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CFX ITS Inspection Reference & Training Manual

Chapter 3

Pull and Junction Boxes And Fiber Optic Manholes

3.0 OVERVIEW OF PULL AND BOXES AND FIBER OPTIC MANHOLES

Pull and junction boxes and fiber optic manholes (FOMHs) are integral to any conduit system. They are typically installed in an accessible location along the conduit path at designated or specific intervals. Pull and junction boxes and FOMHs serve many purposes; their primary function, however, is to facilitate and provide a means of pulling conductors or cables through a conduit. If a conduit run extends too far or has too many bends without having an access point, then it can make it difficult and sometimes impossible to install conductors/cables into the conduit successfully. Pull and junction boxes and FOMHs can also provide a storage location for additional cable slack, provide an access point for maintenance, and house cable splices. This Chapter will cover the different types and sizes of pull and junction boxes and the requirements for both electrical and communications box installation. Later in the Chapter we will cover the requirements for FOMH installations.

3.1 TYPES OF PULL BOXES

There are various types of pull boxes used in CFX's ITS infrastructure, which differ in material, size, shape, and intended use. Most pull boxes installed on CFX's system are made of composite materials and have an open bottom design allowing underground conduits to enter into the box from the bottom and to provide a means of drainage. All pull boxes shall be listed on the Florida Department of Transportation's Approved Product List (APL) unless otherwise specified in the plans. For safety reasons, power and communication cables always need to be separated and therefore will be routed through separate types of pull boxes. In this section, we will review the common types of power (electrical) and communication pull boxes.

3.1.1 Electrical Pull Boxes – Electrical pull boxes are used for power runs and typically house conductors. Electrical pull boxes shall meet the requirements of CFX Technical Specification Section 635-2.4, requiring them to have dimensions of 13"x24"x12" and be stamped "CFX POWER," as shown in Figure 3.1 below.

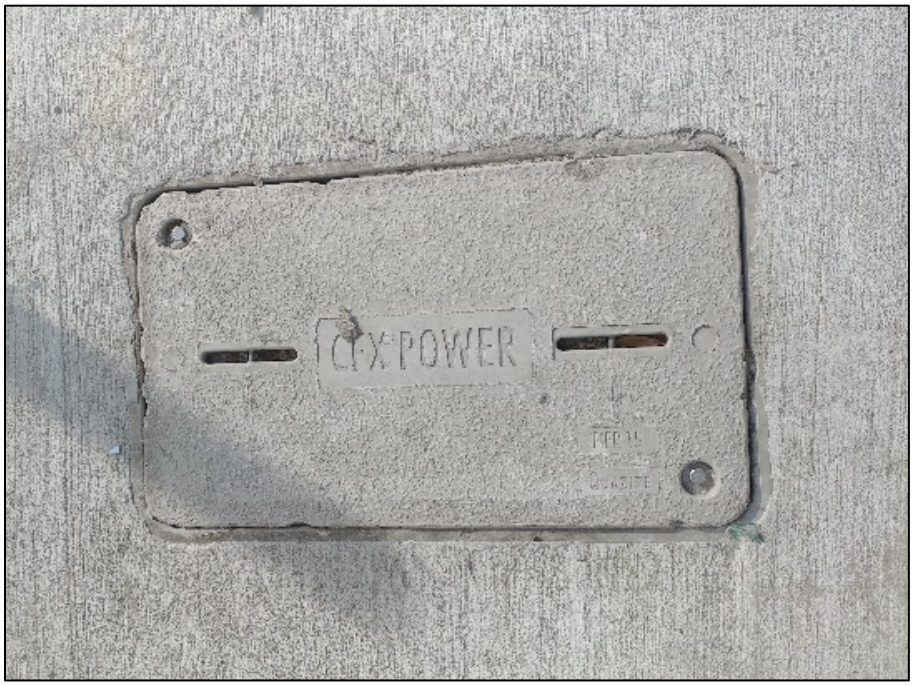

Figure 3.1: Electrical Pull Box

3.1.2 Grounding Pull Boxes – Grounding will be discussed in detail in a future chapter, but for now, please note that CFX requires 13"x24"x12" grounding pull boxes to house the main ground electrode for ITS grounding arrays.

Grounding pull boxes shall be stamped with “CFX GROUNDING,” as shown in the photo in Figure 3.2 below and shall meet the requirements of CFX Technical Specification Section 635-2.5.

Figure 3.2: CFX Grounding Pull Box

3.1.3 Junction Boxes – Junction boxes serve the same purpose as pull boxes acting as an access point for cable and conductor pulling but are installed above grade, as shown in Figure 3.3 below. Junction boxes for use on CFX’s system shall be made of noncorrosive metal such as aluminum or stainless steel. They must have a weather rating, such as NEMA 3R, to protect from the elements and prevent water intrusion. Junction boxes shall be 16”x12”x6” and meet the requirements of CFX Technical Specification Section 635-2.6.

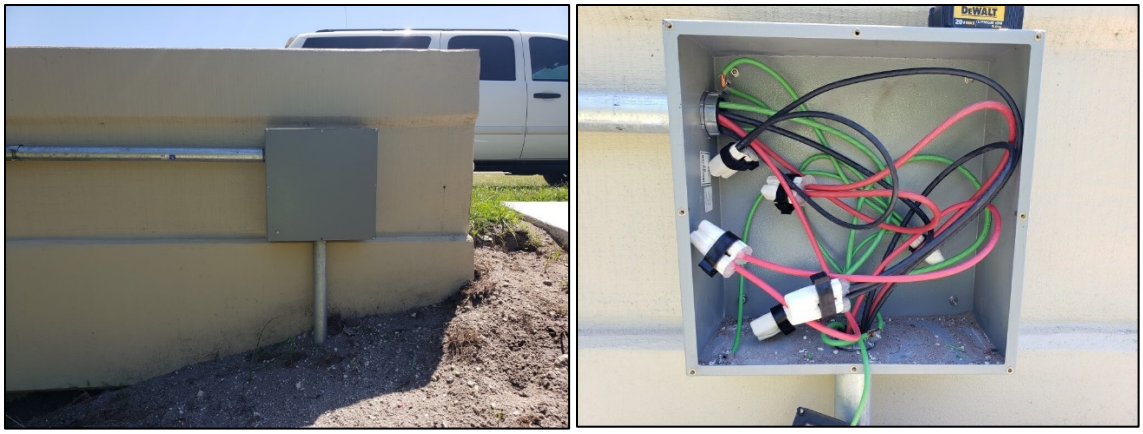

Figure 3.3: Wall Mounted Junction Box

3.1.4 Fiber Optic Pull Boxes – Fiber optic pull boxes are used for fiber optic cable. Unlike electrical pull boxes, fiber optic pull boxes are round and shall be stamped with “CFX FIBER.” Depending on the size of the fiber optic cable passing through it or if it is being used as a splice point, the plans will specify either a small or large fiber optic pull box.

3.1.4-1 Small Fiber Optic Pull Boxes – Small fiber optic pull boxes are round with the top having a minimum opening diameter of 24 inches and the bottom having a minimum opening diameter of 33 ¼” with a depth of 36”. Small fiber optic pull boxes shall meet the requirements of CFX Technical Specification 635-2.3.

Figure 3.4: Small Fiber Optic Pull Box

3.1.4-2 Large Fiber Optic Pull Boxes – Large fiber optic pull boxes are round with a minimum opening diameter of 36 inches at the top and 43 1/8" inches at the bottom with a depth of 36 inches. Large fiber optic pull boxes shall have four galvanized steel "L" shaped brackets, as shown in Figure 3.5 below, capable of securely hanging cable slack in an organized coil within the pull box.

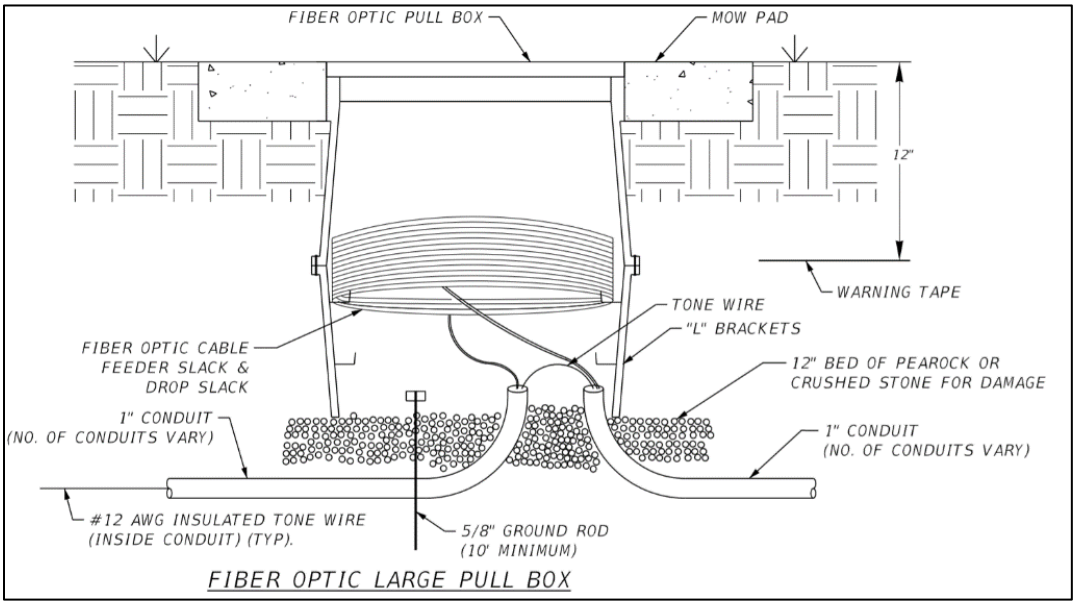

Figure 3.5: Large Fiber Optic Pull Box Detail

3.2 PULL BOX INSTALLATION REQUIREMENTS

This Section will outline the installation requirements for both electrical and fiber optic pull boxes. Both electrical and fiber optic pull boxes shall use aluminum, stainless steel, HDG straps/bolts or screws. These bolts or screws shall be securely fastened so that the lid is tight against the top of the pull box edges. In general, conductor installations for CFX's ITS infrastructure shall meet the requirements of CFX Technical Specification 639A and ITS Design Standards and FDOT Standard Plan 635-001.

3.2.1 Placement and Spacing – As mentioned previously in this chapter, if pull boxes are placed too far apart, it can make cable or conductor installation difficult. In general, the plans will dictate where electrical and fiber optic pull boxes are placed. However, maximum allowable spacing is something that the CEI and contractor need to consider if pull boxes are field adjusted. The maximum allowable spacing for electrical and fiber optic pull boxes is as follows:

- Electrical pull box – 500 ft
- Fiber optic pull box – 2,500 ft

Common locations where pull boxes are utilized include conduit end points, where conduit changes direction, beginning and end of conduit paths installed underneath a roadway, next to power services, ends of directional bores, when a conduit run would require more than 270 degrees of bends for both fiber optic cable and power conductors, and next to ITS cabinets.

3.2.2 Drainage Layer – A drainage layer, consisting of a 12" bed of pea rock or crushed stone, is required for both electrical and communication pull box installations to facilitate drainage, as shown in Figure 3.6 below. The contractor shall protect pull boxes from the ingress of dirt or foreign materials during construction to maintain the integrity of the drainage layer through final acceptance of the project. Figure 3.6 below shows a photo of a compromised drainage layer versus one that has been properly protected and is in acceptable condition.

Figure 3.6: Compromised Drainage Layer (Left) Versus Clean Drainage Layer (Right)

3.2.3 Concrete Apron (Mow Pad) – Mow pads serve to prevent pull boxes from damage while ensuring that boxes can be easily located and are accessible for maintenance personnel. Pull boxes must be installed flush with finish grade, so the area must be at final grade before the contractor install pull boxes. Once the pull box is installed at final grade, a 6" thick concrete apron (commonly referred to as a mow or maintenance pad), shall be poured around the pull box(es). The mow pad shall be installed per the CFX ITS Design Standard, as shown on Sheet E-3. If there are multiple pull boxes placed at a particular location, a single mow pad shall be poured around all boxes at that location as shown in Figure 3.7 below.

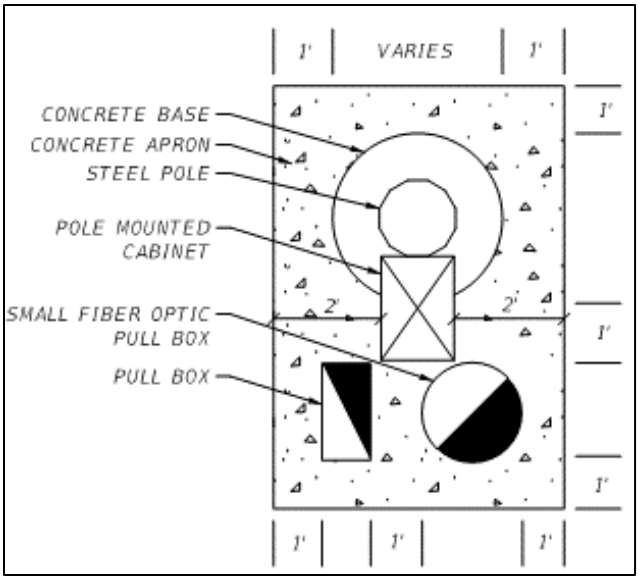

Figure 3.7: Mow Pad Detail

Figure 3.8: Improper Mow Pad Installation (Not level with the top of the box)

3.2.4 Grounding – We will not go into the details of grounding in this Chapter. However, note that in cases where metallic pull box lids are called for, such as FOMHs, they shall be grounded according to Section 620A of the CFX Technical Specifications.

3.3 FIBER OPTIC MANHOLES (FOMH)

Like fiber optic pull boxes, fiber optic manholes (FOMHs) are used for communication runs and house fiber optic cable for CFX's fiber-optic network (FON). FOMHs are 4'x4'x4' or 4'x6.5'x6.5' precast structures with round openings with a cast iron ring and cover as shown in Figure 3.9 below. FOMHs function as an access point for inspection and maintenance personnel and are used to store cable slack and splices. FOMHs shall be lifted using the lifting eyes. FOMHs shall meet the requirements of CFX Technical Specification 636.

Figure 3.9: Fiber Optic Manhole (FOMH)

3.3.1 Cover – FOMH access holes shall be at least 30 inches in diameter or as shown in the plans. A cast iron cover stamped with "CFX FIBER" with two non-penetrating pickup slots and three Penta-bolts for locking the cover, as shown in Figure 3.10 below.

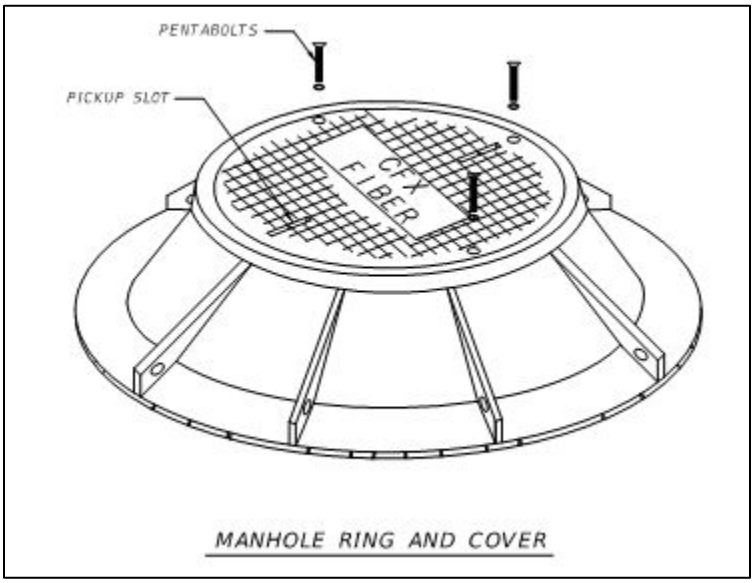

Figure 3.10: FOMH Cover

3.3.2 Cable Racks – FOMHs shall be equipped with cable racks per CFX Technical Specification 636-2.3.1.9. The cable racks, as shown in Figure 3.11 below, are used to coil the fiber optic cable slack neatly within the manhole.

Figure 3.11: Cable Racks

3.3.3 Access Ladder – FOMHs shall be equipped with an access ladder, as shown in Figure 3.12 below, that reaches the base of the manhole in accordance with CFX Technical Specification 636-2.3.1.11. The ladder shall be Series I-3600 as manufactured by Inwesco, Inc., or CFX approved equivalent.

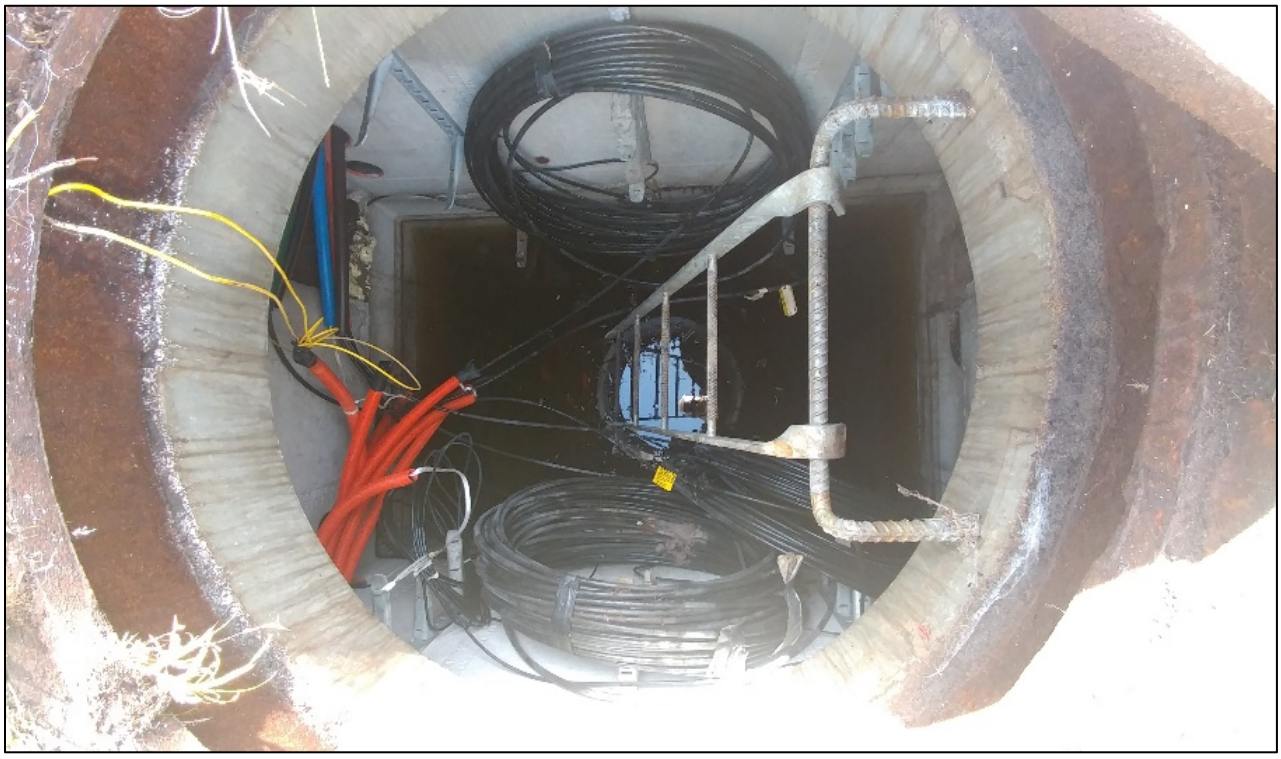

Figure 3.12: Access Ladder

3.3.4 Access Points – All FOMH shall come with precast access points on each wall for conduit ingress and egress. Figure 3.13 below demonstrates the 6" SCH 40 PVC pass-through sleeve and 4" SCH 40 PVC terminators that are required on each wall. When conduits enter the FOMH, an appropriate 4-way or 9-way duct organizer, as shown in

Figure 3.14, on the following page, shall be used. All unused access points shall be sealed with a compression type snug plug or precast terminator.

It is important that the CEI and contractor closely monitor the backfilling operation around the access points to the FOMH. If not backfilled properly, this can create a failure point in the conduit system as the conduits can get damaged by the heavy equipment or become pinched right outside the manhole entry. When backfilling, it is advisable that the CEI and contractor ensure backfill material properly fills the void between the conduits and that 12”-18” of cover is placed on top of the duct bank prior to performing mechanical compaction of the material over the conduits.

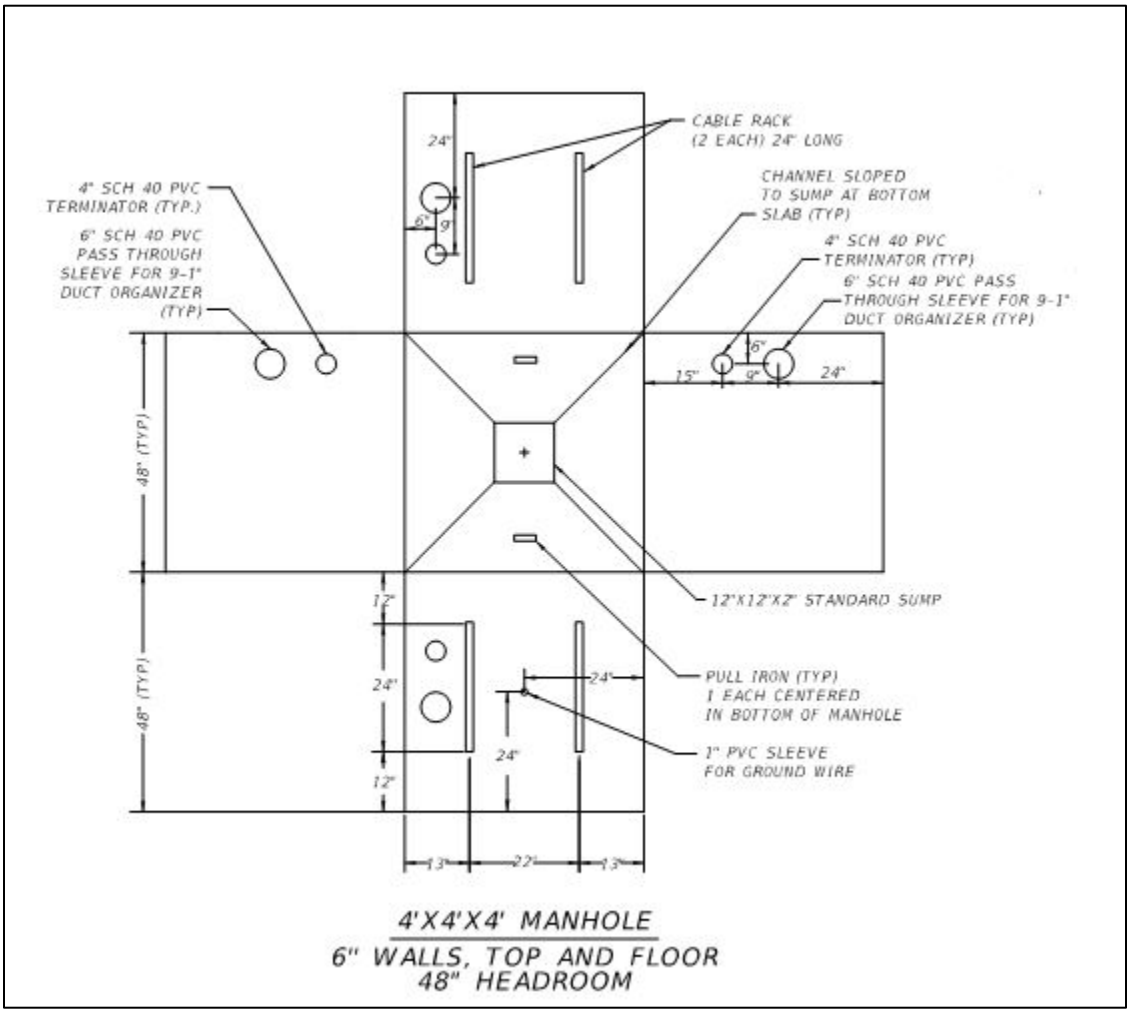

Figure 3.13: FOMH Access Points

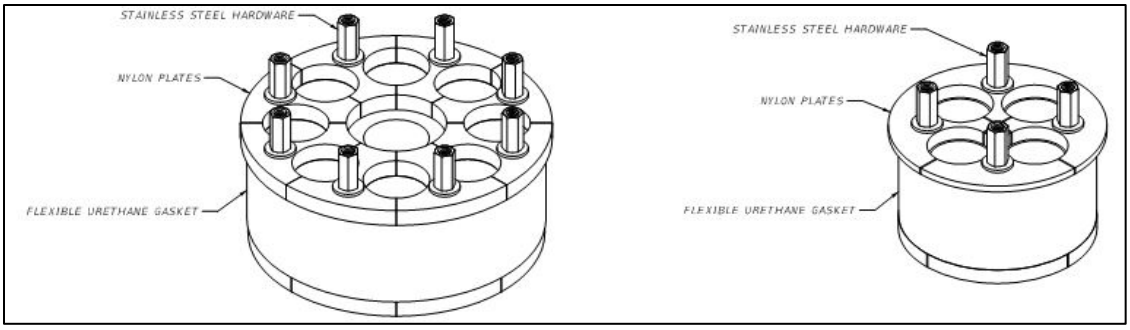

Figure 3.14: Duct Organizers

3.3.5 – FOMH Weatherproofing and Drainage – FOMHs shall be installed on a 12" drainage layer consisting of ½" crushed rock. The bottom of the FOMH will be sloped to a center sump at the bottom of the slab to facilitate drainage. All FOMH penetrations shall be sealed with non-shrink grout and ramneck shall be used to seal all joints to prevent water ingress.

3.3.6 Grounding System – Again, grounding will be discussed in detail in a future Chapter. However, CFX Technical Specification 636-2.3.1.12 outlines the requirements for grounding of FOMH components. The wall of the FOMHs shall come precast with a 1" PVC sleeve for grounding purposes. A bare #6 AWG ground conductor shall be routed through the 1" PVC sleeve and be bonded to an external ground rod and tied to the access ladder and cable racks to ground these components appropriately as shown in Figure 3.15 below.

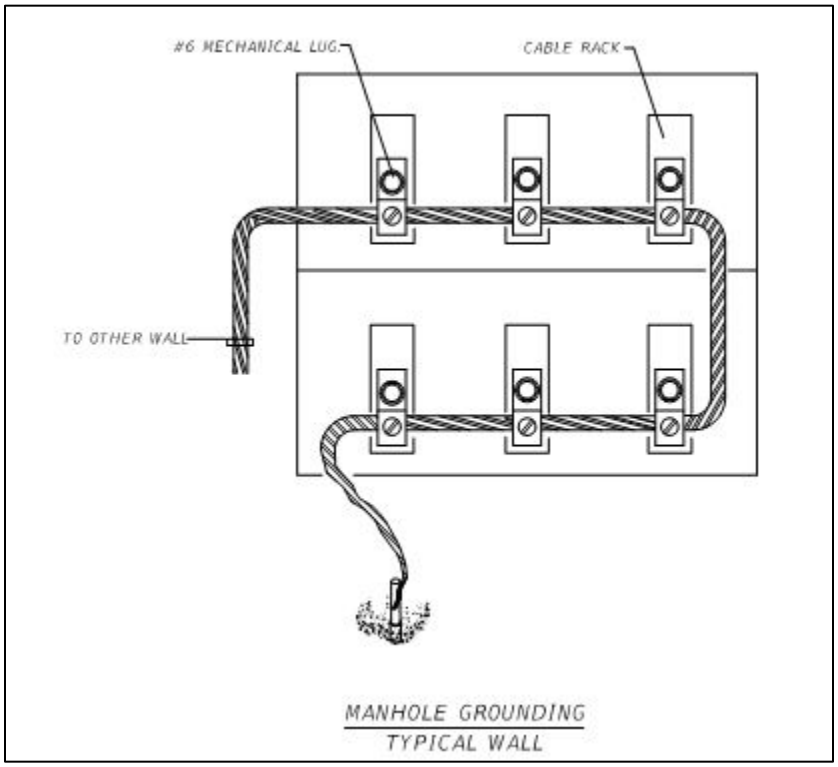

Figure 3.15: FOMH Grounding Detail

3.3.7 Spacing – As discussed in the previous sections on pull boxes, FOMHs shall not be installed with an excessive distance between them, or the contractor may run into complications when attempting to install the fiber optic cable. In general, the plans will dictate where FOMHs are placed. However, maximum allowable spacing is something

that the CEI and contractor need to consider if a FOMH needs field adjusted. The maximum allowable spacing for FOMH is as follows:

- In paved shoulder – 1,500 ft
- In unpaved shoulder – 4,000 ft

3.4 PRE-ACTIVITY CONSIDERATIONS

This Section will serve as a checklist of items that the CEI and contractor shall consider prior to proceeding with pull box or FOMH installations on CFX projects:

1) **Verification of Appropriate Grade -** Ensure that the area is at final grade prior to pull box or FOMH installation. When pull boxes or FOMHs are installed prior to the area being at final grade, you run the risk of damaging them during the grading operation or it is likely that the contractor will have to come back after the area is at final grade to raise or lower the pull box or FOMH.

2) **Drainage Layer Installation** - Ensure that the 12" drainage layer is installed with the appropriate depth of drainage material, prior to and below the proposed pull box or FOMH to achieve proper drainage. The contractor should not be attempting to install the drainage material after the pull box has been installed.

3) **Location of Proposed Pull Boxes and FOMHs** - Identify a flat area at the proposed location that is suitable for the pull box installation. If upon site review the plans call for the pull boxes to be installed on a slope but there is a flat area in the immediate vicinity, the CEI and contractor have the ability to field adjust the final location of the pull boxes or FOMHs. In addition, pull boxes and FOMHs should not be installed in drainage areas.

4) **Verification of Pull Boxes and Raceways** - Verify the appropriate size and quantity of pull boxes are being installed per the plan details and that electrical conduit is terminated at electrical pull boxes and communications conduit is terminated at fiber optic pull boxes, thereby keeping electrical conductors and communications cables separate. Verify that all bolts have been installed.

5) **Organization of Pull Boxes** - Ensure that all pull boxes at a location are installed in an organized fashion and not just placed haphazardly – the CEI and contractor shall thoroughly review and select the concrete apron details provided in the plans and CFX's ITS Design Standards prior to installing pull boxes.

6) **Concrete Apron Details** - Ensure there is adequate spacing, typically 12", between pull boxes and any other infrastructure and that there is sufficient cover surrounding the pull boxes, typically 12" when mow pads are formed. In general, the layout of the pull boxes and concrete apron should closely mirror the detail being used from the plans or CFX's ITS Design Standards.

7) **Protection of Pull Boxes –** When pouring mow pads, ensure the pull boxes are adequately protected during the concrete pour to prevent concrete intrusion and the caking of concrete on the lid or in the bolt holes. Once installed, the location of pull boxes shall be clearly marked to avoid them from being damaged by heavy equipment during construction.

Figure 3.16 below shows an example of an incorrect pull box installation where the pull boxes are not placed in a flat area, the area was not at final grade prior to installations, and the pull boxes are not placed in an organized fashion following the mow pad details in the plans.

Figure 3.16: Improper Pull Box Installation

Figure 3.17 below shows an example of a correct pull box installation at an ITS device location. The concrete apron details in the plans were followed, the boxes and apron are at final grade, and placed in an organized fashion. Notice that the ITS device cabinet, service pole, and ITS device pole are all poured in one monolithic apron along with the pull boxes.

Figure 3.17: Correct Pull Box Installation