PROJECT SPECIAL PROVISIONS

Bridges 235 & 238 over SR 3431 (Pond Road) and Hominy Creek on I-26

RELOCATION OF EXISTING ITS EQUIPMENT

N.C. Project No. B-5178 (WBS # 42549.1.1)
F.A. Project No. BRIMS-0261(80)1
Buncombe County

Prepared for:

North Carolina Department of Transportation
ITS and Signals Unit

NORTH CAROLINA PROFESSIONAL SEAL 17586 ENGINEER J. TODD BROOKS

6/11/12

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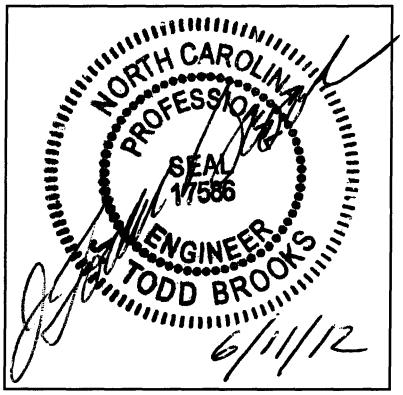

Project Special Provisions

Based On

NCDOT ITS and Signals Project Special Provisions

Version 12.1

Prepared by:

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Contents

1. GENERAL REQUIREMENTS

1.1. SUMMARY OF ITS WORK

The purpose of this project is to relocate existing ITS equipment in conjunction with a road and bridge construction project to replace bridges and the widen I-26 over Pond Road and Hominy Creek in Asheville, North Carolina. The equipment to be relocated consists of an existing metal CCTV pole and the attached equipment that includes: CCTV camera assembly; microwave vehicle detectors (MVD); antennas for wireless communications; and, pole-mounted 336 equipment cabinet. The metal CCTV pole will be relocated south of its current location and reinstalled on a new foundation adjacent to new overhead sign structure that will span the westbound lanes of I-26 westbound south of the new bridge over Hominy Creek and Pond Road. The CCTV camera, the antennas and the equipment cabinet will remain mounted on the metal CCTV pole in its relocated position, but the MVD units will be mounted on the new overhead sign structure.

Perform the following tasks under this contract, as shown in the Plans (the list that follows is not meant to be all-inclusive):

- Perform soil tests, design and construct a new foundation for the existing metal CCTV pole.
- Remove and dispose of the existing metal CCTV pole foundation once pole has been relocated to the new foundation.
- Furnish and install underground conduit, junction boxes, risers with weatherheads, and wood service pole;
- Relocate existing MVD units from existing metal CCTV pole to new overhead signs structure and furnish and install new lead-in cables.
- Remove CCTV camera assembly, antennas and CCTV cabinet from existing metal CCTV camera pole prior to moving the pole, then reinstall the same on the pole when re-erected on new foundation;
- Install new electrical services and associated grounding system;
- Reconnect all field wiring and restore operations of all field equipment in new locations.

1.2. CONSTRUCTION METHODS

(A) General

Before beginning ITS work, verify all existing equipment is in satisfactory working order. Report all defective equipment to the Engineer so as not to be held responsible for defects.

Identify and label all field wiring inside existing pole-mounted CCTV cabinet and where it connects to equipment mounted on the existing metal CCTV pole prior to disconnecting any field wiring.

Locate all underground utilities before beginning drilling, digging, and trenching operations.

Notify Mr. Chad Franklin, Division 13 Electronics Technician, at (828) 298-0094 at least 14 calendar days prior to beginning any ITS work on this project and prior to taking any existing ITS equipment off-line.

Coordinate and schedule ITS work with that of personnel who are constructing new bridge, road widening and overhead sign structure.

1.3. DOCUMENTATION

(A) General

Provide all as-built documentation. All as-built plans and documentation shall be reviewed and accepted by the Engineer prior to final acceptance of the project. All documentation, except as otherwise specifically approved by the Engineer, must meet the following requirements:

1. Provide any documentation that exceeds the size of 11" x 17" paper in a reproducible format 22" x 34" in size.
2. No documentation for as-built plans smaller than 8.5" x 11" will be accepted.
3. Do not fold or crease reproducibles.

As a minimum, provide the documentation described in the paragraphs below.

(B) GPS Coordinates

Provide real world coordinates for all junction boxes, CCTV poles and equipment cabinets installed or utilized under this project. Provide the coordinates in feet units using the North Carolina State Plane coordinate system (1983 North American Datum also known as NAD '83). Furnish coordinates that do not deviate more than 1.7 feet in the horizontal plane and 3.3 feet in the vertical plane. Global positioning system (GPS) equipment able to obtain the coordinate data within these tolerances may be used. Submit cut sheets on the GPS unit proposed to collect the data for approval by the Engineer.

Provide both a digital copy and hard copy of all information regarding the location (including to but not limited to manufacturer, model number, City system ID number and NCDOT inventory number) in the Microsoft Excel spreadsheet using the format shown in example below.

City System ID#	NCDOT Inv #	Name	Location	Latitude	Longitude	Manufacturer	Model #
	05-0134	Equipment Cabinet	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5500	35.6873	McCain	Type-332
	05-0134	Junction Box # 1 (Phase 2 Side)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5516	35.6879	Quazite	PG1118BA12(Box) PG118HA00(Cover)
	05-0134	Junction Box # 2 (Phase 2 Side)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5506	35.6876	Quazite	PG1118BA12(Box) PG118HA00(Cover)
	05-0134	Junction Box # 3 (Near Cabinet)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5501	35.6873	Quazite	PG1118BA12(Box) PG118HA00(Cover)
	05-0134	Junction Box # 4 (Phase 6 Side)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5486	35.6873	Quazite	PG1118BA12(Box) PG118HA00(Cover)
	05-0134	Junction Box # 5 (Phase 6 Side)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5493	35.6876	Quazite	PG1118BA12(Box) PG118HA00(Cover)
	05-0134	Junction Box # 6 (Phase 4 Side)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5503	35.6879	Quazite	PG1118BA12(Box) PG118HA00(Cover)

(C) Plan of Record Documentation

Provide as-built drawings that depict any changes of components, measurement or layout of the Plans. Show all construction changes, with the final location and depth of conduits, wiring external to the cabinet, MVD locations, etc., in detail in a reproducible format. Submit as-built construction changes as soon as a change is complete. Note and date each change on the

drawings. Failure to revise as-built documentation to reflect current work may result in withholding of payments until the as-built documentation is brought current. The submitted as-built documentation may be field-checked by the Engineer at his discretion. If the as-built documentation is found to have an unacceptable number of inaccuracies, the Engineer may withhold payment until the as-built plans are corrected.

The Department will provide the Contractor one electronic copy of the Plans for his use in developing the as-built drawings. Modify the original electronic file such that all changes are marked with callout boxes or other method approved by the Engineer. Any other base maps that may be necessary for the Contractor to prepare the as-built drawings in accordance with these Project Special Provisions will be the Contractor's responsibility. Use CADD conventions that are consistent with those used on the original plans.

Furnish one reproducible copy of the draft as-built plans in hard copy format for review. Provide draft hard copy as-built drawings on 22"x 34" bond plan sheets.

Upon receipt of review comments from the Engineer, correct any errors and make all necessary revisions to the draft as-built plans prior to final acceptance of the project. Submit final as-built plans in electronic and hard copy format. Provide electronic plans in MicroStation (latest release in use by the Department) format on CD or DVD.

1.4. TESTING

After completing the relocation of the existing ITS equipment and reconnecting cables, the Contractor shall:

- Verify that physical construction has been completed,
- Inspect the quality and tightness of ground and surge protector connections,
- Check the power supply voltages and outputs,
- Connect devices to the power sources,
- Perform continuity tests on the surveillance camera's stranded conductor element using a meter having a minimum input resistance of 20,000 ohms per volt and show that each conductor has a resistance of not more than 16 ohms per 984.3 feet of conductor;
- Measure the insulation resistance between the conductors, and between each conductor, ground, and shield using a Megger® meter. The resistance must be infinity. Perform all resistance testing after final termination and cable installation, but prior to the connection of any electronics or field devices; and
- Replace any cable that fails to meet these parameters, or if any testing reveals defects in the cable, and retest new cable as specified; and
- Verify installation of specified cables and connections between the camera, PTZ, camera control receiver, and control cabinet,
- Perform the CCTV assembly manufacturer's initial power-on test in accordance with the manufacturer's recommendation,
- Verify the presence and quality of the video image in the field cabinet with a portable NTSC-approved monitor or laptop computer
- Exercise the pan, tilt, zoom, focus, iris opening, and manual iris control selections, and the operation, preset positioning, and power on/off functions,
- Verify proper voltage of all power supplies, and

- Interconnect the communication interface device with the wireless communication network and verify that there is a transmission.
- Perform transportation management center to field device communications and control tests on the CCTV camera and the MVD units from the Division 13 office.

Test the grounding system per ANSI/IEEE C62.41 and ANSI/IEEE C62.45 as applicable. Measure the ground impedance utilizing an instrument designed specifically to measure and document the ground impedance. Provide written test results of the ground impedance for each location to the engineer prior to backfilling the grounding electrode. The test results shall include the instrument model, date of instrument calibration, and local environmental conditions at the time of testing. Certify and sign the test results by the Contractor.

Repair or replace any Contractor-furnished defective or failed equipment/materials and retest.

Test the wireless communications systems as follows:

- Check all ground, power, data, Ethernet and analog video connections,
- Run power up self test on each piece of equipment,
- Run all available vendor-supplied self-diagnostics,
- Check received signal strength, noise levels, bandwidth, and accuracy of test data transmission between each pair of nodes,
- Adjust hopping patterns as necessary to maximize the quality of the signal strength,
- If adjusting the hopping pattern does not significantly improve the quality of the signal strength, then adjust antenna as necessary to maximize the quality of the signal strength.
- Re-establish and tests communications between the field radio and the Division 13 office.

1.5. MEASUREMENT AND PAYMENT

There will be no direct payment for work covered in this section. Payment at the contract unit prices for the various items in the contract will be full compensation for all work covered by this section. Include the incidental costs for furnishing and/or installing materials and equipment expressly required under the contract for successful completion of the contract, but whose measurement and payment is not specifically stated under any of the contract pay items, into the unit cost(s) for the various items in the contract.

2. RELOCATE EXISTING ITS EQUIPMENT

2.1. DESCRIPTION

Remove an existing metal CCTV camera pole and all existing ITS equipments currently attached to the pole, relocate the pole to a new foundation at another location on the project, and reinstall the existing ITS devices on the re-erected pole and an adjacent overhead sign structure using new cables as shown in the Plans.

2.2. MATERIALS

(A) Attachment Hardware and Mounting Brackets

Reuse existing attachment hardware and mounting brackets as much as possible. Replace with equivalent materials as approved by the Engineer any mounting brackets or attachment hardware that become damaged or missing during relocation or that are too short for new location of equipment.

Furnish non-intrusive mounting brackets and 2-inch nominal diameter aluminum or galvanized steel tubing to attach MVD units to the back side of the new overhead sign structure as shown in the Plans and in accordance with the MVD manufacturer's instructions. Provide all hardware and brackets required to mount the MVD unit on the 2" diameter tubes as shown in the Plans and in accordance with the MVD manufacturer's instructions. Ensure that the mounting brackets will hold the 2" diameter tube firmly in a horizontal position parallel to the road below with the MVD unit attached and will not sag or become loose due to vibration, wind or ice loading. Submit catalog cuts and shop drawings of the proposed attachment methods and hardware for review and approval prior to installing the MVD units on the overhead sign structure.

(B) Cables

Furnish all new cables with new connectors to replace all existing cables that connect the existing antennas, CCTV camera, and MVD units with the existing electronic equipment housed inside the existing pole-mounted equipment. Furnish cables that meet or exceed the specifications of the existing cables that they are replacing. Ensure that cables meet or exceed the requirement of the manufacturer of the equipment to be connected. Provide cables of sufficient length to connect the devices to the cabinet upon relocation while providing sufficient spare (slack) cable to be stored inside the cabinet and in junction boxes to facilitate adjustments in device mounting positions. Cables may either be factory-preassembled and pre-terminated or field-terminated terminated. Be advised that the location of field devices may need to be adjusted following initial installation to provide the required performance of the device as directed by the Engineer. Provide cables of sufficient length, especially if factory preassembled, pre-terminated cables are used, to accommodate such in-field adjustments.

Provide UV-resistant, outdoor-rated RS-422 cable to connect MVD units mounted in new location on new overhead sign structure with corresponding electronic equipment housed inside existing equipment mounted on relocated metal CCTV pole nearby. Provide an RS-422 cable with an outer jacket that is light gray in color. Provide an RS-422 cable with the appropriate number and size conductors required by the MVD manufacturer. Provide appropriate male or

female RS-422 connectors for ends of each cable and terminate the conductors in the RS-422 cable to the appropriate pins on the connector in accordance with the MVD manufacturer's requirements. Furnish RS-232-to-RS-422 converters to connect the new RS-422 cable to the existing MVD units as required. Coordinate with the manufacturer of the MVD units to ensure that the RS-232-to-R-422 converters provided are compatible with and will meet or exceed the performance requirements of the existing MVD units.

Furnish UV-resistant, heat-stabilized nylon cable ties that are light gray in color and of sufficient length for lashing the RS-422 cable to the overhead sign structure.

2.3. CONSTRUCTION METHODS

(A) General

Do not disconnect, deactivate or remove any existing ITS equipment until new foundation has been completed and has reached sufficient strength to support the existing metal CCTV pole. Do not take any existing ITS equipment out of service until such time that existing pole can be relocated immediately and existing ITS equipment reinstalled and reactivated within a 24-hour period.

Do not drill any holes or create any new cable or conduit entrances in the existing metal CCTV pole or new overhead sign structure.

Repair any galvanized surfaces that become scratched or damaged during the removal, relocation and reinstallation of existing ITS equipment and poles using an Engineer-approved galvanized touch up paint and methods.

(B) Cable

Prior to disconnecting and removing existing cables, document and take digital photographs of how existing cable is connected to existing devices as a reference when installing new cables to reconnect the existing cabinet following its reinstallation in a the new locations shown in the Plans. Immediately prior to relocating existing equipment, disconnect, remove and dispose of existing cables that connect the CCTV camera, antennas and MVD units to the existing equipment cabinet.

Install the new cables inside the relocated metal CCTV pole, conduits and risers according to the latest version of the manufacturer's cable installation procedures and the industry-accepted installation standards, codes, and practices, or as directed by the Engineer. Take all precautions necessary to ensure the cable is not damaged during installation. Do not step on the cable nor run over the cable with vehicles or equipment. Do not pull the cable over or around obstructions or along the ground.

Immediately cease work and notify the Engineer and the affected owner should damage to cables or equipment occur. Make the required repairs at no additional cost to the Department.

Install new cable in continuous lengths between equipment cabinet and the field device with no splices outside cabinets. Cut cables to length to minimize coils of spare cable, but provide sufficient coil of spare cable to accommodate field adjustment of device mounting locations as directed by the Engineer. Cut outer jacket and trim conductors per manufacturer's recommendations. Install appropriate durable, outdoor rated, weathertight connectors on cables. Connect cables to appropriate connectors on relocate field devices and inside the equipment cable. Label all cables and connectors using Engineer-approved labels and labeling method.

Install underground cable as shown in the Plans using cable-pulling lubricants approved by the cable manufacturer and the Engineer. Obtain the Engineer's approval of the cable lubricant and method of pulling before the installation of underground cable.

Do not pull the cable through intermediate junction boxes, pull boxes, handholes, or openings in conduit unless otherwise approved by the Engineer.

(C) Existing Metal CCTV Pole

Have the Engineer approve the pole location prior to constructing the new foundation for the existing pole that is being relocated.

Use existing holes and weatherheads to route cables in and out the existing metal CCTV pole. Use non-intrusive methods only for attaching any new hardware and equipment to the existing metal CCTV pole. Use original attachment methods, hardware and mounting locations and orientations for reattaching existing equipment on the existing metal pole.

Do not remove the original identification tag(s) from the pole shaft. Add a new identification tag based on the new location for any reused poles.

Provide shop drawings along with new foundation design for review and approval prior to constructing the new metal pole foundation and re-installing the existing metal CCTV pole on the new foundation.

Remove all existing equipment attached to the existing metal CCTV pole, including the equipment cabinet, prior to removing the pole from its existing foundation and transporting it to its new location. Once the metal has been reinstalled on its new foundation and as approved by the Engineer, re-install all equipment previously attached to the metal CCTV pole, except for the two MVD units, at their original mounting heights and orientations using their original mounting hardware and methods.

(D) CCTV Camera

Remove the CCTV camera unit from the existing metal CCTV pole prior to relocating the pole. Once the pole has been re-erected in its new location, re-install the CCTV camera unit at its original attachment height unless directed otherwise by the Engineer. Mount the CCTV camera on the side of pole that is nearest to the intended field of view, to avoid occlusion of the view by the pole or utility lines. Obtain approval of camera orientation from the Engineer. Assemble the camera attachment hardware for the CCTV camera unit and attach to the pole using stainless steel banding approved by the Engineer.

Install the camera attachment assembly to the pole in a manner that allows for the removal and replacement of the CCTV enclosure as well as providing a weatherproof, weather-tight seal that does not allow moisture to enter the enclosure.

(E) CCTV Cabinet

Carefully remove the existing CCTV cabinet with existing equipment still housed inside from the existing metal CCTV pole prior relocating the pole to the new foundation.

Once the pole has been re-erected on its new foundation, reinstall the CCTV cabinet on the pole using approved hardware and attachment brackets. Have the Engineer approve the proposed mounting position prior to attaching the CCTV cabinet to the pole. Install new cables

and reconnect the CCTV camera cabinet to the CCTV camera assembly using the existing cables.

Ground all cabinets in accordance with the requirements of the Standard Specifications, the Roadway Standard Drawings and the Plans. Keep the ground wire from the cabinet ground bus bar to the ground rod assembly or array as short as possible. Ensure the ground wire is not in contact with any other part of the cabinet.

Neatly arrange all wiring, firmly lace or bundle it, and mechanically secure the wiring without the use of adhesive fasteners. Route and secure all wiring and cabling to avoid sharp edges and to avoid conflicts with other equipment or cabling.

(F) Antennas

Remove the existing antennas from the existing metal CCTV pole prior to relocating the pole. Once the pole has been re-erected in its new location, reattach the existing antennas at their original mounting heights and orientations and using original mounting method unless line of sight and required signal quality necessitate adjustments in mounting height. Obtain engineer's approval of any changes to mounting heights. Install new cables between the antennas and the equipment cabinet and reconnect the antennas to the radios and inside the cabinet. Orient the antennas as directed by the Engineer to re-establish wireless communications. Obtain approval of antenna orientation from the Engineer.

(G) MVD Units

Once the microwave vehicle detector (MVD) units have been removed from the existing metal CCTV pole, store them in a secure location until ready to reinstall them on the new overhead sign structure. The MVD units do not have to be reinstalled immediately upon relocation of the metal CCTV camera pole as the new overhead sign structure may not yet be installed. Install MVD units prior to reopening roadway beneath the new overhead sign structure to traffic.

Attach the new mounting brackets and arms for the relocated MVD units to the back of the new overhead sign structure as shown on the plans. Route a new outdoor rated RS-422 cable between each relocated MVD and the equipment cabinet mounted on the relocated metal CCTV pole via the horizontal members of the new overhead sign structure, a new 1-inch rigid galvanized riser with weatherhead banded to the upright of the overhead sign structure and new underground conduit as shown in the Plans. Install appropriate weathertight, outdoor rated RS-422 connectors on each end of the cables. Mount the MVD units to the 2" mounting tube in accordance with the manufacturer's instructions. Connect the RS-422 cable to the MVD unit and the corresponding equipment in the CCTV cabinet, using RS-232-to-RS-422 converters as required. Secure the RS-422 cables to the overhead sign structure by lashing it to the structure using cable ties or other Engineer-approved method.

Adjust the angle and mounting position of the MVD units as needed in accordance with the manufacturer's instructions and as directed by the engineer to provide for proper detection of the proposed traffic lanes below.

(H) Grounding

Ground all equipment as called for in the *Standard Specifications*, the Roadway Standard Drawings, these Project Special Provisions, and the Plans.

2.4. MEASUREMENT AND PAYMENT

Relocate existing ITS equipment will be paid for at the contract lump sum price. The price and payment will be full compensation for all work required to: relocate the existing metal CCTV pole to a new foundation; remove existing equipment currently mounted on the metal CCTV pole and associated cabling; dispose of existing cabling; reinstall the existing equipment on the metal pole in its new location and on the new overhead sign structure as shown in the Plans; reconnect all relocated equipment using new cabling; and return all equipment to full operations.

No separate measurement will be made for cabling, connectors, RS-232-to-RS-422 converters, cable ties, stainless steel banding hardware for attaching cabinet and devices to the metal pole and sign structure, MVD mounting hardware, brackets and arms, grounding equipment, or any other equipment or labor required to remove existing ITS equipment and existing metal CCTV from their existing location, re-install them in a new location and restore equipment operations as shown on the Plans.

Payment will be made under:

Pay Item	Pay Unit
Relocate Existing ITS Equipment	Lump Sum

3. DRILLED PIER FOUNDATION FOR METAL CCTV POLE

3.1. DESCRIPTION

Design, furnish and install reinforced concrete drilled pier foundation for a relocated existing metal CCTV pole in accordance with the Plans and this project special provision. Remove and dispose of existing metal CCTV pole foundation.

3.2. SOIL TEST AND FOUNDATION DETERMINATION

(A) General

Drilled piers are reinforced concrete sections, cast-in-place against in situ, undisturbed material. Drilled piers are of straight shaft type and vertical.

Based upon this provision and the results of the required soil test, a drilled pier length may be determined and constructed in accordance with the Plans.

(B) Soil Test

Perform soil tests at each proposed metal pole location. Complete all required fill placement and excavation at each metal pole location to finished grade before drilling each boring. Soil tests performed that are not in compliance with this requirement may be rejected and will not be paid. Drill one boring to a depth of 26 feet within a 25-foot radius at each proposed foundation.

Perform standard penetration tests (SPT) in accordance with ASTM D 1586 at depths of 1, 2.5, 5, 7.5, 10, 15, 20 and 26 feet. Discontinue the boring if one of the following occurs:

- A total of 100 blows have been applied in any 2 consecutive 6-in. intervals.
- A total of 50 blows have been applied with < 3-in. penetration.

For each boring, submit a legible (handwritten or typed) boring log signed and sealed by a licensed Geologist or Professional Engineer registered in North Carolina. Include on each boring the SPT blow counts and N-values at each depth, depth of the boring, and a general description of the soil types encountered.

1. Standard Foundation Determination:

Use the following method for determining the Design N-value:

$$N_{AVG} = \frac{(N@1' + N@2.5' + \ldots\ldots\ldots N@\text{Deepest Boring Depth})}{\text{Total Number of N-values}}$$

$$Y = (N@1')^2 + (N@2.5')^2 + \ldots\ldots\ldots (N@\text{Deepest Boring Depth})^2$$

$$Z = (N@1' + N@2.5' + \ldots\ldots\ldots N@\text{Deepest Boring Depth})$$

$$N_{STD\ DEV} = \left[\frac{(\text{Total Number of N-values} \times Y) - Z^2}{(\text{Total Number of N-values}) \times (\text{Total Number of N-values} - 1)}\right]^{0.5}$$

Design N-value equals lesser of the following two conditions:

$$N_{AVG} - (N_{STD\ DEV} \times 0.45)$$

Or

$$\text{Average of First Four N-Values} = \frac{(N@1' + N@2.5' + N@5' + N@7.5')}{4}$$

Note: If less than 4 N-values are obtained because of criteria listed in subsection 2 (Soil Test) above, use average of N-values collected for second condition. Do not include the N-value at the deepest boring depth for above calculations if the boring is discontinued at or before the required boring depth because of criteria listed in subsection 2 (Soil Test) above. Use N-value of zero for weight of hammer or weight of rod. If N-value is greater than 50, reduce N-value to 50 for calculations.

If the existing pole is a standard NCDOT pole and the contractor chooses to use standard foundations, determine a drilled pier length, "L," for each signal pole from the Standard Foundations Chart (sheet M 8) based on the Design N-value and the predominant soil type. For each standard pole location, submit a completed "Metal Pole Standard Foundation Selection Form" signed by the Contractor's representative. Signature on form is for verification purposes only. Include the Design N-value calculation and resulting drilled pier length, "L," on each form.

If the existing pole is a non-standard, site-specific pole, submit completed boring logs collected in accordance with subsection 2 (Soil Test) above along with pole loading diagrams

from the plans to the Contractor-selected pole fabricator to assist in the pole and foundation design.

If one of the following occurs, a non-standard foundation may be required. In such case, contact the Engineer.

- The Design N-value is less than 4.
- The drilled pier length, "L", determined from the Foundation Selection Table, is greater than the depth of the corresponding boring.

Foundation designs are based on level ground around the traffic signal pole. If the slope around the edge of the drilled pier is steeper than 8:1 (H:V) or the proposed foundation will be less than 10 feet from the top of an embankment slope, the Contractor is responsible for providing slope information to the foundation designer and to the Engineer so it can be considered in the design.

The "Metal Pole Standard Foundation Selection Form" may be found at:

www.ncdot.gov/doh/preconstruct/highway/geotech/formdet/misc/MetalPole.pdf

If assistance is needed with the required calculations, contact the ITS & Signals Senior Structural Engineer at (919) 661-4830. However, in no case should the failure or inability to contact the ITS & Signals Senior Structural Engineer be cause for any claims or requests for additional compensation.

3.3. CUSTOM DESIGN OF DRILLED PIER FOUNDATIONS

Design a drilled pier foundation for the existing metal CCTV pole at its new location as shown in the Plans. The Contractor is responsible for obtaining all information about the exiting metal CCTV pole and the attached CCTV camera, antennas and equipment cabinet necessary to design the new foundation for existing pole. This may include but is not limited to one or more of the following:

- Field measurement of all necessary dimensions of the existing metal CCTV pole and attached ITS equipment.
- Requesting design information from manufacturers of the following existing equipment: the metal CCTV pole; the CCTV camera assembly; the pole-mounted equipment cabinet; the two existing antennas.
- Requesting shop drawings and other design data for the existing metal CCTV pole, if available, from the ITS & Signals Senior Structural Engineer at (919) 661-4830 and/or the Division 13 Electronics Technician at (828) 298-0094.

Design all metal pole foundations using the following 4th Edition AASHTO specifications:

- Design for a 50 year service life as recommended by Table 3-3.
- Use the wind pressure map developed from 3-second gust speeds, as provided in Article 3.8.

- Ensure signal support structures include natural wind gust loading and truck-induced gust loading in the fatigue design, as provided for in Articles 11.7.3 and 11.7.4, respectively. Designs need not consider periodic galloping forces.
- Assume the natural wind gust speed in North Carolina is 11.2 mph. For natural wind fatigue stress calculations, utilize a drag coefficient (C_d) computed for 11.2 mph wind velocity and not the basic wind speed velocity.
- Design for Category II fatigue, as provided for in Article 11.6, unless otherwise specified.
- Calculate all stresses using applicable equations from Section 5. The Maximum allowable stress ratios for all signal support designs are 0.9.
- Conform to article 10.4.2 and 11.8 for all deflection requirements.

3.4. CONSTRUCTION METHODS

(A) Drilled Pier Foundation Construction

Construct drilled pier foundations in accordance with the Section 4, "Foundations and Anchor Rod Assemblies for Metal Poles", of these Project Special Provisions.

(B) Metal CCTV Pole Foundation Removal

Following the relocation of the existing metal CCTV pole, remove and promptly dispose of the metal CCTV pole foundation including reinforcing steel, electrical wires, and anchor bolts to a minimum depth of two feet below the finished ground elevation. At the Contractor's option, remove the complete foundation. Use methods to remove the foundations that will not result in damage to other portions of the project or facility. Repair damages that are a result of the Contractor's actions at no cost to the Department. Backfill and compact disturbed areas to match the finished ground elevation. Seed unpaved areas.

3.5. MEASUREMENT AND PAYMENT

Soil test will be measured and paid as the actual number of soil tests with SPT borings drilled furnished and accepted.

Drilled pier foundation will be measured and paid as the actual volume of concrete poured in cubic yards of drilled pier foundation furnished, installed and accepted.

Metal pole foundation design will be measured and paid as the actual number of designs for metal CCTV pole foundations furnished and accepted.

Metal pole foundation removal will be measured and paid as the actual number of metal signal pole foundations removed and disposed.

Payment will be made under:

Pay Item	Pay Unit
Soil Test	Each
Drilled Pier Foundation	Cubic Yard
Metal Pole Foundation Design	Each
Metal Pole Foundation Removal	Each

4. FOUNDATIONS AND ANCHOR ROD ASSEMBLIES FOR METAL POLES

SP9 R05REV

4.1. DESCRIPTION

Foundations for metal poles include foundations for signals, cameras, overhead and dynamic message signs (DMS) and high mount and low level light standards supported by metal poles or upright trusses. Foundations consist of footings with pedestals and drilled piers with or without grade beams or wings. Anchor rod assemblies consist of anchor rods (also called anchor bolts) with nuts and washers on the exposed ends of rods and nuts and a plate or washers on the other ends of rods embedded in the foundation.

Construct concrete foundations with the required resistances and dimensions and install anchor rod assemblies in accordance with the contract and accepted submittals. Construct drilled piers consisting of cast-in-place reinforced concrete cylindrical sections in excavated holes. Provide temporary casings or polymer slurry as needed to stabilize drilled pier excavations. Use a prequalified Drilled Pier Contractor to construct drilled piers for metal poles. Define "excavation" and "hole" as a drilled pier excavation and "pier" as a drilled pier.

This provision does not apply to materials and anchor rod assemblies for standard foundations for low level light standards. See Section 1405 of the *2012 Standard Specifications* and Standard Drawing No. 1405.01 of the *2012 Roadway Standard Drawings* for materials and anchor rod assemblies for standard foundations. For construction of standard foundations for low level light standards, standard foundations are considered footings in this provision.

This provision does not apply to foundations for signal pedestals; see Section 1743 of the *2012 Standard Specifications* and Standard Drawing No. 1743.01 of the *2012 Roadway Standard Drawings*.

4.2. MATERIALS

Refer to the 2012 Standard Specifications.

Item	Section
Conduit	1091-3
Grout, Nonshrink	1003
Polymer Slurry	411-2(B)
Portland Cement Concrete	1000
Reinforcing Steel	1070
Rollers and Chairs	411-2(C)
Temporary Casings	411-2(A)

Provide Type 3 material certifications in accordance with Article 106-3 of the *2012 Standard Specifications* for conduit, rollers, chairs and anchor rod assemblies. Store steel materials on blocking at least 12" above the ground and protect it at all times from damage; and when placing in the work make sure it is free from dirt, dust, loose mill scale, loose rust, paint, oil or other foreign materials. Load, transport, unload and store foundation and anchor rod assembly materials so materials are kept clean and free of damage. Damaged or deformed materials will be rejected.

Use conduit type in accordance with the contract. Use Class A concrete for footings and pedestals, Class Drilled Pier concrete for drilled piers and Class AA concrete for grade beams and wings including portions of drilled piers above bottom of wings elevations. Corrugated temporary casings may be accepted at the discretion of the Engineer. A list of approved polymer slurry products is available from:

www.ncdot.gov/doh/preconstruct/highway/geotech/leftmenu/Polymer.html

Provide anchor rod assemblies in accordance with the contract consisting of the following:

(A) Straight anchor rods,

(B) Heavy hex top and leveling nuts and flat washers on exposed ends of rods, and

(C) Nuts and either flat plates or washers on the other ends of anchor rods embedded in foundations.

Do not use lock washers. Use steel anchor rods, nuts and washers that meet ASTM F1554 for Grade 55 rods and Grade A nuts. Use steel plates and washers embedded in concrete with a nominal thickness of at least 1/4". Galvanize anchor rods and exposed nuts and washers in accordance with Article 1076-4 of the *2012 Standard Specifications*. It is not necessary to galvanize nuts, plates and washers embedded in concrete.

4.3. CONSTRUCTION METHODS

Install the required size and number of conduits in foundations in accordance with the plans and accepted submittals. Construct top of piers, footings, pedestals, grade beams and wings flat, level and within 1" of elevations shown in the plans or approved by the Engineer. Provide an Ordinary Surface finish in accordance with Subarticle 825-6(B) of the *2012 Standard Specifications* for portions of foundations exposed above finished grade. Do not remove anchor bolt templates or pedestal or grade beam forms or erect metal poles or upright trusses onto foundations until concrete attains a compressive strength of at least 3,000 psi.

(A) Drilled Piers

Before starting drilled pier construction, hold a predrill meeting to discuss the installation, monitoring and inspection of the drilled piers. Schedule this meeting after the Drilled Pier Contractor has mobilized to the site. The Resident or Division Traffic Engineer, Contractor and Drilled Pier Contractor Superintendent will attend this predrill meeting.

Do not excavate holes, install piles or allow equipment wheel loads or vibrations within 20 ft of completed piers until 16 hours after Drilled Pier concrete reaches initial set.

Check for correct drilled pier alignment and location before beginning drilling. Check plumbness of holes frequently during drilling.

Construct drilled piers with the minimum required diameters shown in the plans. Install piers with tip elevations no higher than shown in the plans or approved by the Engineer.

Excavate holes with equipment of the sizes required to construct drilled piers. Depending on the subsurface conditions encountered, drilling through rock and boulders may be required. Do not use blasting for drilled pier excavations.

Contain and dispose of drilling spoils and waste concrete as directed and in accordance with Section 802 of the *2012 Standard Specifications*. Drilling spoils consist of all materials and fluids removed from excavations.

If unstable, caving or sloughing materials are anticipated or encountered, stabilize holes with temporary casings and/or polymer slurry. Do not use telescoping temporary casings. If it becomes necessary to replace a temporary casing during drilling, backfill the excavation, insert a larger casing around the casing to be replaced or stabilize the excavation with polymer slurry before removing the temporary casing.

If temporary casings become stuck or the Contractor proposes leaving casings in place, temporary casings should be installed against undisturbed material. Unless otherwise approved, do not leave temporary casings in place for mast arm poles and cantilever signs. The Engineer will determine if casings may remain in place. If the Contractor proposes leaving temporary casings in place, do not begin drilling until a casing installation method is approved.

Use polymer slurry and additives to stabilize holes in accordance with the slurry manufacturer's recommendations. Provide mixing water and equipment suitable for polymer slurry. Maintain polymer slurry at all times so slurry meets Table 411-3 of the *2012 Standard Specifications* except for sand content.

Define a "sample set" as slurry samples collected from mid-height and within 2 ft of the bottom of holes. Take sample sets from excavations to test polymer slurry immediately after filling holes with slurry, at least every 4 hours thereafter and immediately before placing concrete. Do not place Drilled Pier concrete until both slurry samples from an excavation meet the required polymer slurry properties. If any slurry test results do not meet the requirements, the Engineer may suspend drilling until both samples from a sample set meet the required slurry properties.

Remove soft and loose material from bottom of holes using augers to the satisfaction of the Engineer. Assemble rebar cages and place cages and Drilled Pier concrete in accordance with Subarticle 411-4(E) of the *2012 Standard Specifications* except for the following:

(1) Inspections for tip resistance and bottom cleanliness are not required,
(2) Temporary casings may remain in place if approved, and
(3) Concrete placement may be paused near the top of pier elevations for anchor rod assembly installation and conduit placement or
(4) If applicable, concrete placement may be stopped at bottom of grade beam or wings elevations for grade beam or wing construction.

If wet placement of concrete is anticipated or encountered, do not place Drilled Pier concrete until a concrete placement procedure is approved. If applicable, temporary casings and fluids may be removed when concrete placement is paused or stopped in accordance with the exceptions above provided holes are stable. Remove contaminated concrete from exposed Drilled Pier concrete after removing casings and fluids. If holes are unstable, do not remove temporary casings until a procedure for placing anchor rod assemblies and conduit or constructing grade beams or wings is approved.

Use collars to extend drilled piers above finished grade. Remove collars after Drilled Pier concrete sets and round top edges of piers.

If drilled piers are questionable, pile integrity testing (PIT) and further investigation may be required in accordance with Article 411-5 of the *2012 Standard Specifications*. A drilled pier will be considered defective in accordance with Subarticle 411-5(D) of the *2012 Standard Specifications* and drilled pier acceptance is based in part on the criteria in Article 411-6 of the *2012 Standard Specifications* except for the top of pier tolerances in Subarticle 411-6(C) of the *2012 Standard Specifications*.

If a drilled pier is under further investigation, do not grout core holes, backfill around the pier or perform any work on the drilled pier until the Engineer accepts the pier. If the drilled pier is accepted, dewater and grout core holes and backfill around the pier with approved material to finished grade. If the Engineer determines a pier is unacceptable, remediation is required in accordance with Article 411-6 of the *2012 Standard Specifications*. No extension of completion date or time will be allowed for remediation of unacceptable drilled piers or post repair testing.

Permanently embed a plate in or mark top of piers with the pier diameter and depth, size and number of vertical reinforcing bars and the minimum compressive strength of the concrete mix at 28 days.

(B) Footings, Pedestals, Grade Beams and Wings

Excavate as necessary for footings, grade beams and wings in accordance with the plans, accepted submittals and Section 410 of the *2012 Standard Specifications*. If unstable, caving or sloughing materials are anticipated or encountered, shore foundation excavations as needed with an approved method. Notify the Engineer when foundation excavation is complete. Do not place concrete or reinforcing steel until excavation dimensions and foundation material are approved.

Construct cast-in-place reinforced concrete footings, pedestals, grade beams and wings with the dimensions shown in the plans and in accordance with Section 825 of the *2012 Standard Specifications*. Use forms to construct portions of pedestals and grade beams protruding above finished grade. Provide a chamfer with a 3/4" horizontal width for pedestal and grade beam edges exposed above finished grade. Backfill and fill in accordance with Article 410-8 of the *2012 Standard Specifications*. Proper compaction

around footings and wings is critical for foundations to resist uplift and torsion forces. Place concrete against undisturbed soil and do not use forms for standard foundations for low level light standards.

(C) Anchor Rod Assemblies

Size anchor rods for design and the required projection above top of foundations. Determine required anchor rod projections from nut, washer and base plate thicknesses, the protrusion of 3 to 5 anchor rod threads above top nuts after tightening and the distance of one nut thickness between top of foundations and bottom of leveling nuts.

Protect anchor rod threads from damage during storage and installation of anchor rod assemblies. Before placing anchor rods in foundations, turn nuts onto and off rods past leveling nut locations. Turn nuts with the effort of one workman using an ordinary wrench without a cheater bar. Report any thread damage to the Engineer that requires extra effort to turn nuts.

Arrange anchor rods symmetrically about center of base plate locations as shown in the plans. Set anchor rod elevations based on required projections above top of foundations. Securely brace and hold rods in the correct position, orientation and alignment with a steel template. Do not weld to reinforcing steel, temporary casings or anchor rods.

Install top and leveling (bottom) nuts, washers and the base plate for each anchor rod assembly in accordance with the following procedure:

(1) Turn leveling nuts onto anchor rods to a distance of one nut thickness between the top of foundation and bottom of leveling nuts. Place washers over anchor rods on top of leveling nuts.

(2) Determine if nuts are level using a flat rigid template on top of washers. If necessary, lower leveling nuts to level the template in all directions or if applicable, lower nuts to tilt the template so the metal pole or upright truss will lean as shown in the plans. If leveling nuts and washers are not in full contact with the template, replace washers with galvanized beveled washers.

(3) Verify the distance between the foundation and leveling nuts is no more than one nut thickness.

(4) Place base plate with metal pole or upright truss over anchor rods on top of washers. High mount luminaires may be attached before erecting metal poles but do not attach cables, mast arms or trusses to metal poles or upright trusses at this time.

(5) Place washers over anchor rods on top of base plate. Lubricate top nut bearing surfaces and exposed anchor rod threads above washers with beeswax, paraffin or other approved lubricant.

(6) Turn top nuts onto anchor rods. If nuts are not in full contact with washers or washers are not in full contact with the base plate, replace washers with galvanized beveled washers.

(7) Tighten top nuts to snug-tight with the full effort of one workman using a 12" wrench. Do not tighten any nut all at once. Turn top nuts in increments. Follow a star pattern cycling through each nut at least twice.

(8) Repeat (7) for leveling nuts.

(9) Replace washers above and below the base plate with galvanized beveled washers if the slope of any base plate face exceeds 1:20 (5%), any washer is not in firm contact with the base plate or any nut is not in firm contact with a washer. If any washers are replaced, repeat (7) and (8).

(10) With top and leveling nuts snug-tight, mark each top nut on a corner at the intersection of 2 flats and a corresponding reference mark on the base plate. Mark top nuts and base plate with ink or paint that is not water-soluble. Use the turn-of-nut method for pretensioning. Do not pretension any nut all at once. Turn top nuts in increments for a total of one flat (1/6 revolution) for anchor rod diameters greater than 1 1/2" and 2 flats (1/3 revolution) for anchor rod diameters 1 1/2" or less. Follow a star pattern cycling through each top nut at least twice.

(11) Ensure nuts, washers and base plate are in firm contact with each other for each anchor rod. Cables, mast arms and trusses may now be attached to metal poles and upright trusses.

(12) Between 4 and 14 days after pretensioning top nuts, use a torque wrench calibrated within the last 12 months to check nuts in the presence of the Engineer. Completely erect mast arm poles and cantilever signs and attach any hardware before checking top nuts for these structures. Check that top nuts meet the following torque requirements:

TORQUE REQUIREMENTS

Anchor Rod Diameter, inch	Requirement, ft-lb
7/8	180
1	270
1 1/8	380
1 1/4	420
≥ 1 1/2	600

If necessary, retighten top nuts in the presence of the Engineer with a calibrated torque wrench to within ± 10 ft-lb of the required torque. Do not overtighten top nuts.

(13) Do not grout under base plate.

4.4. MEASUREMENT AND PAYMENT

Foundations and anchor rod assemblies for metal poles and upright trusses will be measured and paid for elsewhere in the contract.

No payment will be made for temporary casings that remain in drilled pier excavations. No payment will be made for PIT. No payment will be made for further investigation of defective piers. Further investigation of piers that are not defective will be paid as extra work in accordance with Article 104-7 of the *2012 Standard Specifications*. No payment will be made for remediation of unacceptable drilled piers or post repair testing.

5. ELECTRICAL SERVICE

5.1. DESCRIPTION

At locations called out in the Plans, install a new electrical service, including an external disconnect and meter base.

5.2. MATERIALS

(A) Electrical Service

Material, equipment and hardware furnished under this section must be pre-approved on the Department's QPL by the date of equipment installation.

Provide all materials necessary to form a complete electrical service assembly as shown in the Plans. Furnish new external electrical service disconnects, meter bases and grounding electrode system as well as electrical service conductors and conduits between the disconnect and the equipment cabinet as required.

Furnish external electrical service disconnects with single pole 20 A inverse time circuit breaker with at least 10,000 RMS symmetrical amperes short circuit rating in a lockable NEMA 3R enclosure. Ensure service disconnects are listed as meeting UL Standard UL-489 and marked as being suitable for use as service equipment. Fabricate enclosure from galvanized steel and electrostatically apply dry powder paint finish, light gray in color, to yield a minimum thickness of 2.4 mils. Provide ground bus and neutral bus with at least 4 terminals with minimum wire capacity range of number 14 through number 4.

Furnish NEMA Type 3R meter base rated 100 A minimum that meets the requirements of the local utility. Provide meter base with ampere rating of meter sockets based on sockets being wired with insulated wire rated at least 167 degrees F.

Furnish 4 terminal, 600 volt, single phase, 3 wire meter base with the following:

(1) Line, Load, and Neutral Terminals accept #8 to 2/0 AWG copper/aluminum wire;
(2) Ringed or ringless type, with or without bypass;
(3) Made of galvanized steel;
(4) Listed as meeting UL Standard UL-414; and
(5) Overhead or underground service entrance as specified.

Furnish 1" watertight hub for threaded rigid conduit with meter base.

Equip each meter base with a rigid, durable temporary cover (e.g., plywood, acrylic, sheet metal, fiberglass, etc.) over the opening to block access to the wiring inside until the meter is attached to the meter base by the power company. Do not use cardboard, sheet plastic, tape, etc. to cover the opening.

If meter base and electrical service disconnect are supplied in the same enclosure (i.e., combination panel), ensure assembly is marked as being suitable for use as service equipment. Ensure combination meter and disconnect mounted in a pedestal for underground service is listed as meeting UL Standard UL-231. Otherwise, ensure combination meter and disconnect is listed as meeting UL Standard UL-67.

Provide a grounding electrode system at all new electrical services. In addition to NEC requirements, test grounding electrode resistance for a maximum of 20 ohms. Furnish and install additional ground rods to grounding electrode system as necessary to meet test requirements.

Follow test equipment's procedures for measuring grounding electrode resistance. When using clamp-type ground resistance meters, readings of less than 1 ohm typically indicate a ground loop. Rework bonding and grounding circuits as necessary to remove ground loop circuits and retest. If a ground loop cannot be identified and removed to allow the proper use of a clamp-type ground resistance meter, use the three-point test method.

Submit a completed Inductive Loop & Grounding Test Form available on the Department's website. The form is located on the Department's website at:

www.ncdot.gov/doh/preconstruct/traffic/ITSS/ws/signal_data.xls

Provide a length of marker tape 6 to 12 inches below finished grade directly over grounding electrodes and conductors.

5.3. CONSTRUCTION METHODS

(A) General

All work involving electrical service shall be coordinated with the appropriate electric utility company. Coordinate with the utility company to ascertain the feasibility of installing electrical service at each location before performing any work. Obtain all required local permits before beginning work.

Run service conductors separately from all other conductors in a 1-inch rigid galvanized conduit. Do not allow service conductors to share conduits with any other conductors or cables. Do not route unfused electrical service conductors inside of metal poles.

(B) New Electrical Service for CCTV

At locations identified in the Plans, install new electrical service for a CCTV cabinet in accordance with the details shown in the Plans. Install a new electrical service comprised of an external service disconnect and a meter base housed in a combination panel. If source power lines are overhead (i.e., aerial feed) , install a wood service pole near the relocated metal CCTV pole at a location approved by the engineer, then mount the combination panel on the nearby service pole. If the power company provides an underground service feed, install a free-standing, combination panel with pedestal extension in the ground adjacent to the relocated metal CCTV pole at a location approved by the Engineer. After installation of the meter base, the local

power company will transfer the existing meter or install a new meter and make any necessary connections to the power lines.

5.4. MEASUREMENT AND PAYMENT

New electrical service will be measured and paid for as the actual number of complete, functional electrical service locations furnished, installed and tested.

No measurement will be made of short risers (i.e., from disconnect to underground conduit and from underground conduit to bottom of cabinet), meter bases, service disconnects, underground conduit runs for service conductors between the service disconnect and the CCTV cabinet, acquisition of service fees, electrical service conductors, grounding electrode, ground wire and any remaining hardware and conduit to connect the electrical service to the cabinet as they will be considered incidental to furnishing and installing new electrical service.

No measurement will be made of risers with weatherheads for electrical service as they will be considered incidental to furnishing and installing a new electrical service. No measurement will be made of rigid, durable temporary covers for meter bases as they will be considered incidental to furnishing and installing a new electrical service.

Wood service poles for electrical service supplied from an overhead power source will be measured and paid for in accordance with the Section 1720, "Wood Poles", of the *Standard Specifications*.

Payment will be made under:

Pay Item	**Pay Unit**
New Electrical Service	Each