

**Rensselaer Polytechnic Institute**  
Network & Telecommunications Department

**Division 25100 Design Guidelines and Specifications**  
**January 30, 2004**

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## **General**

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Rensselaer Polytechnic Institute Information Technology's Infrastructure Design Guideline is intended to be used in conjunction with CSI Formatted 3 part Division 25100 Specifications and T series drawings and to be incorporated into RENSSELAER POLYTECHNIC INSTITUTE construction project specifications.

The purpose of the Design Guidelines is to describe and specify the minimum building infrastructure required to support the communications and networking requirements at Rensselaer Polytechnic Institute. Architects, engineers and designers should use these Design Guidelines to incorporate the information provided into Construction Documents. This document is based on industry standards and codes. This document does not replace any national or local standards, regulations or codes, but enhances them. If the standards and practices of Rensselaer Polytechnic Institute exceed national or local standards, regulations or codes, Rensselaer Polytechnic Institute's practices shall take precedent.

The scope of this document includes the design and installation methods of Telecommunication Rooms (TR's), cabling distributions systems and work area outlet locations, cable specifications, testing, documentation and administration. For details on products and installation practices for communications cabling and components refer to the Division 25100 Specifications. This document is subject to change in form and technical content as warranted by advancements in building construction techniques and telecommunications technology. As such, Rensselaer Polytechnic Institute specifically reserves the right to add to and revise, the information contained herein.

2

## **Normative references**

The following codes and standards contain provisions that, through reference in this text, constitute provisions of Document. At the time of publication, the editions indicated were valid. All codes and standards are subject to revision; parties to agreements based on this Document shall apply the most recent editions of the codes standards indicated. All equipment, construction practices, design principles and installations must conform to the latest version of any or all of the following standards and codes, published by the following organizations, where applicable;

Federal Communications Commission (FCC)  
Institute of Electrical and Electronics Engineers, Inc (IEEE)  
National Fire Protection Association (NFPA)  
National Electrical Safety Code (NESEC)  
American National Standards Institute (ANSI)  
Telecommunications Industry Association (TIA)  
Electronic Industries Alliance (EIA)  
Building Industry Consulting Service International (BICSI)  
National Electrical Contractors Association (NECA)

## **Reference Documentation**

3 All RENSSELAER POLYTECHNIC INSTITUTE staff, architects, engineers, contractors and vendors  
4 involved in the design, installation, specifications and details of the RENSSELAER POLYTECHNIC  
5 INSTITUTE Network and Telecommunications Distribution Infrastructure and Wiring must have  
6 access to the following referenced documentation and will be held accountable to the standards set  
7 forth in this document. These documents are to be used in the design, layout and installation of the  
8 RENSSELAER POLYTECHNIC INSTITUTE Network and Telecommunications Distribution  
9 Infrastructure. The standards, codes, and regulations referenced may have corrections, additions,  
10 technical service bulletins, and addendums that are not specifically called out in this section. In all

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1 cases, the latest versions are to be referenced regardless of versions stated in this document.  
2 Questions, problems or comments concerning this document or the referenced document should be  
3 directed to RENSSELAER POLYTECHNIC INSTITUTE Network & Telecommunications Department  
4

5 **FCC Regulations**

6 **FCC Part 68** Regulations for connecting premise cabling and customer provided equipment to  
7 regulated networks

8 FCC Documentation Available from:

9 [http://www.fcc.gov/Bureaus/Engineering\\_Technology/Documents/cfr/1999/47cfr68.pdf](http://www.fcc.gov/Bureaus/Engineering_Technology/Documents/cfr/1999/47cfr68.pdf)  
10

11 **NFPA Codes (2002 Edition)**

12 These NFPA documents are related to telecommunications:

13 **NFPA-70** National Electrical Code Chapter 8- Communications Systems

14 **NFPA-71** Central Signaling Systems

15 **NFPA-72** National Fire Alarm Code

16 **NFPA-75** Protection of Electronic and Computer Data Processing Equipment

17 **NFPA-780** Lightning Protection Code

18 **NFPA-101** Life Safety Code

19 NFPA Documentation Available from:

20 National Fire Protection Association

21 1 Batterymarch Park

22 Quincy, MA 02269-9101

23 Telephone: (617) 770-3000

24 Fax: (617) 770-0700  
25

26 **ANSI/TIA/EIA Telecommunications Building Wiring Standards (latest version)**

27 There are several documents that make up the ANSI/TIA/EIA Commercial Building  
28 Telecommunications Cabling Standards. These include:

29 **-ANSI/TIA/EIA - 568-B** Commercial Building Telecommunications Cabling Standard

30 **-ANSI/TIA/EIA -569-A** Commercial Building Standard for Telecommunications Pathway and  
31 Spaces

32 **-EIA/TIA-606-A** Administration Standard for the Telecommunications Infrastructure of  
33 Commercial Buildings

34 **-EIA/TIA-607** Commercial Building Grounding and Bonding requirements for Telecommunications

35 **-ANSI/NESC** 1997 National Electrical Safety Code  
36

37 ANSI Documentation Available from:

38 Global Engineering Documents

39 15 Inverness Way East

40 Englewood, CO 80112-5776

41 (800) 854-7179 ext7931  
42  
43

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1 **BICSI Methodologies**

- 2 BICSI Telecommunications Distribution Methods Manual (TDMM - 9<sup>th</sup> edition)  
3 BICSI Telecommunications Cabling Installation Manual (2<sup>nd</sup> edition)  
4 BICSI Customer Owned Outside Plant Design Manual (2<sup>nd</sup> edition)

5 **ANSI/NECA/BICSI 568-2001**

- 6 Installing Commercial Building Telecommunications Cabling  
7

8 BICSI Documentation Available from:

- 9 BICSI  
10 8610 Hidden River Parkway  
11 Tampa, FL 33637-1000  
12 (800) 242-7405  
13 <http://www.bicsi.org>

## **DEFINITION OF TERMS, ACRONYMS AND ABBREVIATIONS**

### **General**

This section contains definitions of terms, acronyms, and abbreviations that have a special meaning or that are unique to the technical content of this document. The terms that are used in only one clause may be defined within, and at the beginning of, that clause.

### **Definition of terms**

**Equipment Room (ER):** An ER Room is a special purpose room designed to serve as a campus point of demarcation. An ER Room may service multiple TRBs in a campus design. In large campuses, multiply ERs may be required and interconnected. This room will only contain Network & Telecommunications hardware and CATV. Any other utilities(s) must be approved by the Network & Telecommunications Department management.

**Building Telecommunications Room (TRB) :** A TRB is a special purpose room designed to serve a single building with multiple TRs . The TRB may also contain the necessary equipment to function as a TR for the floor it is located on. This room will only contain Network & Telecommunications hardware and CATV. Any other utilities(s) must be approved by the Network & Telecommunications Department management.

**Telecommunication Room:** A TR is a special purpose room designed to serve a single floor. In buildings with multiple floors, TRs shall be vertically stacked to form a backbone pathway. The TR is the point in the Data and Voice infrastructure that the backbone and horizontal distribution systems are connected to each other. This room will only contain Network & Telecommunications hardware and CATV. Any other utilities(s) must be approved by the Network & Telecommunications Department management.

**Access Point:** - An Access Point is a space use to transition backbone and horizontal cabling between floors within a building riser system.

### **Acronyms**

AP	Access Point
AFF	Above the Finished Floor
BICSI	Building Industry Consultants Service International
CAT	Category
CATV	Community Antenna Television (cable television)

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







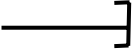
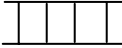
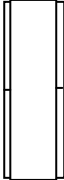
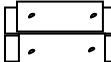
HH	Handhole
MH	Maintenance Hole
PBX	Private Branch Exchange (Phone Switch)
TR	Telecommunication Room
TRB	Building Telecommunications Room
TGB	Telecommunications Grounding Busbar
TMGB	Main Telecommunications Grounding Busbar
TDMM	Telecommunications Distribution Methods Manual (BICSI Publication)
UTP	Unshielded Twisted Pair

Also, see "Normative references" for additional codes and standards Acronyms.

**DESIGN GUIDELINES**

- 1 • Symbols Guide :

**Network Symbols**

	Drop Location: 2 cat 6
3 	Drop Location: 3 cat 6
4 	Drop Location: 4 cat 6
P 	Pay Phone
W 	Wall Phone
	Floor Mounted
	Existing Jack
	110 v 20 amp Receptacle
	Ground Bar
	Vertical Sleeve ( Size as Indicated)
	Horizontal Sleeve ( Size as Indicated)
	Conduit ( Size as Indicated)
	Ladder Rack
	7 foot Equipment Rack ( Front View) with Cable Managers
	7 foot Equipment Rack ( Top View) with Cable Managers

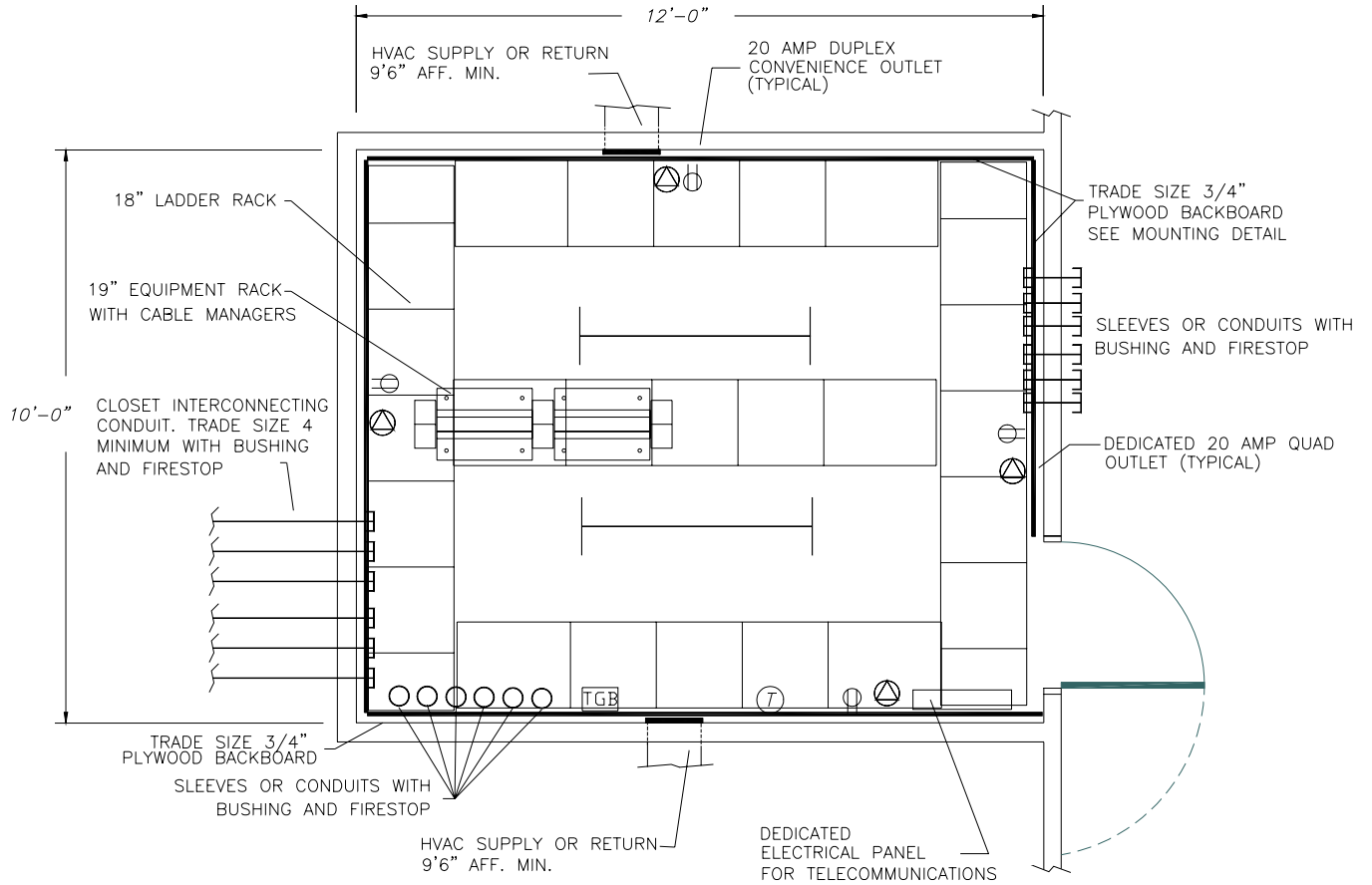
## 25110 TELECOMMUNICATIONS ROOMS

### Telecommunications Room/Building Equipment Rooms

#### General

The following section will outline the location, design and pathway requirements for Building Equipment Rooms (TRB) and Telecommunication Rooms (TR).

Figure 1 – Example of a Telecommunications Room



#### Location

TRBs and TRs locations must meet the following requirements

- Location should be selected so that the room may be expanded.
- Shall be located as close as practicable to the center core of the building to minimize horizontal cable distances (Maximum cable length is 260' (60m) from TR to drop location)
- Shall be accessible through common-use corridors that will allow the delivery of large cable reels and equipment and access for repairs 24x7.
- In multiple applications, TRBs and TRs shall have all 4 walls vertically stacked.

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**TRBs and TRs may not be inside of or be part of a Mechanical space, Equipment room, Washroom, storage area, janitor closet. All room locations must be approved in writing by Rensselaer Polytechnic Institute prior to design.**

**Electromagnetic interference**

Rooms shall be located away from sources of electromagnetic interference. Special attention shall be given to electrical power supply transformers, motors and generators, x-ray equipment, elevator equipment, and induction devices.

**Access**

Access to the Rooms shall be 24 hours-per-day, 365 days-per-year basis (24x7). Access shall be through common use corridors and not accessed by way of any other room.

**Design**

**Architectural**

**Size**

Rooms shall have a minimum inside dimension of 8ft. x 10ft. If these rooms require additional square footage based on additional requirements, the size shall be determined on a case-by-case basis. Rensselaer Polytechnic Institute must approve all room dimensions in writing.

**Walls**

All four (4) walls shall be floor to deck and have a 2-hour fire rating.

**Plywood backboards**

All four (4) walls shall be covered with ¾ in. exterior grade plywood, preferably void free. Plywood shall be fire-rated to meet applicable codes. To reduce warping, fire-rated plywood shall be kiln-dried to maximum moisture content of 15%. Plywood shall be painted on all 6 sides with a white fire retardant paint. Mount plywood 2" above the top of the electrical outlets or surface raceway. Top of plywood shall be level with the top of the cable tray but shall not exceed 9' AFF.

**Ceiling height**

The height between the finished floor and the lowest point of the ceiling should be a minimum of 3 m (10 ft).

**Treatment**

Floors, walls, and ceiling shall be treated to eliminate dust. Finishes shall be light in color to enhance room lighting. Floor covering shall be a vinyl anti-static material. Color shall be determined on a case-by-case basis.

**False ceiling**

Room shall not have a false ceiling to permit maximum use of cable pathways both vertically and horizontally. In such cases where fire-proofing may be sprayed onto the exposed ceiling, the fire-proofing shall be treated to mitigate airborne dust.

**Door**

Doors shall be a minimum of 0.9 m (36 in) wide and 2 m (80 in) high, without doorsill, hinged to open outward (code permitting) or slide side-to-side, or be removable. Consideration should be given to

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using double doors with a removable center-post. The door(s) shall be fitted with a lock, which is keyed for an MH1 key.

#### **Floor loading**

The TRBs shall be located on floor areas designed with a minimum floor loading of 4.8 kPa (100 lbf/ft<sup>2</sup>). The TRs shall be located on floor areas designed with a minimum floor loading of 2.4 kPa (50 lbf/ft<sup>2</sup>). The project structural engineer shall verify that concentrations of proposed equipment do not exceed the floor-loading limit.

#### **Signage**

Signage, if used, should be developed within the security plan of the building.

### **Environmental**

#### **Contaminants**

The rooms shall be protected from contaminants and pollutants that could affect operation and material integrity of the installed equipment.

#### **Heating, Ventilation and Air Conditioning (HVAC)**

##### **Continuous operation**

HVAC shall be available on a 24 hours-per-day, 365 days-per-year basis. A stand-alone unit should be considered for Telecommunication Rooms.

##### **Standby operation**

If a standby power source is available in the building, consideration should be given to also connecting the HVAC system serving the Communications Rooms to the standby supply.

##### **Operational parameters**

The temperature and humidity shall be controlled to provide continuous operating ranges of 18 °C (64 °F) to 24 °C (75 °F) with 30% to 55% relative humidity.

The ambient temperature and humidity shall be measured at a distance of 1.5 m (5 ft) above the floor level, after the equipment is in operation, at any point along an equipment aisle centerline.

##### **Positive pressure**

A positive pressure differential with respect to surrounding areas should be provided with a minimum of one air change per hour.

##### **Vibration**

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

##### **Other mechanical fixtures**

Mechanical fixtures (e.g., piping, ductwork, pneumatic tubing electrical conduits) not related to the support of TR/TRB shall not be installed in, pass through, under or enter the TR/TRB. In addition, the area adjacent to the exterior of the TR/TRB walls shall remain clear for cable pathways entering the TR/TRB.

## **Electrical**

### **Lighting**

Lighting shall be a minimum of 500 lx (50 foot candles) measured 1 m (3 ft) above the finished floor, mounted 8.5 ft minimum above the finished floor. Light fixtures must be independently supported from the building structure. Light fixtures shall not be mounted to, or supported by the cabletray.

*NOTE - Lighting fixtures should not be powered from the same electrical distribution panel as the TR/TRB. Dimmer switches shall not be used and emergency lighting and signs should be properly placed such that an absence of primary lighting will not hamper emergency exit.*

### **Power**

#### **General**

Each TR shall contain an electrical sub panel for the TRB and all the TRs that will be fed from that TRB.

TRs shall be fed from the sub panel in the TRB so that all outlets in all TRs are on emergency power.

#### **Panel**

The electrical sub panel shall be fed from the building emergency electrical power system. The panel shall be sized to accommodate the TRB and all the TRs that will be serviced by it. The panel shall have a laser printed directory to indicate rooms served by breaker.

### **Equipment 110vOutlets**

TRBs / TRs shall be equipped with a minimum of two (2) dedicated 110V, 20A circuits. Outlets shall be 110V, 20A duplex outlets. Outlets may be wall mounted, installed in divided surface raceway or installed on Kindorf channel above equipment racks depending on room configuration. Outlets shall be installed 12" from finished floor to center. All outlets shall have a laser printed circuit identifiers affixed to it indicating the panel room number, panel ID and circuit number. Rensselaer Polytechnic Institute Network & Telecommunications Department may specify additional outlets on a case-by-case basis.

### **Convenience 110vOutlets**

TRBs/ TRs shall be equipped with convenience outlet placed on each wall of the TR for uses other than network equipment (i.e. power tools, testing equipment). This outlet shall be run from a separate electrical panel. All outlets shall have a laser printed circuit identifiers affixed to it indicating the panel room number, panel ID and circuit number. Network & Telecommunications Department may specify additional outlets on a case-by-case basis.

### **Location of power conditioning systems**

Where applicable, dedicated environmental control equipment, such as power conditioning systems, and UPS up to 100 kVA shall be permitted to be installed in the TR. UPS larger than 100 kVA should be located in a separate room. This must be approved in writing by Rensselaer Polytechnic Institute Network & Telecommunications Department prior to design.

### **Bonding and grounding**

TRBs shall have a TMGB installed to which all TGBs in TRs, equipment, conduits, cable shields, cable trays, sleeves, etc. shall be bonded. The TMGB shall be connected to the main electrical

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service ground of the building with a minimum conductor size 2 AWG. A larger conductor size may be required based on the distance between the TMGB and the main electrical service ground. The TMGB shall also be bonded to building structural steel.

TRs shall have a TGB installed to which all equipment, conduits, cable shields, cable trays, sleeves, etc. shall be bonded. The TGB shall be connected to the TMGB located in the TRB with a minimum conductor size 6 AWG. A larger conductor size may be required based on the distance between the TMGB and the TGB. The conductor shall be continuous from the TMGB to the TGB. The TGB shall also be bonded to building structural steel if close and accessible. A separately derived ground or isolated ground system is not permitted.

## **Miscellaneous Requirements**

### **Fire protection**

Fire protection of the Telecommunications Rooms, if required, shall be provided as per applicable code. If sprinklers are required within the spaces, the heads shall be provided with wire cages to prevent accidental operation. Drainage troughs shall be placed under the sprinkler pipes to prevent leakage onto the equipment within the room. For some applications, consideration should be given to the installation of alternate fire-suppression systems, confirm applications with Rensselaer Polytechnic Institute.

### **Water infiltration**

The TRBs/TRs shall not be located below water level unless preventive measures against water infiltration are employed. The room shall be free of water or drain pipes not directly required in support of the equipment within the room. A floor drain shall be provided within the room if risk of water ingress exists.

## **Cable Pathways**

### **General**

Conduits and sleeves should extend 4- 6" into the TR/TRB. If the conduits or sleeves are subject to water intrusion they must drain away from the room and be watertight. All conduits and sleeves must have the ends plugged upon installation to keep debris from entering the conduits and sleeves. Cable tray shall not be run through walls. Conduits and sleeves must have bushings install at all ends and at all pull boxes. Network & Telecommunications Department must approve all pathway designs in writing.

**Conduit pathways built for telecommunication cabling have more stringent bending and pull box requirements than electrical cabling and must be adhered to (i.e. a telecommunication conduit can have no more than 180 degrees of cumulative bends between pull points where as a conduit installed for electrical wiring may have 360 degrees of bends between pull points).**

### **Ladder Rack**

An 18" wide ladder rack shall be run around the inside perimeter of the room for the distribution of cabling inside the room. An 18" wide ladder rack shall also be run down the center of the room for the free standing racks that will be installed. The rack shall be mounted 7'0" from finished floor to the bottom of the tray. There shall be no other equipment, lights, conduits, fixtures etc. attached to, mounted on, running through or on the ladder rack except those needed to support the ladder rack systems. Ladder racking may not be run through walls.

### **Sleeves/Conduits**

#### **Horizontal UTP**

The quantity of horizontal sleeves installed in each TR/TRB for horizontal cabling shall be six (6) 4" sleeves. The sleeves shall be a minimum 8'-0" AFF to the bottom of the sleeves. Sleeves that are

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installed above 9'-0" AFF must have vertical ladder racking installed from the bottom of the sleeve to the top of the cable tray for lashing of cables in the vertical run.

**Vertical Backbone**

In a multi-store building where TRs are stacked to form a riser, a minimum of three (3) -4" sleeves shall be installed between the stacked TRs.

**Horizontal Backbone Inter-building**

Backbone pathways in the form of four (4)-4" conduits shall be installed between the TRB of each building and the nearest designated maintenance hole servicing that building.

**Horizontal Backbone Intra-building**

If the TRs are not vertically stacked on the TRB, backbone pathways in the form of Four (4)-4" conduits shall be installed between the TRB of the building and each TR. All conduits and innerducts are to be threaded with a pull rope with footage markers. In multi-story building where TRs are stacked to form a riser, a minimum of four (4)-4" conduits shall be installed between the TRB and the first TR in the stack. Cable tray can be used for Inter-building Backbone distribution only with the use of properly sized innerduct or by the installation of a physical separation for the protection of the Backbone cables from general cable installation. Rensselaer Polytechnic Institute must approve use of cable tray as a backbone distribution system in writing.

**General Telecommunication Room Design**

Telecommunication Room design shall follow all BICSI TDMM design recommendations. Rensselaer Polytechnic Institute must approve all final design in writing. A detailed T3 drawing will be required for Telecommunication Plans, for more information on drawing detail see BICSI TDMM 9<sup>th</sup> Edition.

**25120 EQUIPMENT ROOMS AND SERVICE ENTRANCES**

**General**

Equipment Rooms / PBX and Service Entrance Rooms shall be located and designed on a case-by-case basis with Rensselaer Polytechnic Institute.

**25130 INTERIOR COMMUNICATIONS PATHWAYS**

**General**

The Interior Communications Pathways will provide a distribution system for all system cabling that will be served by the building TRs. The pathways for a building may include all or some of the following, cable tray, continues conduit systems, conduit stubs, sleeves, and cable hangers. All pathways must be approved in writing by Rensselaer Polytechnic Institute prior to design completion. Interior pathway design shall follow all BICSI TDMM design recommendations and TIA568-B and TIA569-A standards. A detailed T1 and Pathway Logical drawing will be required for all Pathway Plans, for more information on drawing detail see BICSI TDMM 9<sup>th</sup> Edition.

**Conduit pathways built for telecommunication cabling have more stringent bending and pull box requirements than electrical cabling and must be adhered to (i.e. a telecommunications conduit can have no more than 180 degrees of cumulative bends between pull points where as a conduit installed for electrical wiring may have 360 degrees of bends between pull points).**

## **Interior Pathways**

### **Cable Tray**

A continuous cable tray system shall be installed on each floor. Minimum tray size shall be 24" x 4" deep with 1" rungs every 9" on floors that have a TR . For all other floors the cable tray shall be 18" x 4" deep with 1" rungs every 9". When making turn and elevation changes the appropriate tray accessories, having the proper bend radius, must be used. For access to, and installation of, cables in the cable tray, the following clearances are required around the cable tray. The cable tray system shall have 1'-0" clearance measured from the top most surface of the tray. Access from the sides shall be 6" to 1'. Access to the cable tray from below shall be unobstructed its entire length; **MUST HAVE A DROP OUT RADIUS BEND- APPROVED BY NETWORK & TELECOMMUNICATIONS DEPARTMENT.** There shall be no other equipment, lights, conduits, fixtures etc. attached to, mounted on, running through or on the cable trays except those needed to support the tray systems. Cable tray may not be run through walls. The tray shall stop at all walls where sleeves or conduits will be installed, the tray shall continue on the others side of the wall.

### **Conduit:**

#### **General**

Sizes indicated for conduits are trade sizes in all cases.

Conduits shall have an insulated bushing installed prior to the installation of telecommunications cabling.

Conduits must have the ends plugged upon installation to keep debris from entering them.

Conduit needs to run in the most direct route possible, usually parallel with building lines.

Conduit runs shall contain no continuous sections longer than 100 feet. If runs total more than 100 feet, pull points or pull boxes need to be inserted.

Conduit shall have no more than 180 degrees of cumulative bends between pull points or more than 90 degrees of bends at any one point.

Electrical Metallic Tubing shall be electro-galvanized steel.

(See specifications section 25130 for conduit detail)

#### **Intra-building Backbone Conduits:**

See TR pathway requirements in section 25110

### **Outlet / Conduit location**

#### **New construction wall outlet**

Conduit from the cable tray to a typical wall outlet should be a minimum of 1". Each 1" conduit will service only **one** wall outlet location. The conduit will be terminated in a 4" x 4" x 2.75" deep box with a pull string. The box shall be fitted with either a single or double gang mud ring to suit the outlet configuration required. (See 25160 for outlet types)

Outlets are typically located at the following heights to center:

- Desks                   18" AFF
- Wall Phones       48" AFF
- Pay Phones         48" AFF

Conduits run to the cable tray should end approximately 4"- 6" inches away from the top or bottom edge of the cable tray to maintain a proper bend radius.

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**New construction floor outlet**

Conduit from the cable tray to a typical floor outlet should be a minimum of 1". Each 1" conduit will service only **one** floor outlet location. The conduit will start at the cable tray located on the same floor as the work area. Confirm all floor outlets meet Fire Code and will accommodate manufacturers jacks and outlets.

**Renovations**

For areas being renovated, the minimum requirement is for horizontal wiring to be properly supported and secured in the work area in either surface raceway, communications pole, enclosed within the wall or furniture and not exposed to possible damage. From the cable tray to the outlet location, in the area above the drop ceiling, the cable shall be supported by CAT 6 approved cable hangers mounted a minimum of 6" above the ceiling at a maximum distance of 3" on center.

**Sleeves**

Sizes indicated for sleeves are trade sizes in all cases.

Sleeves shall have an insulated bushing installed prior to the installation of telecommunications cabling.

Sleeves must have the ends plugged upon installation to keep debris from entering them.

Sleeves used at wall transition points for cable tray systems shall be 4". Quantity of sleeves shall be equal to the capacity of the cable tray.

Sleeves for distribution of horizontal cable in renovated areas not having conduits to the cable tray shall be sized so that when all cables have been installed at the completion of the project, the sleeve will be at 40% capacity of the sleeves maximum fill.

All sleeves shall have a minimum 2-hour UL listed fire rated assembly installed regardless if the wall or floor is not fire rated or has a rating of lesser value. If the wall or floor has a fire rating greater than 2 hours the sleeve shall have an equal rating in all cases

The minimum sleeve size installed for any penetration shall be 2".

**Bonding and grounding**

All metallic conduits, cable trays, sleeves, etc. shall be bonded back to the TGB in the TR that serves cabling in that serving zone.

**25140 EXTERIOR COMMUNICATIONS PATHWAYS**

**General**

The Exterior Communications Pathways will provide a campus distribution system for all system cabling that will be served by the TRBs. The pathways for a campus distribution system may include all or some of the following, maintenance holes, hand holes, innerduct for both in conduits and direct buried, conduit, multi-cell conduits, All pathways must be approved in writing by Rensselaer Polytechnic Institute prior to design completion. Exterior pathway design shall follow all BICSI TDMM and BICSI Customer Owned Outside Plant Design Manual design recommendations and TIA568B and 569A standards. Rensselaer Polytechnic Institute must approve all final design in writing. A detailed T0 and Pathway logical drawing will be required for all Pathway Plans, for more information on drawing detail see BICSI TDMM 9<sup>th</sup> Edition.

**Conduit pathways built for telecommunication cabling have more stringent bending and pull box requirements than electrical cabling and must be adhered to (i.e. a telecommunications conduit can have no more than 180 degrees of cumulative bends between pull points where as a conduit installed for electrical wiring may have 360 degrees of bends between pull points).**

## **Exterior Pathways**

### **General**

Sizes indicated for conduits and innerduct are trade sizes in all cases.  
For quantities see Backbone Inter-Building in section 25110.

### **Conduit**

All conduits will be in the form of 4" in all cases.

Conduits must have the ends plugged upon installation to keep debris from entering them.

Conduit runs shall contain no continuous sections longer than 200 feet. If runs total more than 200 feet, pull points need to be inserted.

Conduit shall have no more than 180 degrees of cumulative bends between pull points or more than 90 degrees of bends at any one point.

All bends must be long, sweeping bends with a radius not less than six times the internal diameter of conduits 50 mm (2 in) or smaller, or ten times the internal diameter of conduits larger than 50 mm (2 in).

All conduits must be mandreled prior to turning over to Network & Telecommunications Department of occupancy.

All ends of conduit must be reamed.

All conduits entering a building must be pitched to drain away from the building to avert water intrusion.

To prevent conduit shearing, conduits enter through walls shall be metal and extend to undisturbed earth, particularly where such backfill is susceptible to load bearing tension.

All conduits that do not have innerduct install inside of them shall be threaded with pull ropes with footage markers.

Rigid Galvanized Steel Conduit shall be hot-dipped galvanized steel, including threads.

Rigid Non-Metallic PVC Conduit

Extra-Heavy wall conduit: Schedule 80, constructed of polyvinyl chloride, rated for use with 90 degree C conductors, and UL listed for direct burial and normal above ground use.

Heavy wall conduit: Schedule 40, constructed of polyvinyl chloride, rated for use with 90 degree C conductors, and UL listed for direct burial and concrete encasement.

(See specifications section 25140 for exterior conduit detail)

### **Conduit Depth Requirements**

Top of conduit must be buried at least 36 inches below the ground surface.

### **Encasement**

All underground conduits shall be concrete encased with reinforcing bars.

### **Conduit Orientation**

Manufactured conduit spacer shall be used for all conduits in the ductback so conduits can maintain the same orientation at all points of access.

### **Separation From Other Utilities**

Power up to 1KVA:

- 12 in. of well- packed earth
- 4 in. of masonry
- 3 in. of concrete

Gas, Oil, Water, etc.:

- 12 in. when parallel
- 6 in. when crossing

### **Innerducts**

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For quantities see Horizontal Backbone Inter-Building in section 25110.  
Innerducts must have the ends plugged upon installation to keep debris from entering them.  
All innerducts shall be threaded with pull ropes with footage markers.  
Innerduct shall not be directly buried or concentric incased as a replacement to conduits.

## **Maintenance Holes**

### **General**

Joint Use Maintenance Holes (MHs) are not permitted

### **Conduit Entry Points**

Conduits entering the MH are to be placed at opposite ends of a MH.

### **Covers**

Covers shall always be round and centrally located on single- cover maintenance holes.  
Frames and covers used in roads or driveways shall be rated to withstand vehicular traffic.  
For MH over 3.7 m (12 ft) long, follow these guidelines:

- Between 3.7 m (12 ft) and 6 m (20 ft) use two covers.
- Over 6 m (20 ft), use three covers.

### **Interior Hardware**

All hardware in MHs must be galvanized.

MHs shall be equipped with the following:

- Bonding inserts and struts for racking.
- Pulling eyes at least 22 mm (7/8 in) in diameter.
- A sump of at least 200 mm (8 in) in diameter.
- An entry ladder (where feasible).

### **Identifying Covers**

All covers shall have TELECOMMUNICATIONS pre-marked on the cover for easy identification.

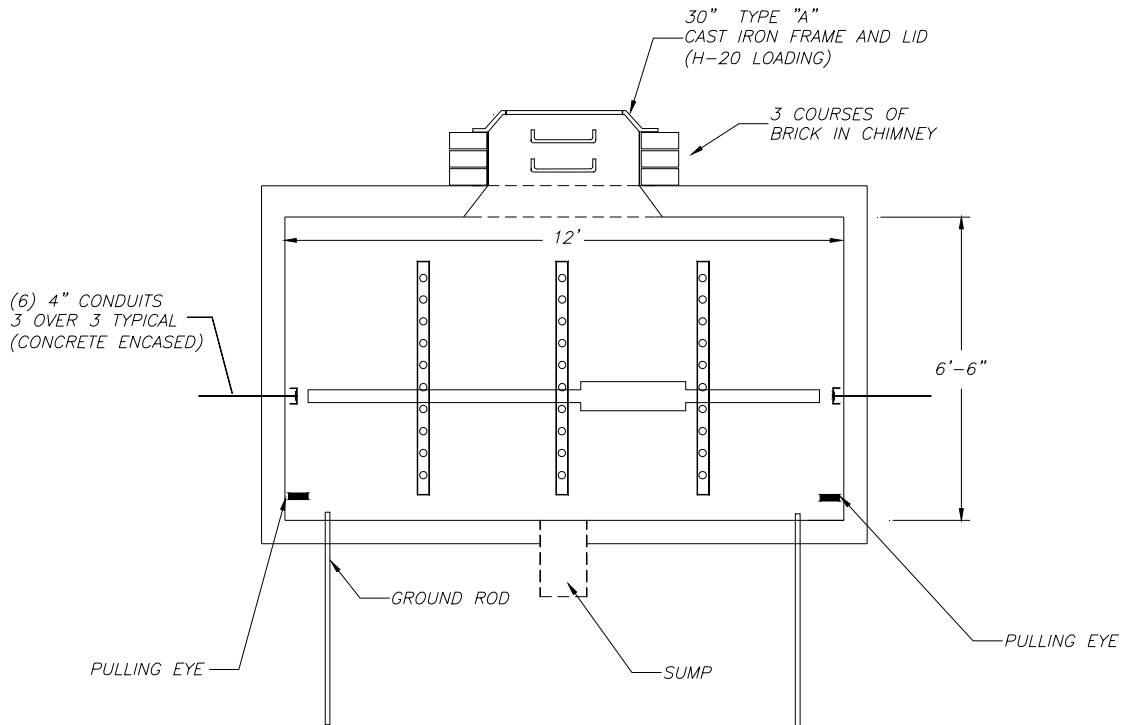
### **Concrete Strength**

The strength of concrete used for MHs shall be at least 24 000 kPa (3500 psi).

NOTE: Stronger concrete may be stipulated in certain installations.

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Figure 2 – Example of a Maintenance Hole



## Handhole

### General

Handholes (HHs) are smaller than maintenance holes (MHs), but the covers provide full access to the entire space inside the hole. HH shall be used as pull-through points only. HHs shall not be used as splice points, unless specified by the project manager. HH shall not be used in conduit runs that have more than three (3) 4in conduits.

Joint Use HH are not permitted.

### Conduit Entry Points

Conduits entering the HH are to be aligned on opposite walls of the HH at the same elevation.

### Covers

Covers shall always be round and centrally located handholes.

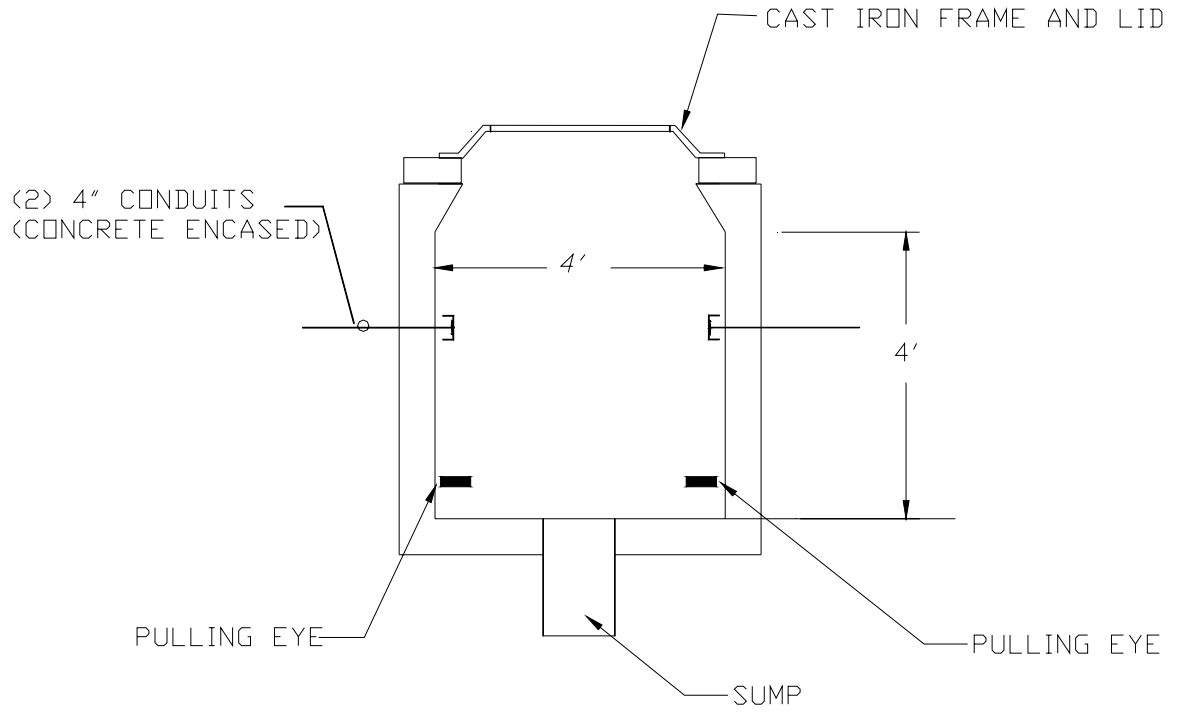
Frames and covers used in roads or driveways shall be rated to withstand vehicular traffic.

### Identifying Covers

All covers shall have TELECOMMUNICATIONS pre-marked on the cover for easy identification.

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Figure 3 – Example of a Handhole



## **25150 BACKBONE CABLING**

### **General**

Backbone cabling is the media over which Voice, Video, Data, Audio, Community antenna television (CATV) signals will be transmitted to the TR's. The media used for the transmission of the signals will be copper, fiber and coax. Backbone cables are broken into two types, inter-building and intra-building. Inter-building cabling has very strict requirements when entering a building. Cable insulation type, lightning protection and termination methods are important considerations when designing outside plant (OSP) cabling.

Sizing of backbone cabling for support of a building is directly related to the building's functions both during initial occupancy and future use. There is no generic backbone installation that will fit all applications. Design of the building's backbone cabling will be on a case-by-case basis. Generally, Optical Fiber, High Pair Count Copper and Coaxial cable will be install for backbone applications. Backbone cable design shall follow all BICSI TDMM design recommendations and TIA568B standards. Network & Telecommunications Department must approve all final design in writing. A detailed T1 and Backbone logical drawings will be required for all Backbone cabling Plans, for more information on drawing detail see BICSI TDMM 9<sup>th</sup> Edition.

## **25160 HORIZONTAL CABLING**

### **General**

The following will describe the **minimum** work area outlet requirements for area such as, a standard 8"x10" office, classroom and conference room, special locations and residents halls. The exact placement and quantities of outlets and pathways must be approved in writing by Network & Telecommunications Department prior to design completion.

Any deviation from this shall require written approval from the Network & Telecommunications Project Manager.

Backbone cable design shall follow all BICSI TDMM design recommendations and TIA568B standards. Rensselaer Polytechnic Institute must approve all final design in writing. Detailed T2 drawings will be required for all Cabling Plans, for more information on drawing detail see BICSI TDMM 9<sup>th</sup> Edition.

In general, install one network drop on each wall measuring 12'-0" in linear length. Provide additional work area outlets as required so that no "point" along the liner wall space is more then 12'-0" from a network outlet. This rule is intended to keep the network station cord from exceeding the maximum length of 16'-0" from the wall outlet to the network device.

A minimum of one duplex electrical outlet shall be installed within 16", but not closer than 8", of every work area outlet. If more then 2 data cables are installed at a single work area outlet location, add duplex electrical outlets in the same proportion.

### **Standard 8'x10' office**

Each office shall have a minimum of two (2) work area outlets, one on each wall perpendicular to the door wall. The work area outlets should be three (3) feet from the back wall (furthest from the door).

### **Classroom**

Each classroom shall have a minimum of two (2) work area outlets and one wall phone outlet. One (1) of the work area outlets shall be an coax drop. The wall phone outlet shall be in the front of the room near the door. The remaining outlet will be located on the wall opposite of the front of the classroom.

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**Conference room**

Each conference room shall have a minimum of two (2) work area outlets. One (1) of the work area outlets shall be a coax drop. Location shall be determined on a case-by-case basis.

**Special locations**

Computer rooms, labs, shared workspaces and other such areas must be reviewed on an individual basis for the quantity and types of work area outlets required.

**Student Living Spaces**

**General**

**Living Area / Living Room**

Each living area or room shall have a minimum of one 1 (one) coax cable.

**Bedroom**

There shall be 1 (one) coax outlet for each room. Location shall be determined on a case-by-case basis.

**Open, Lounge, Common and other areas**

Locations and quantities will be designed and approved by the Network & Telecommunications Department on a case-by-case basis.

**Tables, Desks and Study Carrels**

Locations and quantities will be designed on a case-by-case basis.

**Network Outlet Types**

**Standard Work Area Outlet**

A Standard work area outlet is comprised of three 4-pair Category 6 twisted pair cables, one 4-pair. The faceplates shall be a single gang type.

**Standard Residence Work Area Outlet**

A residence work area outlet is comprised of two 4-pair Category 6 twisted pair cables, one 4-pair. The coax cable will be for video distribution. The faceplates shall be a single gang type.

**Coax Outlet**

A Coax outlet is comprised of one quad-shielded coax cable. The location of a coax outlet will be located on a case by case basis. The faceplates shall be a single gang type.

**Wall Phone Outlet**

A Wall Phone outlet is comprised of one 4-pair Category 6 twisted pair voice cable.

*All wall phone locations shall be ADA compliant*

The faceplates shall be a single gang type.

**Pay Phone Outlet**

A Pay Phone outlet is comprised one 4-pair Category 6 twisted pair voice cable,

*All pay phone locations shall be ADA compliant.*

The cable will be left coiled in the box for the pay phone service provider.

**Wireless Access Point**

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A wireless access point is comprised of one 4-pair Category 6 twisted pair data cable (violet). The location will typically be located above the drop ceiling when possible and terminated in a typical surface or flush mounted jack. The cable will be terminated, tested. The locations for these cables shall be determined by the Network & Telecommunications Department. Contact and arrange for these engineering services on a per project basis and coordinate closely with Rensselaer Polytechnic Institute.

1 **25170 TESTING, IDENTIFICATION AND ADMINISTRATION**

**Testing**

- 2 Testing of Copper UTP cables shall conform to the requirements of TIA 568-B.1
- 3 Testing of Optical Fiber cables shall conform to the requirements of TIA 568-B.1

**Identification**

- 4 Identification of Cabling, Pathways and Hardware shall conform to TIA 606-A

**CSI 3 PART FORMATTED SPECIFICATIONS**

**25110 TELECOMMUNICATIONS ROOMS**

**25120 EQUIPMENT ROOMS AND SERVICE ENTRANCES**

**25130 INTERIOR COMMUNICATIONS PATHWAYS**

**25140 EXTERIOR COMMUNICATIONS PATHWAYS**

**25150 BACKBONE CABLING**

**25160 HORIZONTAL CABLING**

**25170 TESTING, IDENTIFICATION & ADMINISTRATION**

5 **25180 CUTOVER AND TRAINING**

6 **25190 SUPPORT AND WARRANTY**