

CATEGORY 800

TRAFFIC

SECTION 801 - CONCRETE FOUNDATIONS

801.01 DESCRIPTION. This work shall consist of constructing concrete foundations for installing traffic signals, highway lighting and signs at locations specified in the Contract Documents or as directed by the Engineer.

801.02 MATERIALS.

Curing Materials	902.07.03
Concrete Mix No.2	902.10.03
Corrugated Metal Pipe	905
Reinforcement Steel	908.01
Anchor Bolts	909.07
Conduit	921.07
Galvanizing for Hardware	A 153

801.03 CONSTRUCTION.

801.03.01 Excavation. The Contractor shall perform all excavation to neat lines for the levels and dimensions specified in the Contract Documents. All excavation work will be inspected and approved by the Engineer before proceeding with construction.

801.03.02 Galvanized parts that have been cut or chipped to bare metal shall be repaired as specified in A 780.

801.03.03 Concrete Placement. It is intended that all concrete be placed against undisturbed earth. However, where the existing ground will not retain its shape during or after excavation or if the excavation should show any tendency to cave in before placing the foundation, the Contractor shall provide and install a corrugated metal pipe to retain the earth and receive the concrete. The pipe shall remain in place.

Concrete shall be mixed, placed and tested as specified in Section 414. Footings including reinforcement and bolt circle data shall be as specified in the Contract Documents or in conformance with approved working drawings. Anchor bolts shall be plumb. Suitable templates for setting anchor bolts shall be accurately placed and left in place until the concrete has attained its initial set.

Tops of foundations shall be screeded to a dense smooth finish. Exposed surfaces shall be cured by use of a liquid membrane curing compound.

801.03.04 Unusual Soil Conditions. If unexpected subsurface conditions are encountered, the excavation depth shall be modified as directed by the Engineer. Rock or boulders which cannot be removed by ordinary means shall be removed to the levels and dimensions specified in the Contract Documents, or to a depth necessary to obtain the required stability as directed by the Engineer.

801.03.05 Backfill. Material used for backfill shall be free of topsoil, organic, frozen, or other undesirable material. Spaces to be backfilled shall be kept free of trash and shall be cleaned before backfill is placed. Backfill material shall be suitable material from the excavation or other sources conforming to Section 207. All backfill shall be compacted in layers not exceeding 8 in. (200 mm) loose thickness. Compaction shall be done with mechanical or vibratory compaction equipment to obtain at least 92 percent of maximum density at a moisture content within 2 percent of the optimum in conformance with T 180, Method C.

801.04 MEASUREMENT AND PAYMENT. Concrete Foundations for installing traffic signals, highway lighting and signs will be measured and paid for at the Contract unit price per cubic yard for the pertinent concrete foundation item specified in the Contract Documents. The payment will be full compensation for all concrete, excavation, corrugated metal pipe or forms, reinforcement steel, anchor bolts, backfill and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Concrete barrier transitions, conduit, and grounding, if required, will be measured and paid for as specified in the applicable Sections of 611, 802, 803, 804, 805, 808, 816 and 818.

SECTION 802 - GALVANIZED STEEL BEAM SIGN POSTS

802.01 DESCRIPTION. This work shall consist of furnishing and installing galvanized steel beam sign posts as specified in the Contract Documents or as directed by the Engineer.

802.02 MATERIALS.

Bolts, Nuts and Washers	909.07
Galvanizing for Beams	A 123
Galvanizing for Hardware	A 153
Steel Beams	A 709

802.03 CONSTRUCTION. Galvanized parts that have been cut or chipped to bare metal shall be repaired as specified in A 780.

Galvanized steel beam sign posts shall be placed in the ground in a plumb position to the lateral orientation specified in the Contract Documents.

802.04 MEASUREMENT AND PAYMENT. Galvanized Steel Beam Sign Posts will be measured and paid for at the Contract unit price per linear foot for the various sizes of posts specified in the Contract Documents. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Breakaway Base Support Systems, if required in the Contract Documents, will be measured and paid for as specified in Section 821.

SECTION 803 - OVERHEAD SIGN STRUCTURES

803.01 DESCRIPTION. This work shall consist of furnishing and constructing overhead sign structures and other appurtenances as specified in the Contract Documents or as directed by the Engineer. Sign panels, electrical work, luminaires, and foundations are excluded.

803.02 MATERIALS.

Bolts, Nuts and Washers	909.07
Overhead Sign Structures	950.04
Galvanizing for Overhead Sign Structures	A 123
Galvanizing for Hardware	A 153

803.03 CONSTRUCTION. All welding shall be done in the shop as specified in Section 408.

All assemblies and tubular members shall be designed and manufactured as specified in A 385 to permit hot dip galvanizing. All holes required in the supports shall be made before galvanizing. The surfaces shall be protected during transportation and handling.

The structure shall be free from sharp edges and irregularities and from misfits or structural deficiencies. After erection and before final acceptance, the Contractor shall repair or replace damaged surfaces in a manner acceptable to the Engineer.

803.04 MEASUREMENT AND PAYMENT. Overhead Sign Structures will be measured and paid for at the Contract unit price per each. The payment will be full compensation for all overhead sign structures, sign/luminaire supports, nuts and washers, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 804 - GROUNDING

804.01 DESCRIPTION. This work shall consist of furnishing and installing grounding systems as specified in the Contract Documents or as directed by the Engineer. The grounding system shall conform to the latest edition of the National Electrical Code (NEC) and to the latest edition of the National Electric Safety Code (NESC).

804.02 MATERIALS.

Ground Wire and Rods	950.06.04
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804.03 CONSTRUCTION.

804.03.01 Equipment Grounding System. Equipment Grounding System shall consist of the ground wire, electrically continuous metallic conduit system, grounding conductors, ground rods and terminations. Every item of equipment served by the electrical system shall be bonded to the equipment grounding system.

804.03.02 Grounding Conductors. Grounding Conductors shall be of the size and type specified in the Contract Documents.

804.03.03 Ground Rods. Ground rods shall be installed as specified in the Contract Documents. Maximum acceptable earth resistance value shall be 25 ohms. Ground resistance of each rod shall be measured before connecting the rod to the grounding conductor. If the measured resistance exceeds 25 ohms, a 10 ft (3.3 m) extension rod shall be exothermically welded to the top of the first rod, then driven to its full depth. Earth resistance shall again be measured, and if it still exceeds 25 ohms, the Engineer shall be contacted for instructions.

Where rock is encountered and acceptable earth grounds cannot be accomplished by driving as described above, the Engineer may direct the use of a grounding grid utilizing direct buried rods exothermically welded end to end to bond lighting standards and structures in continuous series to some point where an acceptable earth ground can be obtained.

804.03.04 Continuity. Continuity of the equipment grounding system shall be maintained throughout the project.

804.03.05 Terminations. Connection to equipment grounding system shall be made with suitable lugs at all grounding bushings specified in Section 805, and at the ground lugs in lighting structure access holes, or to grounding lugs in breakaway base. Connections to ground rods shall be as specified in the Contract Documents. Connections to neutral grounding systems shall be made with lugs, as specified in Section 805.

804.03.06 Testing. Testing shall conform to Section 820.

804.04 MEASUREMENT AND PAYMENT. Ground Rods, unless otherwise specified, will be measured and paid for at the Contract unit price per each 10 foot length. The payment will be full compensation for all rods, lugs, driving rods, excavation, backfill, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Ground wire will be measured and paid for as specified in 810.04.01.

SECTION 805 - ELECTRICAL CONDUIT AND FITTINGS

805.01 DESCRIPTION. This work shall consist of furnishing and installing electrical conduit and fittings as specified in the Contract Documents or as directed by the Engineer. The requirements of Section 820 shall be a part of this Specification.

805.02 MATERIALS.

Concrete	902.10.03
Metallic Conduit and Fittings	921.07.01
Nonmetallic Conduit and Fittings	921.07.02
Flexible Conduit and Fittings	921.07.02
PVC Coated Metallic Conduit and Fittings	921.07.03

805.03 CONSTRUCTION.

805.03.01 Bends. Unless otherwise specified in the Contract Documents, changes in direction of conduit shall be accomplished by use of manufactured bends or by field bends conforming to NEC requirements unless otherwise specified.

805.03.02 Connections. Conduit runs shall be made with as few couplings as standard length will permit. Rigid steel conduit connections shall be threaded. Field cut threads of galvanized conduit shall be painted with an approved galvanizing repair paint prior to assembly. Nonmetallic conduit shall be connected by a solvent welding process. Fittings for Electrical Metallic Tubing (EMT) conduit shall be watertight cast ferrous compression type.

805.03.03 Conduit Terminations. Pull boxes or conduit bodies shall be used at conduit terminations. Conduits terminating in cast iron junction boxes shall be threaded into hubs with bonding screws furnished and installed on the interior of the box. Conduits terminating in junction boxes without hubs shall be secured with two lock nuts with an insulated grounding bushing furnished and installed. Conduits terminating at concrete foundations and manholes or handholes shall be secured as specified in the Contract Documents. All ends of unused conduit shall be capped.

805.03.04 Cleaning and Capping. Prior to installation of conductors in any run, the conduit shall be checked for cleanliness and all obstructions removed. Each conduit run and all fittings shall be cleaned of all debris by a pull through mandrel type device inserted in the presence of the Engineer. All ends of conduits shall be capped by use of a manufactured cap or plug. Prior to the installation of wiring, manufactured caps or plugs shall be removed and an insulated bonding bushing for GRC, or Bellend fittings for PVC conduit installed.

805.03.05 Pull Wire. After installation, all conduit which will be left empty shall have a pull wire or cord installed. Pull wire or cord shall be made of corrosion resistant material with a minimum breaking strength of 200 lb (91 kg).

805.03.06 Exposed Conduit. Exposed conduit runs shall be parallel to, or at right angles to, walls, slabs, girders, etc. Conduit shall be located to minimize accumulation of dirt and to provide accessibility for painting. Unless otherwise specified in the Contract Documents, conduit shall be attached to steel, concrete, masonry or timber by straps, clamps or hangers of an approved type made of stainless steel or galvanized malleable iron. Spacing of attachments shall be as specified or as directed by the Engineer. When specified, all exposed rigid steel conduit surfaces shall be painted to match the color of adjacent material. All galvanized surfaces shall be prepared as specified in Section 413 before the application of paint approved by the Engineer.

805.03.07 Expansion Joints. Where conduits cross expansion joints in the structure, or where otherwise specified, expansion fittings shall be of the type which assures electrical continuity across the joint.

805.03.08 Buried Conduit. Unless otherwise specified, conduit shall have a minimum cover of 24 in. (600 mm) and shall slope to drain.

805.03.09 Encased Conduit. Conduit to be encased in concrete shall be accurately placed and rigidly held in position so that line and grade are maintained when concrete is placed.

805.03.10 Conduit Installation Under Existing Paved Areas. Except as otherwise specified in the Contract Documents, all conduit placed under existing pavement shall be installed with no disturbance to the existing roadway.

805.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all excavation, backfill, concrete, hot mix asphalt, attachments, hangers, paint, bends, connections, fittings, pull wires and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

805.04.01 Electrical Conduit and Fittings and Electrical Conduit and Fittings Attached to Bridges will be measured and paid for at the Contract unit price per linear foot, complete in place, measured along the center line of the conduit from end to end.

805.04.02 Junction Boxes will be measured and paid for as specified in Section 811.

805.04.03 Electrical conduit and fittings and junction boxes to be constructed into concrete structures will not be measured but the cost will be incidental to the pertinent Concrete Traffic Barrier, Concrete Parapet, and Bridge Wing Wall items specified in the Contract Documents.

SECTION 806 - LUMINAIRES AND LAMPS

806.01 DESCRIPTION. This work shall consist of furnishing and installing luminaires and lamps. The requirements of Section 820 shall be a part of this Specification.

806.02 MATERIALS.

Luminaires and Lamps

950.12

806.03 CONSTRUCTION.

806.03.01 Arm Mounted Luminaires. Luminaire mounting shall be installed on the respective structures and adjusted as specified in the Contract Documents. The socket positions shall be adjusted to provide the required photometric performance.

806.03.02 Bridge Underpass Luminaires. Bridge underpass luminaires shall be installed on structures as specified in the Contract Documents. Luminaires shall be connected and lamp sockets adjusted where necessary as specified in the manufacturer's recommendations.

806.03.03 Cleaning. After installation has been completed and prior to the 30 days performance test, refractors and reflectors shall be cleaned with a product approved for use by the manufacturer.

806.03.04 Installation. All luminaires and lamps shall be furnished and installed as specified in the Contract Documents.

806.04 MEASUREMENT AND PAYMENT. Luminaires will be measured and paid for at the Contract unit price per each. The payment will be full compensation for luminaires, lamps, ballast, mounting hardware, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 807 - CONTROL AND DISTRIBUTION EQUIPMENT

807.01 DESCRIPTION. This work shall consist of furnishing and installing control and distribution equipment necessary to provide a power supply as specified in the Contract Documents or as directed by the Engineer. Requirements of Section 820 shall be a part of this Specification.

807.02 MATERIALS.

Control and Distribution Equipment

950.13

807.03 CONSTRUCTION. The Contractor shall furnish and install all control and distribution equipment, including equipment enclosures, panel boards, transformers, circuit breakers, contactors, photoelectric controls, thermostats, selector switches, fans, disconnects, lightning arresters, conduit, wiring and wiring devices, and all other equipment necessary to provide complete functioning control and distribution centers as specified in the Contract Documents.

The concrete foundation shall be cast in-place to the dimensions specified in the Contract Documents and shall conform to Section 801.

The control equipment cabinet shall be installed and anchored to the foundation as specified in the Contract Documents.

The Contractor shall make certain that all interconnecting wiring between devices and equipment cabinets and the noncurrent carrying parts of all devices in the cabinet shall be connected to the ground rod as specified in the Contract Documents or as directed by the Engineer.

807.04 MEASUREMENT AND PAYMENT.

807.04.01 Control and Distribution Equipment will be measured and paid for at the Contract unit price per each. The payment will be full compensation for all enclosures, panel boards, transformers, circuit breakers, contactors, photoelectric controls, thermostats, fans, selector switches, disconnects, lightning arresters, internal wiring, wiring devices, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

807.04.02 Concrete Foundation will be measured and paid for as specified in Section 801.

807.04.03 Conduit will be measured and paid as specified in Section 805.

SECTION 808- LIGHTING STRUCTURES

808.01 DESCRIPTION. This work shall consist of furnishing and installing low level steel and aluminum lighting poles, bracket arms and fittings, as specified in the Contract Documents or as directed by the Engineer. Concrete foundations are excluded.

808.02 MATERIALS.

Cast Iron	909.04
Hardware	909.09
Painting	912
Conduit	921.07
Lighting Structures	950.07
Galvanization	A 123
Stainless Steel Hardware	A 167, Type 302
Aluminum Castings	B 26 or B 108, alloy 356-T6
Anchor Base Plate for Aluminum Structures	B 209, 6000 series alloy

808.03 CONSTRUCTION. All fabrication and welding shall conform to Section 408. After forming and welding, the pole shall have a smooth finish with only one longitudinal and no transverse welds. Each lighting structure, when fully assembled, shall be installed so that the pole is vertical.

All welding for aluminum poles shall be metallic arc consumable electrode inert gas shielded process. After welding, the entire assembly shall be precipitation heat treated to the T-6 temper by an approved method and rotary sand finished.

All aluminum poles shall be furnished with internal vibration dampening devices.

Bracket Arms. The bracket arm shall be secured to the poles as specified in the manufacturer's recommendations. Each bracket arm shall be perpendicular to the travel lane of roadway, unless otherwise specified.

Concrete foundations shall be as specified in Section 801.

808.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

808.04.01 Lighting Structures will be measured and paid for at the Contract unit price per each pole height, bracket arm length and material type.

808.04.02 Concrete Foundation will be measured and paid for as specified in Section 801.

808.04.03 Breakaway Base Support Systems, if required in the Contract Documents, will be measured and paid for as specified in Section 821

SECTION 809 - TRENCHING AND BACKFILLING

809.01 DESCRIPTION. This work shall consist of excavating and backfilling trenches to the width required to receive underground conduit, wire, or duct cable for traffic control devices as specified in the Contract Documents or as directed by the Engineer.

809.02 MATERIALS.

Backfill	950.05
Conduit Detection Tape	950.11

809.03 CONSTRUCTION. Trenches shall be excavated to the dimensions and lines specified and shall conform to Section 404.

In areas where conduit is trenched, a detector tape shall be placed in the trench at a depth of 6 in. (150 mm) below the finished grade. The color of the tape shall be red. The tape shall be imprinted with a continuous warning message that reads “**CAUTION: SHA ELECTRICAL LINE BURIED BELOW;**” repeated every 36 in. (900 mm). The tape shall be inductively and conductively traceable using a standard pipe and cable locating device.

Cable Treatment. The duct cable and direct buried wires shall be bedded into the special backfill material as specified in the Contract Documents.

Backfill. The trench shall be backfilled and compacted as specified in Section 801 and restored to its original condition, including replacing topsoil, reseeding, and resodding where directed by the Engineer.

All excess or unsuitable material shall be disposed of as specified in Section 404.

809.04 MEASUREMENT AND PAYMENT. Trenching and Backfilling will not be measured but the cost will be incidental to the Contract unit price for the installation of the pertinent conduit, detector tape, wire, or duct cable.

SECTION 810 - ELECTRICAL CABLE, WIRE, AND CONNECTORS

810.01 DESCRIPTION. This work shall consist of furnishing and installing loop detector wires and leads, electrical cable, cable ducts, wire and associated connectors of the type and at the locations specified in the Contract Documents or as directed by the Engineer.

810.02 MATERIALS.

Electrical Cable and Wire	950.06
Cable and Wire Connectors	950.14

810.03 CONSTRUCTION. The Contractor shall furnish and install copper conductor wire and cable of the types and sizes and at the locations specified in the Contract Documents. No splicing will be permitted for cables unless specified in the Contract Documents. When specified, lighting cable splices will be permitted only in junction and pull boxes and handholes. Cable shall not be installed until the entire related raceway, including manhole, handhole, and foundation system is in place. A 6 ft (2 m) cable slack

shall be provided neatly tied, coiled and positioned in the bottom of the handholes and manholes. Eight inch (200 mm) drip loops shall be provided at all overhead entrance points into structures.

810.03.01 Direct Burial Cable. Direct burial cable shall be installed to the depth of cover specified in the Contract Documents. Backfill shall conform to 801.03.05.

810.03.02 Cable in Conduits. Cable in conduits shall be installed in a manner and by methods to prevent harmful stretching of the conductor, injury to the insulation, or damage to the other protective covering. The ends of all cables shall be sealed until ready for connection. Where more than one wire or cable is to be installed in a single duct or conduit, they shall be pulled into the conduits by hand or power winch with the use of cable grips or pulling eyes. Pulling tension shall be governed by recommended standard procedures for straight pulls or bends. A lubricant shall be used.

810.03.03 Preassembled Cable Duct. Prior to installation, the cable duct shall be payed out from its reel as the reel is moved alongside and parallel to the trench. Cable duct shall not be pulled off a reel located in a stationary position. The cable shall be installed using cable grip in a manner that will not stress conductors, insulation, or sheath wall.

After backfilling the Contractor shall demonstrate that the conductors move freely within the duct by pulling the conductors out a minimum length of 2 ft (0.6 m). Pulling tensions shall conform to 810.03.02. The cable shall then be pulled to its original position. Cable duct ends shall be completely sealed with a waterproof removable sealing compound, molded plastic or rubber device.

810.03.04 Cable in Lighting Structures. The cable shall be supported at each luminaire with a suitable clamp as an integral part of the luminaire or a device approved by the Engineer for the application.

810.03.05 Identification Tags. Identification tags for circuit wiring in all handholes, junction boxes, and control cabinets shall be furnished and installed. Nonconductive identifying bands shall be nylon, self clinching type with adequate sized tab for labeling. Each band shall be marked using 1/4 in.

(6 mm) minimum lettering dies, engraving device or other permanent marking process approved by the Engineer. Bands shall indicate circuit number for lighting systems, terminal block position for loop detector cables, and traffic signal phase for all other signal cables.

810.03.06 Loop Detector Wire and Loop Detector Lead-in. Prior to the installation of loop wires, the road surface shall be free of any saw cut debris and be dry. Loop detector wire cable shall be twisted five turns per foot (0.3 m) from the loop itself to the terminal point. Loop detector wire shall be installed at the bottom of the saw cut. A blunt instrument shall be used to seat the loop detector wire at the bottom of the saw cut. Loop detector wire shall be spliced to loop detector lead-in as specified in the Contract Documents.

810.03.07 Grounding Wire. Grounding wire shall be furnished and installed as specified in Section 804.

810.03.08 Connector Kits. Connector kits shall be furnished and installed as required for the types of cables specified in the Contract Documents and shall conform to the manufacturer's recommendations.

810.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all cable, preassembled cable ducts, wire, lubricants, splices, identification tags, trench excavation and backfill, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

810.04.01 Electrical Cable, Cable Ducts, Loop Detector Wire and Loop Detector Lead-in Cable, Grounding Wire and Wire will be measured and paid for at the Contract unit price per linear foot for the type and sizes specified in the Contract Documents.

810.04.02 Connector Kits will be measured and paid for at the Contract unit price per each type.

SECTION 811 - ELECTRICAL HANDHOLES, MANHOLES, PULL AND JUNCTION BOXES

811.01 DESCRIPTION. This work shall consist of furnishing and install-

ing electrical handholes, manholes, pull and junction boxes as specified in the Contract Documents or as directed by the Engineer.

811.02 MATERIALS.

811.02.01 Handholes.

Concrete	902.10.03
Brick	903.02
Bolts	A 276, Type 304
Frames and Covers	AISC 1020 Steel
Precast Concrete	M 199

811.02.02 Manholes.

Reinforced Concrete Pipe	905
Cast Iron Manhole Covers	909.04
Polyethylene (PE)	921.10
Precast Concrete	M 199

811.02.03 Pull and Junction Boxes.

Steel Plate	909.02
Cast Iron	909.04

811.03 CONSTRUCTION.

811.03.01 Handholes and Manholes. Handholes and manholes shall be installed flush to drain with finished grade. Concrete shall be mixed, placed and tested as specified in Section 414. Excavation and backfill shall conform to Section 809. When handholes and manholes are installed in sidewalks, the sidewalk shall be removed and reinstalled to the nearest joint.

Spaces between conduit and the handhole and manhole wall shall be filled or patched with concrete or other sealer as directed by the Engineer.

Handhole and manhole frames shall be set in a mortar or concrete bed as shown in the Contract Documents.

811.03.02 Pull and Junction Boxes. Pull and junction boxes shall be of the size and type specified, but in no case smaller than required by the NEC. Conduit entrance shall be provided with conduit hubs or bosses of sufficient thickness that five full threads of the conduit shall engage the threaded holes in the box.

Concrete shall be mix No. 2 unless otherwise specified in the Contract Documents.

811.04 MEASUREMENT AND PAYMENT. Electrical Handholes, Manholes, and Pull and Junction Boxes will be measured and paid for at the Contract unit price per each unless otherwise specified in the Contract Documents. The payment will be full compensation for all excavation, concrete, bolts, bricks, pipes, backfill, sealer, frames and covers, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 812 - WOOD SIGN SUPPORTS

812.01 DESCRIPTION. This work shall consist of furnishing and erecting wood sign supports as specified in the Contract Documents or as directed by the Engineer. Signs shall be as specified in Section 813.

812.02 MATERIALS.

Wood	921.05
Preservatives	921.06

812.03 CONSTRUCTION. Wood sign supports shall be placed in the ground in a plumb position to the depth and lateral orientation specified in the Contract Documents. Backfill shall consist of suitable excavation material compacted in place. Holes for embedding sign supports shall be augered or dug using methods approved by the Engineer. Wood sign supports shall not be driven or hammered into undisturbed earth.

When specified in the Contract Documents, wood poles shall have drilled holes conforming to the breakaway requirements specified in AASHTO Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, or as shown in the Contract Documents.

812.04 MEASUREMENT AND PAYMENT. Wood Sign Supports will be measured and paid for at the Contract unit price per linear foot for the length and size specified in the Contract Documents. The payment will be full compensation for all excavation and backfill, drilled holes, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 813 - SIGNS

813.01 DESCRIPTION. This work shall consist of furnishing and erecting signs of sheet aluminum or extruded aluminum panels, all with a reflective or nonreflective sheeting background, and all direct applied or silk screened copy or demountable copy with bolts and fittings to erect the signs as specified in the Contract Documents or as directed by the Engineer. Sign supports shall be as specified in Sections 802, 803, and 812.

813.02 MATERIALS.

Sign Panel Supports and Hardware	909.07, 921.05, 921.06, 950.04 A 123, A 153, and A 709
Reflective and Nonreflective Sheeting	950.03
Sign Materials	950.08

813.03 CONSTRUCTION. Extruded aluminum shall have demountable copy. Sheet aluminum shall have direct applied or silk screen copy. After installation of the signs is completed, they will be inspected. If specular reflection is apparent on any sign, its positioning shall be adjusted by the Contractor, as directed by the Engineer.

813.04 MEASUREMENT AND PAYMENT.

813.04.01 Signs will be measured and paid for at the Contract unit price per square foot of area of the vertical front face of the completed sign with no deduction for required shaping. The payment will be full compensation for the mounting hardware and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

813.04.02 When signs and mounting hardware are furnished by the Administration, the signs will be measured and paid for at the Contract unit price per square foot for the vertical front face area of the completed sign installed. The payment will be full compensation for all transportation, drilling holes as specified, installation, and for all materials, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 814 - SIGNAL HEADS

814.01 DESCRIPTION. This work shall consist of pickup, assembly and installation of Administration furnished signal heads and mounting hardware or furnishing and installing signal heads and mounting hardware as specified in the Contract Documents or as directed by the Engineer.

814.02 MATERIALS.

Signal Heads	Furnished by or as approved
Mounting Hardware	by the Office of Traffic & Safety

814.03 CONSTRUCTION. Signal heads on poles or pedestals shall be set back a minimum of 2 ft (0.6 m) behind the face of the curb.

Repairing. The finish on the signal heads and mounting hardware damaged during transportation and erection shall be repaired to match the original finish by and at the Contractor's expense. The repairs will be approved by the Engineer.

Aiming. Signal heads shall be aimed in conformance with the MUTCD.

Drill Holes. The Contractor shall drill all holes to provide cable and wire entrances as specified in Section 810 and the Contract Documents.

814.04 MEASUREMENT AND PAYMENT.

814.04.01 Administration furnished signal head assemblies will be measured and paid for at the Contract unit price per each. The payment will be full compensation for all transportation, drilling holes into the supporting structures as specified in the Contract Documents, installation, and for all

material, labor, equipment, tools, and incidentals necessary to complete the work.

814.04.02 Signal head assemblies furnished and installed will be measured and paid for at the Contract unit price per each. The payment will be full compensation for all mounting hardware, material, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 815 - SAW CUTS

815.01 DESCRIPTION. This work shall consist of saw cutting and sealing the saw cuts within and alongside the roadway, between the detector location and the nearest terminal point, as specified in the Contract Documents or as directed by the Engineer.

815.02 MATERIALS.

Sealer

911.06

815.03 CONSTRUCTION.

815.03.01 Saw Cut. Prior to saw cutting, holes shall be drilled at all turns as specified in the Contract Documents. Saw cutting of curbs and gutters will not be permitted. The saw cut width shall be as specified in the Contract Documents.

815.03.02 Saw Cut Sealing. Sealer used to seal saw cuts shall be applied as specified in the manufacturer's recommendations for washed, clean, dry saw cuts. Saw cut shall not be sealed until electrical testing is performed as specified in Section 820. Sealer shall not be poured when the roadway surface temperature is below 35 F (1 C) or during precipitation of any kind.

815.04 MEASUREMENT AND PAYMENT. Saw Cuts will be measured and paid for at the Contract unit price per linear foot for the width specified measured in place. The payment will be full compensation for all drilled holes, cleaning, drying, sealing, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 816 - TRAFFIC SIGNAL CONTROLLERS AND CABINETS

816.01 DESCRIPTION. This work shall consist of installing Administration furnished traffic signal controller and cabinets or furnishing and installing traffic signal controller and cabinets as specified in the Contract Documents.

816.02 MATERIALS.

Conduit	902.10.03, 921.07.01, 921.07.02 921.07.03, and 950.11
Anchor Bolts & Hardware Cabinets Controllers	Furnished by or as approved by the Office of Traffic & Safety

816.03 CONSTRUCTION.

816.03.01 Base Mounted Cabinets. Base mounted cabinets furnished by the Administration shall be mounted on concrete foundations conforming to Section 801 and as specified in the Contract Documents. Conduit shall be furnished and installed as specified in Section 805.

816.03.02 Pole Mounted Cabinets. Pole mounted cabinets furnished by the Administration shall be installed as specified in the Contract Documents. Conduit shall be furnished and installed as specified in Section 805.

816.04 MEASUREMENT AND PAYMENT.

816.04.01 Installing Administration furnished traffic signal controllers and cabinets will be measured and paid for at the Contract unit price per each. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

816.04.02 Concrete foundations will be measured and paid for as specified in 801.04.

816.04.03 Conduit will be measured and paid for as specified in 805.04.

816.04.04 Ground Rods will be measured and paid for as specified in 804.04.

816.04.05 Traffic signal controllers and cabinets furnished and installed will be measured and paid for at the Contract unit price per each. The payment will be full compensation for all mounting hardware, material, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 817 - PUSH BUTTONS AND PUSH BUTTON SIGNS

817.01 DESCRIPTION. This work shall consist of pickup and installation of Administration furnished pedestrian push buttons and push button signs at locations specified in the Contract Documents or as directed by the Engineer.

817.02 MATERIALS.

Push Buttons	Furnished by the Administration
Push Button Signs	Furnished by the Administration

817.03 CONSTRUCTION. Push buttons shall be located in positions that clearly indicate to the pedestrian which crosswalks are actuated by each push button as specified in the Contract Documents.

The Contractor shall furnish all mounting hardware and drill holes to provide cable and wire entrances for cable and wire in conformance with Section 810 and the Contract Documents.

817.04 MEASUREMENT AND PAYMENT. Installation of Administration Furnished Push Buttons and Push Button Signs will be measured and paid for at the Contract unit price per each unit in place. The payment will be full compensation for all transportation, installation, drilling holes, mounting hardware, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 818 - SIGNAL STRUCTURES

818.01 DESCRIPTION. This work shall consist of pickup and the installation of Administration furnished signal structures of the sizes specified in the Contract Documents or as directed by the Engineer. The anchor bolts, grommets and miscellaneous hardware shall be furnished by the Administration.

818.02 MATERIALS.

Signal Structures	Furnished by the Administration
Hardware	Furnished by the Administration

818.03 CONSTRUCTION. The signal structure shall be installed on a concrete foundation conforming to Section 801 and as specified in the Contract Documents.

Breakaway base support systems, when specified, shall conform to Section 821.

Any finish on the signal structures and mounting hardware damaged during transportation and erection shall be repaired to match the original finish by and at the Contractor's expense and approved by the Engineer.

818.04 MEASUREMENT AND PAYMENT.

818.04.01 Installation of Administration furnished signal structures will be measured and paid for at the Contract unit price per each for the type of structure erected in place. The payment will be full compensation for the transportation and installation of all steel poles, mast arms, twin mast arms, triple mast arms, strain poles, pedestal poles, breakaway base support systems, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

818.04.02 Concrete foundations will be measured and paid for as specified in 801.04.

SECTION 819 - STEEL SPAN WIRE

819.01 DESCRIPTION. This work shall consist of furnishing and installing steel span wire for signal head or sign mountings, interconnect runs, or for tethering purposes when specified in the Contract Documents or as directed by the Engineer.

819.02 MATERIALS.

Steel Span Wire

950.09

Steel messenger rings shall be sized as specified in the Contract Documents and shall be mechanically or hot dip galvanized after fabrication. The coating shall conform to A 153.

819.03 CONSTRUCTION. The span wire shall be attached to poles by wrapping two full turns of the span wire around the pole at the specified height.

The free end of the wrapped span wire shall be 2 ft (0.6 m) in length and shall be secured to the traversing span wire by a three bolt clamp and serving sleeve as specified in the Contract Documents.

All messenger rings shall be spaced 8 in. (200 mm) apart.

819.04 MEASUREMENT AND PAYMENT. Steel Span Wire of the size specified in the Contract Documents will be measured and paid for at the Contract unit price per linear foot for the wire installed. The payment will be full compensation for all hardware, material, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 820 - GENERAL ELECTRICAL WORK AND TESTING

820.01 DESCRIPTION. This work shall consist of furnishing, installing, and testing of all applicable electrical items referred to in Category 800.

820.02 MATERIALS. All materials and equipment installed as part of the

permanent installation shall be new, UL listed, or labeled and shall conform to NFPA 70 (NEC), NESC, NEMA, IES, and local codes applicable to the area of installation.

820.03 CONSTRUCTION.

820.03.01 General. All installations shall conform to NFPA 70 (NEC), NESC, local utility company requirements, and State and local laws and ordinances governing the work. All the work shall be performed by or under the direct supervision of a licensed master electrician. The Contractor shall obtain and pay for all permits, licenses and inspection fees.

820.03.02 Testing. The Contractor shall supply all personnel and equipment required to successfully perform the following tests and shall furnish four certified copies of the complete test reports to the Engineer.

Not less than 30 days prior to the commencement of each required test, the Contractor shall submit to the Engineer the types, styles or catalog numbers of all testing equipment to be used for the tests. A written certification shall be included stating when the testing equipment was last calibrated by an Administration approved testing agency. The calibration date shall be within 120 days of the date when the tests are to be performed. All tests are to be performed in the presence of the Engineer.

Any defects found in the completed materials installation, specified equipment performance or workmanship, shall be repaired or replaced immediately at no cost to the Administration.

(a) **Ground Resistance Testing.** Ground resistance testing shall be conducted using a megger ground tester, using the null balance fall of potential method. Corrected readings greater than 25 ohms will not be accepted.

(b) **Circuit Testing.** A circuit test to determine insulation resistance shall be performed on all cables of every circuit except those installed in lighting structures. The test shall conform to the Administration's testing requirements. Cable insulation resistance shall be a minimum of 10 megohms at 500 volts D.C. except loop

detector wire and loop detector lead in shall have a minimum of 100 megohms at 500 volts D.C.

The Contractor shall demonstrate in a manner acceptable to the Engineer that all conductors are continuous, free from short circuits and unspecified grounds, and that all circuits are properly connected as specified in the Contract Documents.

(c) **Performance Testing.** A performance test using the design power source shall be conducted by the Contractor prior to acceptance. The electrical system, including automatic control equipment, shall be operated for 30 consecutive days without failure. If any component fails, it shall be immediately replaced and the test shall be continued. The Contractor shall record each fault, the method and date of correction of each, and the beginning and end of the 30 day test period. If more than 5 percent of any component fail during the test, the component shall be replaced and the 30 days test cycle for the entire system shall be restarted.

(d) **Illumination Testing.** An illumination test shall be conducted by the Contractor to determine the illumination characteristics of the roadway lighting installation. The test shall conform to procedures approved by the Administration.

820.04. MEASUREMENT AND PAYMENT. General Electrical Work and Testing will not be measured but the cost will be incidental to other pertinent items specified in the Contract Documents.

SECTION 821 - BREAKAWAY BASE SUPPORT SYSTEMS

821.01 DESCRIPTION. This work shall consist of furnishing and installing breakaway base support systems or installing Administration furnished breakaway base support systems as specified in the Contract Documents.

821.02 MATERIALS. Breakaway base support systems shall conform to the breakaway requirements specified in AASHTO Specification for

Structural Supports for Highway Signs, Luminaires, and Traffic Signals as approved by the Engineer.

821.03 CONSTRUCTION. The Contractor shall furnish and install breakaway base support systems for signals, lighting and signing, including post hinge assembly units for sign structures, as specified in the Contract Documents and in conformance with the manufacturer's recommendations. The ground adjacent to the breakaway base shall be graded as specified in the Contract Documents.

The concrete foundation shall conform to Section 801.

821.04 MEASUREMENT AND PAYMENT.

821.04.01 Breakaway Base Support Systems will be measured and paid for at the Contract unit price per each. The payment will be full compensation for all excavation, backfill, grading, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

821.04.02 Breakaway Base Support Systems for Signals. Refer to 818.03 and 818.04.01.