2023

Clemson University Facilities Medium Voltage Guidebook

BMCCARL

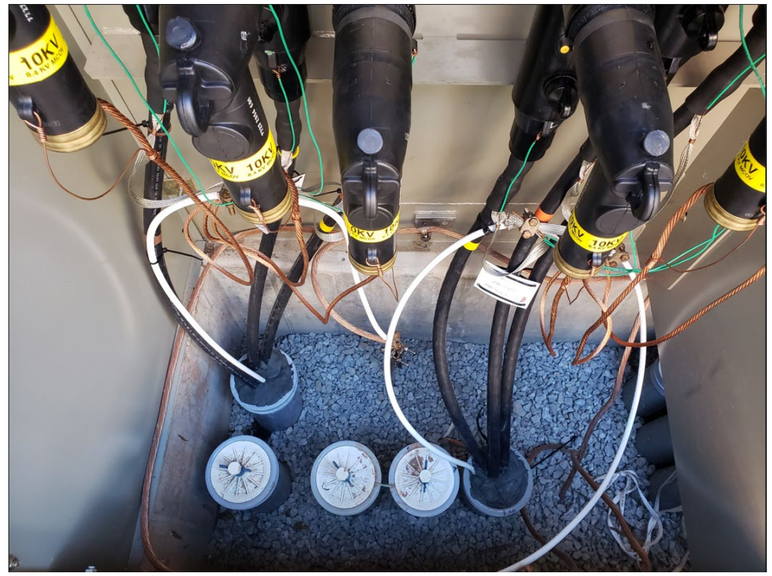
University Facilities

2/3/2023

Transformer and Transformer Pads

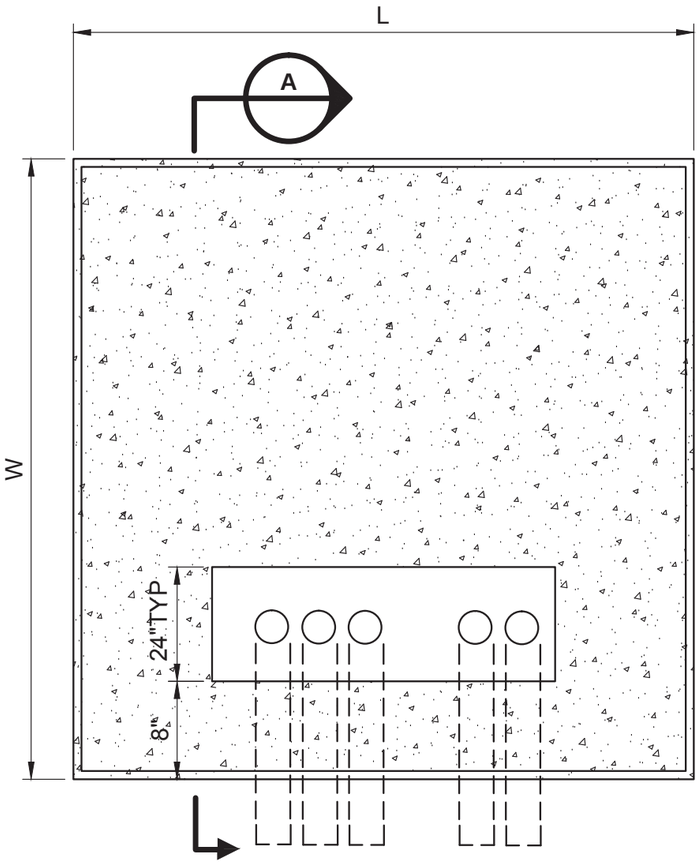
Typical Installations: Verify with CU Project Manager and CU Utilities Engineering Services

- Project contractor to install transformer pad per typical details below and transformer specific pad layout drawing provided once transformer is selected.
- Transformer to be furnished by CU Utilities at project expense.
- Transformer pad installation shall be inspected by CU Utilities prior to pouring concrete.
- Building transformers shall be located in an accessible location such that utility line trucks can set up adjacent to the transformer for servicing and replacement.
- Transformers shall have five feet of working clearance on the sides and back and ten feet in the front.
- Immediate area around the transformer shall be smooth and level.
- Transformers subject to physical damage shall be protected by bollards. Bollards shall not impede the ten-foot working clearance in front of the transformer.
- Grounding access wells shall be installed where the perimeter ground rods are to be located under hardscape.



L = TRANSFORMER LENGTH PLUS 6" ON EACH SIDE

W = TRANSFORMER WIDTH PLUS 6" ON EACH SIDE



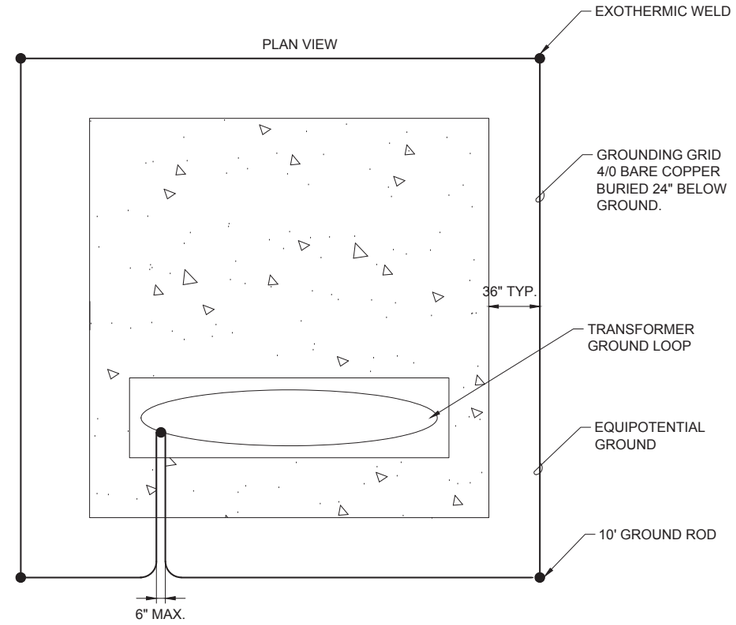
PLAN VIEW

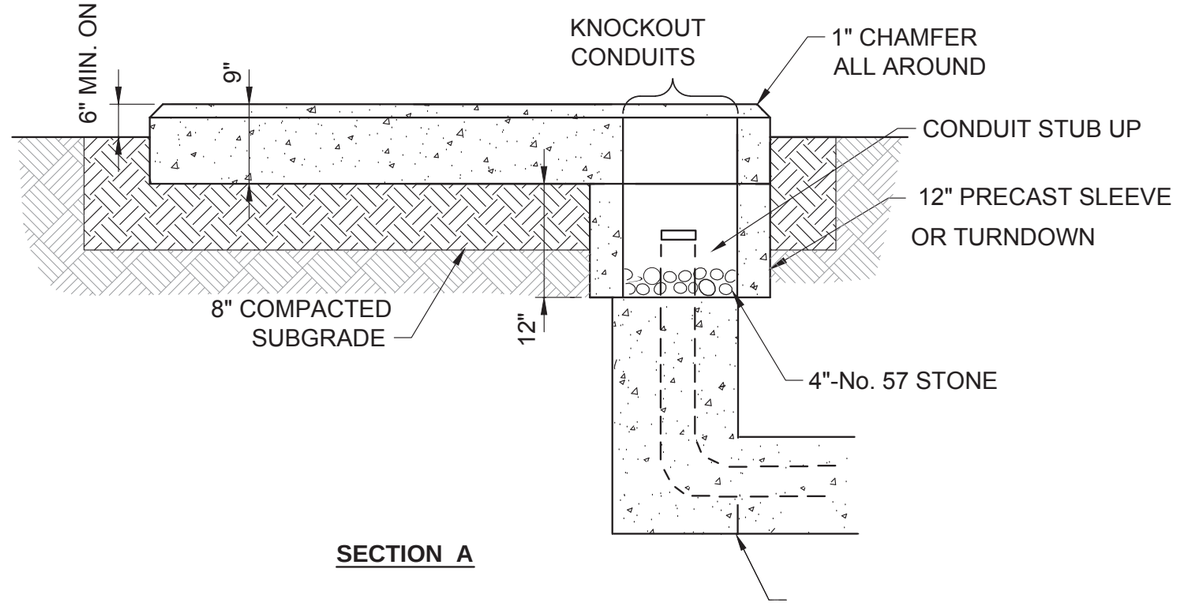
NOTES:

1. INSULATED CAPS SHALL BE USED ON UNUSED BUSHING INSERTS.
2. PLACE ONE 10' GROUND ROD AT EACH CORNER OF EQUIPOTENTIAL GROUND.
3. INSTALL BLEED WIRES ON ELBOWS PER MANUFACTURER'S INSTRUCTIONS.
4. PRIMARY CABLE TAPE SHIELD TO BE CONNECTED TO THE TRANSFORMER GROUND LOOP BY COMPRESSION CONNECTORS PER MANUFACTURER'S INSTRUCTIONS.
5. See site specific transformer pad layout drawing for exact dimensions.

TRANSFORMER GROUNDING DETAIL — B

NOT TO SCALE





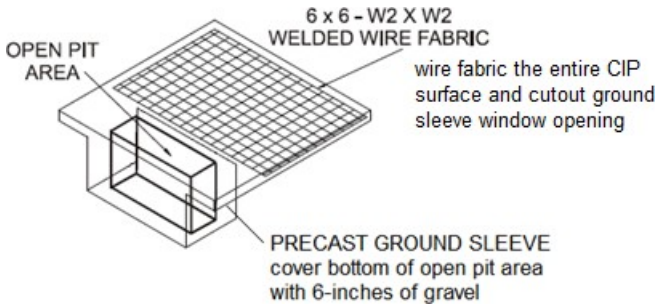
SECTION A

NOTES:

1. SEE SITE DRAWINGS FOR ELECTRICAL EQUIPMENT AND CONDUIT ROUTING DIRECTIONS.
2. COORDINATE PAD DIMENSIONS WITH SUBMITTAL DRAWINGS.

TYPICAL PRECAST CONCRETE TRANSFORMER PAD — 1 / -

Ground Sleeve/Pit Pad Details



Transformer pad will be 9 inches thick minimum with welded wire fabric and #4 reinforcing bars. See site specific pad dimensions furnished by Clemson University Utilities for each transformer location.

Contractor shall contact Clemson University Utilities HV Shop to inspect pad form, dimensions and primary and secondary elbows and conduit stub outs prior to pouring concrete and to inspect grounding system installation for the generator and transformer pads.

Concrete Mix Specifications

1. Concrete mix used for Transformer Pads shall meet the following requirements:
   - Minimum 28 day compressive strength of 4,000 psi
   - Maximum water / cement ratio of 0.50
   - Maximum slump of 4 inches
   - Air-entrainment content between 4 and 8 percent

2. Concrete shall be afforded adequate cure for a minimum of:
   - **five (5) days** if the ambient temperature is **over 70° F**, or
   - **seven (7) days** if the ambient average temperature is **below 70° F**.

3. Adequate cure can be performed by any of the following methods:
   - Waterproof membranes
   - Sprinkling or Soaking
   - Curing Compounds

4. Pad shall be supported on a sub-base of sand, gravel, or crushed stone. The
   - granular sub-base is to be a minimum of four (4) inches thick and shall be
   - compacted with a vibratory compactor.

5. Dampen the sub-base prior to concrete placement. At the time of placement, the sub-base shall not contain standing water.

6. The top of the concrete pad must be steel troweled and completely smooth to prevent “gaps” between the transformer and the surface of the concrete pad.

Installing Conduit in Pit Pads

Conduit for Primary Cables shall be specified by Clemson University Utilities and installed by the contractor when pouring the pad. Conduit shall be Schedule 40 and shall adhere to the following specifications:

Conduit Size	Elbow Radius
4”	36”
5”	36”
6”	36”

All conduits shall be installed so the belled end is “up” in the transformer compartment to minimize damage to the cables during installation.

Secondary conduits shall not cross or interfere with the primary conduits. (The secondary conduit can exit the secondary side either coming out the front, the right side, or the back.)

The secondary conduits shall not extend outside the designated “secondary” area of the window – See manufacturer’s transformer submittal drawings.

Cable length to be determined by contractor. Minimum of ¾ loop from entry to termination point required in each manhole.

350KCMIL-15 KV SHIELDED POWER CABLE (USED FOR FEEDER CIRCUIT LOOPS)

- TYPE MV-105
- COPPER TAPE SHIELD
- EPR INSULATION 133% LEVEL, SINGLE CONDUCTOR, SUNLIGHT RESISTANT
- ACCEPTING OKONITE 115-23-3240 OR PRYSMIAN 306307A OR PRYSMIAN 20148389 OR SOUTHWIRE 46319
- INSTALL ARC-PROOFING TAPE ON INDIVIDUAL CABLE OR BY SET OVER THE ENTIRE LENGTH OF CABLE IN MANHOLES

4/0 AWG CU – GROUND CONDUCTOR TO BE INSTALLED WITH 350KCMIL-15KV CIRCUIT CABLE

- 600 VOLT TYPE RHW-2 OR XHHW
- WHITE COLORED OUTER JACKET

1/0 AWG -15 KV SHIELDED POWER CABLE (USED ON STANDARD TRANSFORMER LOOPS)

- TYPE MV-105
- COPPER TAPE SHIELD
- EPR INSULATION 133% LEVEL, SINGLE CONDUCTOR, SUNLIGHT RESISTANT
- ACCEPTING OKONITE 115-23-3230 OR PRYSMIAN 306303A OR PRYSMIAN 20148385
- INSTALL ARC-PROOFING TAPE ON INDIVIDUAL CABLE OR BY SET OVER THE ENTIRE LENGTH OF CABLE IN MANHOLES

1/0 AWG CU – GROUND CONDUCTOR TO BE INSTALLED WITH 1/0 AWG -15KV CIRCUIT CABLE

- 600 VOLT TYPE RHW-2 OR XHHW
- WHITE COLORED OUTER JACKET

WHERE SPLICES ARE NEEDED, INSTALL 600A DEADBREAK ELBOWS ON 2-POINT JUNCTIONS

600A 15/25 CLASS DEADBREAK JUNCTION

- 2 POINT JUNCTION WITH BRACKET
- EATON COOPER POWER SYSTEMS DJ625A2B OR RICHARDS P625JD42B OR EQUAL
- QUANTITY NEEDED: 3 per splice

600A 15KV DEADBREAK ELBOW (FOR SPLICES AND CONNECTIONS TO 3 PHASE PADMOUNT TRANSFORMERS)

- CAPACITIVE TEST POINT
- ALUMINUM COMPRESSION LUG
- 350 CABLE PART #: 62LCT2K14DD (VERIFY WITH MANUFACTURER FOR CABLE SELECTED)
- 1/0 CABLE PART #: 62LCT2G08BC (VERIFY WITH MANUFACTURER FOR CABLE SELECTED)

Single phase padmount transformers are typically 12470 GND/Y requiring 200 amp loadbreak elbows. Provide (1) 1/0 15kV cable and (1) 1/0 ground cable (x2 for loop connection) for each transformer

200A 15kV LOADBREAK ELBOW

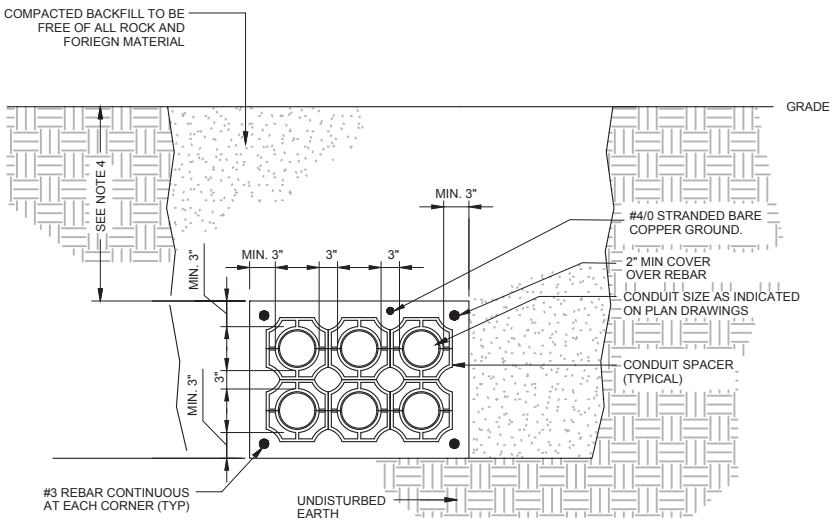
- CAPACITIVE TEST POINT
- ALUMINUM COMPRESSION LUG
- 1/0 CABLE PART #: 21LBT2B8BBC (VERIFY WITH MANUFACTURER FOR CABLE SELECTED)

Cable support required in every manhole.
HEAVY DUTY NONMETALLIC CABLE RACKING (UNDERGROUND DEVICES INC. OR EQUAL)

- 36" STANCHION CR36-B
- 8" RACK ARM RA08
- 14" RACK ARM RA14
- STD QUANTITY NEEDED PER MH: (16) CR36-B - PROVIDE (2) HIGH 36" STANCHION (X2) PER WALL IN NEW MANHOLE
- STD QUANTITY NEEDED PER MH: (32) RA14 – PROVIDE (2) PER STANCHION IN NEW MANHOLE
- STD QUANTITY NEEDED PER MH: (8) RA08 – PROVIDE (2) PER WALL FOR FIBER/INTERDUCT LOOP
- PROVIDE ADDITIONAL SUPPORT AS NEEDED FOR CABLE AND FIBER IN ALL MANHOLES

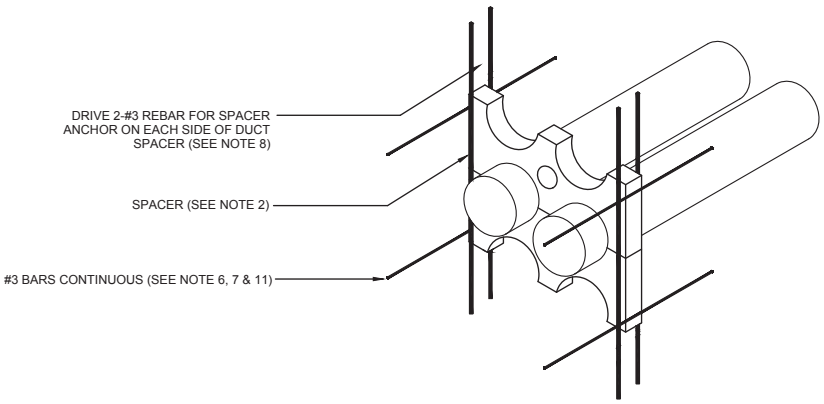
FIBER INSTALLATION
Fiber length to be determined by contractor. Minimum of 15ft service loop in every manhole and 20ft service loop on each side of a splice in manholes where splice is allowed. APPROVAL FOR SPLICING MUST BE RECEIVED IN WRITING FROM CU UTILITIES. Fiber to be racked separately from MV cable. Provide as much separation between MV cable and fiber as possible. Fiber to be protected by innerduct over the entire length AND LABELED WITH TO/FROM INFORMATION IN EVERY MANHOLE.
FIBER INDOOR/OUTDOOR LOOSE TUBE

- 6 STRAND FIBER
- GEL BLOCK
- BELDEN FDSL006RF OR EQUAL
- LABEL FIBER IN EVERY MANHOLE AND TERMINATION POINT
- TEST FIBER AND PROVIDE TEST REPORT
- PROVIDE SUBMITTAL FOR APPROVAL ON PROPOSED SPLICE AND TERMINATION KITS



NOTES

1. PROVIDE DUCTBANK REINFORCING WHEREVER DUCTBANK CROSSES UNDER CURRENT AND FUTURE ROADWAYS, PARKING LOTS, WITHIN 5 FEET OF BUILDING FOUNDATIONS AND FOOTINGS, AND AS OTHERWISE INDICATED.
2. PROVIDE REBAR IN EACH CORNER AND ALONG OUTER EDGE BETWEEN EVERY THREE CONDUITS WHERE REINFORCING IS REQUIRED.
3. FIRST 10' OF CONDUIT ENTERING OR LEAVING A MANHOLE OR STRUCTURE SHALL BE SCH. 40 PVC. CONDUIT SHALL BE ALIGNED PERPENDICULAR TO WALLS AND TERMINATE IN END BELLS.
4. DUCTBANKS SHALL MAINTAIN 2FT OF COVER MINIMUM AND SLOPE TO DRAIN TO MANHOLES WHERE POSSIBLE. DUCTBANKS SHOULD NOT ENTER MANHOLES IN THE TOP OR BOTTOM MOST TERMINATION POINT. DUCTBANKS THAT WILL CONTAIN THE CAME CIRCUIT SHOULD ENTER AND LEAVE MANHOLES AT THE SAME ELEVATION WHERE POSSIBLE. WHERE DUCTBANKS ARE ROUTED BENEATH A BUILDING SLAB, MINIMUM BURIAL DEPTH SHALL BE PER NEC ARTICLES 300.5 AND TABLE 300.50.
5. COLD JOINTS SHALL BE INSTALLED AT ENDS OF POURS NOT ABLE TO BE COMPLETED IN ONE DAYS' TIME. COLD JOINTS SHALL BE NEATLY FORMED WITH A MINIMUM OF 24" OF ALL HORIZONTAL REBARS EXTENDING THROUGH FORM WORK FOR CONTINUATION. END OF POUR FORM WORK SHALL BE REMOVED PRIOR TO NEXT POUR. TERMINATE EACH POUR IN A VERTICAL PLANE AND
6. INSTALL #5 REINFORCING ROD DOWELS EXTENDING 18" INTO CONCRETE ON BOTH SIDES OF JOINT NEAR CORNERS OF ENVELOPE.
7. ON DUCTBANK TERMINATIONS INTO MANHOLES, DRILL AND EPOXY #4 RE-BAR DOWELS WITH 4" EMBEDMENT INTO EXTERIOR MANHOLE WALLS AND TIE TO DUCTBANK REINFORCEMENT.



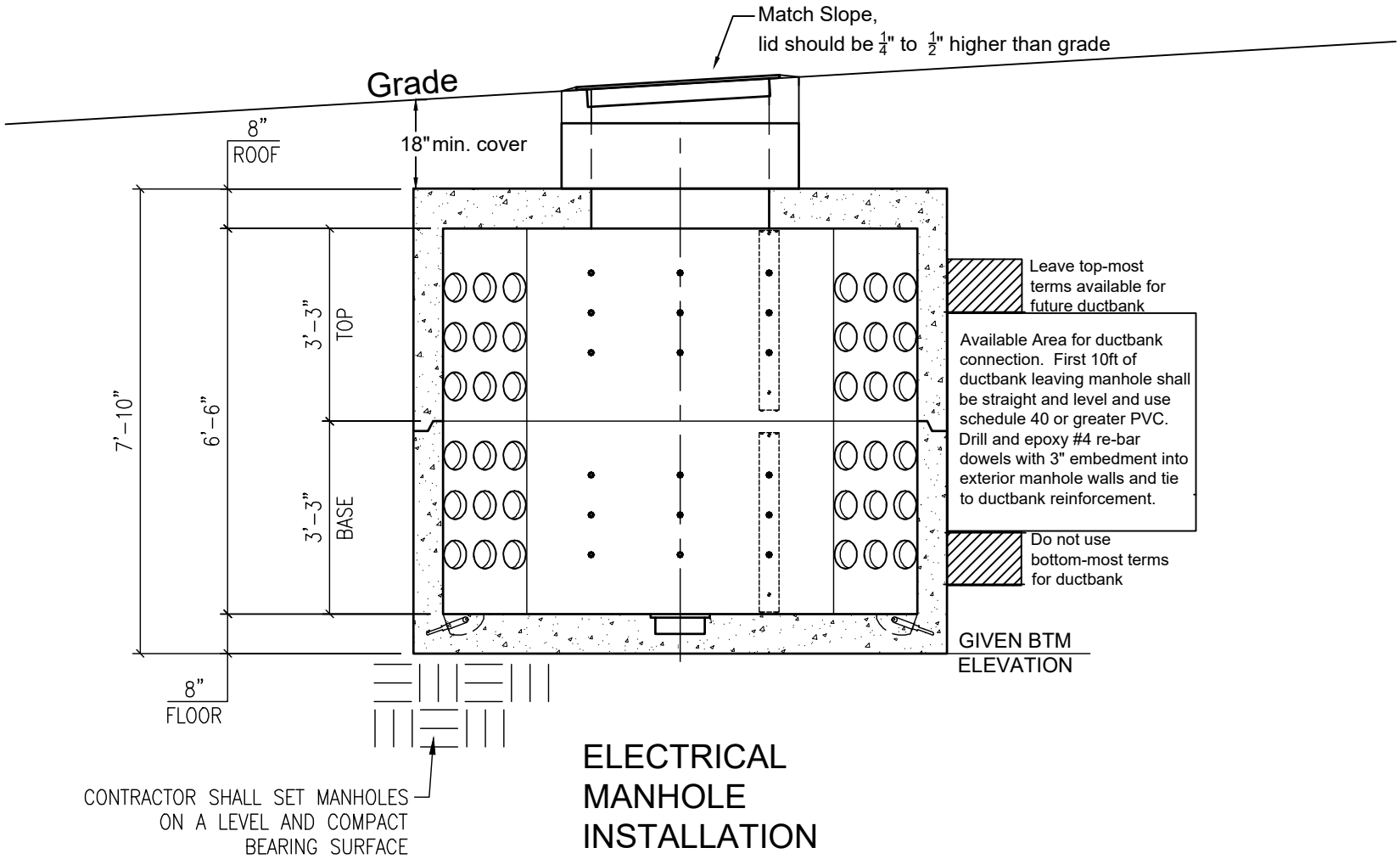
NOTES

1. ALL BENDS TO BE MINIMUM 48" RADIUS.
2. SPACERS SHOULD BE INSTALLED NOT MORE THAN 4'-0" APART.
3. KEEP CONDUITS PLUGGED DURING ALL PHASES OF CONSTRUCTION.
4. ALL EXTERIOR CONCRETE COVER DIMENSIONS ARE MINIMUM.
5. CONCRETE TO BE PER CONCRETE MATERIALS SCHEDULE
6. REBAR TO BE CONTINUOUS #3 IN ALL CORNERS AND IN BETWEEN EVERY THREE CONDUITS HORIZONTALLY AND VERTICALLY.
7. PROVIDE #5 REBAR ON COLD JOINT CONCRETE POUR.
8. LENGTH OF REBAR FOR SPACER ANCHOR WILL VARY PER DUCT BANK HEIGHT.
9. CONTRACTOR TO THOROUGHLY CLEAN AND SWAB DUCT PRIOR TO INSTALLING ANY CABLE.
10. INSTALL PULL ROPES IN ALL CONDUITS AFTER CLEANING.
11. PROVIDE A MINIMUM OF 12" LAP SPLICE FOR ALL RE-BAR INSTALLATIONS.

CONCRETE MATERIALS SCHEDULE								
ELEMENT	28-DAY DESIGN COMPRESSIVE STRENGTH, f'c (PSI)	MAXIMUM WATER/CEMENTITIOUS MATERIALS RATIO	DRY UNIT WEIGHT (PCF)	MAXIMUM AGGREGATE SIZE (IN)	DESIGN AIR CONTENT (%)	AGGREGATE CLASS DESIGNATION (ASTM C33)	MAXIMUM DESIGN SLUMP[1] (IN)	MAXIMUM CHLORIDE CONTENT[2] (%)
DUCTBANK CONCRETE (SLOPE < 18 DEGREES)	4000	0.48	147	1/2"	NONE	1M	3"-4"/NA	0.30
DUCTBANK CONCRETE (SLOPE > 18 DEGREES)	4000	0.48	147	3/8"	NONE	1M	2"-3"/NA	0.30

NOTES:

1. VALUES SHOWN ARE SLUMP WITHOUT SUPERPLASTICIZERS OVER SLUMP WITH SUPERPLASTICIZERS.
2. VALUE STATED IS MAXIMUM PERCENTAGE OF WATER-SOLUBLE CHLORIDE ION CONTENT IN CONCRETE BY WEIGHT OF CEMENT, DETERMINED BY ASTM C1218 AT AGE BETWEEN 28 AND 42 DAYS.
3. EMPLOY MEASURES WHEN INSTALLING DUCT BANKS ON SLOPES SUCH THAT THE CROSS SECTION DOES NOT EXCEED THE DESIGN SECTION BY MORE THAN 4".
4. EMPLOY SPECIAL FORMING TECHNIQUES AS REQUIRED FOR SLOPES GREATER THAN 30 DEGREES.



ELECTRICAL MANHOLE INSTALLATION