Telecommunications Design Standards

16700 Communications

Revision 20.0 – 11 May 2009

Colorado State University

Revisions this version:

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(2) Chapter 3 – Communications Rooms, p. 7 - 8
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Chapter 1: Introduction

1. Departments Involved in The Design Process

This document provides design specifications for voice, video and data communications infrastructure at Colorado State University (CSU), otherwise referred to as the University. Several departments are responsible for this communications infrastructure and should be involved in the design process. These include 1) CSU Telecommunications for the physical infrastructure, 2) Academic Computing and Networking Services (ACNS) for the network equipment and video and 3) Classroom Support Services for Smart classrooms. Contacts for these departments are given below.

<table>
<thead>
<tr>
<th>Department</th>
<th>Name</th>
<th>Phone Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic Computing and Networking Services (ACNS)</td>
<td>Greg Redder</td>
<td>970.491.7222</td>
</tr>
<tr>
<td>Classroom Support Services</td>
<td>Doug Satterfield</td>
<td>970.491.6080</td>
</tr>
<tr>
<td>Telecommunications Project Planner</td>
<td>Pat Demchok</td>
<td>970.491.1148</td>
</tr>
</tbody>
</table>

The individuals above shall be consulted initially during the schematic design phase and engaged during the design (DD) and construction (CD) phases, and must approve all the designs prior to the construction (CD) phase. As questions arise during the construction phase, the above individuals are also to be consulted.

2. Applicable Standards

Telecommunications physical infrastructure as defined by the Telecommunications Industry Association/Electronics Industry Association, or TIA/EIA, consists of six elements: 1) building entrance, 2) building main telecommunications room or Main Distribution Frame (MDF), 3) backbone cabling, 4) telecommunications closets or Intermediate Distribution Frames (IDF’s), 5) horizontal cabling, and 6) work area. These elements will be augmented by a seventh element, networking equipment, required to provide a minimum level of data service for the building. Also included are basic specifications for the delivery of broadband television services via a hybrid single-mode fiber optics and coaxial cable system.

In general, the following standards at a minimum shall be observed for telecommunications infrastructure and are incorporated herein by reference:
This document provides interpretation of the standards referenced in the previous paragraph and provides additional detail, in some cases superseding those standards. Where Systimax guidelines differ from TIA/EIA standards, the Systemax guidelines supersede the TIA/EIA standard. Should the contractor require additional interpretation of these design guidelines, the contractor shall contact the designated University representative (Table 1).

<table>
<thead>
<tr>
<th>System</th>
<th>Standards Hierarchy</th>
<th>Substitutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>TIA/EIA/NEC/BICSI</td>
<td>Grounding, Bonding, and Fire-stopping</td>
<td>None</td>
</tr>
<tr>
<td>Corning</td>
<td>Fiber Optics Glass</td>
<td>None</td>
</tr>
<tr>
<td>Systimax Structured System (SCS)</td>
<td>Category 5e Copper Cabling</td>
<td>None</td>
</tr>
<tr>
<td>TIA/EIA</td>
<td>Data</td>
<td>None</td>
</tr>
<tr>
<td>TIA/EIA</td>
<td>Voice</td>
<td>Must be pre-approved in writing</td>
</tr>
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</table>

3. General Guidelines

Integral to the telecommunications infrastructure in buildings are the secure communications rooms, consisting of the MDF and, generally, one or more IDF’s. These rooms must be secure, environmentally conditioned and clean before Telecommunications can work in them, especially as fiber must be terminated in these rooms requiring a very clean environment. Expensive and delicate networking devices, requiring environmental conditioning, also are housed in these rooms. In this regard, the MDF and IDF’s shall be completed including environmental conditioning and completed early in the project timetable. In particular, all penetrations shall be completed and sealed (e.g., capped) before Telecommunications work can continue in these environments.
4. Equipment and Materials Specifications

Specifications for equipment and materials, used in the construction process, are specified in the Standard Materials List.

**Check with Telecommunications Contact, Table 1, to ensure use of the latest materials list.**

Note that there are some materials for which no substitutions are allowed. Where substitutions are allowed, these must be pre-approved in writing in an addendum prior to the final design bid. Questions about substitutions of these materials should be referred to the University designated representative (Table 1 Contacts).

5. Contractor Certifications

CSU requires contractors to be certified Systimax Business Partners. Systimax classifies Business Partners as Elite, Prestige or Authorized. Approval of certification must be submitted to Telecommunications. In addition, Telecommunications requires that contractor provide Technicians and Installers certified by the Building Industry Consulting Service International, Inc. (BICSI) permanently assigned for the duration of the CSU project. Telecommunications requires a minimum of one (1) BICSI certified technician and a ratio of one (1) BICSI certified installer to three (3) installation workers.

Please refer to Table 1 Contacts for the Telecommunications contact person for questions regarding this section.

**Chapter 2: Horizontal Infrastructure**

**Systimax Structured Cabling System (SCS)** Category 5e cable, connectors, and fixtures shall be used for horizontal data cabling. Data cable runs shall be strictly limited to 90 meters in total length, according to standards. In particular, IDF’s are to be located so as to maintain less than a total 90-meter cable run.

**Plenum Spaces** - Plenum cabling or conduit shall be used in plenum spaces. Contractor shall determine prior to work being started, in consultation with CSU Telecommunications and CSU Facilities, whether the space is a plenum space.

**Asbestos** - Buildings to be wired shall be inspected by CSU Environmental Health Services for Asbestos Containing Material (ACM). Where ACM exists, the University will decide whether to abate the asbestos or circumvent the asbestos by, for example, installing telecommunications infrastructure under the ceiling tiles.

**Conduit** – Please refer to; Building Industry Consulting Services International (BICSI) Telecommunications Distribution Methods Manual v. I, Section I – Horizontal Pathway Systems, Chapter 4 – Horizontal Distribution Systems, p. 4.5 - 4.27
And Telecommunications Distribution Methods Manual v. II, Appendix A – Codes, Standards and Regulations, p. A7-A8 for details on the installation of conduit. Use the following ONLY as guidelines. Questions are to be directed to the Telecommunications Project Planner, Table 1.

Conduit bends shall conform to accepted radii for the type of conduit used. There shall be no more than 180 degrees between pull points. Conduits shall terminate slightly above cable tray and generally perpendicular to the tray without a down-turning end. The Contractor shall ensure that conduit ends are easily accessible for cable installation. Conduit ends shall be fitted with an appropriate bushing to minimize cable chafing. All conduits shall be bonded to the cable tray, bolted lugs and green insulated grounding wire, minimum 10 AWG. Telecommunications conduit(s) entering an MDF and/or IDF shall have ground bushings installed.

Installation of Conduit – Install cable trays with sufficient space to permit access for installing the cables. Clear space shall be provided above the top rail equal to the loading depth but not less than 6 inches. Provide lateral clearance of 24 inches on both sides of trapeze hung on one side of wall hung tray. CSU prefers aluminum ladder type cable tray with 9" spacing on rungs. All cable trays must be trapeze hung. The use of wire baskets is discouraged. If wire baskets are to be used, please contact the Telecommunications Project Planner, Table 1, to discuss installation requirements.

<table>
<thead>
<tr>
<th>Table 3</th>
</tr>
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<tbody>
<tr>
<td>Conduit Fill Capacity</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Number of Conduits</td>
</tr>
<tr>
<td>-------------------</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>&gt;2</td>
</tr>
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</table>

NEC Chapter 9

<table>
<thead>
<tr>
<th>Table 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable Outside Diameter (in)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Trade Size</td>
</tr>
<tr>
<td>------------</td>
</tr>
<tr>
<td>1/2</td>
</tr>
<tr>
<td>3/4</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>1-1/4</td>
</tr>
<tr>
<td>1-1/2</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>2-1/2</td>
</tr>
<tr>
<td>3</td>
</tr>
</tbody>
</table>
Cables shall be pulled with no more than a 25-pound pull force applied at any time during installation.

Testing and Reporting of Test Results – Each Category 3 drop (circuit) installed shall be tested for continuity and the results recorded.

Each Category 5e or Category 6 drop installed shall be tested using a calibrated Fluke Series 4000 Tester or higher version in accordance with the latest EIA/TIA 568 standards, and the results recorded on a separate CD-ROM for each building and provided to Telecommunications.

NOTE: On occasion, CSU will elect to specify Category 6a communications cable. In those cases, each Category 6a drop shall be tested using a calibrated Fluke Series 4000 Tester in accordance with the latest TSB-67 standard, and the results recorded on a separate CD-ROM for each building and provided to Telecommunications.

NOTE: A designated University representative shall be notified prior to any testing so that the representative or designate may be present during the testing. If the circuit testing is conducted in the absence of the University representative or designate, then the University may request a retest with the University representative present at the tester’s expense.

Systimax Certification – CSU requires that upon completion and testing of each building/project, Systimax certification be obtained. The Telecommunications contact person is responsible for coordinating the Systimax certification and facilitating any remedies. Please refer to Table 1 – Contacts for the name of the Telecommunications contact.

As-Builds - Upon completion of termination and testing, as-built drawings of all Category 3, 5e, 6 and/or 6a drops shall be provided within seven work days for each major phase of work; such as 1) floors, 2) wings, or 3) entire buildings. The as-built drawings shall be provided in AutoCAD version 10 or higher format. These files are to be on a separate CD-ROM for each building.

Drop (Circuit) Labeling – Each Category 3, 5e, 6 and/or 6a drop installed shall be labeled per CSU labeling scheme. Each drop shall be labeled on the front of the jack faceplate, on the patch panel in the IDF or MDF, and on both ends of the cable.

Four labels per fiber cable, two for the cable and two for the fiber patch panel, shall be prepared for all fiber cables. The University may elect to install the labels.
Invasive Work and Work Schedules - Invasive work (i.e., core drilling, hammer drilling or work that is noisy, dusty, etc.) shall be conducted during off-business hours. Other work shall be coordinated with the University designated representative (e.g., to pull cables during off-hours), and these arrangements shall be determined by mutual agreement.

Chapter 3: Communications Rooms

Telecommunications room space, MDF and IDF, shall be dedicated to the telecommunications function and related support facilities. Equipment not related to the support of the telecommunications function shall not be installed, passed through, or entered in the telecommunications rooms without review by Telecommunications and Academic Computing and Networking Services (ACNS) and consideration in the sizing of the space, environmental requirements, etc.

ACNS/Telecommunications CANNOT install equipment in communications rooms prior to the completion of the following items; (a) permanent dedicated power, (b) proper grounding and lighting, and (c) secure permanent door and two keys provided to the Telecommunications Contact. ACNS/Telecommunications REQUIRES a minimum of three (3) weeks from the completion of the aforementioned items until the service data for the following services; (a) elevator telephones, (b) fire alarm(s), (c) door security, (d) environmental controls, and (e) voice, data and/or video services.

ACNS/Telecommunications strongly recommend that early in the design phase ALL parties desiring to installs equipment in the MDF and/or IDF’s be collectively engaged to discuss placement of equipment and determine size requirements for the communications rooms.

1. Main Distribution Room – MDF

Telecommunications and ACNS shall provide customized communication room designs based on the requirements of each project. Please contact the Telecommunications Contact Table 1 page 3.

The following are general guidelines in the absence of a custom communications room design.

Buildings shall have a MDF where voice, video and data enter the building. The MDF also serves as the distribution point for voice, video and data and shall be secure to protect the integrity of these systems, particularly E911 services. Grounding and bonding shall be provided in the MDF that includes bonding to equipment racks, cable trays and telecommunications conduits in strict accordance with the TIA/EIA 607 standard and extended to all IDF’s as described therein. All penetrations of the MDF envelope shall be fire-stopped.
There shall be a minimum of one communications room per floor. Additional rooms, one for each area up to 10,000 square feet or the horizontal distance to the work area exceeds 250 feet, shall be required.

In buildings of size 5,000 square feet or greater, a secure room dedicated to telecommunications, shall be provided for the MDF. In smaller buildings, a secure wall-mounted Hoffman box may be an option in lieu of a separate, dedicated room.

TIA/EIA 569 shall be strictly observed for the MDF, especially as to location (away from electromagnetic interference), perimeters (no false ceilings), limited access (i.e., security), HVAC, lighting and electrical. In particular, MDF’s shall be provided with two dedicated and one general use circuits. One 20 amp, 120 volts terminated on double duplex outlets, and one 30 amp, 120 volts NEMA L5-30 outlet on the wall adjacent to the telecommunications racks. The general use outlet shall be near the door for ease of access – these locations shall be determined in consultation with CSU Telecommunications.

Provisioning of power and receptacles for non-Telecommunications/ACNS equipment requiring power installed in the MDF or IDF’s is the responsibility and at the expense of the entity responsible for the equipment. No extension cords are acceptable either “loose” on the floor or tied to the infrastructure.

No piping, ductwork, mechanical equipment, or power cabling or similar shall be allowed to pass through a MDF that is not associated with the communications services in the MDF. Switched lighting of 50-foot candles shall not be sourced from the same circuit as the telecommunications equipment.

MDF’s shall be environmentally conditioned to accommodate network equipment loads up to 1,000 w plus all other applicable cooling loads. Temperature in MDF’s shall not exceed 80°F. Communications equipment in the average MDF emits 3413 BTH/hr—these calculations shall be finalized in consultation with CSU ACNS (refer to Table 1).

The MDF shall have 3/4" A/C plywood wall mounted, void free, 8’ high, painted with two coats of fire resistant matte finish white paint, and capable of supporting attached voice and video distribution equipment as shown. The flame-spread rating shall be no greater than 25 when tested according to ASTM W84.

The voice and video distribution shall be mounted on the walls of the MDF in accordance with the EIA/TIA 569 standard. The MDF also serves as the fiber distribution point for the building and also houses the building-level data switch. In medium and large buildings no other equipment, excluding edge communication switches, shall be housed in the MDF without a review from Telecommunications and ACNS.
In small buildings, where the MDF is the only communications room, the MDF may also house edge switches that are used to distribute the data network to the end user. If only an MDF exists to serve the entire building, it shall serve only one floor. However, there are rare exceptions to this provided the building is small. These exceptions shall be determined in consultation with CSU Telecommunications. In medium to large buildings, CSU prefers that the MDF be located on the ground floor, where telecommunications enters the building, in an area central to the locations of the IDF’s. However, in small buildings, the MDF may be located in the center of the building and on the middle floor if multiple floors exist. In buildings susceptible to flooding, the MDF and all IDF’s should be located on the first floor and not the basement. Note that if data is served out of the MDF, data cable runs are to be limited to 90 meters in length, and this may affect placement of the MDF or require an IDF to be added.

The MDF shall be large enough to accommodate at least two 7’x19” relay racks and 3 - 8.5” vertical organizers; one rack for the building fiber and copper distribution and the other for the building data switch (es) and associated UPS. The MDF shall also accommodate the telephone and video distribution systems which may be wall or rack mounted.

All penetrations of the MDF envelope shall be fire-stopped. These penetrations may consist of vertical penetrations for 4” diameter conduit or horizontal "pass-through" 4” diameter conduit penetrations to ladder racks. **Note that rings or "J-type hangers for riser cables between communication closets, copper or fiber, shall not be used. Note; CSU requires continuous conduit runs for riser cables between the MDF and IDF. The use of J-hooks is not acceptable.**

<table>
<thead>
<tr>
<th>Table 5</th>
<th>MDF SIZES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Size (ASF)</td>
<td>MDF Size (Length x width - ft)</td>
</tr>
<tr>
<td>Less than 5,000</td>
<td>Hoffman Box</td>
</tr>
<tr>
<td>5,000 to 10,000</td>
<td>10x8</td>
</tr>
<tr>
<td>10,000 to 50,000</td>
<td>10x12</td>
</tr>
<tr>
<td>50,000 to 100,000</td>
<td>12x12</td>
</tr>
<tr>
<td>100,000 to 150,000</td>
<td>14x14</td>
</tr>
<tr>
<td>150,000 to 200,000</td>
<td>14x16</td>
</tr>
</tbody>
</table>

There shall be a minimum of one telecommunications room per floor. Additional telecommunications rooms, one for each 10,000 square feet, shall be provided when:

a) the floor area to be served exceeds 10,000 square feet; or
b) the horizontal distribution distance to the work area exceeds 295 feet.
The building use and/or configuration may require reconsideration of the telecommunications room sizing. Ideally, this is addressed during the schematic phase of the project with the contact references in Table 1.

Doors shall open outward and adhere to all fire codes. It may be necessary to install double opening doors for this purpose. Self-closing locksets shall be used to ensure doors are secure upon their closure.

2. Intermediate Distribution Room (IDF)

Each floor shall have a dedicated IDF. The IDF houses the edge data switches that are used to distribute the data network to the end user and the video and telephone connections to the end user. Edge data switches are housed in vertical racks with each rack serving up to 120 users. Telephone connections shall be made on punch-down terminals affixed to 3/4" plywood backboards in the IDF. All exposed backboard surfaces shall be painted with two coats of fire-resistant matte white paint. The flame-spread rating shall be no greater than 25 when tested according to ASTM W84. Video connections shall enter the IDF on dedicated single-mode fiber optic bundles and terminate on rack mounted fiber patch panels. Video connections, from these fiber-optic receivers to the end user, shall be accomplished using splitters and coaxial cables run in a star configuration to every classroom/laboratory.

Grounding and bonding shall be provided in the IDF that includes bonding to equipment racks, cable trays and telecommunications conduits in strict accordance with TIA/EIA J-STD-607-A-2002 standard, the most current edition NEC, and as a reference BICSI DD 120-Grounding Fundamentals for TELCO Facilities, Chapter 4 Telecommunications System Grounding and extended to all IDF’s as described therein. All penetrations of the IDF envelope shall be fire-stopped.

IDF’s shall be located at points that minimize the runs of the data network to the end user, typically in the center of wings of buildings. Data cable runs are to be limited to 90 meters, and this may affect placement of the IDF or require additional IDF’s to be added.

IDF’s shall be secure and environmentally conditioned. IDF’s shall be provided with two dedicated and one general use circuits. One 20 amp, 120 volts, double duplex outlets terminating on double duplex outlet, and one 30 amp 120 volts NEMA L5-30 outlets on the wall adjacent to the telecommunications racks. The general use outlet shall be near the door for ease of access – these locations shall be determined in consultation with CSU Telecommunications.

Provisioning of power and receptacles for non-Telecommunications/ACNS equipment requiring power installed in the MDF or IDFs is the responsibility and at the expense of the entity responsible for the equipment. No extension cords are acceptable either “loose” on the floor or tied to the infrastructure.
IDF’s shall be supplied with 50 foot-candle of switched lighting which shall not be sourced from the same circuit as the telecommunications equipment.

IDF’s shall be sized to accommodate an equipment load of 500 w. Temperature in IDF’s shall not exceed 80°F.

Communications equipment in the average IDF’s emits approximately 1716 BTU/hr – these calculations shall be finalized in consultation with CSU ACNS (refer to Table 1).

IDF’s shall be sized such that there is ample room to install racks to house the equipment. The IDF shall be sized to accommodate a minimum of two vertical 7'x19" relay racks and 3 - 8.5" vertical organizers: one for the fiber, an IDF switch, and UPS; and another for edge network switches. Ideally, there shall be 48” of space on each side of the rack lineup. Preferably, the MDF and IDF shall be vertically stacked within the building.

IDF’s shall be sized to accommodate all connections that may potentially be used from that room. In a typical scenario, an IDF would serve an area of approximately 10,000-15,000 Assignable Square Feet (ASF), depending on density of connections deployed from the IDF.

<table>
<thead>
<tr>
<th>Serving Area/No. of Jacks</th>
<th>Room Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>10,000 sq ft/361-480</td>
<td>10x12</td>
</tr>
<tr>
<td>8000/241-360</td>
<td>10x10</td>
</tr>
<tr>
<td>5000/0-240</td>
<td>10x8</td>
</tr>
</tbody>
</table>

TIA/EIA 569-B 7.11.5.1.1

Doors shall open outward, adhere to all fire codes, and secured with self-locking locksets. It may be necessary to install double opening doors for this purpose.

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

3. Campus Room Types

Several generic types of rooms have been defined for categorization purposes. Except for minimum numbers of jacks, the following are suggested configurations.
In all cases, the final numbers of jacks should be determined in consultation with CSU Telecommunications and the building occupant.

Individual Office – a single individual occupies an individual office. The minimum configuration for communications shall be two outlets, located on opposite walls, each with two data jacks.

Shared Office – more than one individual (e.g., graduate students or staff) may occupy a shared office. At least two data jacks shall be installed in every shared office on opposite walls. The minimum data configuration shall be two data jack per occupant. Data jack outlets shall be spaced around the perimeter of the office at distances of approximately every 12 feet.

Where conduit is used, 1” conduit with a 4 11/16” square box 2 1/8” deep shall be placed to each communications outlet.

General Classroom – a general classroom shall have a minimum of one quad outlet, located at the front of the room, with four data jacks. If the front of the classroom may ever change, additional quad outlets shall be placed on every other wall that may ever be used as the front of the classroom. A podium in every classroom shall be anticipated, with a minimum of four data jacks and appropriate conduit or in-floor ducting should be installed for future use (as described below for a “Smart Classroom”).

Smart Classroom – a smart classroom is one equipped with a computer projection system and a podium. To avoid electromagnetic interference, electrical and communications cables shall be run separately to the podium. Three conduits with long radius sweeps shall be run to each podium, one conduit for electrical power, one 1” conduit dedicated to central data and telephone communications, and one 1 1/4” conduit run from the podium to the computer projector in the ceiling. The computer projector shall be centrally located below the room’s false ceiling with the wiring and conduit permanently attached to the ceiling structure. Every effort shall be made to run cables in or beneath the floor. In addition to the outlets for the podium, a minimum of one additional quad outlet, as described above for a general classroom, shall be installed in the front of the classroom. Electrical power shall also be run to the ceiling-mounted computer projection system. Classroom Support Services (CSS) shall be consulted to assess how many general assignment classrooms in each building might be converted into smart or networked classrooms. The building occupants shall be consulted to determine how many other classrooms, such as open and classroom laboratories, might be converted into smart classrooms.

Computer Laboratory or Networked Classroom – a computer laboratory or a networked classroom may have many computers in it and shall be provided liberally with data and power outlets mounted preferably along the walls. Drop-down conduits shall be avoided wherever possible in computer classrooms as they obstruct vision. The specific design shall be developed in consultation with the building occupant.
Note that electrical power outlets shall be provided in conjunction with data outlets and may require additional power to be run to electrical junction boxes and from there to the computer room. The amount of electrical power supplied to such rooms must be sufficient to accommodate a high density of computers. A podium in every classroom shall be anticipated and appropriate conduit or in-floor ducting shall be installed for current or future use. Classroom Support Services (CSS) shall be consulted to assess how many general assignment classrooms shall be made into networked classrooms, while the building occupants shall be consulted to determine how many other rooms shall be networked classrooms and/or computer laboratories.

Video connections from the fiber-optic receivers located in the IDF’s to the end user shall be accomplished using Belden RG-6 coaxial cable, 90% shield or better, run in a star configuration from the IDF to the podiums in every classroom/laboratory. Where a podium does not exist (e.g., a laboratory), the video connection shall be located at the front of the room. Video cables shall not be terminated (ACNS or Telecommunications will terminate the video cables) and pulled into a junction box provided with a blank faceplate. Sufficient slack (about 12 inches) shall be left on each end of the cable to terminate the video cables.

4. Grounding and Bonding

The telecommunications bonding backbone (TBB) shall be a copper conductor. The minimum TBB conductor size shall be a No. 6 AWG. The TBB should be sized at 2 kcmil per linear foot of conductor length up to a maximum size of 3/0 AWG. The TBB may be insulated. If the TBB is insulated, the insulation shall meet the fire ratings of its pathway. The sizing of the TBB is not intended to account for the reduction or control of electromagnetic interface.

<table>
<thead>
<tr>
<th>TBB length linear M (ft)</th>
<th>TBB Size (AWG)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 4 (13)</td>
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</tr>
<tr>
<td>4 – 6 (14 - 20)</td>
<td>4</td>
</tr>
<tr>
<td>6 – 8 (21 - 26)</td>
<td>3</td>
</tr>
<tr>
<td>8 – 10 (27 - 33)</td>
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</tr>
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<td>10 – 13 (34 – 41)</td>
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</tr>
<tr>
<td>13 – 16 (42 – 52)</td>
<td>1/0</td>
</tr>
<tr>
<td>16 – 20 (53 – 66)</td>
<td>2/0</td>
</tr>
<tr>
<td>&gt; 20 (66)</td>
<td>3/0</td>
</tr>
</tbody>
</table>

Table 7

Sizing of the TBB

TIA/EIA J-STD-607-A
5.4.4.1
Figure 2, below, depicts a typical grounding and bonding scheme for a multistory building. It is intended as a guide rather than explicit instructions.

**Figure 2**
**Building Ground**

Grounding and bonding shall be provided in the MDF in strict accordance with TIA/EIA J-STD-607-A-2002 standard, the most current edition NEC Article 250, and as a reference BICSI DD 120-Grounding Fundamentals for TELCO Facilities Chapter 4, Telecommunications System Grounding, and extended to all IDF’s as described therein. **All penetrations of the IDF envelope shall be fire-stopped.**
Chapter 4: Riser/Building Backbone Infrastructure

The building backbone cabling consists of fiber cable for data and video and copper cable for voice. These cables shall be run between the MDF to all the IDF’s in a star topology.

The infrastructure for the building backbone cabling shall consist of conduit between the MDF and each IDF’s where the run is vertical, or ladders racks (not hooks or rings) where the run is horizontal. Where conduits are run, separate conduits shall be used for copper cables (voice) and fiber cables (data and video). However, where runs are horizontal and ladder racks are used, both types of cables shall be run in a ladder rack.

EIA/TIA 569 shall be strictly observed for the building backbone pathways. Conduits shall be sized to be no more than 40% full by volume. Long-radius metal sweeps shall be used instead of 90° fittings. No more than 180 degrees of bends shall exist in conduits without inclusion of a readily accessible pull box, the location of which shall be clearly marked on drawings. In situations where cable tray, conduit,
or sleeves extend outside the MDF/IDF into occupied portions of the building, they shall be fire-stopped.

Both single-mode and 50-micron multimode fiber cable shall be run between the MDF and each IDF in a star configuration. At minimum, there shall be no less than six single-mode and six multimode fibers installed. A higher fiber optic pair count shall be permissible in consultation with Telecommunications. Fiber cables shall be run in interduct in conduits. The fiber count depends on the number of data jacks in each IDF. One pair of multimode fibers is required for every 48 active data jacks with a 30% allowance for growth. Each number shall be rounded up to the next integer. Table 8 below illustrates fiber counts for a variety of situations:

<table>
<thead>
<tr>
<th>Number of active data jacks</th>
<th>Base fiber count</th>
<th>30% allowance</th>
<th>Total fiber count</th>
</tr>
</thead>
<tbody>
<tr>
<td>96</td>
<td>2 pair</td>
<td>1 pair</td>
<td>3 pair</td>
</tr>
<tr>
<td>144</td>
<td>3 pair</td>
<td>1 pair</td>
<td>4 pair</td>
</tr>
<tr>
<td>240</td>
<td>5 pair</td>
<td>2 pair</td>
<td>7 pair</td>
</tr>
<tr>
<td>336</td>
<td>7 pair</td>
<td>3 pair</td>
<td>10 pair</td>
</tr>
</tbody>
</table>

Note that fiber bundles are available only in certain numbers of pairs. As an example, consider the example where bundles with 12 fibers (6 pairs) are used. For the second example above, 144 active jacks, one 12-count (6-pair) cable would be required. For the last example above, 336 active jacks, two 12-count cables would be required.

For video distribution, single-mode fiber shall be run in a star configuration between the MDF and all IDF’s. A separate fiber optic single-mode cable bundle shall be run in its own interduct for video distribution in addition to the 50-micron multimode fiber used for data transmission. However, both multimode and single-mode fiber can be run in the same conduit, each in its own interduct. Alternatively, a composite (single and multimode) bundle may be installed. Bundles shall typically consist of 12 strands of single-mode fiber.

Single-mode fiber shall be pre-tested with an Optical Time Domain Reflectometer (OTDR) at 1310 nm & 1550 nm, upon cable delivery.

Multimode fiber shall be tested post installation at 850 nm and 1300 nm.

A bidirectional end-to-end test shall be conducted at dual wavelength for each fiber installed.

Prior to acceptance by the University, the OTDR and end-to-end test shall be random sampled and retested by the University.
Test results shall be electronically documented and submitted to the University designated representative.

Cable ladder racks shall be hung in a manner that ensures a minimum of 12" vertical clearance and 18" horizontal clearance on at least one side to allow for sufficient access to the ladder rack for cable installation and maintenance. Mount cable ladder racks between 7 and 8 feet AFF (above the finished floor) so as to be accessible by cable handlers using standard 6-foot ladders. Transitions where changes in height are unavoidable shall be gradually sloping. The cable ladder rack shall be routed so as not to interfere with installation of other systems or access to those systems for maintenance. Coordination with other systems shall be maintained so that, where these systems traverse above or below the ladder rack, access shall not be blocked or interfered with. Cable ladder racks shall not pass through firewalls. Instead, the ladder rack shall stop on either side of the firewall and be interconnected via multiple 4" diameter conduits passing through the firewall. The bottom of these pass-through conduits shall be aligned with the top of the cable ladder to ensure proper cable support and unrestricted passage. These pass-through conduits shall be no more than 40% full.

Chapter 5: Building Entrance Infrastructure

1. General

At the University, telecommunications typically enter the building into the Main Distribution Frame or MDF. Thus, generally at the University, the Building Entrance and the MDF are one and the same.

EIA/TIA 569 shall be strictly observed for the building entrance. Underground conduits entering a building shall be dedicated for the exclusive use of Telecommunications and no more than 25% full by volume.

Telecommunications may request removal of unauthorized cable(s) within Telecommunication’s entrance conduits. Copper and fiber cables shall be brought into the building in separate conduit systems. No more than a total of 180 degrees of bends between pull points, using only large radius PVC conduit at rigid sweeps, shall exist in conduit runs between pulling points.

2. University Policy Governing Entrance Infrastructure

ACNS/Telecommunications must be contacted, refer to Table 1 – Contacts, during the early planning stages for new constructions or remodels that will require new or modification of entrance infrastructure.

Chapter 6: Outside Plant Infrastructure

1. Introduction and Project Conditions
The following specifications govern services contracted by Colorado State University (CSU). Contractors shall fully adhere to these specifications, unless the University designated representative authorizes a waiver or modification in writing.

The contractor shall be responsible for conducting all potholing and/or locates of all utilities along the prescribed route. The contractor is responsible for contacting UNCC at 811 or 1-800-922-1987. In addition, it is the contractor’s responsibility to ensure that all utilities are located including but not limited to CSU’s utilities. Facilities Management telephone number is 970-491-0099.

Locate and protect existing utilities and other underground work in a manner that will insure that no damage or service interruption will result from excavating and backfilling.

Protect property from damage that may result from excavating or backfilling.

Protect persons from injury at excavations by use of barricades, warnings, and illumination in accordance with common industry standards.

Excavations shall be coordinated with projected weather conditions to minimize washouts, settlements and delays to the project.

Provide temporary enclosures or coverings and heat, as necessary, to protect excavation work from freezing and frost.

The contractor shall be responsible for acquiring all relevant permits for street, alleys, easements, utility corridors, etc. from the City of Fort Collins.

When utilities are damaged, the contractor shall immediately contact CSU Telecommunications (970-491-5881) and CSU Facilities Management (970-491-0077).

The contractor agrees to remedy all defects identified by CSU during the final inspection of the contractor’s work. The scheduling of the remedies shall be approved by CSU. The contractor shall be responsible for obtaining a final work acceptance signature, from the University designated representative, on a mutually agreed upon "punch list" to indicate acceptance of the contractor’s work by CSU.

The contractor is responsible for adhering to all applicable industry and personal safety standards.

The contractor shall be responsible for providing an as-build drawing. Please refer to As-Builds page 7 for details. However, for outside plant infrastructure projects, the contractor in addition shall illustrate route(s), depth and benchmark measurements from existing landmarks and fixtures.
The contractor shall report on the progress of the work to the University designated representative on a mutually agreed-upon schedule.

2. Landscaping

When the Contractor (or its subcontractors) causes damage to shrubs and trees that have been designated to be protected, the Contractor shall be responsible for the cost of the replacement with a size as close as can be purchased. A pre-qualified contractor will accomplish selection and replacement with approval of CSU Grounds Department.

Landscape, shrubs, trees, lawn, soil conditions, etc. shall be returned to their original state prior to the completion of the work.

Soil shall be compacted at ninety-eight (98%) and shall require CSU inspection and approval.

CSU Property Only: If existing sod is damaged, grass turf removed shall be leveled and new sod replaced. Turf shall be maintained to promote growth until it has visibly taken hold and has been inspected and approved by CSU’s Ground Department.

3. Irrigation Systems

When the Contractor (or its subcontractors) cause damage to the turf and/or the sprinkler system beneath the turf at the work site, inside or outside of the construction limits, either by his actions or the necessity to shut off an area of the sprinkler system to accomplish the project, necessary repairs and renovation will be performed by a pre-qualified contractor. The Contractor shall be responsible for the costs associated with the repair of such damages. Contractor shall replace damaged turf with new sod of a quality and type that is acceptable to CSU. The Contractor shall coordinate watering of new sod with CSU Grounds Department.

The following are the Contractors responsibilities for the protection of the existing irrigation system prior to beginning actual work:

Fence off area around solenoid valves, shut-offs, and drains (visible fencing, not just stakes).

Flag all sprinklers in construction area.

Hand dig and expose mainline where excavation will occur.
The Contractor is responsible to pay for all necessary repairs to damaged irrigation systems.

All repair work performed must be completed by irrigation contractors on the pre-qualified list from CSU Facilities Management.

Contractor must insure immediate or same day repair of main line.

Contact CSU Grounds Maintenance immediately upon damage to main line, irrigation lines, sprinklers. CSU Grounds Maintenance will have final say as to the extent of damage and the remedy.

At excavation time, the Contractor shall:

Immediately upon cutting through irrigation line, cut and tape ends so dirt and debris does not enter into lines.

Backfill and tamp or puddle up to the level of irrigation line that will be repaired. After repair is completed, backfill to grade but do not tamp directly on top of irrigation line.

4. Field Location of Utilities

Locations of underground utilities shown on drawings are approximate and shall not be relied on for actual location. CSU Facilities Management shall verify all approximate locations.

Requests for CSU utility field locates must be made to Facilities Management Locate Personnel five (5) business days before excavation commences. Location will be furnished free of charge to the Contractor. Arrangements and scheduling for all field locations of utilities that belong to entities other than CSU are the responsibility of the Contractor.

Regulations regarding the accuracy of utility location marks are the applicable current state laws of Colorado.

Maintaining utility locate markings, once completed by CSU, is the Contractor’s responsibility.

5. Site Protection and Excavation
Excavation shall not proceed until work is ready to proceed without delay so that total time lapsed from excavation to completion of backfilling will be minimal.

NOTE: Site protection and excavation requirements, to the extent applicable, are valid for communication vault(s) installations.

Protect all existing development on site and on adjacent properties including existing trees, turf, soil, buildings, equipment, underground utilities, walls, fences, sidewalks, paving, curbs, etc. Trees are easily rendered hazardous by uncontrolled construction work around them. Any existing site development damaged by willful or negligent acts of the Contractor or any of his employees shall be replaced or repaired at no expense to the Owner and in a manner satisfactory to the Owner’s Representative before project acceptance is given.

Fencing: Four-foot red/orange plastic construction for fencing

Stakes: Metal T-posts, 5 to 7 feet long

Plywood: Sheets of 3/4" x 4'-0" x 8'-0"

Tree Protection: Prior to construction/excavation, all existing trees in or adjacent to construction area shall have a fence erected that protects the area within the drip-line of the tree. The drip-line is defined as the area on the ground covered by the spread of the branches.

Construction staging should take place in paved areas. If staging takes place within green space, a fence shall be erected around the boundary of the staging area, outside the drip-line of all trees.

No equipment or materials shall be parked or stored within the drip-line of any tree.

No stock piling of excavated soil may take place within the drip-line of existing trees.

Do not attach any signs to trees.

If there is limited space on the site, and passage beside a tree is necessary, a bridge is to be constructed over the root zone. Protect trunks of trees with 2" x 4" boards tied vertically around the trunk.

When raising or lowering the grade around an existing tree, a dry well or retaining wall is required.

Trenching should not be done within the drip-line of a tree. See Table 9 below for guidelines. If a trench cannot be routed around a tree, tunnel under it. Trenching and tunneling must be approved by Facilities Management Grounds Department. Trenching of more than 50% of the supporting roots will render the tree unstable.
When trenching occurs in an area containing tree roots, any severed roots must be cut smoothly with flush cuts and backfilled as soon as possible.

<table>
<thead>
<tr>
<th>Tree Size (Diameter in Inches)</th>
<th>Minimum Undisturbed Radius (From Trunk Face)</th>
<th>Minimum Depth of Tunnel/Bore</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 3”</td>
<td>3 feet</td>
<td>3 feet</td>
</tr>
<tr>
<td>3” through 8”</td>
<td>6 feet</td>
<td>3 feet</td>
</tr>
<tr>
<td>8.1” through 14”</td>
<td>8 feet</td>
<td>4 feet</td>
</tr>
<tr>
<td>14.1” through 20”</td>
<td>10 feet</td>
<td>4 feet</td>
</tr>
<tr>
<td>20.1” through 30”</td>
<td>15 feet</td>
<td>5 feet</td>
</tr>
<tr>
<td>30.1” through 40”</td>
<td>20 feet</td>
<td>5 feet</td>
</tr>
</tbody>
</table>

Sawcut existing concrete curbs, walks, flatwork and roadway asphalt as necessary to allow for excavation. Sawcuts shall be perpendicular or parallel to existing lines or joints. Remove existing concrete work back to nearest control joint as required.

All excavation shall be vertical-sided excavation to greatest extent possible except where otherwise indicated. Provide sheeting and cross-bracing to sustain sides of excavation where required. Remove sheeting and cross bracing wherever possible during backfilling such that removal will not endanger the work or other property. Where sheeting and cross bracings are not removed, cut sheeting off at sufficient distance below finished grade to not interfere with other work.

Conduit ductbank trenches shall be excavated to the dimensions shown on the drawings unless larger clearance is required for proper installation of joints and fittings. Excavation for other work shall provide not less than the minimum practical but adequate working clearances.

Excavation for work to be directly supported on undisturbed soil shall not extend beyond indicated depths, and hand excavation shall cut bottom to accurate elevations. Unless otherwise noted, support cast in pace concrete on undisturbed soil at bottom of excavations.

Where unsatisfactory soil conditions exist at bottom of indicated excavation, excavate additional depth to reach a satisfactory soil bearing condition. Backfill the excavation with sub-base material and compact to the excavation depth.

Excavation near trees and shrubbery shall be done by hand. Protect root systems from damage and/or dryout to greatest extent possible. Cover exposed roots with burlap and maintain moist condition for root systems.

Excavated material from beneath pavement or concrete areas shall be removed from the site.
Excavated material shall be temporarily stored near excavation in such a manner not to interfere with or damage excavation or other work. Do not store under trees.

Excavated material that complies with requirements for backfill material shall be retained for that use.

Excavated material, which does not comply with requirements for backfill material or is in excess of quantity needed, shall be disposed of. Remove unused material from project site and dispose of in a lawful manner.

Where required by conditions, remove water to maintain dry excavating. Protect excavations from inflow of surface water. Minor inflows of ground water shall be pumped from excavations. Installing temporary sheeting and waterproofing shall protect excavations from major inflows of ground water. Adequate barriers shall be provided to protect other excavations and below-grade property from being damaged by water, sediment or erosion from or through electrical work excavations.

Install and operate well-point de-watering system to maintain ground water at level approximately 2'-0” below electrical work excavations until backfilling of electrical work is completed.

6. **Excavation Backfill**

Subbase materials shall be a graded mixture of gravel, sand or crushed stone.

Where required, finely graded subbase material shall be well-graded sand, gravel or crushed stone with 100% passing a 3/8” sieve.

Backfill material for landscaped areas shall be soil material suitable for compacting to required densities. Material shall comply with AASHTO Designation M145, Group A-1, A-2-4, A-2-5, or A-3. Reuse of original material is acceptable but with 100% passing a 3/8” sieve.

Backfill material for paved areas or beneath concrete work shall be “FlowFill” material meeting the following requirements:

- **Cement:** Type I or II
- **Fly Ash:** Class C

The fine aggregate for flowable motor backfill shall be a fine sand that will stay in suspension in the flowable mortar backfill to the extent required for proper flow. Uniformly graded sand in the following gradation range has generally shown good
flow characteristics when using the normal amount of fly ash (300 pounds per cubic yard).

<table>
<thead>
<tr>
<th>Table 10</th>
<th>Sand Gradation Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sieve Size</td>
<td>Percent Passing</td>
</tr>
<tr>
<td>3/8”</td>
<td>100%</td>
</tr>
<tr>
<td>No. 8</td>
<td>90 - 100%</td>
</tr>
<tr>
<td>No. 16</td>
<td>60 - 100%</td>
</tr>
<tr>
<td>No. 30</td>
<td>45 – 80%</td>
</tr>
<tr>
<td>No. 50</td>
<td>12 – 50%</td>
</tr>
<tr>
<td>No. 100</td>
<td>5 – 25%</td>
</tr>
</tbody>
</table>

The flowable mortar backfill material shall be tested for fluidity prior to incorporation into the work. The Engineer may accept the results of a testing laboratory, or samples may be submitted for fluidity testing. The Engineer prior to incorporation into the work shall approve the mix design.

Mix Design: The mix design for flowable mortar backfill is as follows:

<table>
<thead>
<tr>
<th>Table 11</th>
<th>Approximate Quantity of Dry Materials Per Cubic Yard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement</td>
<td>100 pounds</td>
</tr>
<tr>
<td>Fly Ash</td>
<td>300 pounds</td>
</tr>
<tr>
<td>Fine Aggregate</td>
<td>2,600 pounds</td>
</tr>
</tbody>
</table>

These quantities of dry materials, with approximately 70 gallons of water, will yield approximately one cubic yard of flowable mortar backfill material of the proper consistency. The quantity of water used for the trial mix or at the project may require adjustment to achieve proper solids suspension and optimum flow-ability. Fine aggregate and water may be adjusted to achieve required fluidity and yield.

Mixing: The flowable mortar backfill material shall be completely mixed in a central mix plant, truck mixers, or stationary mixers. The flowable mortar backfill material shall be delivered to the job in a truck mixer, and the truck mixer shall remix the material for a minimum of 20 revolutions of the mixing drum at mixing speed at the job site prior to discharge. When water is added to the delivery site, the flowable mortar backfill material shall be mixed for not less than 20 revolutions of the mixer drum at mixing speed before discharge.

Fluidity: The fluidity of the flowable mortar backfill material shall be measured by ASTM designation C939.
Drainage fill material shall be washed and uniformly graded gravel or crushed stone with 100% passing a 1-1/2" sieve and not more than 5% passing a No. 4 sieve.

Subbase material for communications shall be installed where required and compacted by tamping to form a firm base for the communications work.

Unless noted otherwise, backfilling shall be as follows:

Backfill with properly qualified and graded material.

Electrical work shall be backfilled and compacted to elevations that match adjacent grades.

Backfill material shall be conditioned as necessary to facilitate compaction to required densities by either drying or adding water uniformly. Use of frozen soil material for backfilling will not be permitted.

Communications work shall be simultaneously backfilled on opposite sides and compacted simultaneously. Backfilling and compacting shall not dislocate existing utilities from its installed location.

Excavations shall be backfilled in courses 8" high of backfill materials and uniformly compacted to 95% density, using power-driven hand-operated compaction equipment. Densities listed shall be a percentage of maximum density per ASTM D 1557. Provide documentation that specifies densities have been obtained.

Installations Conditions For FlowFill Backfill:

The flowable mortar backfill material temperature shall be between 50°F and 90°F at the time of placement and shall not be placed on frozen ground.

When ambient air temperature is below 35°F, the Contractor shall maintain the flowable mortar backfill surface temperate above 50°F during the curing period.

The minimum curing period shall be three days.

Each filling state of the flowable mortar backfill material shall be as continuous an operation as practical.

Vibrate flowable mortar backfill to remove voids and large air pockets. Do not over vibrate.

Repair and/or replace removed concrete walk, gutter, or other flatwork to match existing undisturbed condition.
Repair and/or replace removed asphalt using hot patch asphalt paving to original
grade and compaction.

7. Directional Boring Specifications

a. Materials

Installed two-inch (2") inner duct, quantity to be determined.

The inner duct shall have a No. 12 UF type tracer wire installed outside the duct
along the entire path of the duct. The University representative shall approve any
deviation.

Conduit shall only have virgin (new) 2400 lb. Sequential Mule Tape, supplied and
installed by the contractor, in each duct without knots and splices. The mule tape
shall be exposed at least six feet (6’) for aiding in tying on to cable. POLYROPE
SHALL NOT BE ACCEPTED WITHIN THE DUCT.

b. Installation

The inner duct shall be installed a minimum of forty-eight inches (48") in depth.

The inner duct shall have a gradual 2” sweep into the J-box or a location marked
by CSU prior to start of work (e.g., manhole).

The inner ducts shall have duct plugs installed and secured around cable to
prevent any debris from entering the conduit.

All vacant inner ducts shall have a duct plug installed and secured.

Building Entrance Only: Inner ducts exposed on the exterior of a building shall
have installed metallic or PVC fittings to National Electrical Code (NEC)
specifications attached for building entry conduit and approved by CSU. Plenum
and non-plenum areas may require additional consideration.

Splices, where applicable, shall be dug to the depth of the bore and be in a
straight line with the two (2) adjoining bores.

c. Manholes

Manholes shall be pumped and cleaned before and after work is completed.

Manholes shall have sufficient racking drilled and mounted for cable attachment
and service coil support. CSU shall be consulted for determination of service coil
length and racking requirements.
Inner duct entering through the manhole or concrete foundations shall be link sealed.

d. Traffic Control

The contractor shall be responsible for providing traffic control commensurate with the requirements of the work it is conducting, and adheres to all municipal, State, and Federal guidelines and standards.

e. Sanitation

Contractors working on CSU property must arrange for sanitary facilities (e.g., portable toilets) adequate to service the requirements of their employees.

8. Trenching

a. Materials

The contractor shall coordinate with the Telecommunications contact. The Telecommunications contact shall specify and approve the vault(s) for each project.

The contractor shall install a four-inch (4") Yellow Caution Tape labeled “Caution" twelve inches (12") from the bottom of the trench.

Conduit duct shall have a No. 12 UF type tracer wire installed outside the conduit. The Telecommunications contact shall approve any deviation.

Conduit shall have only virgin (new) 2400 lb. Sequential Mule Tape, supplied and installed by the contractor, in each duct without knots and splices. The mule tape shall be exposed at least six feet (6’) for aiding in tying on to cable. POLYROPE SHALL NOT BE ACCEPTED WITHIN THE DUCT.

b. Installation of Conduit and Vault

The contractor shall trench a forty-eight inch (48") path from grade along the entire route.

All conduits shall be installed a minimum of forty-eight inches (48") in depth. When PVC conduit is placed in a trench, PVC coated GRC large radius sweeps shall be use or fiberglass large radius sweeps.

Contractor shall ensure that the integrity of the vault is retained throughout its installation. To the extend necessary, the contractor shall internally brace the vault to ensure its integrity throughout installation and soil compaction. Also refer to Chapter 6 Section 6 – Excavation Backfill for more details.
Each newly installed or reinstalled vault shall be excavated two feet (2’) deeper in order to accommodate for two feet (2’) of rock to bring the vault to grade and maintain adequate drainage.

Each newly installed or reinstalled vault shall have a 3M 1401 – XR 4” Ball Marker installed inside the vault.

**Vaults shall NOT be drilled or penetrated.**

Vaults shall be sized to neatly accommodate copper and/or fiber optic cables and service coils.

Conduits shall gradually sweep in below the bottom of the fiberglass vaults.

Ducts shall have duct plugs installed and secured around cable to prevent any debris from entering the conduit.

c. Landscaping

Refer to Chapter 6, Section 5 - Site Protection and Excavation.

d. Traffic

The contractor shall be responsible for providing traffic control commensurate with the requirements of the work it is conducting, and adheres to all municipal, State, and Federal guidelines and standards.

e. Sanitation

Contractors working on CSU property must arrange for sanitary facilities (e.g., portable toilets) adequate to service the requirements of their employees.

9. **Steam Tunnel Cable Installation**

a. Entry

The CSU Heating Plant must be contacted to schedule work prior to commencing any work in the University steam tunnels. The Heating Plan shall also be advised of LOCATION, TIME, AND WHO shall be conducting the work.

b. Safety

All entry areas shall be barricaded and identified with caution flagging. Policy requires that a person shall be above the tunnel at each entry/exit area with a
radio or other means of directly communicating with the person or persons in the tunnel.

Contractor vehicles shall be clearly marked and in designated parking areas approved by CSU Parking Management prior to the beginning of any work.

c. Installation

The predetermined and approved route shall have lead or stainless anchors drilled every three feet (3’) and secured with one bolt support and mounted with plated bolts and washers to secure duct to concrete walls.

The conduit shall be Green, HDPE, heat resistant type PVC installed to a predetermined location approved by CSU during site walkthrough. Penetration through the stream tunnel walls must be also pre-approved by CSU.

Conduit identification labels are required every 20 feet (20’) along the entire conduit path.

Conduits shall not be located in a fashion that will congest or block other utilities in the tunnel. CSU may, at its discretion, require the contractor to reroute duct affecting other utilities or unreasonably congesting the tunnel.

Multiple ducts shall be strapped in parallel (no twisting or wrapping around existing ducts or structures) with stainless steel hose clamps sized in accordance with the duct count to be installed.

Conduit shall have only virgin (new) a 2400 lbs. Sequential Mule Tape installed for the length of the duct. The mule tape shall be exposed at least six feet (6’) for aiding in tying on to cable. POLYROPE SHALL NOT BE ACCEPTED WITHIN THE DUCT.

Steam tunnel to outside transitions shall be installed to National Electrical Code (NEC) specifications and gradual PVC or EMT sweeps attached and sized to the in accordance to the Scope of Work.

Cores and/or penetrations through the steam tunnel walls shall be drilled perpendicular to the wall or at the same direction angle the conduit exits the tunnel. These cores/penetrations shall be sealed/link sealed.

d. Traffic

The contractor shall be responsible for providing traffic control commensurate with the requirements of the work it is conducting, and adheres to all municipal, State, and Federal guidelines and standards.
e. Sanitation

Contractors working on CSU property must arrange for sanitary facilities (e.g., portable toilets) adequate to service the requirements of their employees.

Chapter 7 Network and Television Hardware

Buildings shall be supplied with a building data switch and sufficient edge switches to provide network access to current users. Edge switches are to be the 10/100 Ethernet auto-sensing device type. In general, a 70% activation rate is to be assumed, that is a 30% allowance shall be made for ports that are not initially activated. Switches provide additional network security and much higher performance bringing the network up to campus standards. ACNS is responsible for contacting the building occupants in this regard.

**ACNS shall be responsible for specifying the specific brand and model for network equipment.** Using this standard equipment will ensure that the network equipment is compatible with campus backbone network equipment. Indeed, this is the only way to ensure that performance, advanced features such as Quality of Service (QoS), multicast, security, and manageability, will exist and interoperate with campus networking infrastructure.

A fiber optic television splitter shall be provided in the MDF for video distribution to the IDF's. Each IDF shall have its own fiber optic splitter and coaxial splitters.

**NOTE:** Network electronic (ACNS) and video equipment specifications shall be respectively provided on a case-by-case basis to ensure that the latest technology and lowest price is applied to the project.

Please refer to **Table 1 Contacts** on page 3 for appropriate ACNS contacts.

Chapter 8 Wireless Network

**To be completed**

Chapter 9 Emergency and Inter/Intra Building Life and Safety Infrastructure

Colorado State University has contracted with Rave Wireless for Rave Alert. Rave Alert is an emergency text notification service that delivers emergency notification to subscriber's cellular devices. Emergency text notifications will be composed by CSU emergency/police and/or public relations personnel in case of an emergency on campus and/or an outside event that affects the campus community. Rave Alert is an optional subscription service for registered students and faculty and staff.