

Building Telecommunications Infrastructure Requirements

This page identifies specific requirements for the design of telecommunications infrastructure for buildings at Clemson University. (Revised October, 2013)

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1. Introduction

The information in this document should be useful in making design-related decisions that will not only satisfy Clemson Computing and Information Technology (CCIT) requirements but also meet the needs of the building and its future occupants with respect to voice, video and data communications. The intention of this document is to provide the architect, at very early stage of the project, sufficient information relevant to the design of telecommunications pathways and spaces.

CCIT bases its requirements on ANSI/EIA/TIA standards such as: 568-B-- Commercial Building Telecommunications Cabling Standard; 569-- Commercial Building Standards for Telecommunications Pathways and Spaces; 606-Administration Standard for the Telecommunications Infrastructure of Commercial Buildings; 607-Commercial Building Grounding and Bonding Requirements for Telecommunications; BICSI Telecommunications Distribution Methods Manual (TDMM) and NFPA 70--National Electric Code (NEC).

Requirements dictated by NEC shall be adhered to completely. Adjustments to some of the requirements stated in this document that are not NEC based must be addressed on a case by case basis and must be coordinated with CCIT.

2. Entrance conduits

New buildings must be connected to the Clemson telecommunications manhole, tunnel and conduit system. New manholes and/or hand holes may need to be placed. CCIT will give design advice as to where the point of connection should be, and recommend a pathway for the new conduit. All costs for connecting the new building to the existing campus fiber network must be included in the project.

In some circumstances, new conduit may need to be placed to reinforce an existing conduit run which is full. As a general standard, at least four 4" conduits will be installed to a new building. 3/8" pullrope, not pull string, with 200 lbs minimum tensile strength must be provided in each conduit. All conduits must be mandrilled after installation. The minimum bending radius for the conduit sweeps is 22'. Conduits may only penetrate manholes and handholes through the end walls (i.e. the short walls).

Note that it is important that the general contractor obtains substructure locations for all existing utilities prior to starting excavation work. The contractor should use both PUPS 811 and campus survey sources.

3. Requirements for telecommunications spaces

The requirements below apply to all telecommunications spaces:

A. Location

There must be at least one telecommunications equipment room (TER) in a single-story building. For multi-story buildings, one TER on the first floor (or basement) is required and at least one smaller telecommunications room (TR) is required on each floor above. TERs and TRs must be designed so that they are within 295 "cable feet" (90 meters) of every telecommunications outlet (TO) on that floor. If this is not possible then more than one TR per floor is required. (295 cable feet includes cable lengths through vertical walls, conduits, cable trays and other pathways between the patch panels in the TR and the TO.)

The best location for TERs or TRs is the building core. The rooms should be vertically aligned or stacked. They must be accessible either from the building exterior, public hallway or other common areas. They must not be located inside office spaces, class rooms, and auditoriums.

TERs and TRs must be dedicated to telecommunications, intended for use for the life of the building. They may not contain or be used for storage, electrical, mechanical, HVAC, fire alarm panels or custodial spaces. Equipment not related to the TER and TR such as piping, duct work, building column and distribution of building power must not be located in or pass through the TER or TRs.

B. Size

The size of the telecommunications spaces depends on the function and total area served. (Please refer to the sizing method for each specific type of telecommunications space in items K and L.)

C. Doors

The doors to the telecommunications rooms must open 180 degrees outward unless restricted by building code. They must be a minimum of 36" wide and 80" high with no door sills. For security reasons, doors must be equipped with locks. Locks must be keyed to Clemson standard utility room key (5-11). This key assignment must be included in the keying schedule. Telecommunications rooms must not have windows.

D. Floors

Carpet is not permitted in any telecommunications spaces. Floors (also walls and ceilings) should be treated and sealed to eliminate dust. Static-controlled vinyl tiles are the preferred floor cover.

The rating for distributed floor loading for telecommunications room must be greater than 100 lbs/sq. ft. Concentrated loading must be greater than 2000 lbs in areas that will support telecommunications equipment.

E. Walls

All walls must be lined with ¾" void free A-C grade (or better) plywood. The plywood must be fire retardant or treated with at least two coats of fire retardant paint on all sides. Use light colored paint to aid with lighting in the rooms. The bottom of the plywood should be mounted 4"- 6" above finished floor (AFF).

F. Ceiling

Drop ceiling or suspended ceiling is not permitted in telecommunications spaces. The minimum acceptable ceiling height is 8.5'. It should be unobstructed to provide space over the equipment racks for suspended cable trays and horizontal ladder racks. Sprinkler heads must be provided with cages to prevent accidental operations. Drainage troughs must be provided under the sprinkler pipes to prevent leakage onto the equipment. They must be as high as possible to avoid accidental operation from cable pulling activities.

G. Electrical power

Power requirements for a standard telecommunications room containing active network equipment will be a minimum of two dedicated non-switched 3-wire 120 volt A/C quad outlets are required for equipment power; each one on a separate branch circuit otherwise specified. Branch circuits for equipment power shall be protected and wired for 20A capacity unless otherwise specified. The outlets should be mounted 80 inches from the finished floor and aligned with the ladder rack that secures and attaches to the equipment racks unless otherwise specified. Additional power requirements for other systems or services must be provided separately. Duplex convenience outlets shall be installed at standard height and at 6-foot interval around the room. Emergency power should be utilized whenever possible. If there is a UPS and/or a generator in the building then the TRs should be connected to it.

H. Lighting

Lighting must have uniform intensity of 50 foot candles when measured 3 feet from the finished floor. Indirect lighting is not permitted. Lighting fixtures must be on separate electrical circuits separate from the circuit that feeds the electrical outlets in the room. Do not place light fixture above equipment racks, cabinets, frames or other freestanding equipment to avoid blocking of light.

I. Environmental control

The temperature inside telecommunications rooms must be maintained between 64 °F-75 °F and relative humidity between 30%-55%. There must be at least one air exchange per hour in the rooms to maintain positive pressure inside the rooms. HVAC requirements for TER's containing active equipment are calculated by totaling the BTU output from the network devices required to service all the TO's that terminate in that room. A typical device that will support 48 network jacks generates approximately 5,000 BTU's. Additional network equipment generating more BTU's may be required. Consult with CCIT for additional information prior to determining HVAC requirements for TER's.

J. Grounding

Per NEC and ANSI/EIA/TIA-607 requirements, the telecommunications grounding and bonding infrastructure shall be designed and routed through each telecommunications space. Each telecommunications room shall be equipped with a Telecommunications Grounding Busbar (TGB) bonded directly to the Telecommunications Bonding Backbone (TBB). The busbars shall be a minimum of 6" in length, 2" in width and 1/4" thick. They shall be drilled and tapped to accommodate standard NEMA compliant grounding hardware. The TBB shall be a minimum of #6 AWG stranded copper grounding conductor and should be in conduits. All TBBs must be tied to the telecommunications main grounding busbar (TMGB) located in the equipment room (or main telecommunications room). The TMGB must be bonded to the building system ground with a minimum of 3/0 AWG stranded copper bonding conductor (BC). The ohmic resistance to ground from any point in the telecommunications grounding system must not be more than 3 ohms.

K. Telecommunications Equipment Room (TER)

A telecommunications equipment room (TER) is where the entrance conduits terminate. It is usually located on the ground floor but may also be located in the basement. A TER typically functions as the main cross-connect (MCC). It is the main telecommunications serving point for the building. It will contain telecommunications cabling and equipment, much of it mounted on 19" racks. Cables may be spliced and terminated on the walls. It is important that the entrance conduits stub up in the TER as close to a corner as possible.

Typical TER dimensions are 12' x 12-1/2' (minimum) for a building serving fewer than 200 work areas --a typical work area (WA) is 10'x10' or 100 sq. ft. A larger building will require a larger TER.

In certain buildings, the TER will be further designated as a Network Core Room. A Network Core Room is used as a cabling hub not just for that building but for other buildings in that neighborhood of the campus. A Network Core Room requires additional space and HVAC. It may require 30 amp outlets. In some cases, where a Network Core Room is designated in a building, a separate TR on the same floor as the Network Core Room may also be required.

CCIT will advise the University Facilities Project Manager and the architect in the initial planning stage if a Network Core Room has been designated. No water sprinklers may be installed in a Core Room. A separate fire suppression system, based on one of the approved replacements for Halon, must be installed in coordination with the campus Fire Marshall.

A Network Core Room will house switches and routers for campus wide area network (WAN), related local area network (LAN) switches, optical fiber cross connects and optical communications gear. Hence, it should be located so that it is accessible for the delivery of large equipment throughout its useful life. It must be at least 10' from a potential source of EMI (motors, transformers, photocopying equipment and the like).

L. Telecommunications Rooms (TRs)

TRs are smaller than TERs. They are the cabling hubs for floors within a building. They also contain network electronics, typically mounted in 19" racks. Rooms must be sized properly, the following is industry standard sizing;

- A TR serving 50 WAs or 5000 sq. ft. must be at least 10'x 8' in size. (A typical Work Area (WA) is 10'X10' or 100 sq. ft.)
- A TR serving an area larger than 5000 sq. ft. and less than or equal to 8000 sq. ft. must be at least 10'x 9'.
- A TR serving an area larger than 8000 sq. ft. and less than or equal to 10,000 sq. ft. must be at least 10'x 11'.
- For a building where useable floor area served is much less than 5000 sq. ft., a small 8'x 6' TR is adequate.
- A minimum of four 4-inch vertical riser conduits or sleeves are required between TRs. They must be installed as close to a corner in the TR as much as possible.

4. Horizontal pathways

The Horizontal Pathway System is the pathway through which cables are pulled from the TER or TR to the outlets on that floor. Outlets must be connected to a TR on the same floor.

A. Homerun conduits

Telecommunications outlets (TOs) must be connected to the TR with a home run 1" conduit. Conduits should be run in the most direct route possible. The number of bends in the conduit should be minimized. No more than two 90 degree bends between pull boxes is allowed. The use of "condulets" or "LB" type fittings is not allowed. No continuous run conduit may exceed 100'. For runs more than 100 feet, pull boxes must be installed so that no segment between pull boxes exceeds 100 feet. The conduit must have a pullstring with 200 lbs minimum test rating.

A 2-inch conduit is required to each wall-mounted box that supports a multi-user telecommunications outlet assembly (MUTOA). A MUTOA is a special type of telecommunications outlets that can support up to 12 voice/data jacks. It is suitable for use in locations where there is a cluster of machines where each one is within 15 feet from the MUTOA.

Two 2-inch conduits are required from the TR to each 2'X2' enclosure designated as a consolidation point (CP). Consolidation points are usually mounted in the ceiling. CPs are effective in serving floor areas consisting of modular furniture where furniture re-configuration occurs. It allows permanent cabling between TR and CP. Short replaceable cable runs are placed from the CP to the TOs in the cubicles. When the furniture configuration is changed, then it is only necessary to re-pull the cables from the CP to the cubicles, thus avoiding cable replacement back to the TR.

Flexible conduits such as metallic flexible conduit are not desirable pathways for telecommunications cables because they tend to "creep" and "shift" and cause sheath damage to the cables. Therefore, the use of flexible conduits as pathway for telecommunications cables must be avoided as much as possible.

B. Cable trays

TOs can also be connected to the TR via a combination of cable tray and conduit. Clemson has standardized on using Flex-Tray type cable trays. TOs should be connected to the cable tray with home run 1" conduits.

It is important that the path for the cable tray is clear of obstructions, such as HVAC ducts, large pipes and structural beams within the building. Where fire or smoke barriers are penetrated by the cable tray, they shall be fire stopped to maintain the rating of the barrier. Alternatively, conduit sleeves may be used through the penetrations. They must be fire stopped as well. The number of sleeves required depends on the number of cables and size of tray. Use 50% fill ratio to determine the number of sleeves. Two additional spare sleeves should be installed to accommodate future cable placement.

Place cable trays above drop ceilings in corridors. Do not place them above offices or inaccessible spaces. There must be at least 4 inches of vertical space between the suspended ceiling tile and the bottom of the cable tray; 12 inches of vertical clearance from the top of the cable tray to the true ceiling; and 2' total side clearance (meaning, if the cable tray is wall mounted and there is no clearance on one side, then minimum clearance on the other side should be 2').

It is desirable that the cable tray originates from the TR. If it does not originate from the TR then 4" conduits may be used to connect the TR to the cable tray. The number of 4" conduits required depends on the number of cables and size of tray. Use 50% fill ratio to determine the number of 4" conduits. Two additional spare conduits should be installed to accommodate future cable placement.

Access ceiling panels must be installed at 5-foot interval if cable tray is passing through a hard-lid ceiling. The panels should be within 2 feet from the cable tray. They shall not be mounted directly underneath the cable tray.

All metallic cable trays must be grounded but should not be used as grounding conductor for equipment.

C. Perimeter raceway system

In a perimeter raceway, power and telecommunications cables must be in separate compartments and must comply with applicable electric codes. When metallic barrier is provided, it must be bonded to ground. The barrier must run continuously throughout the length of the raceway.

A double-gang pull box must be placed in the wall at 10-foot interval along the length of the raceway. Each box must have a 1-1/4 conduit either homerun to the TR or to the cable tray.

D. Riser conduits

A minimum of four 4-inch vertical riser conduits are required between TRs.

5. Telecommunications outlets

A. Standard telecommunications wall outlets

The standard Clemson telecommunications outlet (TO) used for voice and data requires a double gang box, 4 11/16" x 4 11/16" x 2 1/8" deep, with a single gang mud ring. It is mounted flush in the wall at same height as the convenience electrical outlet-- 18" AFF. Telecommunications wall outlets will typically consist of 2 blue category 6A horizontal cables terminated on orange, AMP NETConnect SL series category 6A jacks using the 568B wiring scheme (unless otherwise specified). Details and accepted manufacturer information is available on the [Master Format Division 27 – Communications](#) document.

Indicate TO locations on the prints with half-shaded triangles. Use appropriate symbols to differentiate TOs that have additional interface such as video or that support special devices like a wireless access point.

A TO for wireless access point is typically mounted above the drop ceiling grid. It must be designated with appropriate subscript on the drawings. CCIT installs the transmitters after the building construction is complete. Typical wireless access point transmitters have an 8"X10" off white decorative plastic cover that protrudes four inches from the wall or ceiling. Very small green indicator lights "LEDs" are visible from the bottom of the cover.

6. Miscellaneous

A. Card Access, Fire Alarm, BAS, CATV, A/V, intercom, and paging systems

Card Access, Fire Alarm, Building Automation Systems (BAS), CATV, Audio-visual (AV) systems, intercoms and any other devices are the responsibility of the system owner and architect. These systems are not designed, specified, supported or maintained by CCIT NST. Devices for these systems that are to be located in the TR must be specified and their system power and communications needs determined by the appropriate party responsible for providing and supplying the system. Space for housing the equipment needed for these systems must be accounted for in sizing the TR rooms and rack layout.

7. Rerouting conduits

For on campus buildings site work may mean that existing telecommunications cables in the area need to be rerouted. The architect is responsible for designing the conduit, manholes etc. necessary to connect the building to the University fiber network and the project is expected to pay all costs associated with the reroute. CCIT will provide design advice and information. University Facilities must specify the requirements for conduits and determine who is to install any new underground conduit and manhole facilities.

CCIT will engineer routing of cables through old or new conduit. Outside plant (OSP) fiber cabling will not be done by the general contractor. CCIT will prepare a separate bid document for the OSP fiber cabling, select a contractor and coordinate the install. No existing telecommunications cables or fiber can be damaged or demolished until the new cabling is complete. This needs to be made clear in the general bid documents. CCIT will advise University Facilities during the design stage how much time must be allowed in the construction schedule for the cabling and provide a budgetary estimate for the project.

8. References

Most current edition of the following documents:

Telecommunications Distribution Method Manual (TDMM) most current edition by Building Industry Consulting Services Incorporated (BICSI)

ANSI/EIA/TIA 568-C Commercial Building Telecommunications Cabling Standard

ANSI/EIA/TIA 569- Commercial Building Standards for Telecommunications Pathways and Spaces

ANSI/EIA/TIA 606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings

ANSI/EIA/TIA 607 Commercial Building Grounding and Bonding Requirements for Telecommunications

NFPA 70--National Electric Code (NEC)

[Master Format Division 27 – Communications](#)