installation in a separate pathway. Projects which include "shell space" must allow for future cabling requirements for those unfinished spaces in determining tray and conduit size.

Cable ladder tray inside IDFs for telecommunication cables are subject to the sizing requirements listed under "Specific Telecom Room Requirements" in this document.

Telecommunications rooms should not be used as pathways for other building systems.

Interior-building-rated cables are not designed to withstand the moisture and condensation which can occur in underground or below-slab conduits, which will render the cable(s) unusable in a short period of time. Conduits for interior grade telecommunication cables, such as riser rated and horizontal station cables, may be placed in a slab-on-grade, but must never be placed below the slab for any reason. Nevertheless, avoid placing conduits inside a slab-on-grade whenever possible.

ENT conduit is **not** acceptable for pathway for telecommunications cables.

Pathways and spaces shall be designed and installed to support horizontal cabling in accordance with the requirements of the most recent version of ANSI/TIA-569.

BACKBONE CABLING

Cabling from the Main Telecommunications Room (MDF, BDF, IDF-1) to each Telecommunications Room (IDF-2) is considered as backbone/riser cable.

Splices in backbone cable runs are not permitted. Copper and fiber cables must be continuous from telecommunications room termination to telecommunications room termination.

The copper intra-building cabling and the riser cabling shall meet ANSI/TIA-568 Category 3 requirements.

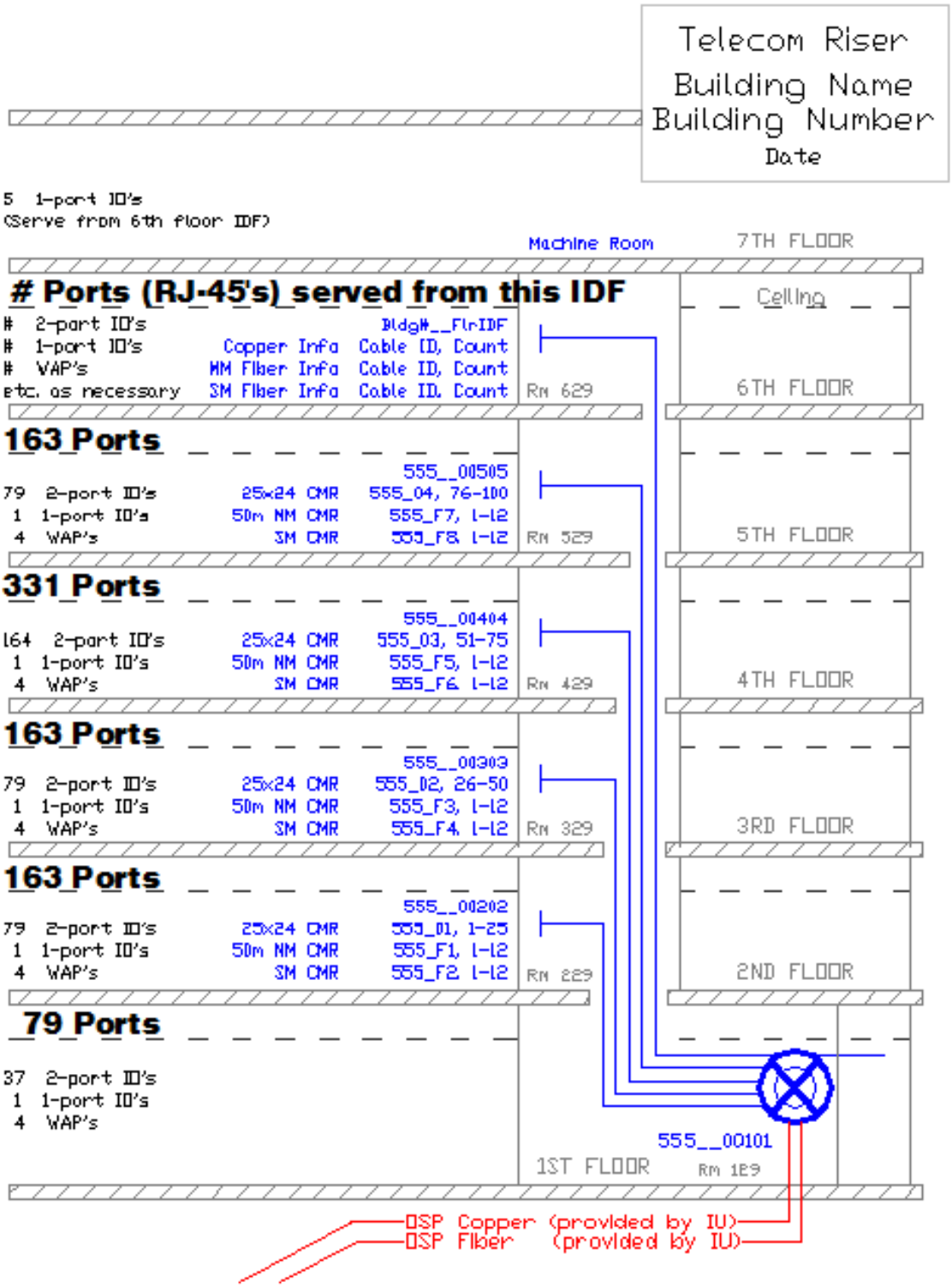
DESIGN SUMMARY

The design architect/engineer must prove a summary sheet with Information Outlet counts by type, port counts by type, and total ports per serving IDF, as shown in the following example.

A	*B*	*C*	*D*	*E*	*F*	*G*	*H*
					*= D * E*	*= SUM(F)*	
FLOOR	**SERVED FROM**	**IO TYPE**	**IO TYPE (# ports)**	**# IO's**	**# PORTS**	**IDF TOTAL PORTS**	**INSTALLED RACKS**
6	00606	ELEV	1	5	5	-----	-----
5	00505	STD	2	79	158	-----	-----
5	00505	WALL	1	1	1	-----	-----
5	00505	WAP	4	2	8	-----	-----
SUM	-----	-----	-----	-----	-----	**172**	1
4	00404	STD	2	163	326	-----	-----
4	00404	WALL	1	1	1	-----	-----
4	00404	WAP	4	2	8	-----	-----
SUM	-----	-----	-----	-----	-----	**335**	2
3	00303	STD	2	79	158	-----	-----
3	00303	WALL	1	1	1	-----	-----
3	00303	WAP	4	2	8	-----	-----
SUM	-----	-----	-----	-----	-----	**167**	1
2	00202	STD	2	79	158	-----	-----
2	00202	WALL	1	1	1	-----	-----
2	00202	WAP	4	2	8	-----	-----
SUM	-----	-----	-----	-----	-----	**167**	1
1	00101	STD	2	37	74	-----	-----
1	00101	WALL	1	1	1	-----	-----
1	00101	WAP	4	2	8	-----	-----
SUM	-----	-----	-----	-----	-----	**83**	1

"IO" = Information Outlet

The design architect/engineer will provide a riser diagram which indicates port counts, along with cable types, sizes and counts, developed in conjunction with the appropriate UITS representative. This diagram is used to provide network equipment cost estimates for budget purposes, as well as be included as part on the bid documents and construction specification drawings. The appropriate UITS representative will provide or must approve cable counts.


Telecom Riser
Building Name
Building Number
Date
5 1-port ID's
(Serve from 6th floor IDF)
Machine Room
7TH FLOOR
Ceiling
Ports (RJ-45's) served from this IDF
2-port ID's
1-port ID's
WAP's
etc. as necessary
Bldg#_FlrIDF
Copper Info
MM Fiber Info
SM Fiber Info
Cable ID, Count
Cable ID, Count
Cable ID, Count
Rm 629
6TH FLOOR
163 Ports
555_00505
79 2-port ID's
1 1-port ID's
4 WAP's
25x24 CMR
50m NM CMR
SM CMR
555_04, 76-100
555_F7, 1-12
555_F8, 1-12
Rm 529
5TH FLOOR
331 Ports
555_00404
164 2-port ID's
1 1-port ID's
4 WAP's
25x24 CMR
50m NM CMR
SM CMR
555_03, 51-75
555_F5, 1-12
555_F6, 1-12
Rm 429
4TH FLOOR
163 Ports
555_00303
79 2-port ID's
1 1-port ID's
4 WAP's
25x24 CMR
50m NM CMR
SM CMR
555_02, 26-50
555_F3, 1-12
555_F4, 1-12
Rm 329
3RD FLOOR
163 Ports
555_00202
79 2-port ID's
1 1-port ID's
4 WAP's
25x24 CMR
50m NM CMR
SM CMR
555_01, 1-25
555_F1, 1-12
555_F2, 1-12
Rm 229
2ND FLOOR
79 Ports
37 2-port ID's
1 1-port ID's
4 WAP's
555_00101
1ST FLOOR
Rm 129
OSP Copper (provided by IU)
OSP Fiber (provided by IU)

HORIZONTAL DATA CABLING

Horizontal cabling extends from the work station information outlet terminations to the telecommunications room terminations. Horizontal cabling includes horizontal cables, Information Outlet/connectors in the work area, and jackfield termination equipment in the telecommunications room.

In addition to satisfying today's telecommunications requirements, the horizontal cabling should be planned to reduce on-going maintenance and relocation, as well as accommodate future equipment and service changes. After construction of the building, the horizontal cabling is often much less accessible than the backbone cabling, with the result that the time, effort, skills and subsequent costs required for changes can be extremely high. Access to horizontal cabling can cause disruption to occupants and their work; therefore the amount of cabling not in conduit and which passes through office spaces should be minimized.

All new horizontal station cabling and terminations shall be Category 6A. Infrastructure will be sized and constructed to meet Category 6A requirements and specifications. Special care must be taken regarding bend radius requirements if installations are to pass acceptance testing.

These factors make the choice and layout of horizontal cabling structures very important to the design of the associated building structures. Consideration should be given to accommodating a diversity of user applications in order to reduce or eliminate the probability of requiring changes to the horizontal cabling as user needs evolve.

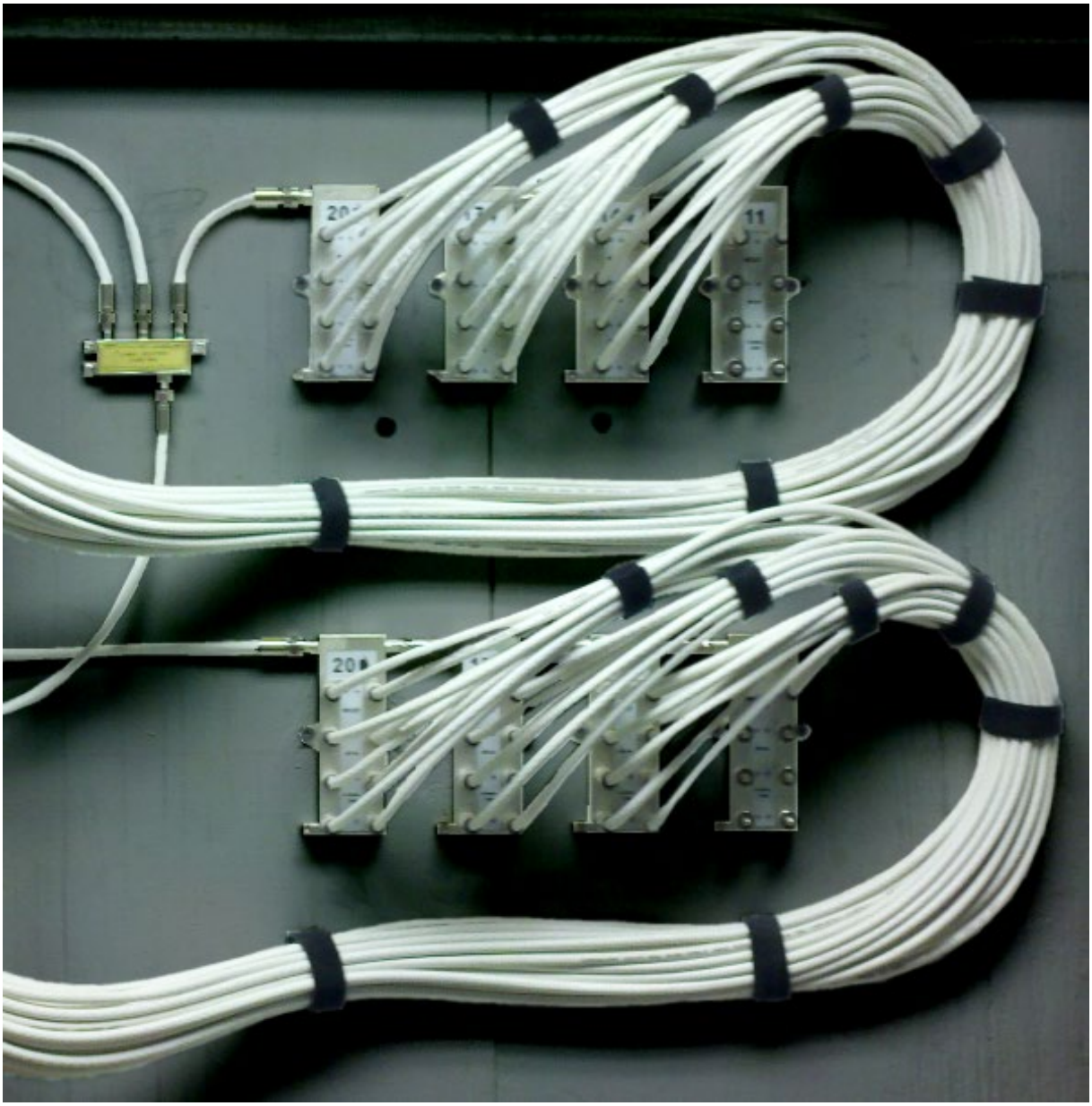
Horizontal cable length is the distance of cable between terminations, that is, from the mechanical termination of the media at the horizontal cross-connect in the telecommunications room, to the termination on the Information Outlet/connector in the work area. Hence path layout for horizontal cabling should be made with reference to total cable length, and not by floor plan linear measurements.

The maximum horizontal cable length for a Category 6A station wire shall be 90 m (295 ft). Any horizontal station wiring run longer than this will not be accepted by the University. Splices in horizontal cable runs are not permitted. Wiring must be continuous from outlet termination to jack field termination.

All horizontal cabling from a given room and within a specified serving area shall terminate in the same telecommunications room.

HORIZONTAL COAXIAL CABLING

Terminations for coaxial horizontal station cabling for Campus TV connections should be wall mounted in a neat manner as illustrated in the following picture. These terminations shall **not** be made in telecommunications rooms.



INFORMATION OUTLETS (IO's)

An Information Outlet, as described below and used in this document, is defined as "providing access to all available communication media: twisted pair, coaxial cable, and in the future, fiber." Data connectivity is the basic element of an outlet; if optional video and/or fiber optic services are required, they shall be so indicated in individual room or area descriptions.

The maximum horizontal copper station cable length is based on a maximum length of 5 m (16 ft) of work area cord. Therefore no Information Outlet will be installed such that the intended workstation or device cannot be reasonably reached by a 16 ft cord.

Information Outlet assemblies shall be located in fully accessible, permanent locations such as building columns and permanent walls. Multi-user Information Outlet assemblies shall not be located in ceiling spaces or in any obstructed area.

Information Outlet ports shall not be co-located in back boxes used for the audio/visual wiring and terminations which pull back to a wiring closet dedicated to audio/visual equipment.

Except for audio/visual locations which incorporate multiple connection types including university data network ports, Information Outlet ports shall not be co-located in back boxes used for coaxial cabling and terminations, nor with other cables which pull back to and terminate in a location dedicated to in-house (non-campus network system) cable television or CCTV equipment.

Gang assemblies will require minimum 2-7/8" deep 5-square boxes as specified in the Division 27 document to accommodate the IO assemblies and bending radius of future horizontal wiring.

See the list of "Information Outlet Types at IU" in this document.

DESIGN DRAWINGS

Design drawings for **new buildings and large renovations** shall include, but not be limited to:

1. Backbone cable routing and schematic riser diagram, including:
   1.1. Backbone cable types and sizes
   1.2. Information Outlet count, by type, by IDF
   1.3. Total port count (RJ45's) by IDF
   (see example)
   (telecom plans will not be approved without this diagram, updated as necessary)
2. Telecommunication room locations, layouts, and details

3. Conduit / cable tray routing, elevations in relation to other mechanicals and building structures, sizes, and pull box and access point locations
4. Other supporting structures for telecommunications cabling
5. Grounding schematic for telecommunications rooms
6. Information Outlet locations and types with port counts and TIA-606 compliant labeling information (as shown in the Division 27 document), with:
6.1. either Information Outlet IDs called out on the appropriate floor plans for each outlet location,
6.2. or, an Information Outlet Schedule which includes room number, label(s), IDF room number, number of data ports, and outlet use description, including:
6.2.1. elevator outlet(s) location(s) which connect to either voice or data services,
6.2.2. fire alarm outlet(s) location(s) which connect to either voice or data services, and
6.2.3. all station cables which leave the building envelope and therefore require OSP rated cable and electrical protection. See Division 27 for specifics.

Design drawings for **smaller renovations** shall include, but not be limited to:

1. Telecommunications room information:
1.1. IDF room number, IDF ID, and proximity to project area.
1.2. Current patch panel capacity, availability of RUs available to mount new patch panels and other equipment.
1.3. Total port count to be added (RJ45 jacks) by IDF
2. Information Outlet locations and types with port counts and TIA-606 compliant labeling information (as shown in the Division 27 document), with:
2.1. either Information Outlet IDs called out on the appropriate floor plans for each outlet location,
2.2. or, an Information Outlet Schedule which includes room number, label(s), IDF room number, number of data ports, and outlet use description.

See the following example of an “IDF TELECOM SCHEDULE”.

IDF (room #) TELECOM SCHEDULE				
ROOM NUMBER	LABEL	IDF ROOM NUMBER	DATA PORTS	DESCRIPTION
102	102-A1/A2	195	2	Single Gang Information Outlet
103	103+WD-A1/A2	195	2	Wireless Access Point
103	103-A1/A2/A3/A4	195	4	Single Gang Information Outlet
103	103-B1/B2/B3/B4	195	4	Single Gang Information Outlet
104	104+WD-A1/A2	195	2	Wireless Access Point
104	104+WD-B1/B2	195	2	Wireless Access Point
104	104-A1/A2	195	2	A/V Input Location
104	104-B1/B2/B3/B4	195	4	A/V Input Floor Box
104	104-C1/C2	195	2	A/V Display Rough-In
104	104-D1	195	1	Ceiling Mounted Projector
106	106-A1/A2	195	2	Single Gang Information Outlet
128	128-A1/A2	195	2	Single Gang Information Outlet
192	192+BA-A1	195	1	Lighting Control
193	193+FP-A1	195	1	Fire Panel
199	199-A1/A2	195	2	Wireless Access Point
199	199-B1	195	1	Ceiling Mounted Security Camera Rough-In
199	199-C1	195	1	Wall Mounted Security Camera Rough-In
199	199-D1/D2	195	2	Digital Signage Location
199D	199D-A1/A2	195	2	Single Gang Information Outlet
EXTERIOR	EXTERIOR-B1/B2	195	2	Emergency Phone Pedestal
WAPs TOTAL			4	
Ports GRAND TOTAL (incl WAPs)			41	

SPECIFIC TELECOM ROOM REQUIREMENTS

These requirements are for new construction and major renovations. There are many older buildings at all of the main and regional campuses that have dated telecom room designs; in many cases, it is acceptable to leave some components as they currently exist, but only if by doing so, ***safety, security, and acceptable network connectivity are ensured and maintained.*** Exceptions may be considered on a case-by-case basis, in coordination with the Capital Planning & Facilities office and UITS, as noted below.

1. Rooms should be located such that horizontal station cabling runs from mechanical termination at the Information Outlet to mechanical termination in the serving equipment room will not exceed a maximum cable length of 295 feet. (Note that typically 20-40 feet of cable is lost due to routing and dressing in the telecom room, while routing outside the telecom room is rarely direct and can result in an actual length as much as 30-40% greater than straight line measurements.)

2. Rooms must be clear of mechanicals such as ventilation ducts, water, sewer, steam pipes, and any electric over 277v. (Note: As discussed above, it is imperative to minimize access to telecom rooms. In older rooms, these mechanicals are often present, but rarely require access. If security can be ensured, likely via electronic locks, it may be acceptable to leave some mechanicals in older rooms. However, it is not acceptable to have high voltage too near the rack.)

3. Do not locate near alternating current (AC) switch gear as defined in NEC Article 110 and referenced sections.

4. Minimum room height: 8'6"; no ceiling (walls must extend to deck to make room secure). (Note: Exceptions are possible on a case by case basis, through discussion with the UAO and UITS.)

5. Minimum door dimensions: 36"w and 80"h

6. Room is preferred to be fire rated with a fire rated door and frame, provided with a heat sensor rather than sprinkled.

7. 4' x 8' plywood backboard, 3/4" thick, fire rated, **or** painted with a light colored fire retardant paint, shall be mounted 4" AFF on all walls. Fire rated plywood may be painted with light colored fire retardant paint, but it is not required.

8. Control of heat and humidity is essential, to be maintained between 64°F and 78°F and between 25%RH and 55%RH non-condensing. (Note: Thermostats and temperature control are often not available in older telecom rooms. Running temperature of network equipment is critical, and can be determined from log files on those devices. Should the temperature of network equipment become too high or too low, appropriated measures MUST be taken to correct the issue. Installation of HVAC, room enlargement, or other forms of ventilation are required.

8.1. Current network equipment generates the following maximum heat loads:
1-142 ports – 7400 btu/hr max (HP5406 chassis, J9306A power supply)
143-284 ports – 11100 btu/hr max (HP5412 chassis, J9306A power supply)
285-426 ports – 18500 btu/hr max (HP5412 + HP5406, see above)

Including potential growth, but excluding other heat generating equipment in an IDF room, for a:
Small building or serving area, design for 7400 btu/hour max
One rack solution, design for 18500 btu/hr max
Two rack solution, design for 37000 btu/hr max

Initial heat loads may be less than the maximum; therefore room cooling should be capable of adjustment.

8.2. Consideration should be given to the critical nature of extended telecommunications services to the building. Determine for each telecommunications room if telecommunications network equipment and room cooling should be connected to the building emergency power source such as the building UPS or generator system. If any IDF is required to have backup power and cooling, then the MDF must also have backup power and cooling.

9. Telecommunications Room key cores, electronic door systems, and security systems shall be included as part of the project.
9.1. Floor Telecommunications Rooms and Main Building Telecommunications Room key sets should be the same.
9.2. Campus telecommunications personnel shall approve key/locking arrangements.

10. Fluorescent lighting with a minimum of two fixtures should provide a minimum lighting level of 30-40 fc.
10.1. Emergency lighting should be provided for telecommunications rooms.

11. Provide duplex outlets for task lighting and tools.

12. Depending on the size of the project and the number of stations served from each telecommunications room, provide one or two (or more) equipment racks with vertical wire management, 7' high and to accommodate 19" bay-mounted equipment in each telecommunications room.
12.1. Equipment racks must be attached to floor and stabilized with overhead runway to a wall; additional racks may be required on specific projects.

13. Provide two (2) 208v circuits, each terminated on NEMA L6-20R outlets, wall mounted, for each network switch to be installed (typically one switch per 19" rack).
13.1. Mount between 12 and 24 inches aff off the back side of the equipment racks, and with 12 inches of the nearest equipment rack, but not between the equipment rack and the wall.
13.2. These outlets should be connected to the building emergency power source(s) if it is determined that the building's or an individual IDF serving area network systems are required to run at all times, such as building or alarm systems. See previous item 7.2.
13.3. In single rack installations which might see a second rack added a future date:
13.3.1. install a center-type Patchrunner Vertical Cable Manager to allow for future expansion.
13.3.2 install a second pair of duplex outlet boxes above or below the first two outlets for future 208v power needs as described in 12.1. above.
13.4. See the "IDF ROOM – RACK LAYOUT" drawing.

14. At the network equipment rack location, standard 18" height, provide one 120v 20 amp dedicated duplex receptacle; isolate feed from motors, AC switch equipment, lighting circuits; minimize noise and interference.

14.1. This outlet should be connected to the building emergency power source(s) if it is determined that the building network systems or an individual IDF serving area are required to run at all times.
14.2. This outlet must be wall mounted adjacent to the point where the network equipment rack is mounted nearest to a room wall.

15. The riser system (Main Telecommunications Room to each Telephone Room, or, IDF-1/BDF to IDF-2) minimally should be sized as follows:
15.1. Category 3 shielded UTP for voice grade and alarm services, 25 pair 24 gauge
15.2. 12 fiber optic 50 micron multimode cable
15.3. 12 singlemode 8.3 micron cable
15.4. Final cable sizes must be verified during the design stage of the riser system.
15.5. Coaxial cables and equipment shall not be collocated in IDF rooms. Coordinate CATV cable, equipment selection (such as amplifiers), and system design with IU Building Systems (Electronics) personnel and IU Engineering Services (see http://www.indiana.edu/~phyplant/operations/building-systems/index.shtml); the Division 27 document contains part numbers and vendor information which is subject to revised design criteria provided by those groups.

16. Provide ladder-type cable tray, sized as indicated in the following table, based on the Chatsworth Cable Fill Capacities chart for their 10250-Xnn products:

CABLE TRAY CAPACITIES & ROOM SIZES			
Racks	Category 6A Cables	Tray Width	Minimum Room Size
One	1-250	12-inch	10'x11'
Two	251-382	18-inch	10'x11'
Two	383-500	24-inch	10'x11'
Three	501-637	30-inch	14'x14'
Three	638-792	36-inch	14'x14'

16.1. Ladder tray should surround room at a minimum height of 7' aff from the bottom of the tray, and with a minimum unobstructed clearance of 12” above the tray.
16.2. Size the ladder tray above the equipment rack(s) one size larger than the ladder tray surrounding the IDF room.
16.3. Bond all equipment racks and raceways per NEC.

17. A TGB (Telecommunications Ground Bus bar) shall be located in each Telecommunications Room and shall be tied back to the TMGB (Telecommunication Main Bus bar located in Main Telecommunications Room).

INFORMATION OUTLET (IO) TYPES AT IU

STANDARD Information Outlet (IO): Two Category 6A station cables terminated onto two Category 6A RJ-45 modules in a double or single gang configuration installed at the same height as 120 volt AC outlets (normally 18" above finished floor).

Courtesy Phone Jack (inside building): One station cable terminated on an RJ-45 surface mount wall phone plate jack. Top of phone set must be installed below 48" aff for compliance with ADA requirements; therefore, the wall mounting plate with jack must be mounted no higher than 45" aff, or less, such that the maximum set top height of 48"is not exceeded.

Emergency Phone Jack (outdoors): One multi-pair buried drop (outside, protected) terminated on an RJ-45 surface mount jack, mounted inside of a University specified phone base. Outside emergency telephone cable(s) must be electrically protected. In addition to electrical service, separate conduit(s) must be designed and installed back to the nearest building telecom IDF in accordance with NEC requirements for bonding and grounding for building entrance cables.

Elevator Phone Jack: One station cable terminated to one RJ-11 or RJ-45 (to be coordinated between UITS and elevator installer) surface mount jack, mounted in outlet box adjacent to, but outside of, the elevator control box. Jack must be openly accessible for testing and troubleshooting purposes.

Wall Jack: One Category 6A station cable terminated on one (1) RJ-45 jack. Wall mounted telephones require a special wall telephone jack that provides mounting lugs for the telephone and an eight position jack. The outlet box for this installation is a 2 gang box with a single gang plaster ring and will be positioned such that any aspect of an install phone shall be at 48" A.F.F. or slightly lower.

Modular Furniture Information Outlet (IO): Category 6A data cables installed into Category 6A data modules installed into a modular furniture bezel. Quantities to be determined by individual needs. Height will be determined by the furniture. Contact https://telecom.iu.edu/services/ for additional information.

Advanced User Information Outlet (IO): Multiple Category 6A station cables terminated into Category 6A RJ-45 jacks, designed to meet TIA-568-B.2-1 Category 6A standard, in single gang or double gang configurations installed at the same height as 120 volt AC outlets (normally 18" above finished floor). Quantity of RJ-45 jacks and configurations to be determined as part of the design process and in conjunction with the proper UITS Telecommunications representative.

WAP Jack (Wireless Access Point): Two Category 6A data station cables terminated into RJ-45 modules, in a single or double gang configuration, typically installed wall mount at 7'0" in height or ceiling mounted, unless otherwise specified. Refer to the following "WIRELESS DESIGN" section of this document.

Note 1: *RJ45 jack outlets are to be wired to the TIA 568A wire map standard.*
Note 2: *Information outlets are to be installed 5 Square boxes.*

WIRELESS DESIGN

Initial Wireless Design

UITS is responsible for the wireless system design and the installation of all 802.11 type wireless access points at Indiana University. The design, implementation and changes should be approved by and coordinated with the UITS wireless representative.

The project is responsible for the installation of the horizontal infrastructure and cable necessary to support the wireless access points.

The total number of access points and their locations cannot be finalized until a wireless network predictive analysis has been engineered. For general coverage and budgeting purposes one (1) wireless access point shall be installed for every 1200 square feet of building space. In addition to providing general coverage, special considerations need to be made for large public areas, classrooms and conference rooms. Use the following chart to estimate the number of wireless access points necessary to provide coverage in these areas.

Classroom/Conference Room Access Points

Number of Seats	Number of Access Points
Up to 25	1
26 to 50	2
51 to 75	3
75 to 100	4

For bid/construction document purposes, the UITS wireless system representative will need the following kinds of information.

By Room

1. Room purpose (Classroom, Dormitory, Office, Hallway, Lounge, etc.)
2. Square footage
3. Number of Information Outlets
4. Number of Users
5. Wall type (Concrete block, solid concrete, metal studs with drywall, etc.)
6. Wireless expected usage (WiFi VoIP, Data, Email, Web browsing, Video, etc.)
7. Expected Quality of Service (network capability vs. server capacities)
8. Expected growth in demand for services

Outdoor Coverage

Designate on drawings if and where outdoor wireless connectivity is required. Provide further information as described under "**By Room**".

Additional information should include:

1. Antennas can be hidden or visible, with the understanding that hidden antennas may not offer the same degree of service. Methods of concealment can be discussed with and must be approved by the appropriate UITS representative.
2. Antennas can be on rooftops, pole mounted, or exterior wall mounted, but must first be approved by the University Capital Planning Office on a case by case basis.

Indoor Infrastructure Requirements

1. Wireless Access Points should never be mounted in close proximity to one another, including on opposite sides of the same wall.
2. All wireless information outlets shall have a minimum of one (1) 1-inch conduits servicing the wireless information outlet.
3. Each access point information outlet shall have one (1) CAT 6A cable installed.
4. The wireless information outlet shall be terminated on a 1-port Panduit faceplate with one (1) 568A - RJ 45 outlet in one of two configurations:

5. MOUNTING REQUIREMENTS

5.1. **Option 1: <u>CEILING-MOUNT REQUIREMENTS (Preferred)</u>**. Ceiling mounting of wireless access point in a UITS designated Acceltex unit is the standard default option for all wireless deployments, unless otherwise specified by UITS Wireless Engineer. UITS supplied design documents will show each location. If finished ceiling height is above 12'0", use OPTION 2 for wall-mounting. Final approval of adjustments is needed from UITS Wireless Engineer. Ceiling mount will consist of one of two options:

1. **Lift out ceiling** 2x2 foot tile applications shall use an Acceltex ATS-03879 Suspended Ceiling Locking Mount tile substitution for all AP unit types. The Acceltex ATS-03879 must be supported independently from the suspended ceiling grid.

Figure 1.

Acceltex ATS-04080 (ADDENDUM 4)

3. **Hard ceiling** applications tentatively shall use an ~~Aruba AP-310-MNT-W3~~ mount kit for Aruba 315 APs, or an ~~Aruba AP-220-MNT-W3~~ mount kit for Aruba 335 or 345 APs, if determined by the UITS Wireless Engineer. If necessary, an allowance can be included for AP mounting equipment.

Acceltex ATS-04080 (ADDENDUM 4)

5.2. **Option 2: <u>WALL-MOUNT REQUIREMENTS</u>**. Wall mounting of wireless access points utilizing a 5-Square box is acceptable if approved by the UITS Wireless Engineer. WAP Jack shall be located at a nominal height of 7'0" above floor, and no more than 12'0" above floor. Any deviations from the 7'0" height shall be coordinated with and approved by the UITS Wireless Engineer.

Figure 2. Wall-Mount Examples

6. All wireless information outlets shall be labeled clearly with a labeler and with a +WD after the jack id number, as specified in the IU Division 27 specification.

INTERIOR COURTESY PHONES

IU Building Telecommunications Design Guidelines
v.11092018

The guidelines for security phones at IU were adapted at the direction of the Office of Public Safety and Institutional Assurance (PSIA), with assistance from UITS Telecommunications.

The goal of these guidelines is to ensure at least one (1) analog (non-VOIP) phone is installed on each floor of an IU owned building. Exceptions may include former residences that have been converted into IU office space.

More information on PSIA can be found at https://protect.iu.edu/about and https://protect.iu.edu/police-safety/building-facility/base-bid-standards.html.

The following individuals participated in the development of these guidelines:

Tom Davis - Chief Security Officer
Jerry Minger- Director of Public Safety
Diane Mack- University Director of Emergency Management and Continuity
Debbie Fletcher- IU Bloomington Director, Emergency Management & Continuity
Joe Romero- Regional Campus Director, Emergency Management & Continuity
Carlos Garcia- IUPUI Director, Emergency Management and Continuity
Ken Long- Assistant Director for IU Bloomington Emergency Operations
Michael Morgan- Manager, Converged Communications
Paul Clegg - Manager, IU Voice Operations

The guidelines for determining the placement of Interior Courtesy Phones are described below:

- Interior Courtesy Phones
  - 1 analog phone will be placed on every floor, of every building, near passenger elevators.
  - It will have the ability to make 911, Campus, Local and toll free calls.
  - Depending on building size and layout, additional courtesy phones may be required. The following individuals will be the authority for adding additional courtesy phones.
    - **IUB-** Debbie Fletcher and/or Laury Flint
    - **IUPUI** Carlos Garcia and Bob True
    - **Regional Campuses** Joe Romero and respective campus police chief
  - Additional courtesy phones can also be installed by a department at the expense of the department.
- Campus Rewire Project
  - As part of the campus rewire project, security phones will be installed per the guidelines above, and in compliance with Division 27 standards.
  - Funding for the installation shall come from the rewire project.
- New Construction
  - Courtesy phone installation shall follow the guidelines set forth in Division 27.
  - Funding for the installation shall come from the building project.

Guideline established March, 2013

EMERGENCY PHONES

Outside pedestal mounted emergency phones and interior emergency phones are addressed in the Indiana University Division 28 document.

AUDIO/VISUAL ROOMS and SECURITY ROOMS

Another class of rooms loosely associated with telecommunications rooms are A/V and Security rooms. The specifications for these rooms are not part of this document, but space for these increasingly important equipment installations needs to be allocated during the earliest phases of building design.

OUTSIDE PLANT CONDUIT SYSTEM

On any building construction that requires outside plant conduit and manhole systems, the cost of providing a necessary functioning underground facilities conduit path from a UITS designated existing telecommunications maintenance structure (manhole or handhole) containing UITS cables, to the new building or structure is a project cost. The strong preference is that new conduits should be provided back to a manhole where cable can be spliced if necessary; the extending of conduits from handholes must be approved by the appropriate UITS representative. If an existing conduit run is to be cut off, and/or extended and reterminated into a new manhole or handhole for the purpose of pulling new cables through those existing conduits, then it becomes the responsibility of the project to determine their functionality and, if necessary, repair or replace the existing conduits until substantial completion of the project, just as though they were new construction. Such work shall ultimately provide a cleared, tested and usable conduit system as described in the Indiana University Division 27 specifications.

For convenience, this section references information from the Telecommunications Industry Association TIA-758 Customer-Owned Outside Plant Telecommunications Infrastructure Standard. Refer to the document for further details.

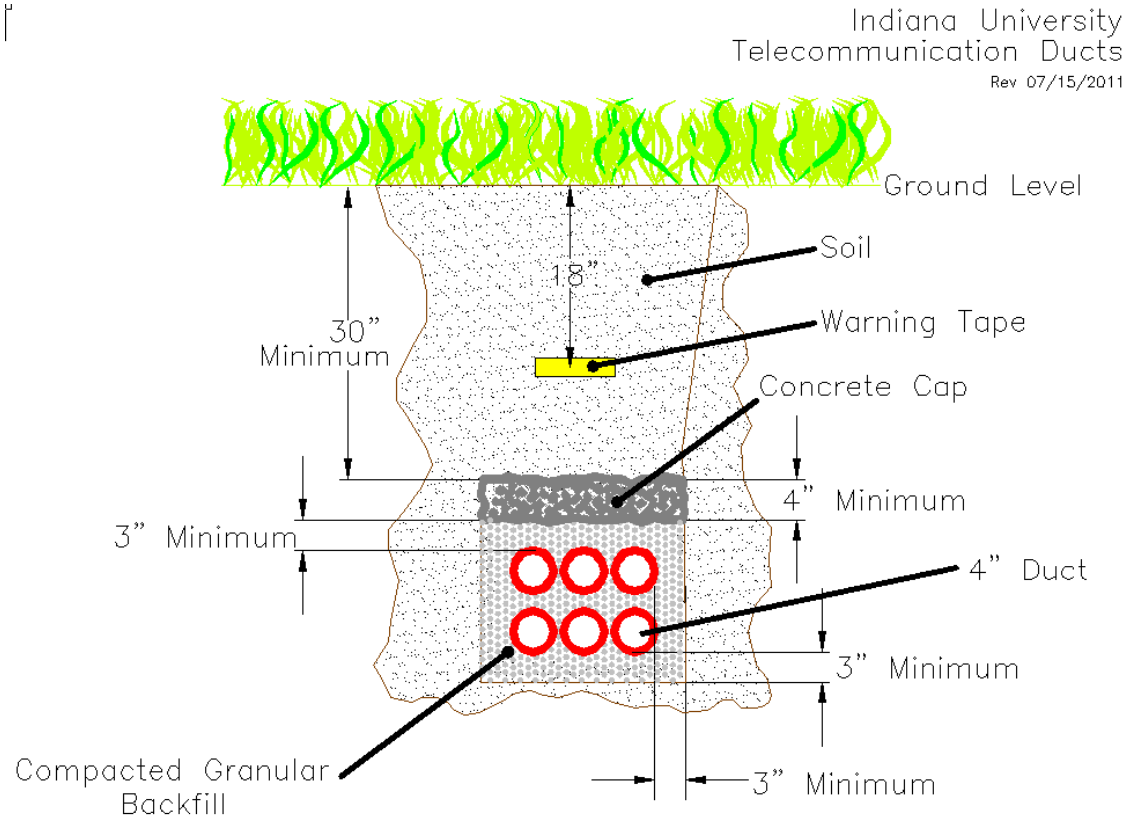
Conduits: Typically, Schedule 40 nonmetallic that meets NEMA standard TC-2. The outside of conduits installed into manholes should be sealed against moisture and dirt penetration.

Where possible, conduits should penetrate manhole at precast knockout locations or at same height. Conduits should NOT penetrate manholes in the collars, in the middle 50% of side walls, at an angle other than perpendicular, or in the case of existing manholes, at locations blocked by existing cables. Conduit terminations should not extend beyond the

manhole walls. Conduit penetration locations should allow for easy racking of cables around the manhole walls. Conduits that penetrate the walls of manholes, handholes, and building entrances through walls, must be terminated flush to the wall using bell ends, illustrated below.

Conduits should be installed at a minimum depth of 30” for directionally bored installations, or 36” for trenched installations (as illustrated in this section) surrounded with granular backfill material for a minimum of 3” all sides and capped with a minimum of 4” of concrete. An orange warning tape should be placed above the concrete cap at 18” from ground level. Mule tape should be installed in all conduits.

One conduit per run should have a conductive wire install for the purpose of utility locates.



See IU Division 27 for more details.
Pulling points: A manhole or handhole. Pulling points should be located for safe and easy access by personnel and equipment; the location should allow for necessary water pumping operations.

Manhole: Standard manhole size is 12'x6'x7' Type A for inline, Type J for corners in manhole runs, with 32" lid with penta-head bolts and labeled "Communications". Manholes are typically used for splice points and pulling points. Manholes shall have corrosion-resistant pulling irons, grounded cable racks, and ladder. The floor should have a sump for drainage.

Handhole: Standard handhole size is a 4'x4'x4'concrete precast unit with sumphole; a 30"x4'x4' handhole may be used for one or two duct runs only and with prior approval by the appropriate University representative. Handholes are typically used as pulling points only. Handholes should be installed in a manner to provide adequate drainage.

Lengths: The section length of conduit between pulling points should not exceed 600 ft without prior approval of the appropriate University representative. Friction and tension design should not allow for pulling tensions on fiber optic cables of greater than 600 lbs.

Bends: Sharp bends, that is a bend with a radius of less than 10 times the diameter of the conduit, must NOT be utilized for conduits that will carry communications cables. Bends which reduce the inner diameter of the conduit are not permitted. The number of bends should be minimized; the total degrees of bend in conduit(s) between pulling points should not exceed 180 degrees.

Slope: Conduits should be installed to slope away from buildings and toward pulling points.

Duct Plugs: Conduits must be sealed to resist liquid and gas infiltration at all building entrance points and maintenance holes.

Innerduct: Innerducts will not be used unless specifically requested by the appropriate University representative.

Bridge crossings: Route design should avoid attachments to bridges and similar structures unless approved by the appropriate University representative.

OUTSIDE PLANT CABLING

GENERAL

On the IUB and IUPUI campuses, UITS provides outside plant (OSP) cables and terminations to a new building IDF-1 (MDF) without cost to the project. Conduits and manholes are a project cost in all situations.

On the regional campuses, the cost for materials and installation of both copper and fiber optic outside plant cabling must be included in the project design and construction costs.

OSP cable will be placed in underground conduit entirely when at all possible. Other options are direct buried, on aerial strand, or some combination of these three.

OSP COPPER

OSP copper cables for low risk applications may be RDUP PE89 type cable, while cables which are all or in part direct buried and require additional mechanical and/or rodent protection must be RDUP PE39 type cable.

OSP FIBER OPTIC

OSP Fiber cables:

Loose tube (ALTOS) Gel Free all-dielectric cable, designed for outdoor and limited indoor use for backbones in lashed aerial and duct installations

Corning:

- 12 strand SM fiber (012EU4-T4101D20)
- 24 Strand SM fiber (024EU4-T4101D20)
- 72 Strand SM fiber (072EU4-T4101D20)
- 144 Strand SM fiber (144EU4-T4101D20)

Loose tube (ALTOS) Gel Free double jacket cable, designed for duct and aerial (lashed) installation.

- 12 Strand SM fiber (012EUE-T4101D20)
- 24 Strand SM fiber (024EUE-T4101D20)
- 72 Strand SM fiber (072EUE-T4101D20)
- 144 Strand SM fiber (144EUE-T4101D20)

Indoor/Outdoor (FREEDM) loose tube gel-free riser cables are flame-retardant, indoor/outdoor, riser-rated cables designed for interbuilding and intrabuilding backbones in aerial, duct and riser applications.

- 12 Strand SM fiber (012EUF-T4101D20)
- 24 Strand SM fiber (024EUF-T4101D20)
- 72 Strand SM fiber (072EUF-T4101D20)
- 144 Strand SM Fiber (144EUF-T4101D20)

OSP Fiber Hardware:

Corning Pretium Connector Housing

- 4 U rack housing (PCH-04U)

Corning Coupler panels

- Duplex APC, 12 F, SM (CCH-CP12-D9)

Corning Fuselite LC Buffer Tube Fanout splice on connectors
- Singlemode APC (SOC-LCA-FAN-SM)

Corning Buffer Tube Fan out, Outdoor
- 12 F, 25" (FAN0D25-12)

Corning CCH Connector module housing, pigtailed
- LC-APC 12 F single fiber, Singlemode (CCH-CS12-B3-P00RE)

AFL Connector Housing
- Xpress Fiber Management 4U panel (FM001090-B)

AFL Coupler panel
- 6 LC Duplex Panels (FM002804)

AFL Poli-MOD Splice on Module
- 12 fiber LC-APC fuse module (PM-L-12-ALC-0-S-01)

AFL Adaptor plate (For Corning CCH/PCH panels)
- FM001636

Sumitomo LC Duplex Panel w/6 adapters = 12 ports
- FTLA06D2

Sumitomo LC Quad Panel w/6 adapters = 24 ports
- FTLC06Q2LC

Sumitomo Field Termination Kit for 6F bundle
- FTFLD06

Sumitomo SC Duplex Panel w 6 adap 12 ports SM Bl
- FTSC06D1

Sumitomo Wall Mount Fiber Box 24 Fiber Max
- YFT24WFM

Sumitomo Fanout, Single Fibers, 12F, color coded legs
- FOS-012-O

Sumitomo Fanout, Single Fibers, 6F, color coded legs
- FOS-006-O

Sumitomo Splice Cassette, 06 fibers, LC-APC, OS2, Tight Buffer

- FTLC-SP06TBOS2-A

Sumitomo Splice Cassette, 12 fibers, LC-APC, OS2, Tight Buffer

- FTLC-SP12TBOS2-A

Associated mounting hardware

- All hardware shall be mounted according to manufacturer's specifications
- All hardware shall be mounted securely and completely; all required crews, bolts, tie wraps, etc., shall be utilized
- All necessary bonding and grounding hardware
- Examples of mounting hardware are 6" D Rings, Panduit LPMF-58-M Low Profiles, and Panduit PLT35-M
- 11" Tie-wraps, or equivalents

APPENDIX: DIVISION 27 PREPARATION

The current Indiana University UITS Division 27 document shall be inserted **unedited** into the project specifications document. Parts which are not applicable may be deleted from a given project's documentation, but with section label still included and labeled as "Not Applicable" or "Removed". Additions may be made to the document as required, but must be identified as such. However, the Division 27 specification is not subject to either interpretation or revision without express written approval by the appropriate UITS representative.

The UITS Division 27 document should be used as an addendum to this Design Guide during design the design process. Likewise, this document serves as an addendum to the UITS Division 27 specification for bidding and construction.

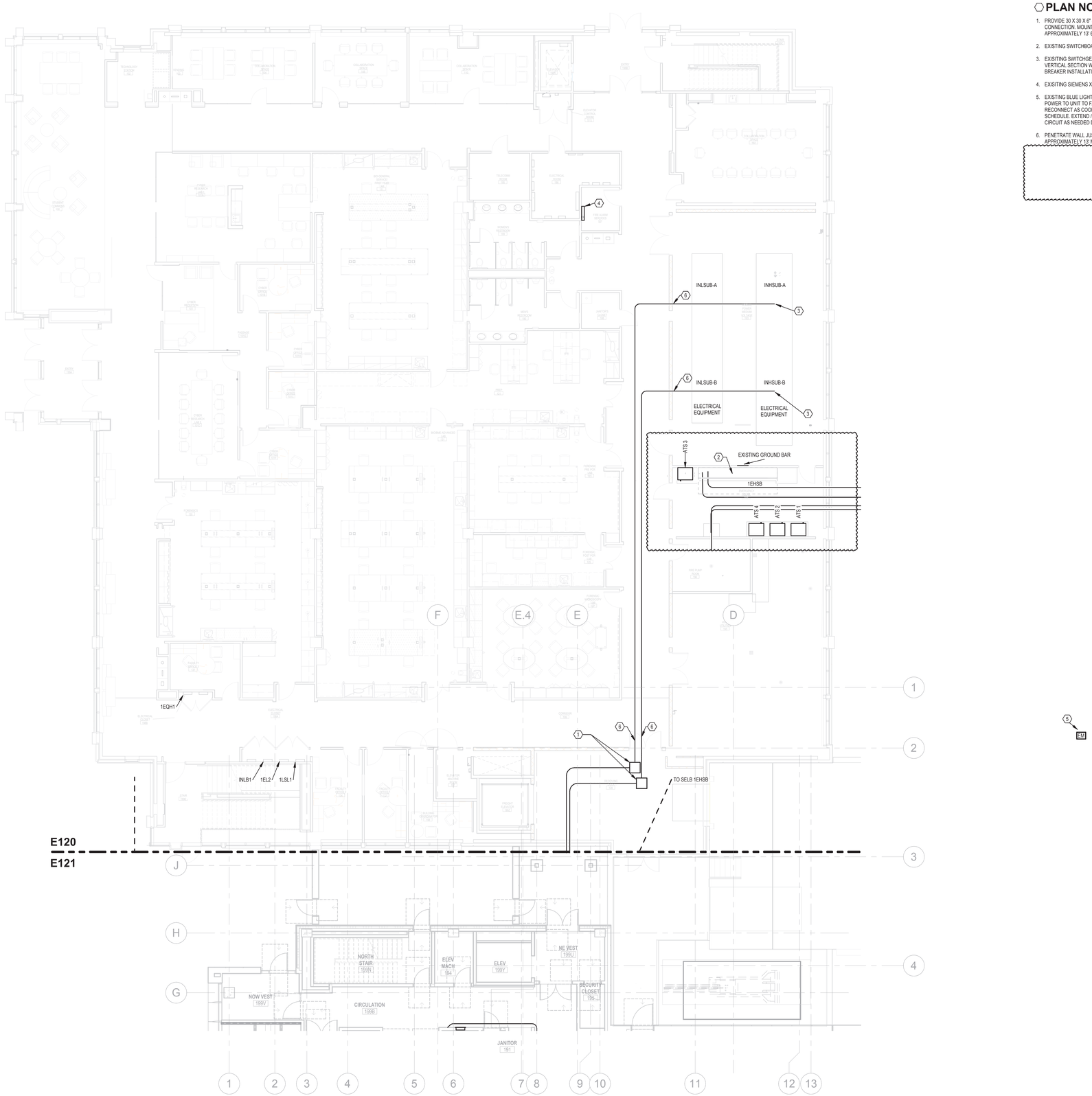
This page intentionally left blank.

GENERAL NOTES:

A. FOR CONDUIT SIZES, REFER TO ONE LINE DRAWINGS.

PLAN NOTES

1. PROVIDE 30 X 30 X 6" JUNCTION BOX FOR CONDUIT CONNECTION. MOUNT BOX AS HIGH A POSSIBLE, APPROXIMATELY 13'-6" MH.
2. EXISTING SWITCHBOARD TO REMAIN.
3. EXISITING SWITCHGEAR TO REMAIN. STUB INTO VERTICAL SECTION WITH SPACE FOR NEW BREAKER INSTALLATION.
4. EXISITING SIEMENS XLS FIRE ALARM PANEL.
5. EXISTING BLUE LIGHT / PHONE. DISCONNECT POWER TO UNIT TO FACILITATE CONSTRUCTION. RECONNECT AS COORDINATED WITH SITE WORK / SCHEDULE. EXTEND / REPAIR EXISTING BRANCH CIRCUIT AS NEEDED DUE TO RENOVATION.
6. PENETRATE WALL JUST UNDER BEAM, APPROXIMATELY 13' MH.



1 **EXISTING SELB CONDUIT PLAN**
SCALE: 1/8" = 1'-0"

arcDESIGN
architecture + interiors

201 N. Delaware Street, Suite B
Indianapolis, IN 46204
317.951.9192 T | 317.951.9194 F
www.arcdesign.us

HEAPY
PROJECT NO. 2023-06075

KEITH A SCHEID
REGISTERED
No. PE60910071
STATE OF INDIANA
PROFESSIONAL ENGINEER
10-25-24

INDIANA UNIVERSITY INDIANAPOLIS
20230276 - IN000B - IU INDIANAPOLIS
MULTI-BUILDING SCIENCE LABORATORY & RENOVATION
ADDRESSES VARY

BID SET

REVISIONS:

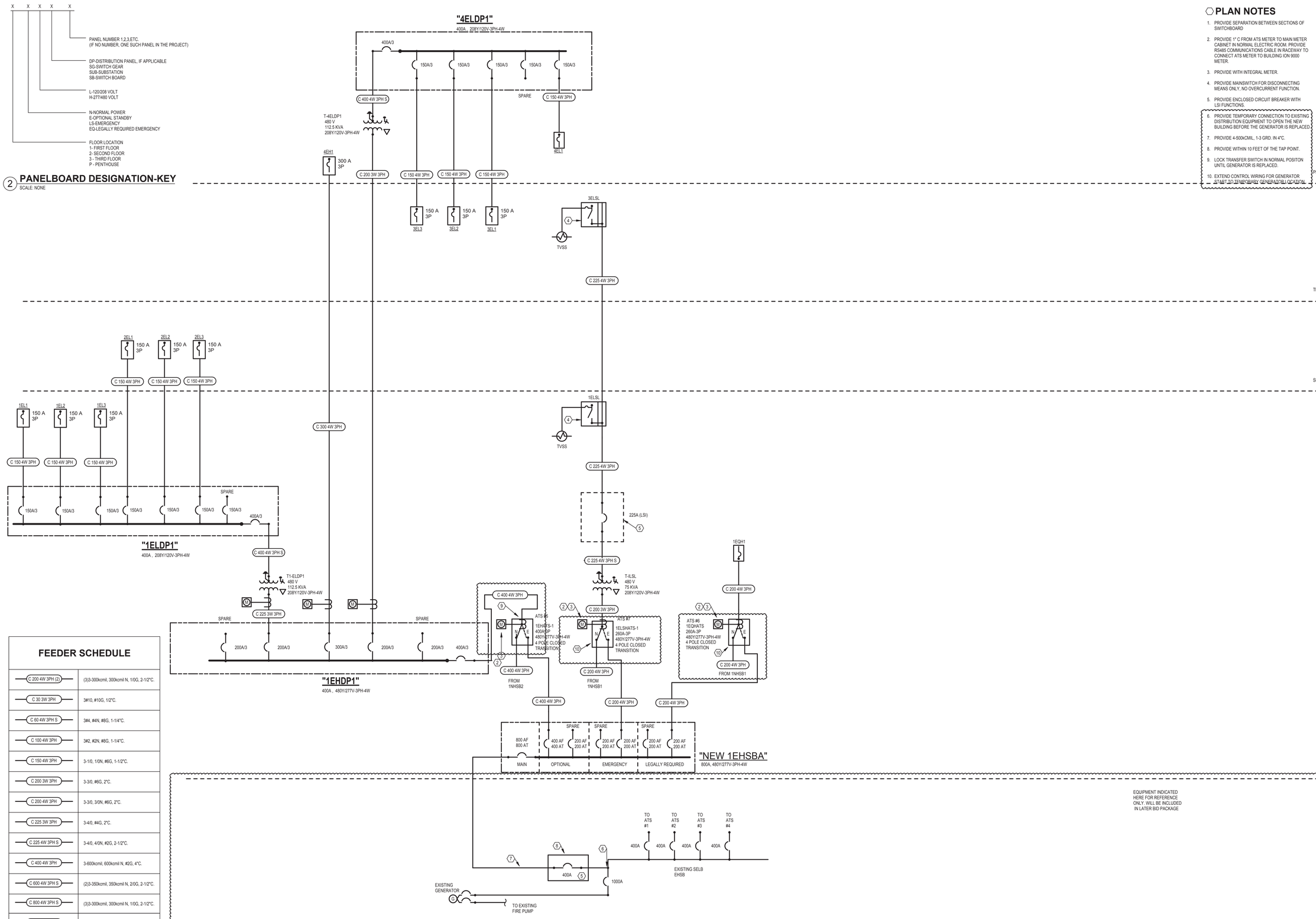
2	11.15.24	ADDENDUM 2
4	11.20.24	ADDENDUM 4

DATE:
10.25.2024
arcDESIGN PROJECT NUMBER:
23176
CLIENT PROJECT NUMBER:
20230276
DRAWN BY:
JPF

DRAWING TITLE:
EXISTING SELB CONDUIT PLAN

TRUE NORTH

DRAWING NUMBER:
E120
EL BUILDING



PLAN NOTES

1. PROVIDE SEPARATION BETWEEN SECTIONS OF SWITCHBOARD
2. PROVIDE 1" C FROM ATS METER TO MAIN METER CABINET IN NORMAL ELECTRIC ROOM. PROVIDE RS485 COMMUNICATIONS CABLE IN RACEWAY TO CONNECT ATS METER TO BUILDING ION 9000 METER.
3. PROVIDE WITH INTEGRAL METER.
4. PROVIDE MAINSWITCH FOR DISCONNECTING MEANS ONLY, NO OVERCURRENT FUNCTION.
5. PROVIDE ENCLOSED CIRCUIT BREAKER WITH LSI FUNCTIONS.
6. PROVIDE TEMPORARY CONNECTION TO EXISTING DISTRIBUTION EQUIPMENT TO OPEN THE NEW BUILDING BEFORE THE GENERATOR IS REPLACED.
7. PROVIDE 4-500kCMIL, 1-3 GRD. IN 4"C.
8. PROVIDE WITHIN 10 FEET OF THE TAP POINT.
9. LOCK TRANSFER SWITCH IN NORMAL POSITON UNTIL GENERATOR IS REPLACED.
10. EXTEND CONTROL WIRING FOR GENERATOR START TO 2EMDPSBASY GENERATORLOCATION.

2 PANELBOARD DESIGNATION-KEY

SCALE: NONE

FEEDER SCHEDULE

C 200 4W 3PH (2)	(3)3-300kcmil, 300kcmil N, 1/0G, 2-1/2"C.
C 30 3W 3PH	3#10, #10G, 1/2"C.
C 60 4W 3PH S	3#4, #4N, #8G, 1-1/4"C.
C 100 4W 3PH	3#2, #2N, #8G, 1-1/4"C.
C 150 4W 3PH	3-1/0, 1/0N, #6G, 1-1/2"C.
C 200 3W 3PH	3-3/0, #6G, 2"C.
C 200 4W 3PH	3-3/0, 3/0N, #6G, 2"C.
C 225 3W 3PH	3-4/0, #4G, 2"C.
C 225 4W 3PH S	3-4/0, 4/0N, #2G, 2-1/2"C.
C 400 4W 3PH	3-600kcmil, 600kcmil N, #2G, 4"C.
C 600 4W 3PH S	(2)3-350kcmil, 350kcmil N, 2/0G, 2-1/2"C.
C 800 4W 3PH S	(3)3-300kcmil, 300kcmil N, 1/0G, 2-1/2"C.
C 3000 4W 3PH	(8)4-500kcmil, 400kcmil, G, 4"C
C 1200 4W 3PH	(6)4-500kcmil, 3/0g, 4"c
C 800 4W 3PH (2)	(2)4-600kcmil, 1/0G, 4"C.
C 70 3W 3PH	3-2, #6g, 1.25" c
C 1200 4W 3PH (2)	(6) 4-600kcmil, 4/0 G, 4"C

1 SINGLE-LINE EMERGENCY POWER

SCALE: NONE

arcDESIGN
architecture + interiors
201 N. Delaware Street, Suite B
Indianapolis, IN 46204
317.951.9192 T | 317.951.9194 F
www.arcdesign.us

HEAPY
PROJECT NO. 2023-06075

KEITH A SCHEID
REGISTERED
No. PE60910071
STATE OF INDIANA
PROFESSIONAL ENGINEER
10-25-24

INDIANA UNIVERISTY INDIANAPOLIS
20230276 - IN0000B - IU INDIANAPOLIS
MULTI-BUILDING SCIENCE LABORATORY &
RENOVATION
ADDRESSES VARY

BID SET

REVISIONS:

1	11.08.24	ADDENDUM 1
2	11.15.24	ADDENDUM 2
4	11.20.24	ADDENDUM 4

DATE:
10.25.2024
arcDESIGN PROJECT NUMBER:
23176
CLIENT PROJECT NUMBER:
20230276
DRAWN BY:
JPF

DRAWING TITLE:
SINGLE LINE DIAGRAM – EMERGENCY POWER – NEW WORK

DRAWING NUMBER:
E502

TRUE NORTH