SECTION 614 -- ELECTRICAL CONDUIT

Description

1.1 This work shall consist of furnishing, installing and testing conduit of the size and type specified, including sweeps, bends, joints, hangers, pull boxes, special fittings, plastic warning tape and other appurtenances, as shown on the plans or ordered. This work shall include the disposal of discarded materials and the restoration of disturbed surfaces when not otherwise included under other items in the contract.

Materials

2.1 Steel conduit shall conform to ASTM A 120 Standard Weight and shall be galvanized unless otherwise specified.

2.2 Electrical plastic tubing (EPT) and electrical plastic conduit (EPC) including fittings and joint requirements shall conform to NEMA TC 2 and shall be made from polyvinl-chloride (PVC) or polyethylene (PE) compounds. Conduit shall be marked in accordance with NEMA TC 2-6.1.

2.3 Concrete for cast in place conduit encasement shall conform to 520 Class B. Precast concrete encased conduit will not be permitted.

2.4 Plastic warning tape shall be American Public Works Association standard six (6") inch wide polyethylene color coded and marked in accordance with the utility industry standards for marking underground utility lines.

2.5 Concrete pull boxes, either precast or cast in place, shall be constructed using concrete conforming to 520, Class A. Frame and cover castings shall be gray iron conforming to AASHTO M 105. Unless otherwise specified, all gray iron castings shall be Class 30.

2.6 Molded pull boxes shall be either fiberglass-filled high density polyethylene, fiber reinforced polyester mortar, or fiberglass reinforced polymer concrete, all with high impact resistance and ultraviolet stabilization. The box shall be capable of withstanding 5,000 lbs. load exerted over a 10" x 10" area centered over any portion of the top edge of the closure sidewall with cover in place and shall also be distributed uniformly at the cover center over a 10" x 10" area with no breakage or permanent deformation. The box and cover shall be designed for incidental vehicular traffic. Cover shall be attached to box with penta-head bolts.

Construction Requirements

3.1 General.

3.1.1 Installation within the limits of the traveled way and shoulders, whether paved or unpaved, shall be constructed with Schedule 80 PVC conduit (EPC), rigid steel conduit, concrete encased Schedule 40 PVC (EPC) or concrete encased PE electrical tubing (EPT).

3.1.2 Installations beyond the limits of the traveled way and shoulders shall be constructed with Schedule 80 PVC conduit (EPC), Schedule 40 PVC conduit (EPC), rigid steel conduit or concrete encased PE electrical tubing (EPT). These materials may also be used under sidewalks and parking lots subject to incidental vehicular activity.

3.2 Bedding. All conduit to be laid in the ground shall be placed on a prepared bedding which shall provide a firm foundation. Where rock or unstable soil is encountered, the bottom of the proposed bedding surface shall have a 6 inch layer of Granular Backfill -- sand conforming to 209.2.1.3.1, compacted as directed.

3.3 Laying.

3.3.1 Conduit shall be laid to a pitch of not less than 3 inches per 100 feet.

3.3.2 All conduit lines located under pavement shall be installed in a straight line. Field bends required in other areas shall be made with an approved conduit bender. Not more than four 90 degree bends or equivalent (360 degree total) shall be used on a continuous conduit line. Bending radius shall not be less than 30 feet unless otherwise directed. Bends in conduit entering pull boxes, light pole bases, signal and meter pedestal bases, transformer pads, signal controller bases and at riser shall be made with manufactured electrical standard elbows.

3.3.3 All conduit connections shall be waterproof and conform to NEMA TC 2-3.4. When conduit of one material is to be joined to an existing conduit of another material, weatherproof adapters manufactured for the purpose shall be used. Waterproofing and sealing compounds containing bituminous material shall not be used.

3.3.4 When conduits are encased in concrete, concrete cover around ducts shall be a minimum of 3 inches with a minimum separation of 1-1/2 inches between ducts unless otherwise specified or ordered. After the initial set, the concrete shall be protected from the air and sun. Fill shall not be placed over the conduit until authorized by the Engineer.

3.3.5 Conduit risers installed on poles or other structures shall extend a minimum of 10 feet above the elbow and be of a type and total height to meet utility company requirements. Conduits shall be attached with an approved support strap. A suitable plug shall be installed in the end of the conduit riser.

3.3.6 When ordered, conduit shall be placed under existing pavement by approved jacking or drilling methods which do not disturb the pavement. Pavement shall not be disturbed without the written permission of the Engineer. Jacking and drilling pits shall be kept 2 feet clear of the edge of pavement.

3.3.7 When so directed, and whenever a continuous traffic signal conduit line is greater than 90 feet, additional pull boxes shall be installed. Cable splices shall not be made in these boxes without permission.

3.3.8 A minimum of 3 feet of space shall be left between the ends of conduit runs where there may be a future junction. When conduit is installed which does not terminate in a pull box, equipment base or similar type foundation, a witness marker consisting of a No. 5 re-bar of sufficient length to allow for the top of the marker to be set flush with the final grade shall be placed vertically at each end of such buried conduit.

3.3.9 Unless otherwise directed, a No. 14 galvanized steel pull wire or plastic/nylon rope having a minimum tensile strength of 200 lbs., shall be placed in all conduit runs. At least 24 inches of wire or rope shall be left coiled at each end of the conduit.

3.4 Backfilling.

3.4.1 All backfill material adjacent to conduit shall be approved material. Backfill material shall be free from hard lumps or clods larger than 3 inches in diameter and free from rocks and stumps. Backfill within the pavement structure shall be of the same type material and match the depths encountered.

3.4.2 When conduit is installed beyond traveled ways and shoulders, and outside of areas such as sidewalks and parking lots, the backfill shall be placed to 6 inches above the conduit and compacted by pneumatic tampers, vibratory compactors, or other approved means. The remainder of the backfill material shall then be placed and compacted by an approved method.

3.4.3 When conduit is installed within traveled ways, shoulders, sidewalks and parking areas, the backfill shall be
placed to 6 inches above the conduit or encasement and compacted by pneumatic tampers, vibratory compactors, or other approved means. Additional backfill shall be placed in layers not greater than 6 inches. All backfill shall be compacted to not less than 95 percent of AASHTO T 99.

3.4.4 Bituminous or Portland Cement concrete pavement removed to excavate the trench shall be replaced with hot bituminous pavement conforming to the requirements of 401 unless otherwise directed. Pavement shall be placed in thoroughly compacted layers of not more than 2 inches to give a total thickness equal to that of the existing pavement.

3.4.5 Conduits provided for future use shall have suitable plugs installed at each end. Conduit ends shall not be backfilled until reference measurements are made by the Engineer.

3.4.6 A plastic warning tape shall be installed over all conduits at approximately 12 inches below final grade.

3.5 Testing.

3.5.1 After the trench has been backfilled, excluding pavement if applicable, the Contractor, in the presence of the Engineer shall test the installation by pushing through the entire length of the conduit line a device with a diameter not smaller than 1/4 of an inch less than the inside diameter of the conduit. All obstructions, including stones, dirt and the like, shall be removed. Broken or other unsatisfactory conduits shall be replaced at no expense to the Department.

3.5.2 When ordered, existing conduit to be incorporated into a new system shall be cleaned with a mandrel and blown out with compressed air.

3.6 Pull Boxes.

3.6.1 Concrete or molded pull boxes shall be constructed and installed as shown on the plans.

3.6.2 All pull boxes shall be placed on a minimum of 6 inches of granular material extending at least 4 inches beyond the outside of the pull box.

3.6.3 Pull box covers shall indicate the type of service enclosed.

3.6.4 An approved 2 inch galvanized "J" hook shall be installed as directed in pull boxes designated to be used for traffic signal circuits.

Method of Measurement

4.1 Conduit will be measured by the linear foot of the specified type, size and number of ducts of the size required, to the nearest 0.1 of a foot.

4.1.1 When a conduit is connected to a foundation for a signal pole, control cabinet pole or light pole, measurement will be made only to 3 feet from the center of the base, measured horizontally. The limit of measurement where conduit is joined to previously existing conduit will be at the junction of the two conduits.

4.2 Pull boxes will be measured by each, but will not be deducted from the length of the conduit.

Basis of Payment

5.1 The accepted quantities of conduit will be paid for at the contract unit price per linear foot of the type, size and number of ducts specified complete in place, with the following exceptions:

5.1.1 All rock structure excavation, and any excavation of unsuitable material required below the conduit will be paid for under 206.

5.1.2 New material ordered for use as backfill below the subgrade will be paid for under 304.

5.1.3 Hot bituminous pavement required in 3.4.4 will be paid under 403. If the item of 403 is not included in the contract, this work will be paid as provided in 109.04.

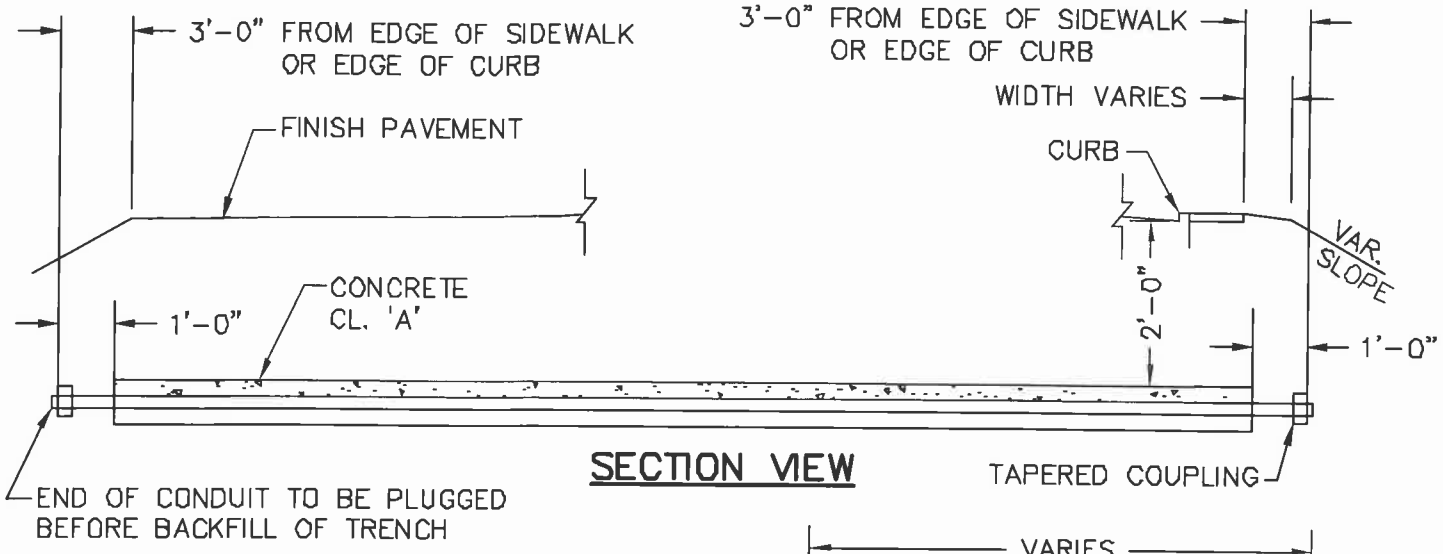
5.2 Pull boxes of the type specified will be paid for at the contract unit price per each.

5.2.1 No extra payment will be made for material specified in 3.6.2.

Pay items and units:

614.121	2" Conduit, Concrete Encased, Incl. Specified Excavation	L.F.
614.131	3" Conduit, Concrete Encased Incl. Specified Excavation	L.F.
614.132	3" 2-Duct Conduit, Concrete Encased, Incl. Specified Exc.	L.F.
614.133	3" 3-Duct Conduit, Concrete Encased, Incl. Specified Exc.	L.F.
614.141	4" Conduit, Concrete Encased Incl. Specified Excavation	L.F.
614.142	4" 2-Duct Conduit, Concrete Encased Incl. Specified Excavation	L.F.
614.3121	1-1/4" Steel Conduit Including Specified Excavation	L.F.
614.321	2" Steel Conduit Including Specified Excavation	L.F.
614.331	3" Steel Conduit Including Specified Excavation	L.F.
614.3311	3" Steel Conduit, Jacked or Drilled, Including Specified Excavation	L.F.
614.341	4" Steel Conduit Including Specified Excavation	L.F.
614.3411	4" Steel Conduit, Jacked or Drilled, Including Specified Excavation	L.F.
614.511	Concrete Pull Box -- 14"	Each
614.512	Concrete Pull Box -- 18"	Each
614.522	Molded Pull Box – 13" x 24"	Each
614.523	Molded Pull Box – 17" x 30"	Each
614.7214	2" PVC Plastic Conduit, Schedule 40, Incl. Specified Excavation	L.F.
614.7218	2" PVC Plastic Conduit, Schedule 80, Incl. Specified Excavation	L.F.
614.7224	2" 2-Duct PVC Plastic Conduit, Schedule 40, Incl. Specified Excavation	L.F.
614.7228	2" 2-Duct PVC Plastic Conduit, Schedule 80, Incl. Specified Excavation	L.F.
614.7314	3" PVC Plastic Conduit, Schedule 40, Incl. Specified Excavation	L.F.
614.7318	3" PVC Plastic Conduit, Schedule 80, Incl. Specified Excavation	L.F.
614.7324	3" 2-Duct PVC Plastic Conduit, Schedule 40, Incl. Specified Excavation	L.F.
614.7328	3" 2-Duct PVC Plastic Conduit, Schedule 80, Incl. Specified Excavation	L.F.
614.7414	4" PVC Plastic Conduit, Schedule 40, Incl. Specified Excavation	L.F.

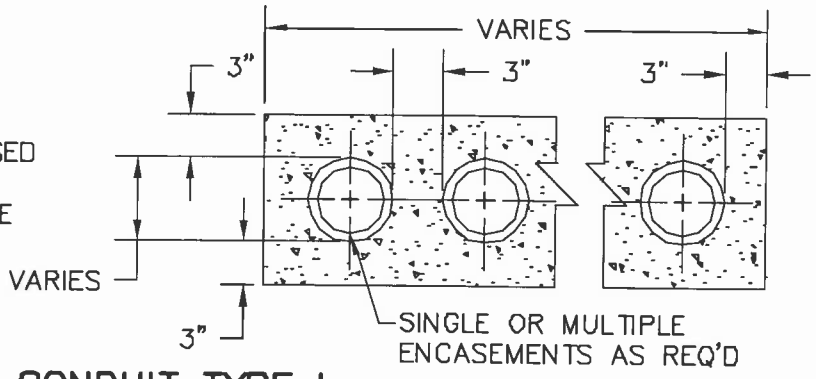
614.7418	4" PVC Plastic Conduit, Schedule 80, Incl. Specified Excavation	L.F.
614.7514	5" PVC Plastic Conduit, Schedule 40, Incl. Specified Excavation	L.F.
614.7518	5" PVC Plastic Conduit, schedule 80, Incl. Specified Excavation	L.F.



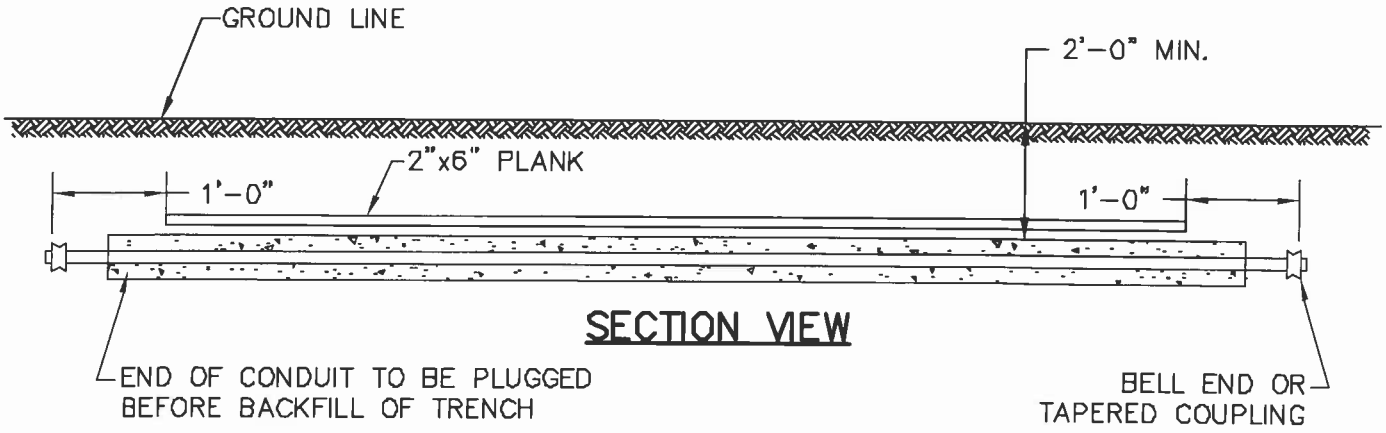
SECTION VIEW

NOTE:

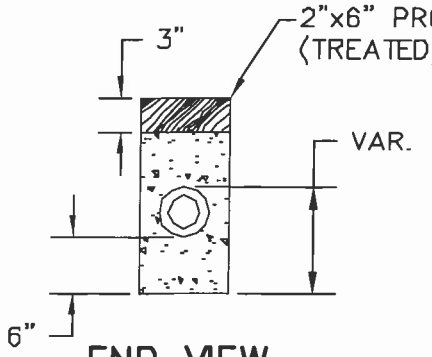
PRECAST CONDUIT TYPE III MAY BE USED IN PLACE OF TYPE I.
TYPE III EXTENDS THE ENTIRE DISTANCE FROM 'A' TO 'B'.



CONDUIT TYPE I



SECTION VIEW



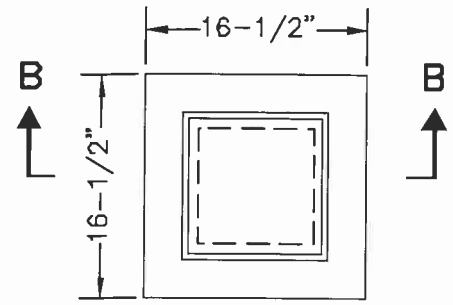
END VIEW

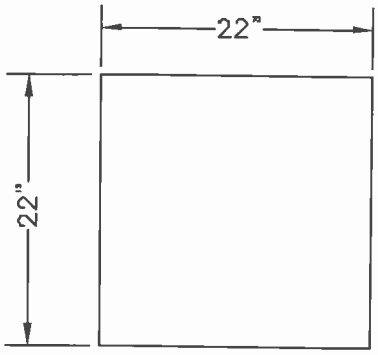
CONDUIT TYPE II

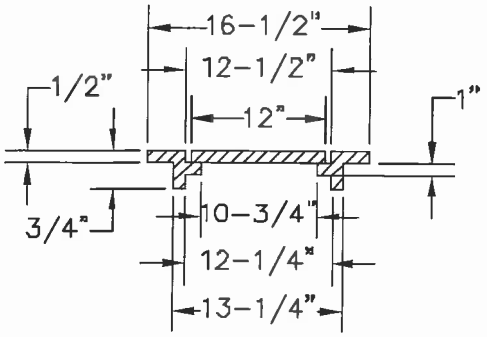
CONDUIT DETAILS

\DWG\DETAILS\614-1 CONDUIT.DWG

NOT TO SCALE
FIG. 614-1

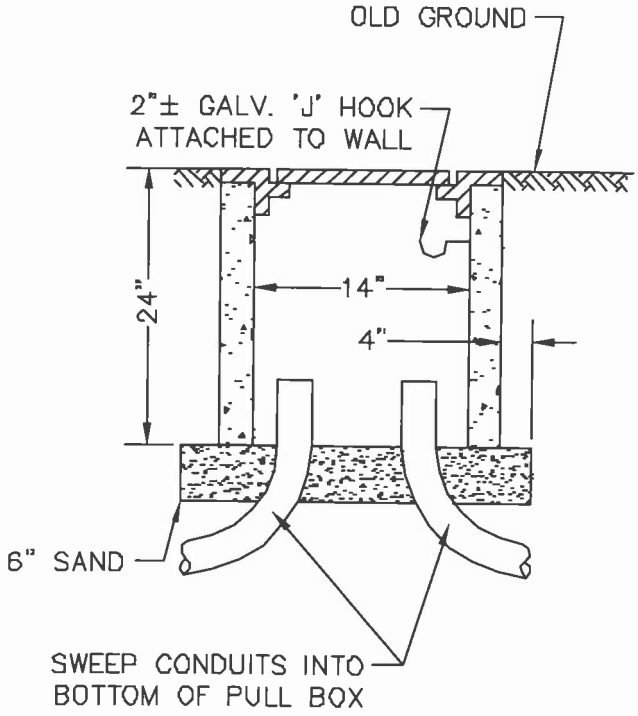


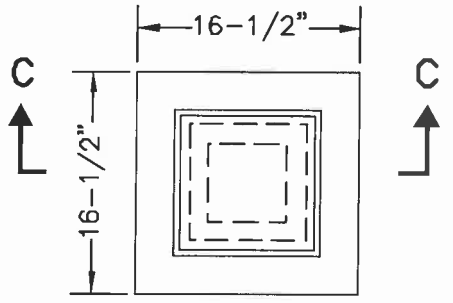


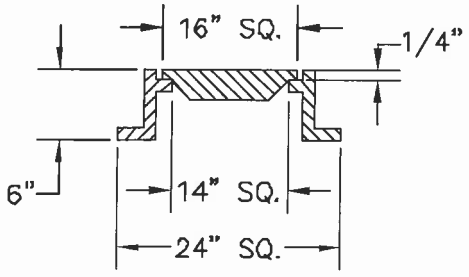


SECTION B–B

CAST IRON FRAME & COVER







SECTION C–C

NOTES:

HEAVY DUTY REQUIRES 5" WALL THICKNESS.

CONCRETE SHALL BE CLASS 'A'.

6" SAND BED FOR DRAINAGE, TAMPED.

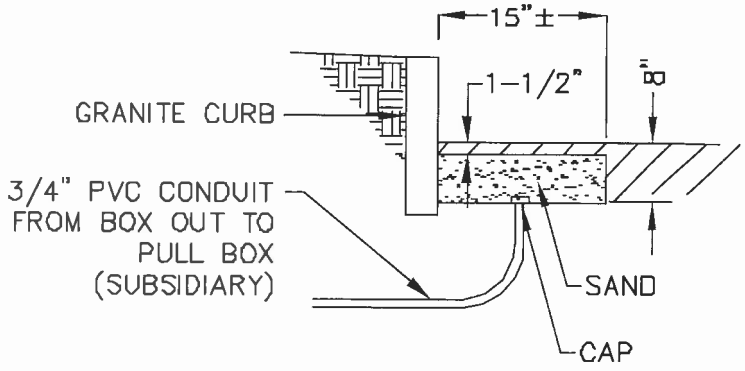
GROUNDING BUSHING SHALL BE INSTALLED AT ALL ENDS OF STEEL CONDUIT.

HEAVY DUTY CAST IRON FRAME & COVER
(APPROX. WEIGHT = 250 LB.)

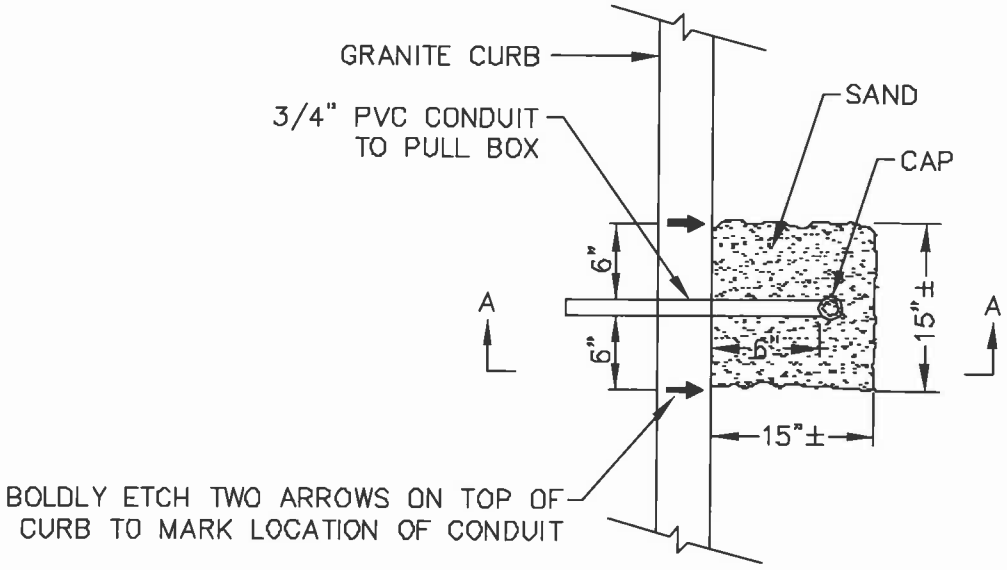
PULL BOX, FRAME & COVER

S:\DWG\DETAILS\614-2 TRFCOF.DWG

NOT TO SCALE
FIG. 614–2



SECTION A-A



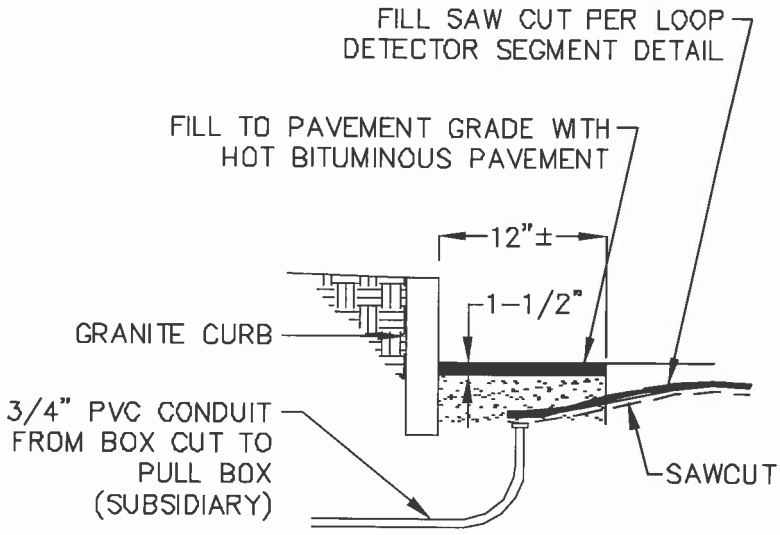
PLAN

DETECTOR BOX OUT DETAIL
STAGE 1: AT PAVING

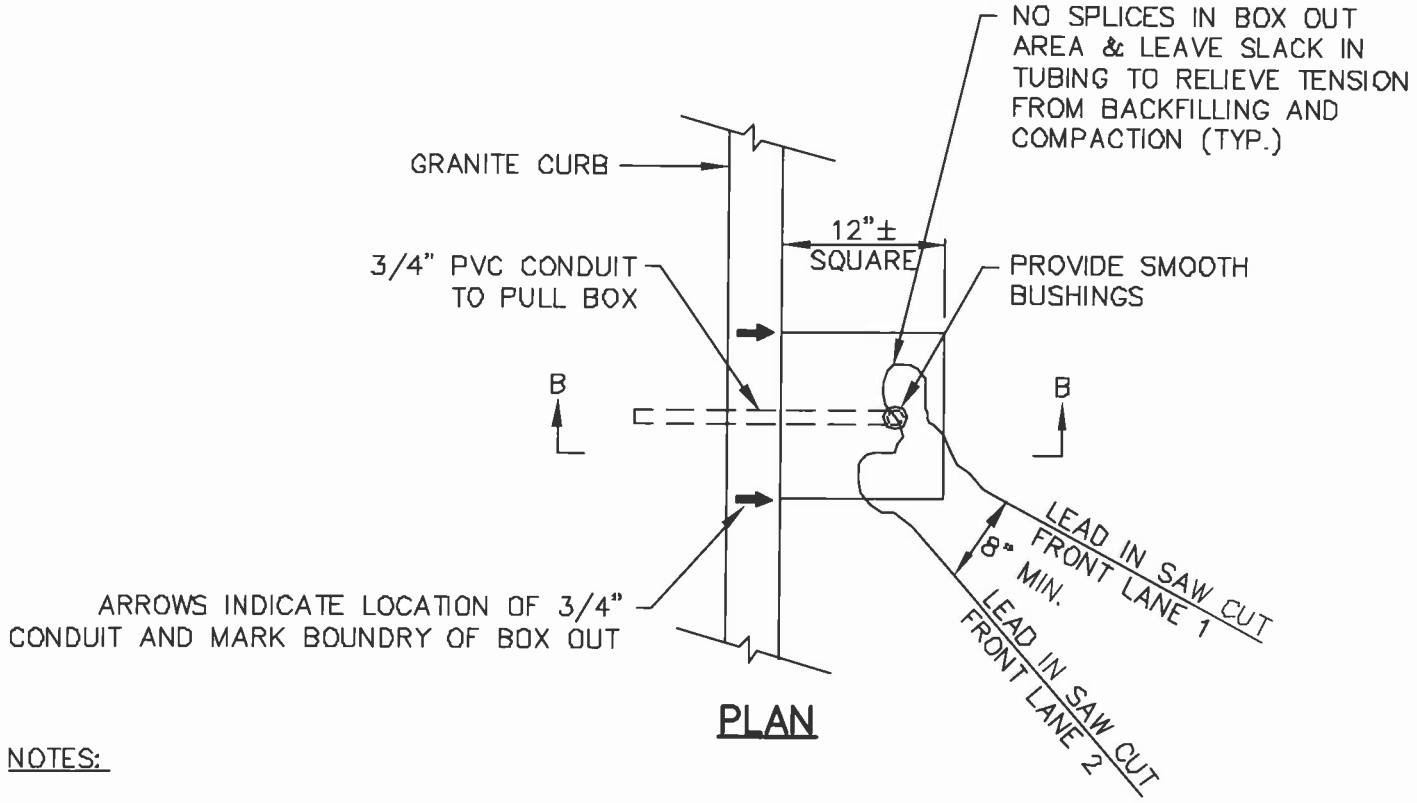
S:\OWC\614a DETAILS\SIGNAL DETECTOR BOX.DWG

NOT TO SCALE

FIG. 614-3a



SECTION A-A



PLAN

NOTES:

1. MAXIMUM OF TWO LEAD IN PAIRS PER 3/4" PVC CONDUIT.
2. TAPE TUBING 3" ON EACH SIDE OF THE SAW CUT BOX OUT BOUNDRY WITH ELECTRIC TAPE.
3. AFTER TUBING IS INSTALLED FILL CONDUIT WITH CRUMPLED PAPER AND SEAL WITH PLIABLE DUCT SEALANT.
4. USE CONSTRUCTION SAND TO COVER AND SUPPORT THE VINYL PLASTIC TUBING.

DETECTOR BOX OUT DETAIL
STAGE 2: AT LOOP INSTALLATION

S:\DWG\DETAILS\614-3b SIGNAL DETECTOR BOX.DWG

NOT TO SCALE

FIG. 614-3b

SECTION 616 -- TRAFFIC SIGNALS

Description

1.1 This work shall consist of furnishing and installing traffic signals, pedestrian signals, or flashing beacons including poles, mast arms, foundations, and all necessary fittings, cables, and components ordered.

1.2 Traffic signal terms shall be in accordance with those defined in the MUTCD.

Materials

2.1 A list of the recommended materials required to install the system may be included as an amendment to this specification, but the Department will give no guarantee as to the completeness of this list.

2.1.1 Electrical materials shall meet the standards herein, local and utility codes, and the National Electrical Code, where applicable.

2.1.2 Drawings, manufacturer's specifications, and applicable catalog cuts for all materials and components shall be submitted in accordance with 105.02. An additional set of final approved documents, to total 6 sets, shall be supplied to the Engineer.

2.2 Traffic Signal Heads.

2.2.1 Housings. Housings shall be constructed of die cast aluminum or polycarbonate with a smooth outer surface and shall be capable of holding the optical units securely in place. Housings shall be adaptable for pedestal, bracket, or rigid mast-arm vertical or horizontal mounting. The assembled housing shall be dust proof and moisture proof. Each housing shall be equipped with a hinged door of die cast aluminum or polycarbonate to hold the lens and parts of the optical units. The doors shall be designed to insure uniform pressure around the door frame when closed. Doors shall be fastened by hinged wing nut assemblies or other approved fasteners. Unless otherwise indicated on the plans, lenses shall be furnished with approved sun shield visors, not less than 10 inches in length. If either longer visors than those specified above or louvres are deemed necessary, they shall be furnished and installed.

2.2.1.1 The assembled housings shall be made up of individual sections fastened together with bolts. The assembly of sectional units shall present a smooth unbroken contour of pleasing appearance. Each end of the housing assembly shall have an opening for a 1-1/2 inch pipe nipple. The area around this opening shall be reinforced and serrated
so that lock nuts will seat firmly.

2.2.1.2 One cap shall be supplied with each assembled housing to act as a cover over the hole in the top to prevent water from entering.

2.2.2 Housing adaptors. Housing adaptors for pedestal mounting shall be constructed of metal. They shall be adjustable with serrated surfaces to permit the housing to be locked in the desired horizontal position. The adaptors shall be secured to the bottom of the housing by means of a close nipple, shall slip-fit at least 7 inches over a standard traffic signal post 4 inches in diameter, and shall be secured to the post by means of set screws. Adaptors shall contain raceways from the housing to the post to protect the wires from the elements.

2.2.3 Mast arm brackets. Mast arm brackets shall be as indicated in the recommended list of materials shown in the proposal.

2.2.4 Receptacles. The lamp receptacle shall be of heat resisting material designed to hold an A-21 bulb or 60 to 150 watt traffic signal lamp with the light center at the focal point of the reflector. This receptacle shall be provided with a lamp grip to prevent the lamp working loose due to vibration. Provision shall be made on either the lamp receptacle or reflector holder to permit the proper focusing of lamps, with a secure fastening provided to retain the desired focus.

2.2.4.1 Each receptacle shall be wired with two leads which shall terminate in a junction block in each signal head. Separate leads shall be used to wire the block to the base. Leads shall be 18 AWG stranded wire. All colors shall be bright and clearly defined and cover the insulation the entire length of the lead. The color of these leads shall be as follows:

(a) From the receptacle behind the red lens: one red wire and one white wire with a red tracer;
(b) From the receptacle behind the yellow lens: one yellow wire and one white wire with yellow tracer;
(c) From the receptacle behind the green lens: one green wire and one white wire with a green tracer;
(d) From the receptacle behind the green arrow: one blue wire and one white wire with a blue tracer.

2.2.5 Optics. Optical units shall consist of certified 10,000 hour lamps, receptacles, reflectors, lenses, and other necessary equipment which shall give clearly visible signal indications within an angle of at least 45 degrees and at a distance from 10 feet to 300 feet under all normal light and atmospheric conditions. The units shall be designed to minimize the effect of all phantom light. The units shall be readily accessible for maintenance.

2.2.5.1 Reflectors shall reflect parallel light rays from a properly focused traffic lamp. Reflectors shall be constructed of one-piece polished alzak aluminum.

2.2.5.2 Lenses shall conform to the standards set forth by the Institute of Transportation Engineers and shall be of the color indicated, circular in shape, with a

visible diameter of approximately 12 inches, or approximately 8 inches, if so specified. Each lens shall be true to color, of best quality plastic, free from imperfections, of high luminous transmission, conforming to the standards of ANSI D 10.1. Lens configuration shall be as specified in the MUTCD,

2.3 Pedestrian Signal Heads.

2.3.1 General. Pedestrian signal heads shall be of the incandescent type conforming to the Institute of Transportation Engineers Standard for Adjustable Face Pedestrian Signal Heads. All heads shall be rectangular in shape and shall consist of the lettered messages WALK and DON'T WALK. Both messages shall be contained in a single section head. The light source shall be designed so that in case of an electrical or mechanical failure or the word DON'T, the word WALK of the DON'T WALK message shall also remain dark.

2.3.2 Housings. Housings shall be one piece die cast aluminum alloy complete with top, bottom, sides, and back. For mounting purposes, the top and bottom of the housing shall have openings to accommodate standard 1-1/2 inch pipe brackets. The outside surface of the openings shall be serrated to provide for positive positioning of the housing. Doors and fasteners shall be as specified in 2.2.1. The completed assembly shall be dust and moisture proof.

2.3.3 Lamps and receptacles. The pedestrian signal head shall be furnished complete with A-21 traffic signal lamps and compatible receptacles. Receptacles shall be of molded bakelite, molded phenolic, or ceramic and shall have a brass screw shell and adjustable lamp grip to allow positioning of the lamp. Receptacles shall be centered and pre-focused.

2.3.3.1 Each lamp receptacle shall be provided with one colored 18 AWG lead from the receptacle and one white 18 AWG lead from the screw shell to a terminal block mounted within the housing.

2.3.4 Lenses. The inside face of each lens within the message section area shall be painted with an approved transparent color to produce a Portland orange DON'T WALK message and a lunar white WALK message when illuminated by
the lamp. All areas surrounding the letters shall be opaque black. The letters shall be at least 4-1/2 inches in height with a stroke width of 5/8 inch. When not illuminated, neither message shall be readily distinguishable.

2.4 Traffic Signal Poles, Mast Arms and Pedestals.

2.4.1 General. Traffic signal structures shall be designed in accordance with the current AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals for 80 mph wind zone to support fixed signals, signs, fire pre-emption equipment, and luminaires as shown on the plans.

2.4.1.1 Steel structures, unless otherwise indicated, shall be hot dip galvanized in accordance with ASTM A123.

2.4.1.2 Concrete foundation shall be concrete Class B meeting the requirements of 520. Reinforcing steel shall meet the requirements of 544. The foundation shall be as shown on the plans.

2.4.1.3 Anchor bolts shall conform to ASTM A36 M55 having minimum yield strength of 55,000 psi with threaded end and hex nuts (2 per bolt), galvanized in accordance with ASTM A153.

2.5 Traffic Signal Controllers and Cabinets.

2.5.1 General. The controller shall operate on 120 volt, 60 cycle alternating current, and shall be delivered completely wired and enclosed in a weatherproof cabinet. All components shall be new, and unless noted, the use of solid state components shall be required. Controllers shall be modular by phase, with dual maximum timing and exclusive pedestrian timing capability in phase one. Timing shall be set by thumbwheel, unless otherwise directed. All controllers and cabinets finished shall comply with the National Electrical Manufacturers Association (NEMA) current standard.

2.5.1.1 All 8 phase controllers shall be wired to flash yellow in phase 2 and phase 6, and red in all other phases. Following an interruption of power all eight phase controllers shall start in a flashing mode of operation and will begin automatic operations at the beginning of the green period for phase 2 and phase 6.

2.5.1.2 Bench test. All components of the controller and cabinet shall be bench tested for a minimum of 48 continuous hours by the Contractor, prior to delivery to the project. Testing shall be accomplished by the use of a test board utilizing the phasing shown on the plans. Testing will be checked by the Engineer. The Contractor shall notify the Engineer at least 3 days prior to testing. Any defective components shall be replaced and subsequent testing shall be performed to the satisfaction of the Engineer. Upon completion of satisfactory bench testing, a written approval will be supplied to the Contractor by the Engineer. This approval authorizes delivery to the project only and does not relieve the Contractor from ensuring proper operation of the equipment. The approval shall accompany the cabinet and controller when delivered to the project.

2.5.2 Controller cabinet. All timing and flashing mechanisms shall be enclosed within a dust and moisture proof sheet aluminum base mounted housing provided with 2 shelves, a main door, and a switch compartment door. Painting shall be in accordance with 3.12.

2.5.2.1 All cabinet components shall be factory wired to include police panel control button, signals on/off switch, manual/automatic switch; plastic print holder with 3 sets of manuals and prints; thermostatically controlled (on at 60 degrees F and above)

ventilation fan, thermostatically controlled (on at 30 degrees F and below) heat lamp of 100 to 150 watts; line filter, G.F.I wired duplex convenience outlet with light receptacle, controller on/off switch, circuit breaker disconnect, lightning/surge arrestors, loop detector transient protectors, cube-type load switches with LED on the input side, cube-type NEMA flasher; pedestrian and vehicle test push button, one time switch (Electrotechnics Corp. Model TC/12-104, or approved equal), one circuit wired for maximum two, one circuit wired for Uniform Code Flash.

2.5.2.2 Connecting cables from the back panel to the controller shall be long enough to reach any NEMA timer on the top shelf. The back panel shall have all load switches, flash transfer relays, and ancillary relays completely wired for present or future use. All cabinet components including amplifiers, relays, ancillary equipment, and loop and pedestrian terminals shall be identified by label and/or tagged as to their use.

2.5.3 Lock. The lock for the main door of the cabinet shall be a tumbler type lock as recommended by the manufacturer of the signal equipment. A police-type lock shall be provided in the auxiliary door. Two keys shall be furnished for each lock.

2.5.4 Contacts. All contacts used in connection with interval indications shall be of pure coin silver or equivalent, and shall be capable of breaking and carrying 10 amperes at 125 volts alternating current. The contacts shall be readily accessible and capable of being replaced in the timer without the use of any tools other than pliers and screw drivers.

2.5.5 Flashers. Intersection beacon flashers shall be housed in an approved cabinet containing: 25 ampere NEMA cube-type flasher, 10 ampere circuit breaker, and disconnect switch. All components shall be completely wired and mounted within the cabinet. Painting shall be in accordance with 3.12.

2.5.6 Pedestals. Meter pedestal shall be as indicated on the plans.

2.5.7 Radio and television interference. Electrical equipment shall be prevented from interfering with radio and television reception.

2.6 Cable and Wire.

2.6.1 General. Cable shall be plastic covered cable meeting the applicable requirements of the International Municipal Signal Association (IMSA) specifications. The conductor color coding shall not be by means of printed code. Actual color coding shall be used.

2.6.2 The minimum size wire for the circuits shall be as follows:

Service	A.W.G. #

(a) To Controller	8 stranded
(b) Controller to Pole or Pedestal	12 stranded
(c) Pole or Pedestal to Receptacles	14 stranded
(d) Controller to Push Buttons	14 stranded
(e) Detector Loop Leads	16 IMSA Spec. 50-2
(f) Detector Loop Wire	14 IMSA Spec. 51-5
(g) Equipment Grounding Conductor	8 stranded

2.7 Conduit. Traffic signal conduit, pull boxes, frames, and covers shall conform to 614.2.

2.7.1 Conduit for all lines, except the service, shall be 3 inches in diameter. Service conduit shall be rigid steel conduit 1-1/4 inches inside diameter.

2.8 Painting. Prior to erection and assembly, if not manufactured of polycarbonate material, the entire traffic or pedestrian signal housing and visors shall be painted with zinc-chromate primer 708-NH 1.50 and a finish enamel coat of federal yellow 708-NH 3.72. The doorface and inside visor shall be black 708-NH 3.75.

2.9 Backfill for foundations, unless otherwise ordered, shall be Granular Backfill conforming to the requirements of 209.

Construction Requirements

3.1 All electrical installations shall comply with the requirements specified herein, local and utility codes, and the National Electrical Code (NEC).

3.2 Each signal head mounted on a mast arm shall be installed with 1/8 inch diameter aircraft cable, looped around the mast arm and mast arm bracket, as a safety device to prevent the signal head from falling. Cable ends shall be fastened by two opposing "U" clamps. When suspended by this cable, the top of the signal head shall be no more than 6 inches below the bottom of the mast arm.

3.3 Conduit lines. All conduit lines necessary shall be constructed for the proper operation of the signals and shall conform to 614.3

3.3.1 All conduits terminating in the cabinet shall be sealed with duct sealants.

3.4 Concrete foundations with anchor bolts to secure the traffic signal structures, flasher or controller cabinets, and meter pedestals, shall be installed at the locations specified. When directed, the concrete foundation for the controller cabinet shall be raised to any height up to 18 inches above the surface.

3.4.1 The void created by the leveling nuts between the foundation and the base plate of the structure shall be filled with an approved non-shrink grout.

3.4.2 Prior to placing the controller cabinet on its foundation, silicone sealant shall be applied to the area of contact.

3.5 Inductive Loop Detectors.

3.5.1 Loop Installation.

3.5.1.1 Curb entry. Nonmetallic conduit shall be utilized from the pull box to its intercept with the saw cut. The visible portion of the curbing shall not be cut for conduit installation. The chase from the saw cut to the splice box should extend no more than one foot from the curb. Conduit shall be installed so that it directly receives the lead-in wire.

3.5.1.2 Saw cut. The saw cut shall be a clean, well defined 5/16 inch wide saw cut without damage to adjacent area. The saw cut depth shall be at least 1-3/4 inches for asphalt and 1-1/4 inches for concrete. The saw cuts shall be overlapped to provide full depth at all corners, and all
slots requiring a right angle turn of wire shall be cut at a 45 degree diagonal angle. Prior to the installation of wire, the saw cuts shall be checked for the presence of ragged edges or protrusions, and cleaned and dried. Cutting dust, grit, oil, moisture, or other contaminants shall be removed.

3.5.1.3 Loop wire installation. All loop installations shall be made without damage to the wire or its insulation. All damaged wire shall be replaced. The loops shall be installed as per plans, and shall contain the required number of turns as shown or as recommended by the manufacturer.

3.5.1.3.1 The wire shall be laid in the slot so that there are no kinks or curls and no straining or stretching of the insulation. Loop wire shall be installed as far down in the slot as possible, using a blunt object similar to a wooden paint stirrer, to seat the loop wire, but in no case shall a screwdriver or other sharp tool be used for this purpose. The loop lead-in wires shall be twisted to provide a minimum of one turn per foot from the loop to the pull box.

3.5.1.3.2 A minimum of 3 feet of slack shall be coiled and left in the pull box. Where the loop wire crosses cracks or joints in the pavement, plastic sleeving shall be used to insulate the wire, to a minimum of 4 inches on either side of the crack or joint.

3.5.1.4 Initial testing. Prior to the sealant, the loop and the lead-in shall be checked for continuity and resistance. In addition, the integrity of the insulation shall be checked by applying a megohm meter between each end of the loop lead-in and the nearest reliable electrical ground. In the event that no available ground exists, a suitable ground shall be established for the measurement. The megohm meter reading shall be in excess of 10 megohms under all conditions. The Contractor, with the Engineer in

attendance, shall test and record the meter reading at each location for satisfactory compliance.

3.5.1.5 Sealant. Saw cut sealant shall be an approved flexible embedding sealant used strictly in accordance with the manufacturer's instructions. The sealant shall be poured into the slot to half depth, checked for air bubbles or material pile up, then filled to the roadway level. Excess sealant shall be removed by means of a squeegee, and in any case, be neither a trough nor a mound formed. Sufficient time shall be allowed for the sealant to harden in accordance with manufacturer's instructions before allowing traffic access to the area.

3.5.1.6 Final testing. Repeat the test procedure specified in 3.5.1.4.

3.5.1.7 Detector feeder cable installation. The feeder cable and the loop lead-in wire shall be terminated in the pullbox and all connections shall be spliced, soldered, compounded and taped. The entire splice shall be encapsulated in a waterproof splice kit approved by the Engineer.

3.5.1.8 Record keeping. A record of any modifications to the original installation shall be made by the Contractor. The Contractor shall furnish the Engineer with 3 copies of the initial and final test results.

3.6 Service and Meter Box

3.6.1 When required, the Contractor shall furnish and install a service riser on the pole selected by the power company in conformity with the plans, and shall also furnish the power company its choice of equipment above the switch or breaker. Wire sizes shall be as specified by either the plans or the power company. In case of discrepancy the large size shall be used.

3.6.2 A NEMA weather proof disconnect switch and cabinet shall be furnished and installed at the location specified. The circuit breakers in this switch shall be 30 amperes.

3.6.3 The Contractor shall make all arrangements for the service connection and be responsible for all charges incurred thereby.

3.6.4 Under no conditions shall any equipment be installed on any utility pole unless specifically stated on the plans.

3.6.5 The Contractor shall notify the telephone company whenever a service connection is to be made on a jointly owned pole, providing the telephone company with the following information:

(a) Intersection
(b) Pole Number
(c) Date and time of preliminary arrangement with electric power company.

3.6.6 In the case of underground services, the Contractor shall furnish and install all equipment as required by the power company, be responsible for all charges incurred thereby, and complete the work to its satisfaction. Meters shall not be installed in manholes.

3.6.7 The Contractor shall be responsible for all outstanding bills of the electric power company for preliminary work done by the power company during the construction of the road to facilitate the service connection of that particular installation. The Contractor shall also be responsible for all service charges until the signals are accepted for operational use by the Engineer.

3.7 Signal Cable and Wire Installation.

3.7.1 The Contractor shall furnish and install sufficient cable and wire to operate the system properly and at least 4 spare conductors in each cable run shall be provided.

3.7.2 No more than one cable shall be permitted in a conduit except to eliminate splices in pull boxes. When more than one cable is permitted, the area of combined cables shall not exceed 30 percent of the inside area of the conduit.

3.7.3 All pedestrian signals and push buttons shall be individually wired from the field to the cabinet terminals.

3.8 Signal bases, housings, and controllers shall be furnished and installed as required. All structures and housings shall be plumb after erection.

3.8.1 Multiple housings on a single post shall be grouped together using 1-1/2 inch galvanized pipe and 1-1/2 inch galvanized rail fittings. All attachments to the posts shall be made by means of adaptors conforming to 2.2.2. The center of all housings shall be in the same horizontal plane.

3.9 Miscellaneous electrical equipment. All additional electrical fittings, service conduit, switches, fuses, traffic signal bulbs, and such other hardware as is necessary to properly and securely install the equipment shall be furnished. All electrical fittings shall be weatherproof.

3.10 Wiring and connections. All connections shall be spliced, soldered, compounded, and taped, using the following color code:

(a) Red Wire	Red, Main Street
(b) Orange Wire	Yellow, Main Street
(c) Green Wire	Green, Main Street
(d) Red with tracer	Red, Side Street
(e) Orange with tracer	Yellow, Side Street

(f) Green with tracer	Green, Side Street
(g) White	Neutral for all signals
(h) Blue	All steady burning arrows
(i) Blue with tracer	Intermittent arrows
(j) Remaining	Push buttons and spares

Note: The white wire shall be used for all neutral connections and shall be connected to the service ground.

3.11 Ground connections. All installations and equipment shall be bonded and grounded to the service ground rod in accordance with the requirements of the electric power company.

3.11.1 Each signal cable run shall be installed with one green plastic covered copper ground wire to which all equipment shall be bonded in accordance with standard practice. Each base and post, cabinet, and any other component that would be considered a part of the signal system shall be bonded to the ground wire. This ground wire shall be connected to the ground rod at the controller cabinet.

3.11 Painting. The following colors of enamel shall be used:

(a) Controller Cabinet	Outside: Green (1); Inside: White (4)
(b) Housings	Yellow (3)
(c) Visors	Inside: Black (2); Outside: Yellow (3)
(d) Meter Box.	Same color as its mounting

(1) Green Enamel	= 708-NH 3.74
(2) Black Enamel	= 708-NH 3.75
(3) Federal Yellow Enamel	= 708-NH 3.72
(4) White Enamel	= 708-NH 3.73

After the signals have been completely installed, two coats of enamel shall be applied to all unpainted or scratched surfaces after the surface has been lightly sanded to remove gloss.

3.13 Operating sequences shall be as shown on the plans or ordered.

3.14 Installation of signals and equipment. The signals and equipment shall be installed by competent workmen or the manufacturer's representative.

3.14.1 Prior to placing the signals in operations, the signal housing shall be hooded with approved non-transparent material or turned to clearly indicate that the signals are not in operation.

3.14.1.1 Signs mounted with the signals shall be covered as specified in 619.

3.14.2 All material including poles, foundations, fittings and cable shall be supplied and installed to make complete operative installation.

3.15 Operation. The Contractor shall commence the operation of the signal system only when permitted by the Engineer.

3.16 Warranty. Upon completion of the project, the Contractor shall forward to the Commissioner all warrants to the purchaser that the equipment which has been installed hereunder shall be free from defects in materials, workmanship, and title, and shall be of the kind and quality designated or described in the contract. The foregoing warranty supersedes all other warranties whether written, oral, or implied. If it appears within 6 months from the date of final acceptance of the work that the equipment installed hereunder does not meet the warranties specified above, the Contractor shall promptly correct any defect of nonconformance with the specifications. This warranty does not relieve the Contractor of the requirement of 106.04.

Method of Measurement

4.1 Traffic signals and flashing beacons will be measured as a unit. Where more than one unit is specified in the contract, separate item numbers will appear for each separate and complete unit.

Basis of Payment

5.1 The accepted quantity of traffic signals or flashing beacons will be paid for at the contract lump sum price complete in place.

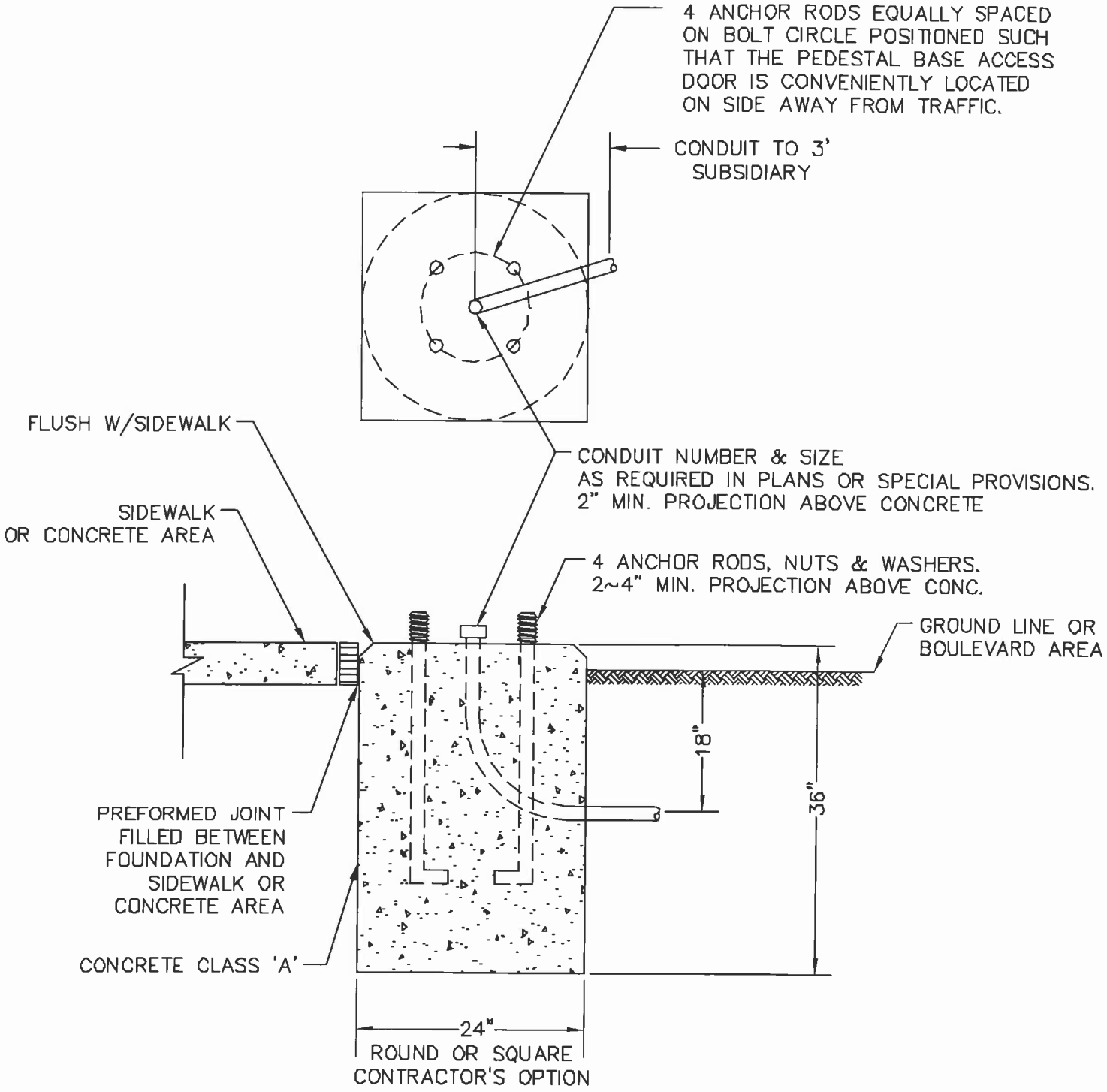
5.2 When an item of conduit appears in the contract, conduit for traffic signals will be paid for under 614.

5.2.1 When no item for conduit appears in the contract, any conduit required will be subsidiary.

5.3 Materials required under 3.9 shall be subsidiary.

Pay Items and Units:

616.1__	Traffic Signals	Lump Sum
616.2__	Flashing Beacons	Lump Sum



SIZE OF FOUNDATION MAY BE CHANGED IN THE PLANS OR SPECIAL PROVISIONS, OR IN THE FIELD AS DIRECTED BY THE ENGINEER.

ANCHOR RODS SHALL BE SET ACCORDING TO MANUFACTURER'S RECOMMENDATIONS.

UPPER PART OF FOUNDATION SHALL BE BEVELED OR CHAMFERED IN A NEAT MANNER AS DIRECTED BY THE ENGINEER IN THE FIELD.

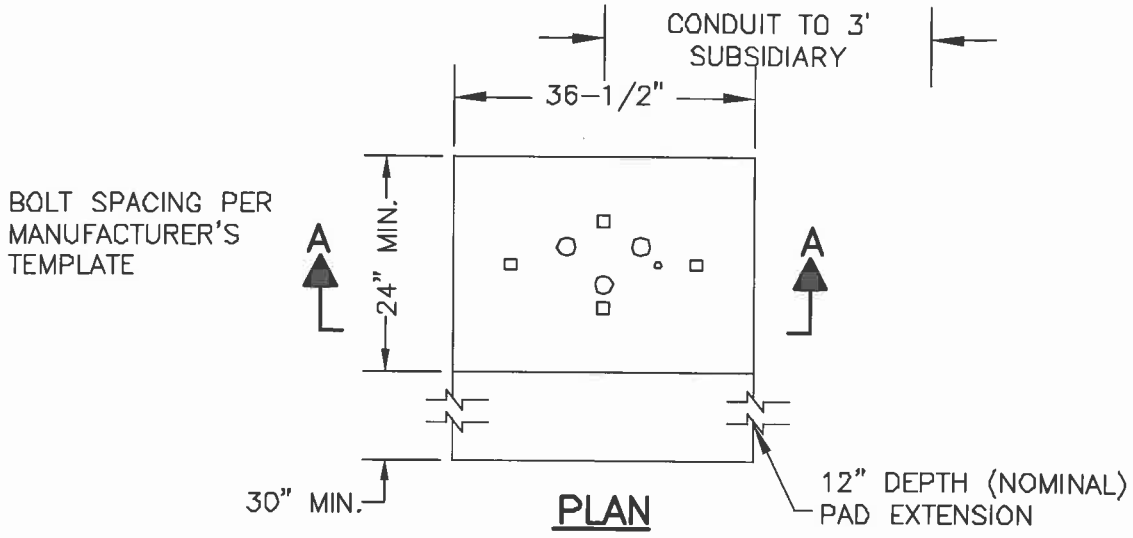
OPEN END OF ALL CONDUIT INTO FOUNDATION SHALL BE CAPPED UNTIL SIGNAL CABLES ARE INSTALLED.

CONC. FOUNDATION FOR STD. TRAFFIC SIGNAL POST

NOT TO SCALE

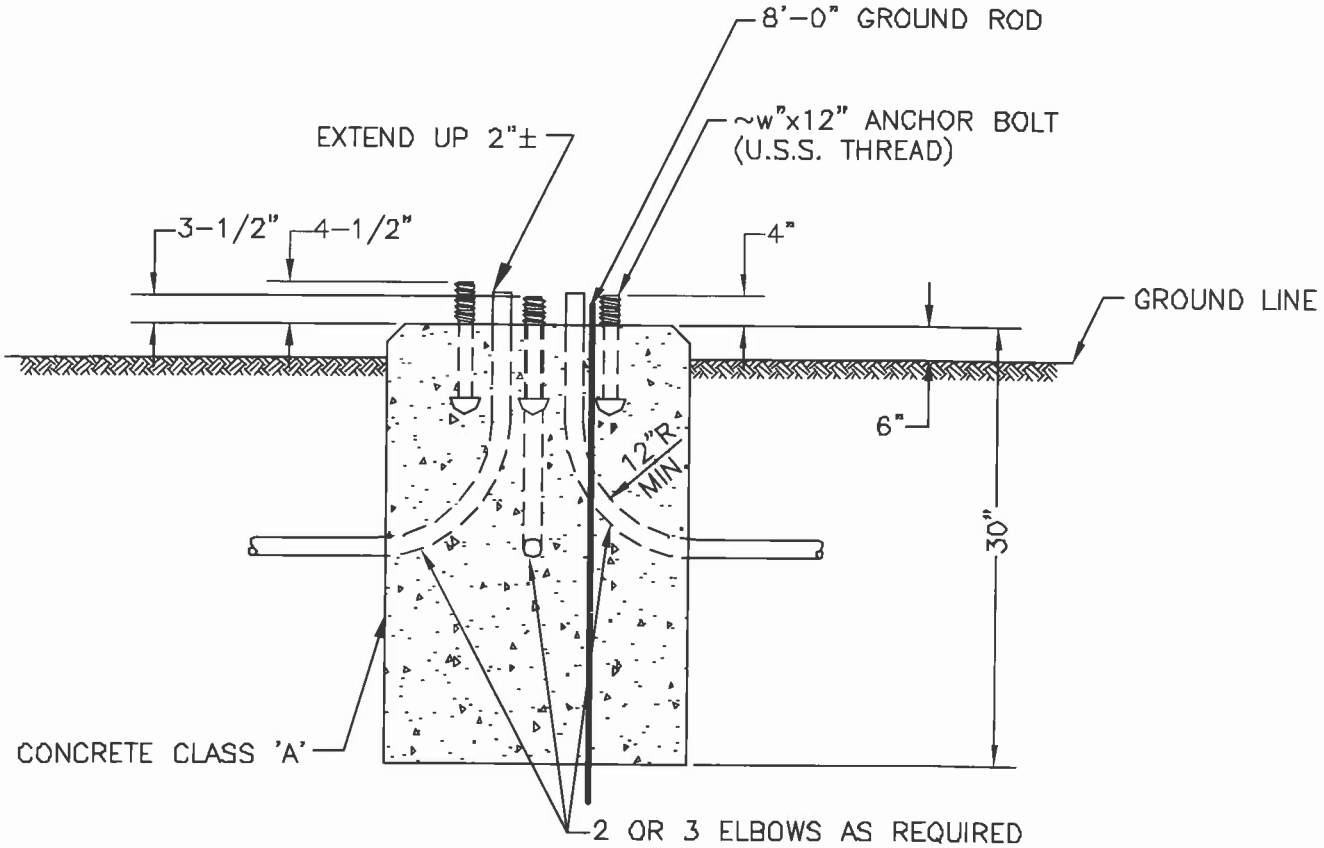
S:\DWG\DETAILS\616-1 TPFOUND.DWG

FIG. 616-1



PLAN

*FOUNDATION SHALL BE 6" WIDER AND LONGER THAN CABINET BASE TO BE INSTALLED



SECTION A-A

PAD MAY BE ELIMINATED IF CONTROLLER IS IN SIDEWALK SECTION.

UPPER PART OF FOUNDATION SHALL BE BEVELED OR CHAMFERED IN A NEAT MANNER AS DIRECTED BY THE ENGINEER IN THE FIELD.

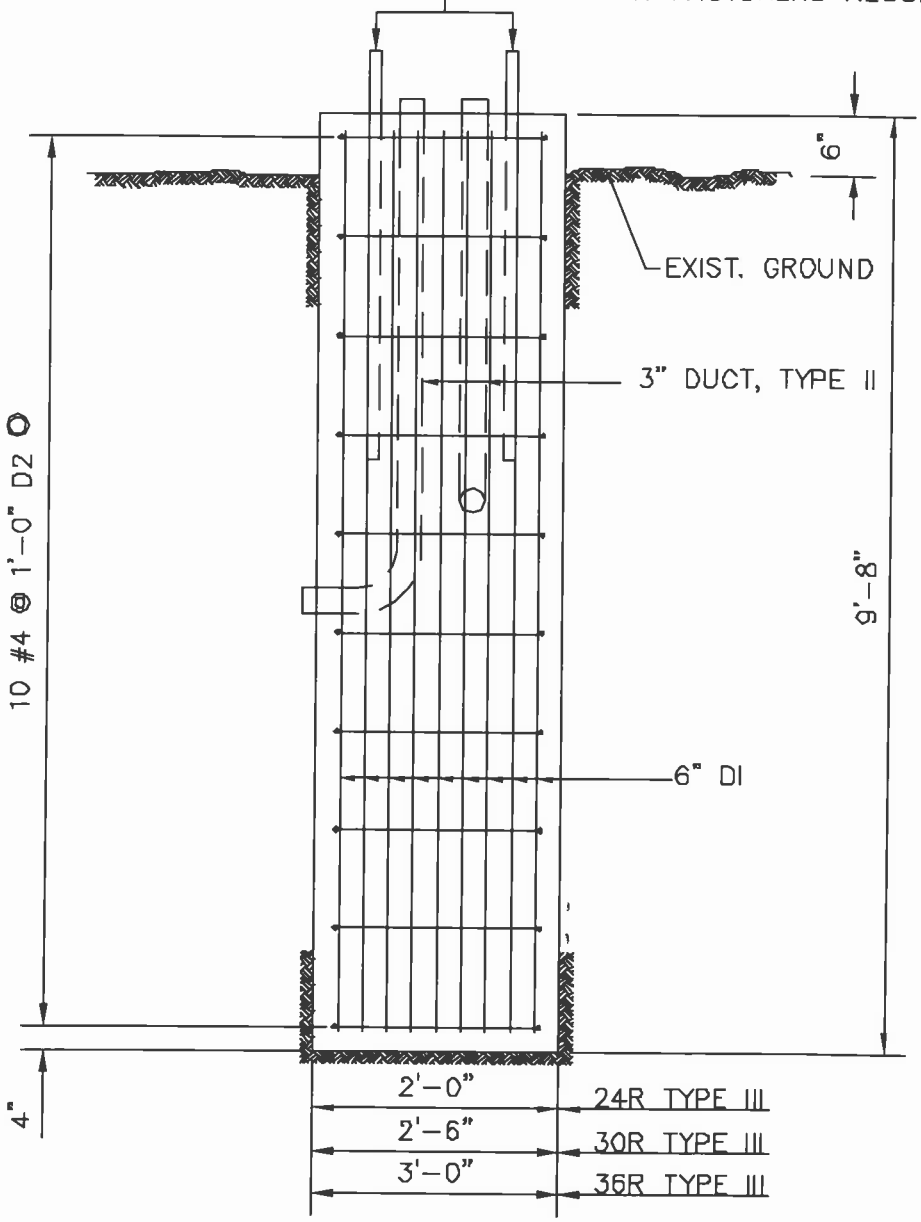
CONC. FOUNDATION FOR CONTROL CABINET

S:\DWG\DETAILS\616-2 CABFOUND.DWG

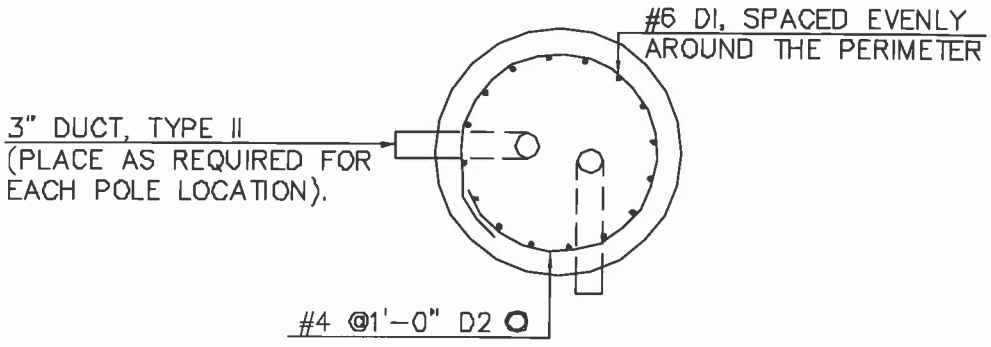
NOT TO SCALE

FIG. 616-2

GALVANIZED ANCHOR BOLTS SHALL BE SET ACCORDING TO POLE MANUFACTURERS RECOMMENDATIONS



ELEVATION



PLAN

TRAFFIC SIGNAL FOUNDATION

NOT TO SCALE

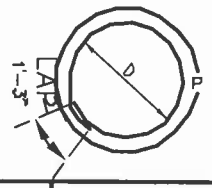
FIG. 616-3

FOUNDATION TYPE III -- 24R, 30R, 36R*

REINFORCING STEEL SCHEDULE - FIG. 616-4a

MARK	SIZE	NO.	UNBENT LENGTH	TYPE
D1	#6	"X"	9'-2"	——
D2	#4	10	"Y"	

FOUNDATION SIZE	NO "X"	UNBENT LENGTH "Y"
24R	12	5'-11"
30R	18	7'-8"
36R	20	9'-1"



#4 D2

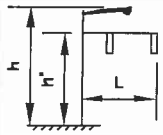
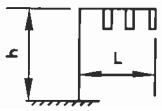
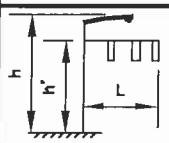
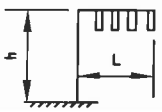
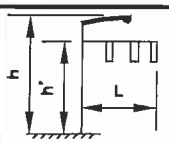
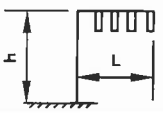
FOUNDATION SIZE	DIMENSION	
	D	P
24R	1'-6"	4'-8"
30R	2'-0"	6'-3"
36R	2'-6"	7'-10"

TYPICAL QUANTITIES PER BASE - FIG. 616-4b

ITEM NUMBER	ITEM	UNIT	QUANTITY FOR FOOTING SIZE		
			24R	30R	36R
▲ 508	STRUCTURAL FILL	CU. YDS.	29	31	34
520.11	CONCRETE CLASS A (FOOTINGS)	CU. YDS.	1.2	1.8	2.6
544	REINFORCING STEEL	LBS.	205	271	336

STANDARD ROUND TRAFFIC SIGNAL FOUNDATION - FIG. 616-4c

DETERMINATION OF SIZE FOOTING REQUIRED

FOOTING SIZE	CASE I MAX. h = 40'-0" MAX h' = 22'-0"			CASE II MAX. h = 22'-0"		
	SHAPE	MAX. LENGTH OF ONE MAST ARM WITH ONE LUMINAIRE ON THE SAME POLE (L)	MAX. NUMBER OF SIGNALS FOR CASE I	SHAPE	MAX. LENGTH OF ONE MAST ARM WITH ONE LUMINAIRE ON THE SAME POLE (L)	MAX. NUMBER OF SIGNALS FOR CASE II
24R-TYPE III (2'-0" x 9'-8")		16'-0"	2		26'-0"	3
30R-TYPE III (2'-6" x 9'-8")		26'-0"	3		36'-0"	4
36R-YTPE III (3'-0" x 9'-8")		36'-0"	3		45'-0"	4

NOTE: COMBINATIONS OTHER THAN THOSE SHOWN IN THE ABOVE CHART SHALL NOT BE USED WITHOUT DESIGN APPROVAL

*SEE TRAFFIC SIGNAL FOUNDATION PLAN GENERAL NOTES (FIG. 616-4d)

TRAFFIC SIGNAL FOUNDATION

S:\DWG\DETAILS\616-4abc SIGFNDN.DWG

FIG. 616-4a,b,c

GENERAL NOTES

DRILLED HOLES

1. THE ROUND TYPE III FOOTING SHALL BE POURED IN DRILLED HOLES AGAINST UNDISTURBED MATERIAL. THE MAXIMUM DESIGN SOIL PRESSURE IS 1–1/2 TONS/SQ.FT. (BOTH HORIZONTALLY & VERTICALLY). IF THE SOIL IS NOT CAPABLE OF A BEARING PRESSURE OF 1–1/2 TONS/SQ.FT. OR WILL NOT STAND VERTICALLY, THE ENGINEER SHALL REQUEST AN EXCAVATED HOLE AS BELOW.

2. THE DRILLED HOLES FOR THE ROUND TYPE III FOOTINGS SHALL BE MADE WITH THE PROPER SIZE AUGER DRILLED TO 9'–2" BELOW THE FINISHED GROUND SURFACE.

3. TRENCHES FOR THE CONDUITS SHALL BE HAND DUG WITHIN 5'–0" OF THE PROPOSED FOOTING SURFACE, DISTURBING AS LITTLE SOIL AS POSSIBLE IN PLACING OF THE CONDUITS (APPROXIMATELY 2'–6" MAXIMUM DOWN FROM THE EXISTING GROUND SURFACE). THE RESULTING TRENCHES SHALL BE COMPLETELY BACKFILLED WITH ITEM 508 AND COMPACTED ACCORDING TO THE NH SPECIFICATIONS. THE HORIZONTAL LIMIT OF ITEM 508 SHALL BE 5'–0" FROM THE FOOTING SURFACE.

4. THE ENGINEER SHALL REQUEST A BORING AT ANY LOCATION WHERE HE DEEMS QUESTIONABLE SOILS BEFORE PROCEEDING WITH THE DRILLING OPERATION. IF, AFTER THE DRILLING OPERATION, THE SOILS ARE FOUND TO BE UNSUITABLE, THE ENGINEER SHALL REQUEST AN EXCAVATED HOLE AS BELOW OR THE USE OF EITHER TYPE I OR OR II SPREAD FOOTING.

5. WHERE LEDGE IS ENCOUNTERED THE DRILL SHALL PENETRATE THE LEDGE A MINIMUM OF 3'–0" AND IN ALL CASES A MINIMUM FOOTING LENGTH OF 5'–0" SHALL BE OBTAINED WHERE LEDGE IS DRILLED 3'–0". MAXIMUM DRILL PENETRATION SHALL BE 9'–2".

6. ALL REINFORCING STEEL SHALL BE EITHER GRADE 40 OR GRADE 60.

7. ALL REINFORCING STEEL SHALL BE A MINIMUM 3" CLEAR.

▲ EXCAVATED HOLES

1. AS AN ALTERNATIVE TO THE ABOVE DRILLED HOLES, THE ROUND TYPE III FOOTINGS MAY BE POURED IN EXCAVATED HOLES, USING THE PROPER FORMS WHICH MUST BE REMOVED, OR PRECAST AND PLACED IN THE EXCAVATED HOLES.

2. THE EXCAVATED HOLES SHALL BE AT LEAST 2'–0" CLEAR OF THE FOOTING SIDES AND 1'–0" DEEPER THAN THE FOOTING. CARE SHALL BE TAKEN TO AVOID OVER EXCAVATING AROUND THE TOP OF THE FOOTING.

3. ANY LEDGE ENCOUNTERED SHALL BE REMOVED TO THE ABOVE LIMITS IF POSSIBLE OR THE ENGINEER SHALL REQUEST A REDESIGN.

4. THE TOTAL EXCAVATED HOLE FOR EACH FOOTING SHALL BE COMPLETELY BACKFILLED WITH STRUCTURAL FILL, ITEM 508, AND COMPACTED ACCORDING TO THE NH SPECIFICATIONS.

TRAFFIC SIGNAL FOUNDATION GENERAL NOTES

SECTION 618 -- UNIFORMED OFFICERS AND FLAGGERS

Description

1.1 This work shall consist of furnishing qualified officers and flaggers, when ordered.

Requirements

2.1 Uniformed officers shall be hired from the Manchester Police Department whenever possible for the control of traffic on City streets. The Contractor shall give the Manchester Police Department a minimum of 48 hours notice prior to his need for their services.

2.2 In the event a Police Officer is not available, the Contractor may procure uniformed officers and flaggers from a commercial security company, provided they are acceptable to the Manchester Police Department for the purpose of traffic control.

2.3 Uniformed officers employed by the Contractor shall have had formal traffic control training, as provided by the Police Standards and Training Council.

2.4 Officers and flaggers shall have been given specific instructions from the Contractor as to their duties and responsibilities, both to the public and to their fellow workers on the job. They shall handle the movement of the travelling public and shall do all that is reasonable to expedite that movement. They shall have authority to direct the actions of the construction vehicles as well.

2.5 Contractors or subcontractors supplying flaggers shall have an employee that has been certified as a trainer of flaggers. Individuals doing the flagging shall have been trained by that trainer or have taken an approved flagging course.

2.6 Uniformed officers and flaggers shall be clothed in a suitable and characteristic manner that will readily distinguish them from all other employees.

2.6.1 Uniformed officers shall be attired with regulation duty uniforms, headgear and reflective vests with or without white stripes, and shall wear an exposed badge.

2.6.2 Flaggers shall be attired with blaze orange caps and vests with or without white stripes. Inappropriate attire shall not be allowed.

2.7 Authorities providing uniformed officers or subcontractors supplying flaggers will designate a person as the responsible party to coordinate the traffic control procedures with both the general superintendent and the Engineer. This person will be responsible to collect and report the time of actual traffic control to all interested parties.

2.8 Personnel Requirements and Authority.

2.8.1 Flaggers shall possess the following qualifications: at least average intelligence and alertness, good sight and hearing, courteous but firm manner, neat and presentable appearance, pleasing personality and a sense of responsibility.

2.8.2 Uniformed officers shall have police powers granted by the authorities having legal jurisdiction in the work area.

2.8.3 Uniformed personnel from commercial security firms shall be regarded as flaggers.

2.8.4 For night operations, high-intensity reflectorized clothing and the use of lighting shall be required, as stated in the Traffic Manual.

Equipment

3.1 Traffic paddles and flagger equipment shall conform to those described in the Traffic Manual (MUTCD)

Method of Measurement and Payment

4.1 Work performed under this Section will be paid for in the same manner as extra work. The allowance amount established in the proposal will not limit the Engineer in the value of work ordered performed under this item.

4.2 The Bidder's attention is called to the price inserted in the proposal under this item, which price is the allowance the City has established to pay for uniformed officers and flagger. This figure (1) must not be altered by the Bidder on his proposal and (2), must be included to obtain the grand total of the bid.

4.2.1 Payment of the amount included in the proposal will not be on a lump sum basis. Only the value of work ordered will be paid for.

4.3 Payment for uniformed officers and flaggers hired by the Contractor from the Police Department or commercial security company shall be based on receipted bills computed on an hourly basis for services rendered to which no mark-up factor will be added.

4.4 No additional compensation will be due the Contractor under this item for flaggers supplied by the Contractor from his work force.

4.5 Appropriate time record will be required, signed by the employees, the Contractor's representative and the Engineer, to support the reimbursement.

Pay Item and unit:

618.109 Uniformed Officers and Flaggers Allowance

SECTION 619-- MAINTENANCE OF TRAFFIC

Description

1.1 This work shall consist of providing and maintaining safe and passable traffic accommodations for public travel, preventing dust nuisance, furnishing, erecting and maintaining construction signs, barricades, delineators, lights, flashers and other warning devices and the application of short term pavement markings and the removal of inappropriate pavement markings as shown or as ordered.

1.2 When the proposal contains a pay item for construction and warning devices, a list showing the permanent signs and warning devices will appear on the plans. The Contractor's method of operation will determine the actual needs for operational signs and warning devices. Operation signs and warning devices shall be provided in sufficient type, quantity and placement configuration to meet the **Standards** and the **Traffic Manual (MUTCD).**

Materials

2.1 Construction Signs.

2.1.1 Base Material shall meet product standard PS-1, American Plywood Association and shall be 1/2 inch thick medium density overlay (MDO) exterior grade plywood with faces and backs grade BB or better, inner core grade C or better and paper-covered on at least one side.

2.1.2 Sign Blanks shall be prepared in accordance with current practice as recommended by the sheeting manufacturer.

2.1.3 Reflective Sheeting shall be applied over the entire surface of the sign and shall conform to 718, Type IIA or Type III Reflective Sheeting.

2.1.4 Application of Sign Text. The sign text shall consist of the letters, digits and symbols either applied by brush or screened, to conform with the dimensions and designs indicated on the plans for the various types of signs. The materials and methods shall be in accordance with standard commercial processes as approved.

2.1.4.1 Symbols, legend and background shall conform with the plans or the Traffic Manual.

2.1.5 Supports, posts and easels shall be as shown on the plans. Posts other than those shown shall be approved by the Engineer prior to their installation, and shall conform to the current AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals."

2.1.6 Hardware required to attach signs to supports shall be such that no staining or discoloration from exposure occurs on the face of the sign.

2.2 Barricades, Delineators and Vertical Panels shall be as shown on the plans or ordered.

2.3 Hazard Markers shall be as shown on the plans or ordered.

2.4 Lighting Devices shall conform to the requirements of Section 6E of the Traffic Manual except as modified on the plans.

2.5 Channelizing devices shall be as shown on the plans or ordered.

2.6 Temporary Pavement Marking Materials.

2.6.1 Reflectorized traffic marking paint and beads shall conform to the requirements of 708.

2.6.2 Reflectorized traffic marking tape shall conform to the requirements of 711.

2.6.3 Raised pavement markers shall be retroreflective markers **as approved by the Department.**

2.7 Calcium Chloride shall conform to AASHTO M 144, Type S, Grade 3. Other dust pallative material may be submitted to the Engineer for approval.

Construction Requirements

3.1 Maintenance of Traffic Including Dust Laying.

3.1.1 The Contractor's attention is called to the following:

3.1.2 Whenever the street is open to public traffic through any part of the project, the Contractor shall provide and maintain sufficient surface for at least one lane traffic, and two lanes whenever possible. One lane traffic shall be controlled as directed by the use of uniformed officers, flaggers (when no officers are available), radio or pilot vehicle. The Engineer may order the control of traffic by the use of a pilot vehicle at such other times as in his opinion, such control is necessary to insure proper workmanship and for the convenience of the travelling public. Control of one lane traffic will be required for 24 hours each day, unless otherwise permitted.

3.1.2.1 When directed, persons regulating traffic shall be equipped with an approved two-way radio system to be used with or without a pilot car. An approved radio system shall be dependable, allowing clear communication at all times between the operators. Operators shall be given sufficient instruction and training to be effective. When a pilot car is being used, the traffic regulators shall be notified when the car turns

around and is ready to conduct traffic through the work area, and they shall be made aware of such other information as may be necessary for the proper maintenance of traffic. Safety precautions shall be taken to avoid any accidents during blasting operations due to the use of radios.

3.1.3 Whenever heavy equipment is operating adjacent to a roadway open to public travel, the Contractor shall provide adequate traffic control to keep traffic lanes open and safe for such travel.

3.1.4. The Contractor shall also provide and maintain in a safe and passable condition such temporary by-passes, accesses to adjacent properties and approaches to intersecting streets.

3.1.5 When ordered, temporary approaches and portions of the existing street surface between the beginning and end of the project shall be paved.

3.1.6 Guide, regulatory and warning signs showing route designations, directions and other information either existing or supplied by the City, shall be maintained at appropriate locations for the use of the travelling public during the construction period. Signs which are not applicable to construction conditions shall be covered, removed or relocated. Signs that are removed or relocated, will be retained and re-erected by the Contractor. The Engineer and the Manchester Traffic Department shall be notified when any sign is removed or relocated.

3.1.7 Temporary guard rail when required, shall be furnished, erected and maintained under this item unless a separate item is included in the proposal.

3.1.8 Dust laying shall be performed in an approved manner generally by the use of water and shall be continued whenever necessary even though all other work on the project is suspended.

3.1.8.1 The Engineer shall determine when the use of Calcium Chloride is warranted to control dust nuisance. It shall be uniformly applied at a rate sufficient to control dust.

3.1.9 Before any suspension of the work, the Contractor shall make passable and shall open to traffic, such portions of the project and temporary roadways or portions thereof as may be agreed upon between the Contractor and the Engineer.

3.1.10 When construction is acceptable to the engineer, to the extent that traffic is maintained on a paved surface, the City will assume the maintenance of the road without cost to the Contractor during the time the work is suspended. The City will provide for snow removal for the needs of normal traffic.

3.1.11 When work is resumed after any suspension, the Contractor shall replace or renew any work or materials lost or damaged because of such temporary use on the project.

3.1.12 If proper maintenance of traffic and proper provisions for traffic control are not being provided by the Contractor, the City may assume maintenance of the road and deduct the cost from any money due or to become due under the Contract.

3.1.13 Any work performed by the City either when construction operations are taking place or during periods of suspension, shall not invalidate any of the provisions of the contract.

3.2 Construction Signs and Warning Devices.

3.2.1 All construction signs, barricades and warning devices supplied for the project, shall be covered with Type IIA or Type III sheathing, free from scratches, abrasions, chipping or any other damages that may at the discretion of the Engineer, be such as to render them unsatisfactory for use or to reduce reflectivity to less than 70% of new material.

3.2.1.1 All permanent construction signs shall be furnished in new or similar condition.

3.2.1.2 At anytime during the life of the contract, at the discretion of the Engineer any sign, barricade or warning device that is damaged, disfigured or found to be in unserviceable condition may be required to be replaced.

3.2.1.3 Signs not specifically mentioned in the specifications or on the plans, shall be designed, constructed, placed, operated and maintained in accordance with the requirements of the MUTCD or as ordered.

3.2.2 Construction signs shall be erected at the locations indicated on the plans or as ordered. The posts shall be plumb. The signs shall be installed on posts, barricades or easels so that the text will be horizontal. Signs on easels or barricades shall not be tilted more than 30 degrees from the vertical.

3.2.3 Barricades and delineators shall be erected wherever necessary for the protection of public travel. Such hazards as pits and open trenches, drop-offs, exceptionally rough stretches of the traveled way and all obstructions of any kind, including equipment parked on the roadway shall be barricaded in an approved manner.

3.2.4 Operational signs and channelizing devices shall not be setup until weather conditions will allow adequate visibility.

3.2.5 Lighting devices required or ordered shall be provided to delineate hazards from sunset to sunrise. The type and number of lights and flashing beacons shall conform to the plans and/or the MUTCD.

3.2.6 All signs, barricades, guard rail, delineators, lighting devices and other materials furnished by the Contractor, shall remain the property of the Contractor unless otherwise specified.

3.3 Temporary Pavement Marking Tape.

3.3.1 The Contractor shall install temporary tape to delineate the traveled way. Tape required shall be readily available to the project at the proper time and shall conform to 2.6. Type to be used shall be shown on the plans or as ordered by the Engineer.

3.3.2 Installation. The use of tape in construction work zones shall be placed in accordance with the Traffic Manual and as follows:

3.3.2.1 Tape shall be applied to clean, dry surfaces in accordance with the manufacturer's recommendations or a method approved by the Engineer.

3.3.2.2 At the end of each day's work, tape shall be in-place as required on each paving lift that is open to normal traffic flow. The tape shall be maintained by the Contractor.

3.3.2.3 The Contractor shall be required to remove or cover the tape after it has served its purpose. The use of heat, solvents, grinding or blast treatment shall not be employed in the removal of temporary tape.

3.4 Temporary Painted Pavement Markings. The Engineer may elect to apply temporary painted pavement markings. In this event, the Contractor shall cooperate with the Engineer in the installation and shall protect the markings.

Method of Measurement

4.1 Maintenance of traffic including dust laying and construction signs and warning devices will each be measured as a unit. Signs when shown on the plans, represent estimated requirements based on anticipated operations.

Basis Of Payment

5.1 The accepted quantities of maintenance of traffic will be paid for at the contract lump sum price for each of the items as listed below with the following exceptions:

5.1.1 Bituminous material placed or applied under 3.1.5 and 3.1.11, will be paid for as provided for under 403.

5.1.2 The material cost of calcium chloride will be paid for as provided for under 109.04. The labor and equipment necessary for material application shall be subsidiary.

5.2 Construction signs and warning devices will be paid for at the contract lump sum price. Payment will be made periodically based on the anticipated construction period contingent upon the installation of the permanent signs and delivery of operational controls.

5.2.1 If new signs or devices are purchased and delivered to the project site, an initial payment will be made based on a paid invoice up to 50 percent of the amount bid. Subsequent payments will be made periodically based on the anticipated construction period.

5.2.2 Replacement of any sign, barricade or warning device required by 619.3.2.2 will be subsidiary.

5.2.3 The material cost of permanent construction signs ordered but not included in the listing on the contract plans will be paid for as provided in 109.04. The labor and equipment cost for installation will be subsidiary.

5.3 Short term pavement markings will be paid at the contract unit price complete in place for each of the items constructed. Although different colors may be required or ordered, no color distinction will be made in the pay items. Payment for short term pavement markings placed will include repair, and replacement as required.

5.4 Work ordered under 3.1.11 that resulted from Department maintenance operations will be paid as provided in 109.04.

5.5 Unless an item is included in the contract for moving signs, moving of Type A signs (only) will be paid as provided in 109.04. All other guide signs covered, removed or relocated as provided in 3.1.6 will be subsidiary.

5.6 When no provision for these items is included in the contract, the work will be subsidiary.

Pay Items and Units:

619.1	Maintenance of Traffic Including Dust Laying	Lump Sum
619.2	Construction Signs and Warning Devices	Lump Sum
619.31	Short Term Reflectorized Paint & Pavement	Lump Sum

SECTION 620 -- CALCIUM CHLORIDE

Description

1.1 This work shall consist of furnishing and applying flake calcium chloride as ordered at such locations as the Engineer may direct for the purpose of reducing the dust nuisance to the travelling public or adjacent residences.

Materials

2.1 Calcium Chloride shall conform to AASHTO M144, Type 1 except the requirements for "total alkali chlorides" and other impurities shall not apply.

Construction Requirements

3.1 Calcium chloride shall be uniformly applied at the rate ordered.

3.2 Calcium chloride will be ordered when the Engineer determines that its use is warranted to control dust. Application of calcium chloride will ordinarily be ordered to control dust on sections of construction open to the public during holidays and weekends only. It may be ordered for detours at anytime.

Method Of Measurement

4.1 Calcium chloride will be measured by the ton in accordance with 109.01 on the basis of delivery slips forwarded to the Engineer but not to exceed the rate ordered. Measurements will be made to the nearest 0.01 of a ton.

Basis Of Payment

5.1 The accepted quantity of calcium chloride will be paid for at the contract unit price per ton complete in place.

Pay Item and Unit:

620	Calcium Chloride	Ton