SECTION 27 05 43 – OUTSIDE PLANT FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 REFERENCES

A. General provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections.

B. Architectural, Electrical, and Technology Drawings. Other systems drawings may apply. Division 26 Basic Electrical Materials and Methods sections apply to work in this section.

1.2 SUMMARY

A. This section describes the codes, standards, specifications, recommendations, and practices required for outside plant (OSP) construction at The University of Colorado Denver | Anschutz Medical Campus for the Office of Information Technology (OIT) department. Section 27 05 43 applies to all OIT outside plant projects at all university campuses.
   1. University OSP should be designed to facilitate a 75 year lifespan.

B. The project general contractor (GC) is responsible for building OSP pathways and spaces as per the requirements described in this standard. OIT is responsible, through its contractor, for providing copper and fiber media placed in the OSP pathways and spaces.

C. Submit corrections, comments, questions, or omissions about this OSP standard to the OIT department via the university project manager.

D. Planning.
   1. To facilitate expansion of telecommunications services via OSP pathways and spaces, provide OIT with floor plan drawings for new building construction and major renovation projects during design and at construction. Provide CAD drawings of the Electrical/Communications plans to OIT upon release of construction document through the university project manager. These documents will serve as a baseline for OSP build out and expansion.
   2. The preliminary plans, indicating service locations and space requirements, will be returned to project managers for inclusion in the final plans.

E. Consult with OIT for the following.
   1. Acceptability for specific substitutions of specified products.
   2. Guidance in the application of a standard or specification in a non-listed or design situation.
   3. Approval for deviation from standards and specifications or industry-standard methods and procedures if indicated by special circumstances.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of contract and Division 1 Specification Section.

B. Product Data for the following products:
   1. Maintenance holes and fittings.
   2. Hand holds and fittings.
   3. Conduits and fittings.

C. Installation Instructions: Manufacturer’s written installation instructions for maintenance holes, hand holes, and underground conduits and associated products.

1.4 QUALITY ASSURANCE

A. The following list of codes, standards, specifications, recommendations, and methods and procedures are applicable to the provisioning of OSP at the university. They are incorporated by reference. The most current version is referenced.

1.	NFPA 70	National Electric Code (NEC) (2008)
2.	IEEE C2	National Electric Safety Code (NESC)
3.	TIA/EIA−606	Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
4.	J−STD−607	Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
5.	TIA/EIA−758	Customer−Owned Outside Plant Telecommunications Cabling Standard
6.	BICSI	Telecommunications Distribution Methods Manual (TDMM), 11th Ed.; Network Design Reference Manual, 5th Ed.; Customer-Owned Outside Plant Design Manual 3rd Ed.; Wireless Design Reference Manual, 2nd Ed; Electronic Safety and Security Design Reference Manual, 1st Ed.; AV Design Reference Manual, 1st Ed.
7.	OSHA	Standard 29 CFR 1910.268

1.5 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

1.6 SEQUENCING AND SCHEDULING

A. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

1.7 PROJECT SITE CONDITIONS

A. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

1.8 WARRANTY

A. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

1.9 SPECIFICATION RESPONSE

A. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

1.10 DEFINITIONS

A. Telecommunications. Any transmission, emission, or reception of signs, signals, writings, images, and sounds, or information of any nature by wire, radio, visual, or other electromagnetic systems. Includes, but is not limited to, voice communications networks, Local Area Networks (LAN), Wide Area Networks (WAN), and Local Exchange Carriers (LEC).

B. OSP Spaces. Consists of maintenance holes (MH), handholes (HH), pedestals, cabinets, and vaults. MHs are used as access points for pulling and splicing cables. HHs are smaller than MH and are used for pulling cables. HHs do not typically serve as splice points. Pedestals provide access to smaller splices, interconnects, and cables. Cabinets are used as cross-connects for aerial and direct buried solutions. Vaults provide environmentally protected spaces either above grade or below grade.

C. OSP Pathways. Pathways are the conduits that interlink OSP spaces and end points such as buildings. Pathways can be underground or direct buried infrastructure. The third OSP pathway method, aerial pathways, is not used on campus.

D. Telecommunications Entrance Facility (TEF). Serves as the entry point into a building for the campus backbone media. TEFs interconnect the building backbone to campus backbone. The TEF is where conductive copper media receives it primary protection from sustained hazardous voltages. Also called the Service Entrance (SE).

E. OSP media. Copper and fiber optic media placed in the OSP pathways to link structures back to the campus core. These materials are typically placed by OIT or their approved contractor.

F. Campus backbone. The pathways and media that provides connectivity between buildings.

G. Office of Information Technology (OIT). University department responsible for telecommunications on the University of Colorado Denver | Anschutz Medical Campus (the university) campuses.

H. Outside Plant (OSP). The pathways, spaces, and media that provide telecommunications between buildings. OSP is used to support voice, data, video, electronic security, building automation systems, fire, life, and safety systems, and other low voltage systems, as they evolve.

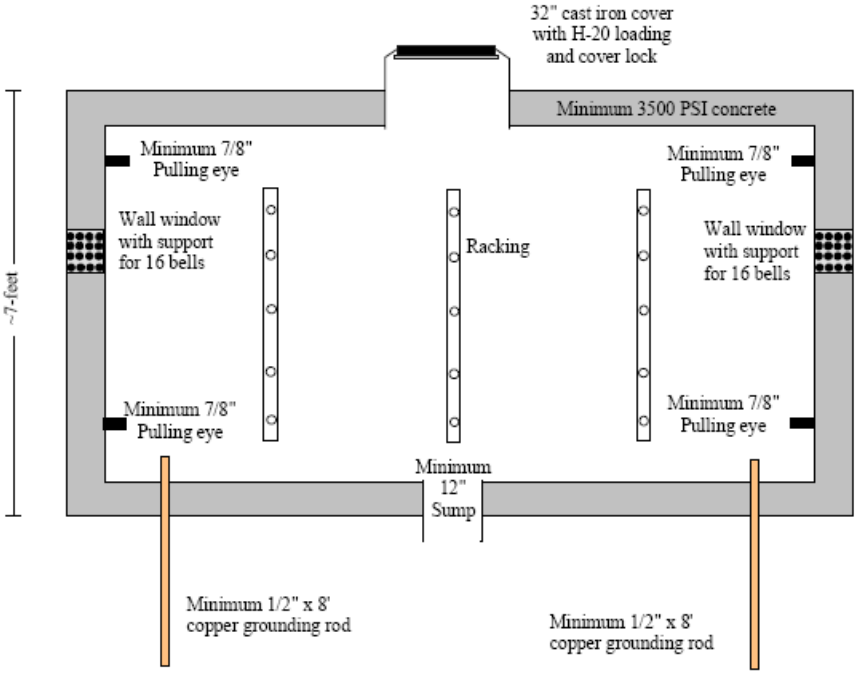
I. OSP Consultant. A firm or member of a firm that has considerable technology and OSP design experience and possesses working knowledge and subject matter expertise in telecommunications code (NEC and NESC), industry standards (see TIA/EIA standards in references), and BICSI methods and procedures (Telecommunications Distribution Methods Manual and Customer-Owned Outside Plant Design Manual).
    1. OIT maintains a list of pre-screened technology consultants that can be obtained from the university project manager via OIT.
    2. Select technology consultants for the university projects from the pre-screened technology consultant list.
    3. Technology consultants not listed on the pre-screened technology consultant list must meet with OIT for certification and possible inclusion on the list. Firms vying for campus technology consultant designation must possess a registered communication distribution designer (RCDD) with outside plant (OSP) certification on staff. The RCDD/OSP must be thoroughly familiar with campus standards and methods and procedures and be dedicated to the assigned project. Contact the OIT Director of Operations (303.724.3443) for possible interview times.

PART 2 - GENERAL

2.1 OSP DESIGN SPECIFICATIONS AND CONSTRUCTION REQUIREMENTS

A. OSP Trunk (backbone) Spaces.
    1. Maintenance Hole (MH).
        a. General description.
            1) MHs are concrete enclosures with a removable lid that permits internal access. MHs house splice closures, racking, a grounding and bonding system, drainage, sump, cabling, and other components. MHs are used to facilitate placement of fiber and copper cables. MHs are considered confined spaces.
        b. Safety.
            1) MHs are considered confined spaces containing possible hazardous atmospheres such as flammable, explosive, asphyxiating, or toxic environments. Prior to entry, check all MHs for hazardous atmosphere conditions. Mitigate all conditions found. Ensure the MH area is free of other hazards such as engulfing, immersion, entrapment, auto emissions, etc. MHs on or near roadways require traffic control, signage, and safety cones to prevent vehicular accidents. Two-person crews are required when entering campus MHs.
        c. Joint use.
            1) Joint use of OIT MHs is prohibited. OIT MHs are not shared with other utilities except those needed to directly service OIT requirements.
        d. Material.

1) Precast concrete MHs are preferred. These ASTM standards apply ASTM C 478, ASTM C 857, ASTM C 858, ASTM C 891, and ASTM C 1037. Precast MH vendors include Amcor and Vaughn Concrete Products, among others. Place MH on a minimum 12" bed of gravel, sand, or squeegee (pea-sized gravel mixed with sand).



e. Conduit run length.
   1) The maximum conduit run length between campus MHs is 600'.

f. Physical placement.
   1) Place MHs out of roadways, if possible. MHs shall not be placed within 50' of the curb radius of intersecting roads. The desired location for MH location is under sidewalks paralleling campus roads. MHs are placed to provide convenient telecommunications access to buildings.

g. Sizing.
   1) Campus MHs are 10' wide x 10' long x 7' high.

h. Loading.
   1) H-20 loading or better desired. Minimum concrete strength is 3500 PSI. Higher loading strength may be required depending upon MH placement locale.

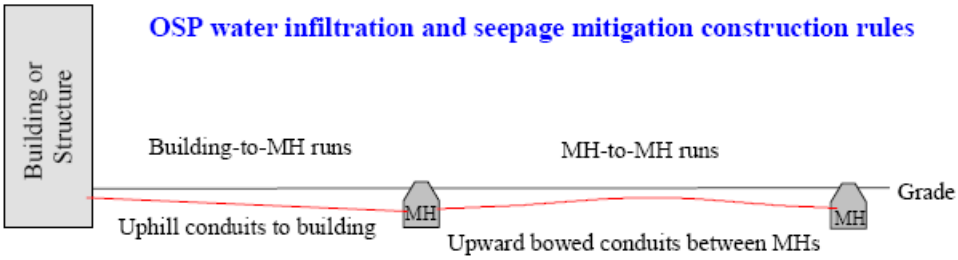
i. Orientation.
   1) Place MHs so their four walls are oriented north-south and east-west.

j. Windows.
   1) Place MH windows in each wall capable of supporting 16 bells. All four walls and windows may support cable placement.

k. Equipment.
   1) Equip all MHs with a cast iron 32" cover, minimum 12" sump, corrosion-resistant pulling irons with minimum 7/8" pulling eyes, grounded cable racks (if metallic), grounding and bonding system, and a fixed ladder. MH copper grounding rods shall be a minimum ½" in diameter by 8' in length. Bond and ground all metallic parts to the grounding rod with a minimum 6-AWG green insulated conductor.

l. Water infiltration and seepage mitigation.
   1) Seal MH bells to preclude water infiltration and seepage. Sump pumps may be specified to mitigate unusual conditions. Place MH-to-building underground

conduit runs uphill so that water infiltration and seepage flows to the MH, as shown in the sketch below. A minimum drain slope of 12.5" per 100' is required when extending conduits away from building structures. Bow MH-to-MH conduit runs upwards to preclude MH-to-MH water infiltration and seepage, as illustrated below. A minimum drain slope of 12.5" per 100' shall extend from the middle of the span to each MH.



m. MH designator.
   1) OIT will assign campus MHs a letter and number designator.

n. Opening.
   1) Each MH shall have a single opening, given their 10' x 10' x 7' dimensions.

o. Covers.
   1) MH covers shall be 32" in diameter. Covers larger than 32" may be needed on occasion. Covers larger than 32" diameter shall be approved by OIT prior to placement. If larger covers are required, they shall be 38" in diameter, if approved by OIT. The 38" cover, if approved, shall also have a reducer cover for easier access and removal.

p. Cover labeling.
   1) All campus OIT MH covers shall be permanently labeled "COMMUNICATIONS".

q. Cover material.
   1) Cast iron covers are required.

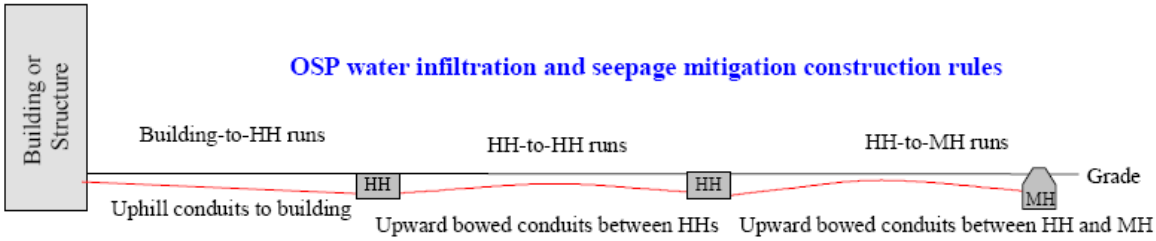
r. Cover loading.
   1) MH covers shall be rated for the expected dynamic and static loads, typically H-20 or better.

s. Cover locks.
   1) MH covers shall include a lock, as specified by OIT. The locking cover shall use the university registered key.

t. Cover lock signage.
   1) All cover locks shall be labeled to show owner and contact number, as illustrated below.

u. Flush mounted covers.
   1) Place MH covers so they are flush with road surfaces, sidewalks, or the grade.
v. Documentation.
   1) Deliver As-builts of the MH OSP system to OIT, in the prescribed format and media.

2. Hand Hole (HH).
   a. General description.
      1) HHs facilitate placing of cables in a conduit system. HHs shall not be used in place of a MH or in the main campus conduit system. HHs support connections to the campus conduit system. HHs shall not be used for splicing cables together.
   b. Joint Use.
      1) Joint use of OIT HHs is prohibited. OIT HHs are not shared with other utilities except those needed to directly service OIT requirements.
   c. Placement.
      1) HHs are placed when the bends exceed two 90-degree bends or a total of 180-degrees. HHs are also placed when the secondary, in-tract run length exceeds 200' to the main campus backbone conduit system or other pathway. HHs are placed out of roads and other heavy load areas.
   d. Sizing.
      1) HHs shall not exceed 4' in length by 4' in width by 4' in depth.
   e. Conduits supported.
      1) HHs shall not house more than four 4" Trade Size 4 conduits, except as authorized by OIT.
   f. Covers.
      1) HH covers shall be of about the same size as the HH and rated for the expected load.
   g. Water infiltration and seepage mitigation.
      1) Seal HH conduit bells to preclude water infiltration and seepage. Place HH-to-building underground conduit runs uphill so that water infiltration and seepage flows to the HH, as shown in the sketch below. A minimum drain slope of 12.5" per 100' is required when extending conduits away from building structures. HH-to-HH or HH-to-MH conduit runs shall be bowed upwards to preclude HH-to-HH or HH-to-MH water infiltration and seepage, as illustrated below. A minimum drain slope of 12.5" per 100' shall extend from the middle of the span to each HH. HHs shall have provisions for drainage such as an open bottom, drain holes, sump-hole, etc. HHs shall be placed on a 12" bed of gravel, sand, or squeegee.



h. HH designator.
1) Campus HHs shall be assigned a three-letter and number designator by OIT (NAC1 for example). The HH designation letters are associated with the project the HH is supporting.

i. Documentation.
1) Deliver As-builts of the HH OSP system to OIT, in the prescribed format and media.

3. Pedestals.
a. General description.
1) Pedestals house splice closures and terminals. A BD3 primary distribution pedestal housing a 50-pair cable and a 100-pair splice is the largest pedestal permitted on campus.

b. Limited use.
1) Pedestals may be used to support temporary structures such as construction trailers.

c. Mounting.
1) Pedestal may be mounted on concrete pads or directly on the ground.

d. Security.
1) Pedestals shall be secured via hasp or padlock, as stipulated by OIT.

e. Cables supported.
1) Pedestals shall not house more than 4 cables.

4. Cabinets.
a. Cabinets are not used in campus backbone OSP infrastructure.

5. Vaults.
a. Vaults are not used in campus backbone OSP infrastructure.

B. OSP Trunk (backbone) Pathways.
1. Underground conduits.
a. General description.
1) Underground conduits are the required pathway in main campus conduit system runs, also known as the IT campus backbone.

b. Material.
1) Construct underground conduits of Rigid Nonmetallic Conduit Schedule 40.
2) Use Trade Size 4, 4” conduits, OIT shall specify the number of conduits to be placed in each run.
a) For planning purposes, OSP backbone pathways should range in capacity from 8 to 16 Trade Size 4, 4” conduits.

c. Innerduct.
1) OIT may specify Carlon Multi-Gard multiple cell PVC in lieu of innerduct installed in Schedule 40 conduits. Carlon Multi-Gard PVC Type C, Schedule 40 outer shell with four 1.25” multiple cells (innerduct maximum inside diameter is 1.19” and the maximum outside diameter is 1.31”) is the standard prefabricated innerduct used on campus, as illustrated in the picture.
2) OIT may alternately specify Maxcell Innerducts in lieu of Carlon Multi-Gard. Each Trade Size 4 conduit shall have two (2) 4” 3-cell Maxcell Innerducts placed in it, as specified by OIT. Maxcell Innerducts are factory lubricated and have pull tapes are pre-installed.

d. Length.

1) No section of underground conduit shall exceed 600' between pulling points (i.e. MH or HH).

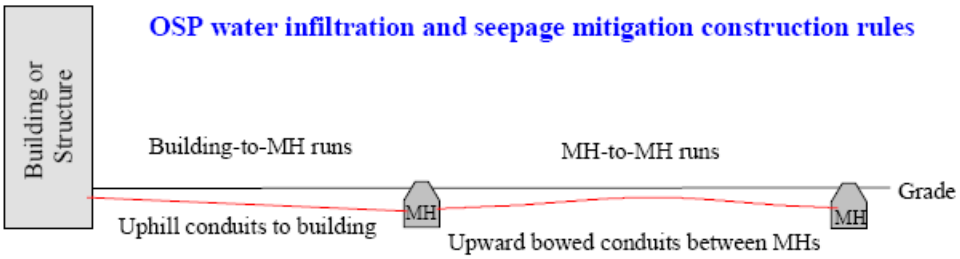
e. Depth.
1) Place the tops of underground conduits a minimum of 48" below grade.

f. Loading.
1) Construct Underground conduits to dissipate H-20 static or dynamic loads.

g. Electrical underground clearances.
1) The minimum clearance between electrical conduits and underground IT conduits is 12" of well-tamped earth or 3" of concrete.

h. Foreign structure underground clearances.
1) The minimum clearance for parallel underground foreign structures such as gas, oil, or water pipelines is 12" of well-tamped earth. The minimum clearance for crossing underground foreign structures is 6" of well-tamped earth.

i. Water infiltration and seepage mitigation.
1) Place MH- or HH-to-building underground conduit runs uphill so that water infiltration and seepage flows to the MH or HH, as shown in the sketch below. That is, all conduits entering a building shall be pitched to drain away from the building. A minimum drain slope of 12.5" per 100' (0.125 inch per foot) is required when extending conduits away from building structures. Bow MH-to-MH conduit runs upwards to preclude MH-to-MH water infiltration and seepage, as illustrated below. A minimum drain slope of 12.5" per 100' shall extend from the middle of the span to each MH. Conduits entering a window's bell shall also be compound sealed.



j. Vacant conduit sealing.
1) Seal vacant conduits with duct plugs at all MHs, HHs, and building entrance points to preclude water infiltration and seepage. Provide adjustable duct plugs with a metal base and a screw-type expandable outer rubber surface.

k. Bends.
1) There shall be no more than the equivalent of two 90-degree bends, or 180-degrees total, between pulling points, including kicks (a pipe bend of less than 45-degrees made to change the pipe's direction) and offsets (two mirror-image bends made to avoid an obstruction). Use manufactured bends where possible. Back-to-back 90-degree bends placed closer together than 10' shall be avoided.

l. Sweeps.
1) Sweeps are preferred to 90-degree bends. Trade Size 4, 4" conduit sweeps should possess a minimum 48" bend radius.

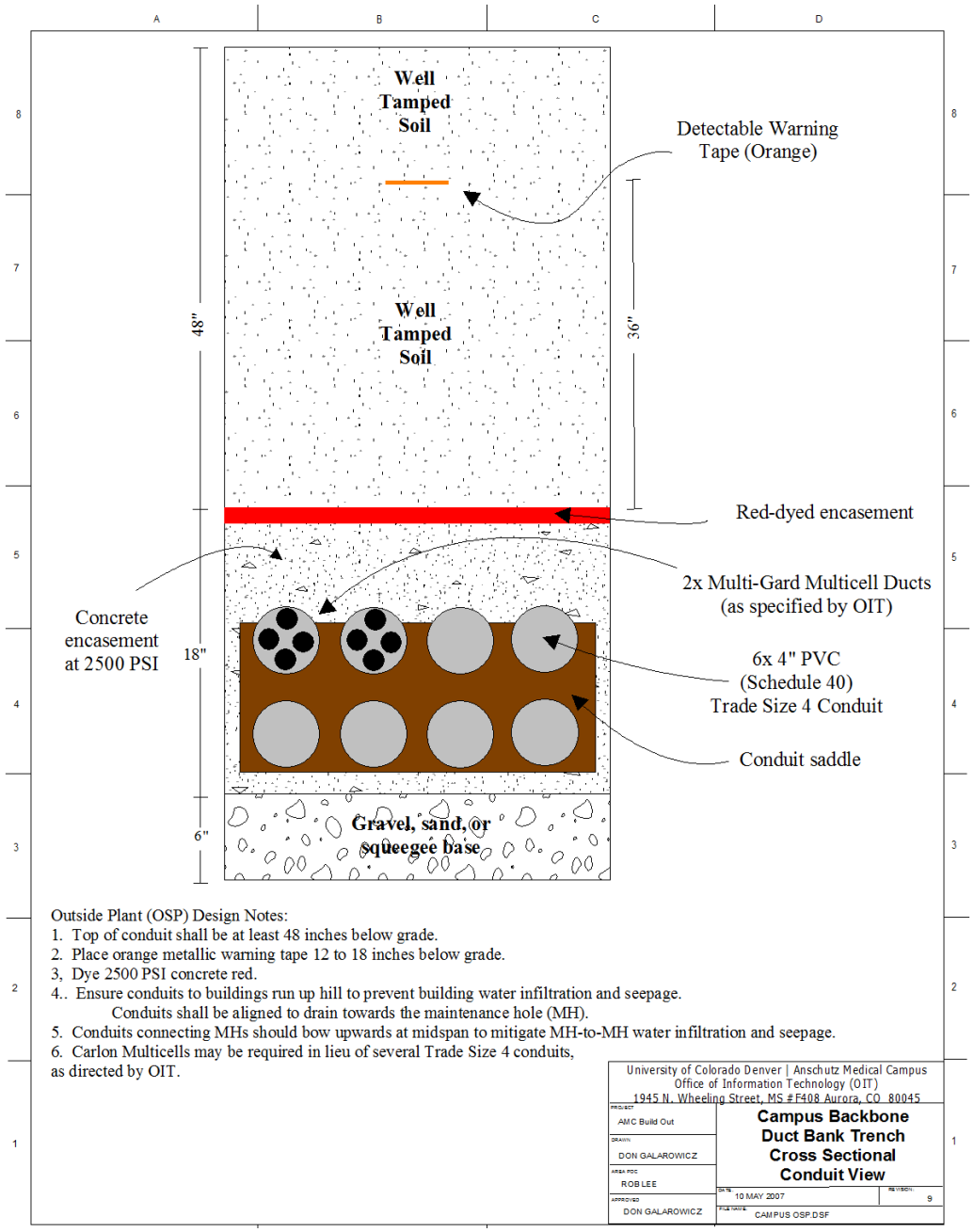
m. Diverts.
1) Limit the maximum divert or change in direction in any plane between lengths of straight rigid conduit without the use of bends or sweeps to 5 degrees.

n. Pulling tape.
1) Equip each underground conduit with a minimum 3/8" diameter pulling tape, rope, or strap with a rated tensile strength meeting or exceeding 2500 pounds. Pull rope tails of a minimum of 36" shall be secured at the end of each conduit.

o. Measuring tape.
1) Provide a pre-lubricated conduit measuring tape in at least one conduit in every run. The conduit measuring tape shall be waterproof with permanent printed footage.

p. Encasement.

1) Encase all underground conduits in minimum 2500 PSI concrete with #4 rebar run parallel with the conduit on all four corners. Minimum thickness of the concrete encasement top shall be 4 inches. Permanently dye the concrete encasement orange or red. A typical main campus conduit system run (campus backbone) is shown below.



q. Warning tape.
1) Place orange detectable warning tape within 12” to 18” of the surface for the length of the underground conduit run.

r. Conduit supports.
1) Pre-manufactured conduit support saddles/seats are required. Allow a minimum of 2” between conduits and a minimum of 3” of perimeter concrete encasement.

Saddle supports shall be interlocked and placed a minimum of every 5' along the entire run. The conduits shall be staked down at each saddle and #3 crossties installed.

s. Soil compaction.
1) After encasement, backfill the trench with native soil in lifts no greater than 12". Mechanically compact the replaced soil by tamping so as to maintain a minimum relative density of 95 percent, which is considered "well-tamped." The university shall conduct field tests to verify compaction compliance in accordance with ASTM D 2922 (Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)), ASTM D 1556 (Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method), or ASTM D 2167 (Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method).

t. Certification and commissioning.
1) Test all underground conduits prior to commissioning. Certify underground conduits by pulling a mandrel through them. The mandrel shall be equivalent to the nominal inside conduit diameter and not less than 12" long. If the mandrel does not pass through the conduit, the conduit shall be repaired or replaced at the failure point. OIT personnel shall witness the certification test and commission the underground conduits in writing.

u. Documentation.
1) Deliver As-builts of the underground conduit OSP system to OIT, in the prescribed format and media.

2. Direct buried cables.
a. General.
1) Direct buried cable is placed under the ground surface in such a manner that it cannot be removed without disturbing the soil.

b. Limited campus use.
1) Direct buried infrastructure is suitable for use in short-term infrastructure such as construction trailers.

c. Marking.
1) Direct buried cable shall be marked every 50' along its run length to preclude inadvertent damage during project construction. The run length markings may be stakes, placards, or other suitable signage.

d. Depth.
1) Place direct buried cable a minimum of 24" below grade.

3. Aerial pathways.
a. Aerial pathways shall not be used on campus, without prior approval by OIT.

C. Building In-tract pathways to campus Trunk (backbone) spaces.
1. Place a minimum of two Trade Size 4, 4" conduits to the nearest MH or as specified by OIT.
2. Place a second, redundant pathway of a minimum of two Trade Size 4, 4" conduits to a nearby MH as specified by OIT.
3. In-tract pathways should be placed, encased, and marked as per the OSP Trunk pathways described above.
4. Media placed to support the building is provided by a separate contract managed by OIT, as described below.

D. OSP Media.
1. All OSP media is provided by the OIT department under a separate project and contract.
2. Fiber media.
a. Between the campus core and each distributed building or structure, 72 strands of single mode fiber (SMF) are typically placed, or as directed by OIT.
1) Maximum connector loss per mated pair: 0.75 dB.
2) Maximum splice loss: 0.3 dB.
3) Maximum cable attenuation at 1310 nm and 1550 nm: 1.0 dB/km.

4) Minimum return loss: 35 dB.

b. Angled polished connectors (APC) may be required for specialized applications, as specified by OIT.

1) APC should possess an angle of 8°, an insertion loss of 0 to 0.5 dB, and an optical return loss of 60 dB.

3. Copper media may be placed to support telephony and other low voltage circuitry. The numbers of pairs placed is reflected in the structure's predicted load, as specified by OIT. Depending upon distance, 22 (0.64 mm) or 24 (0.5 mm) AWG copper wire may be required.

4. OSP media is labeled according to the campus standard, as specified by OIT.

E. Street marking for OSP.

1. Use the APWA uniform color code [ANSI Z535.1] for marking excavation sites and underground facilities in conflict with an excavation.

White	.....Proposed Excavation
Pink	.....Temporary Survey Markings
Red	.....Electric Power Lines, Cables, Conduit and Lighting Cables
Yellow	.....Gas, Oil, Steam, Petroleum or Gaseous Materials
Orange	.....Communication, Alarm or Signal Lines, Cables or Conduit
Blue	.....Potable Water
Purple	.....Reclaimed Water, Irrigation and Slurry Lines
Green	.....Sewers and Drain Lines

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END OF SECTION 27 05 43