Project Description

Project Scope

The City of San Antonio is soliciting bids from qualified contractor(s) to install, replace or remove components of existing traffic signals located throughout the City of San Antonio. Unless otherwise noted elsewhere, the City of San Antonio will furnish equipment to be installed.

Services will include, but are not limited to, the installation, removal or replacement of vehicle detectors (VIVDS and/or radar), vehicle signal heads, pedestrian signal heads, pedestrian detectors (push buttons and/or audible pedestrian signals), LED signal lamp units, CCTV's, and traffic signal controller cabinets. Upon completion of each task order, fully operational systems will be required.

This contract is intended to provide installation assistance for various programs designed to upgrade specific equipment at existing traffic signals. This contract is not intended to be used to provide response maintenance assistance.

The contractor will be required to install and make fully operational equipment furnished by the City. Any ancillary items needed by the contractor for a fully functional installation are the responsibility of the Contractor and shall be subsidiary to the applicable bid items.

These services are required by the Transportation & Capital Improvements Department Traffic Operations and Safety Section.

Project Duration and Amount

This contract is a Task Order contract and task orders will be provided based on requested projects and available funding. The contract shall be terminated 365 calendar days after the first task order's notice to proceed. The construction time for each task order will be determined by the Project Manager.

Important Notes

1. All work shall follow the latest edition of the "City of San Antonio Standard Specifications for Construction" published by the City of San Antonio and any Special Provisions for this contract.

2. No direct payment will be made for the following items all associated costs shall be subsidiary to the various applicable items:

    A. Insurance and Bond
    B. Item 100 - Mobilization

C. Item 101 - Preparing of Right of Way
D. Item 530 - Barricades, Signs and Traffic Handling
E. Item 540 - Storm Water Pollution Prevention Plans (SW3P)

3. Unit prices established shall remain valid throughout the duration of the contract.

4. **The quantities shown are estimated quantities used for budgetary purposes only. There is no minimum guarantee on the amount of work shown on the proposal with the awarding of this contract.**

5. The projects will be assigned as they become available through the individual task orders. Specific project information including project limits, work required time allotted for task order and estimated quantities will be provided with each Task Order. Task Orders will be coordinated with Contractor prior to issuance.

6. Workers exposed to traffic will be attired in bright, highly visible clothing at all times and all work zone safety rules shall be adhered to.

7. **The City of San Antonio expects "priority" service regarding the scheduling, timely completion and quality assurance of all work being completed under this contract.**

8. Task Orders will be coordinated with Contractor prior to issuance; however Contractor is expected to be sufficiently staffed to complete up to 5 task orders, if needed, at one time.

9. The Contractor shall continuously execute work until all work required by each Task Order is complete.

10. Before beginning work, contractor shall provide a written schedule of work for each Task Order. Work for each task order shall be scheduled to comply with the time allowance defined in each Task Order. Any deviation from this schedule will require approval from the City of San Antonio's Project Manager prior to implementation of the schedule change.

11. Final adjustment of any equipment installed, as required by the Engineer, shall be done by the Contractor and shall be subsidiary to the applicable bid items.

12. All traffic signal equipment installed shall maintain the minimum clearance required by the electrical utility company from all overhead electrical lines. Additional clearance requirements shall be as directed by the electrical utility company.

13. Any damage done by the contractor while performing the work under this contract will be corrected by the contractor at his expense. The decision to repair or replace items damaged will be at the Engineer's discretion.

14. The contractor shall present to the City of San Antonio a QA/QC plan that will be implemented to ensure all work performed under this contract is of the highest quality. Quality work is expected at all times. Work that does not meet the specifications and is deemed non-quality by the City will be re-done at the Contractor's expense.

CITY OF SAN ANTONIO, TEXAS
GOVERNING SPECIFICATIONS

ITEM	DESCRIPTION
100	MOBILIZATION
101	PREPARING RIGHT-OF-WAY
102	INSURANCE AND BOND
103	REMOVE CONCRETE
308	DRILLED SHAFTS AND UNDER-REAMED FOUNDATIONS
502	CONCRETE SIDEWALKS
530	BARRICADES, SIGNS & TRAFFIC HANDLING
531	SIGNS
540	TEMPORARY EROSION, SEDIMENTATION, AND WATER POLLUTION PREVENTION & CONTROL
552	REMOVING AND RELOCATING IRRIGATION SYSTEMS
600	TRAFFIC SIGNAL GENERAL CONDITIONS
615	TRAFFIC SIGNAL CONTROLLER CABINET
618	CONDUIT
620	ELECTRICAL CONDUCTORS
624	GROUND BOXES
625	ZINC-COATED STEEL WIRE STRAND
628	ELECTRICAL SERVICES
655	CONTROLLER FOUNDATION AND PEDESTAL POSTS
656	FOUNDATIONS FOR TRAFFIC CONTROL DEVICES
680	INSTALLATION OF HIGHWAY TRAFFIC SIGNALS
682	VEHICLE AND PEDESTRIAN SIGNAL HEADS
683	LED COUNTDOWN PEDESTRIAN SIGNAL MODULE
684	TRAFFIC SIGNAL CALBES
685	FLASHING BEACON ASSEMBLIES
686	TRAFFIC SIGNAL POLE ASSEMBLIES (STEEL)
687	PEDESTAL POLE ASSEMBLIES
688	PEDESTRIAN DETECTORS AND VEHICLE LOOP DETECTORS
693	INTERNALLY LIGHTED STREET NAME SIGN ASSEMBLIES
694	VIDEO IMAGING VEHICLE DETECTION SYSTEM
1000	WEB PORTAL

SPECIAL SPECIFICATIONS

ITEM	DESCRIPTION
633	BATTERY BACKUP SYSTEM FOR TRAFFIC SIGNAL
696	RADAR VEHICLE DETECTION DEVICES (RVDD)
4004	SCREW-IN TYPE ANCHOR FOUNDATION
8100	ITS TRAFFIC MONITORING CAMERA

TEXAS DEPARTMENT OF TRANSPORTATION
STANDARD SPECIFICATIONS

ITEM DESCRIPTION

441 STEEL STRUCTURES
442 METAL FOR STRUCTURES
445 GALVANIZING
610 ROADWAY ILLUMINATION ASSEMBLIES

SPECIAL PROVISIONS

All work shall conform to the 2008 Edition of the "Standard Specifications for Construction" published by the City of San Antonio and these Special Provisions.

Item 100: Mobilization

Mobilization will not be paid for directly, but will be subsidiary to the various bid items.

Item 103: Remove Concrete

Breaking up, removal and disposal of existing concrete associated with the modification of traffic signal equipment shall be executed in accordance with this item.

When only a portion of the existing concrete is to be removed, care shall be exercised to avoid damage to the portion that is to remain in place. The existing concrete shall be cut to neat lines shown on the plans or as established by the Engineer, by sawing with an appropriate type circular concrete saw to a minimum depth of ½-inch. Any existing concrete which is damaged or destroyed beyond the neat lines so established shall be replaced at the Contractor's expense. Where reinforcement is encountered in the removed portions of the concrete, a minimum of 1-foot shall be cleaned of all old concrete and left in place to tie into the new concrete construction.

Item 101: Preparing Right – of – Way

The contractor will be responsible for obtaining all permits required to complete the assigned task orders. This item will not be paid directly, but will be subsidiary to the various bid items.

Item 102: Insurance and Bond

This item will not be paid directly, but will be subsidiary to the various bid items.

Item 308 Drilled Shafts and Under-Reamed Foundations

For task orders including this bid item, contractor shall ensure materials and construction methods conform to the requirements of this items and the pertinent requirements of the items referenced within this specification.

Foundations installed under this bid item shall comply with TxDOT's Traffic Signal Pole Foundation detail standard sheet. Concrete used shall be Class "C".

Measurement of the drilled shaft foundation will be by the linear foot of acceptable shaft in place. Payment for drilled shaft foundation installed shall be unit price per linear foot. Unit price shall be full compensation for a complete foundation in place including furnishing and placing all concrete and reinforcing steel.

Anchor bolts will be provided by the City of San Antonio.

An additional 2' schedule 40 PVC stub out shall be installed at each pole foundation. Stub outs shall be one-foot in length and appropriately capped below grade for future use. This shall be subsidiary to the various bid items.

The use of the "rock" bid item shall be at the City's discretion.

Section 308.7 is amended with the following bid items:

Item 308.24 – Drilled Shaft (24 inch diameter) – per linear foot
Item 308.30 – Drilled Shaft (30 inch diameter) – per linear foot
Item 308.36 – Drilled Shaft (36 inch diameter) – per linear foot
Item 308.130 – Drilled Shaft (30 inch diameter) (Rock) – per linear foot
Item 308.136 – Drilled Shaft (36 inch diameter) (Rock) – per linear foot

Item 502: Concrete Sidewalks

Replacement of incidental concrete required by traffic signal equipment modification activities shall be in accordance with this item except for measurement. Replacement of concrete will be measured by the square foot of surface area regardless of depth and reinforcing steel needed to match existing conditions. Concrete to be replaced or repaired shall be as indicated on the plans or as directed by the Engineer.

Section 502.7 is amended with the following bid item:

Item 502.40 – Replace Concrete Miscellaneous – per square foot

Item 530: Barricades, Signs & Traffic Handling

The contractor will be responsible for furnishing and installing all signs, barricades, and other incidentals necessary for proper traffic control, in accordance with Part VI of the Texas MUTCD, the attached Work Zone Standards and as directed by the engineer. All warning signs shall be factory made and in satisfactory condition.

In the event of non-compliance with the TMUTCD, the ROW user shall be notified in writing on the violation. In the event of continued non-compliance, the Director of Public Works may revoke the Permit, in addition to any other remedies available to the City.

Traffic control setup and maintenance will not be paid for directly, but will be subsidiary to the various bid items.

Lane closures will require prior approval and shall be coordinated with the City's Row of Way Management Office.

Normal working hours will be 9 a.m. to 4 p.m., Monday through Friday. When directed, high traffic volumes in urban areas will require work during non-peak hours, weekends, and nights. No work to be performed on National holidays or State observed holidays unless otherwise shown on plans or approved.

Item 531: Signs

Signs to be installed will be provided by the City of San Antonio. The City of San Antonio will provide signs and posts for task orders requiring installation of ground mounted signs. The contractor shall provide the necessary hardware for mounting on the signal pole, post, mast arm, span wire or other traffic signal component as directed for task orders requiring installation on a traffic signal. All mounting hardware necessary for a complete sign installation will not be paid for directly, but will be subsidiary to the various items.

Section 531.7 is amended with the following bid items:

Item 531.97 – Remove Sign – per each
Item 531.98 – Install Sign on Traffic Signal – per each
Item 531.99 – Install Ground Mounted Sign – per each

Item 540: Temporary Erosion, Sedimentation, and Water Pollution Prevention and Control

Cost associated with this item, if necessary, will not be paid for directly, but will be subsidiary to the various bid items.

Item 600: Traffic Signal General Conditions

Contractor shall refer to this item accordingly for additional information. All work shall comply with the City of San Antonio Right of Way Ordinance and the Utility Excavation Criteria Manual.

Contractor will pick up City supplied materials at and deliver salvageable materials to the City of San Antonio Traffic Signal Shop at 223 S. Cherry St. Contractor will call Tracey Smith at 207-7771 one week prior to beginning work to coordinate equipment pick-up.

Contractor will return to the City any equipment removed and deemed salvageable by the Engineer. At his expense and with no additional payment, the contractor will appropriately dispose of any items removed and deemed not to be salvageable by the Engineer.

This work shall not be paid directly and is considered subsidiary to the various bid items.

Item 615: Traffic Signal Controller Cabinet

For task orders requiring the replacement of traffic signal controller cabinets, the City of San Antonio will furnish cabinets to be installed by the contractor. The contractor shall be responsible for removing existing traffic signal controller cabinets and installing City of San

Antonio issued cabinets on existing foundation. The contractor shall furnish all additional materials and equipment necessary to ensure a complete installation.

The Contractor shall ensure equipment inside the cabinet and all wiring is not damaged during the cabinet replacement. The contractor shall demonstrate to the Engineer's satisfaction that field wiring and the equipment has been properly reinstalled in the new cabinet. City of San Antonio forces will connect the field wiring to the controller and set up and turn on the controller.

Section 615.11 is amended with the following bid items:

Item 615.90 – Replace Traffic Signal Controller Cabinet (Post-top Mounting) – per each
Item 615.91 – Replace Traffic Signal Controller Cabinet – per each

Item 624: Ground Boxes

Removal of ground boxes will be measured as each ground box removed. Price is full compensation for removal of ground box, apron, if any, and any other items associated with the existing ground box installation as directed by the Engineer. If existing ground box is not to be replaced, payment will be full compensation for removing the ground box, apron and all equipment, labor, tools and incidentals required to blend location with the existing finished ground.

For task orders that include installation of ground box(es), the City of San Antonio will furnish the ground box(es) to be installed by the Contractor. Payment will be full compensation for excavating and backfilling; constructing and installing the ground boxes provided and constructing and installing concrete aprons when required; and equipment, labor, materials, tools and incidentals.

The installation of the traffic signal ground box in new traffic signal controller cabinet foundations shall be subsidiary to the various bid items for Item 655 "Controller Foundation and Pedestal Posts".

Section 624.7 is amended with the following bid items:

Item 624.90 – Remove Ground Box and Apron – per each
Item 624.91 – Install Ground Box with Apron – per each

Item 625: Zinc-Coated Steel Wire Strand

For task orders requiring the installation of guy wires with anchors, 3/8" messenger cable shall be used. Installation of a standard guy or sidewalk guy shall be as indicated on the plans or as directed by the Engineer and in accordance with TxDOT San Antonio District Standard FBTP(1)-06. Measurement will be for each guy wire installation complete in place including anchors, cable, guards and all incidentals.

Task orders requiring the installation of traffic signal span wire shall be in accordance with this item except for measurement and payment. Span wire installations shall be measured and paid by the linear foot of span wire installed. All incidentals required for a complete installation shall be subsidiary to this item.

Section 625.7 is amended with the following items:

Item 625.10 – Traffic Signal Span Wire (Steel Stranded Cable 5/16) – per linear foot
Item 625.20 – Install Standard Guy with Anchor – per each
Item 625.30 – Install Sidewalk Guy with Anchor – per each

Item 628: Electrical Service

Measurement will be for each fully functioning electrical service or electrical service disconnect complete in place. Payment is full compensation for all materials, including but not limited to risers and conduits, fees and incidental costs in accordance with the payment clause of this item.

Section 628.7 is amended with the following item:

Item 628.30 – Electrical Service Disconnect – per each

Item 633: Battery Backup System for Traffic Signal

For task orders that include Item 633 Battery Backup System for Traffic Signal, the contractor shall furnish and install battery backup systems that meet the requirements of Special Specification Item 633 "Battery Backup System for Traffic Signal".

Item 655: Controller Foundation and Pedestal Posts

The foundation for new traffic signal controller cabinet assembly shall not include an in-ground battery box. The City of San Antonio will furnish ground boxes required by the plans or standard detail. Contractor shall furnish and install ground rods as shown on the plans or standard detail. The price for this item shall be full compensation for a complete foundation in place including installation of controller foundation ground boxes and ground rods.

Task orders for installation of ground rods will be measured as each ground rod furnished and installed by the contractor complete in place. Contractor shall furnish 5/8 inch X 8' copper weld ground rods installed in the traffic signal controller foundation ground box or as directed by the Engineer. Acceptance of ground rod installation will depend on verification of depth of installation by the City of San Antonio representative.

Section 655.7 is amended with the following item:

Item 655.3 – Install Ground Rod 8' (5/8 Diameter) – per each

Item 682: Vehicle and Pedestrian Signal Heads

For task orders requiring the installation of vehicle signal heads, the City of San Antonio will furnish vehicle signal heads with LED lamp units, backplates and mounting assemblies. Unit payment shall be full compensation for installation of each complete assembly to include vehicle signal heads with LED lamp units, backplates and mounting assemblies.
For task orders requiring the removal of vehicle signal, the contractor shall remove complete vehicle signal head assembly including backplates and mounting assemblies. Unit payment shall be full compensation for removal of each complete assembly to include vehicle signal head assembly, backplates and mounting assemblies.

For task orders requiring the installation of pedestrian signal heads, the City of San Antonio will furnish pedestrian signal heads with LED lamp units and mounting arms.

For task orders requiring the replacement of vehicle signal head lamp units, the Contractor will remove existing lamp units and install LED lamp units furnished by the City of San Antonio. Measurement for replacement of lamp units will be for each lamp unit replaced. The contractor can expect task orders for replacement of lamp units to be for replacement of all vehicle signal head lamp units at each location assigned.

Some vehicle signal heads may have incandescent bulbs. In these instances, the contractor shall remove all the components required by the incandescent bulb and replace with the appropriate LED lamp unit provided at no additional cost to the City of San Antonio.

Contractor shall furnish any additional materials needed to ensure a complete, fully functional installation.

Section 682.7 is amended with the following items:

Item 682.91 – Install Vehicle Signal Head – per each
Item 682.92 – Remove Vehicle Signal Head – per each
Item 682.93 – Replace Vehicle Signal Head – per each
Item 682.94 – Replace Signal Lamp Unit on Existing Vehicle Signal Head – per each
Item 682.95 – Replace Existing Pedestrian Signal Head – per each
Item 682.96 – Install Pedestrian Signal Head – per each

Item 683: LED Countdown Pedestrian Signal Module

For task orders requiring the replacement of pedestrian signal indication lamps, the Contractor will remove existing lamp units and install LED countdown pedestrian signal modules furnished by the City of San Antonio. Measurement for replacement of lamp units will be for each lamp unit replaced. The contractor can expect task orders for replacement of lamp units to be for replacement of all pedestrian signal head lamp units at each location assigned.

Some pedestrian signal heads may not have the LED countdown pedestrian signal modules. In these instances, the contractor shall remove all the components required by the existing pedestrian signal indication lamp and replace with the appropriate LED lamp unit provided, at no additional cost to the City of San Antonio.

Contractor shall furnish any additional materials needed to ensure a complete, fully functional installation.

Section 683.7 is amended with the following items:

Item 683.97 – Replace Signal Lamp Unit on Existing Pedestrian Signal Head – per each

Item 684: Traffic Signal Cables

All proposed signal cable shall be #14 a.w.g. solid copper.

Item 685: Flashing Beacon Assemblies

For task orders requiring the installation of a roadside flashing beacon assembly, the City of San Antonio will furnish the complete roadside flashing beacon assembly to be installed. The unit price shall be full compensation for erecting the flashing beacon assembly provided; complete foundation in place; furnishing and placing anchor bolts, nuts washers and template: and equipment, materials, labor, tools and incidentals.

For task orders requiring the relocation of an existing roadside flashing beacon assembly, this unit bid price shall be full compensation for removing the existing flashing beacon assembly; removing the existing foundation; installing a new complete foundation; replacing the assembly on its new foundation with all manipulations and electrical work; salvaging; disposal of unsalvageable material; loading and hauling; furnishing and placing anchor bolts, nuts washers and template: and equipment, materials, labor, tools and incidentals.

For task orders requiring the removal of an existing roadside flashing beacon assembly, this unit bid price shall be full compensation for removing the existing flashing beacon assembly; removing the existing foundation; salvaging; disposal of unsalvageable material; loading and hauling; and equipment, materials, labor, tools and incidentals.

Item 686: Traffic Signal Pole Assemblies (Steel)

Traffic signal pole assemblies shall be provided by the City and installed by the contractor. New foundations shall be paid under Item 308 "Drilled Shafts and Under-Reamed Foundations".

Section 686.7 is amended with the following items:

Item 686.30 – Install Traffic Signal Pole Assembly (Steel) (Single Mast Arm 24' thru 32') – per each
Item 686.40 – Install Traffic Signal Pole Assembly (Steel) (Single Mast Arm 36' thru 48') – per each
Item 686.50 – Install Traffic Signal Pole Assembly (Steel Strain 30') – per each

Item 688: Pedestrian Detectors and Vehicle Loop Detectors

For task orders requiring the installation of pedestrian detectors (push buttons), the City of San Antonio will furnish pedestrian push button/sign assemblies.

For task orders requiring the installation of audible pedestrian signals, the City of San Antonio will furnish the APS unit to be installed.

For task orders requiring the replacement of existing pedestrian detectors, the Contractor will remove existing equipment and replace with ADA complaint pedestrian push button/sign assemblies furnished by the City of San Antonio.

The contractor shall furnish all additional materials and equipment necessary to ensure a complete, fully functional installation.

Section 688.7 is amended with the following items:

Item 688.11 – Replace Pedestrian Detector (Push Button and Sign Assembly) - per each
Item 688.12 – Install Pedestrian Detector (2 inch Push Button and Sign Assembly) – per each
Item 688.91 – Install Audible Pedestrian Signal Unit – per each

Item 693: Internally Lighted Street Name Sign Assemblies

For task orders requiring the installation of internally lighted street name signs (ILSN), the City will furnish the ILSNs, legend, and mounting hardware.

The contractor shall furnish all additional materials and equipment necessary to ensure a complete installation.

Section 693.7 is amended with the following item:

Item 693.12 – Install Internally Lighted Street Name Sign - per each

Item 694: Video Imaging Vehicle Detection System

For task orders requiring the installation of video imaging vehicle detection systems (VIVDS), the City of San Antonio will furnish the VIVDS camera assemblies, mounting hardware, and cable. The contractor shall focus and zoom the cameras as directed by the Engineer to ensure a complete, fully functional VIVDS installation.

The camera assemblies shall be mounted above the roadway on the mast arms and/or luminaire arms, as directed by the Engineer. Camera assembly height shall be a minimum of 25 feet above the roadway or in accordance with manufacturer recommendation to obtain optimum detection, as determined by the Engineer.

For installations requiring a luminaire arm, the City of San Antonio will furnish the luminaire arm. The contractor shall furnish any ancillary items needed to mount the luminaire arms to the wood or steel strain poles.

Payment of processor unit installations will be full compensation for the installation of all items required for a fully operational system including but not limited to installation of power distribution panel, surge arrestor and related wiring.

The contractor shall furnish all additional materials and equipment necessary to ensure a complete, fully functional installation.

Section 694.15 is amended with the following items:

Item 694.12 – Install VIVDS Camera Assembly - per each
Item 694.14 – Install VIVDS Communication Cable (COAXIAL) – per linear foot
Item 694.15 – Install VIVDS Luminaire Arm – per each
Item 694.17 – Install VIVDS Processor Unit - per each

Item 696: Radar Vehicle Detection Devices (RVDD)

The contractor shall furnish and install all items required for fully operational installations for task orders that include the following bid items:

Item 696.01 - Radar Advance Detection Devices (RADD) (furnish and install)
Item 696.02 – Radar Presence Detection Device (RPDD)(furnish and install)
Item 696.03 – Radar Advance Detection Device (RADD) Communication and Power Cable (furnish and install)
Item 696.04 – Radar Presence Detection Device (RPDD) Communication and Power Cable (furnish and install)

The City of San Antonio will furnish the equipment for the contractor to install and make fully operational for task orders that include the following bid items:

Item 696.12 – Install Radar Detection Devices
Item 696.14 – Install Radar Communications Cable

The contractor can expect installation of these devices to be on existing poles. The contractor shall make field adjustments as necessary and as directed by the Engineer to ensure a fully functional RVDD installation.

The contractor shall furnish all additional materials and equipment necessary to ensure a complete, fully installation.

Item 4004: Screw-In Type Anchor Foundation

Contractor shall furnish and install the screw-in type anchor foundation in accordance with the requirements of the Special Specification Item 4004 Screw-In Type Anchor Foundation.

Item 8100: ITS Traffic Monitoring Camera

For task orders requiring the installation of ITS Traffic Monitoring Cameras, the City will furnish the camera, mounting hardware and communication and power cable(s).

The contractor can expect installation of these devices to be on existing poles. The contractor shall make field adjustments as necessary and as directed by the Engineer to ensure a fully functional CCTV camera installation.

The contractor shall furnish all additional materials and equipment necessary to ensure a complete installation.

Section 8100.6 is amended with the following items:

Item 8100.4 – Install ITS Traffic Monitoring Camera - per each
Item 8100.5 – Install ITS Traffic Monitoring Camera Cable – per linear foot

TxDOT Standard Specification Item 610: Roadway Illumination Assemblies

This bid item will be used to remove and replace existing light fixtures on traffic signal poles. The City will furnish the light fixtures to be installed. The contractor shall remove the existing light fixture and install the new light fixture provided by the City. The unit bid price for Item 610.01 "Replace Luminaires (Light Fixtures), shall be full compensation for removing and disposing of the existing luminaires; installing and making fully operational the new luminaire; and materials, equipment, labor, tools and incidentals.

Texas Department of Transportation

Standard Specification Item 610

Roadway Illumination Assemblies

1. DESCRIPTION

- **Installation**. Furnish, Fabricate, and install roadway illumination assemblies.
- **Relocation.** Remove and relocate existing roadway illumination assemblies.
- **Removal.** Remove existing roadway illumination assemblies.
- **Replace Luminaires (Light Fixtures).** Remove and replace existing luminaires.

2. MATERIALS

Provide new materials that comply with the details shown on the plans, the requirements of this Item, and the pertinent requirements of the following Items.

- Item 416, “Drill Shaft Foundation”
- Item 421, “Hydraulic Cement Concrete”
- Item 441, “Steel Structures”
- Item 442, “Metal for Structures”
- Item 445, “Galvanizing”
- Item 449, “Anchor Bolts”
- Item 616, “Performance Testing of Lighting Systems”
- Item 618, “Conduit”
- Item 620, “Electrical Conductors”

Fabrication plants that produce roadway illumination poles, including luminaires arms, must be approved in accordance with DMS-7380, “Steel Non-Bridge Member Fabrication Plant Qualification.” This includes fabricators of aluminum roadway illumination poles and luminaire arms. The Construction Division maintains a list of approved fabrication plants of roadway illumination poles.

Furnish light fixtures from new materials that are in accordance with DMS-11010, “Roadway Illumination light Fixtures.”

Provide prequalified light fixtures from the Department's MPL. When required by the Engineer, notify the Department in writing of selected materials from the MPL intended for use on each project.

Do not provide shop drawings for complete assemblies that are fabricated in accordance with this Item and the details shown on the plans. Electronically submit shop drawings in accordance with Item 441, "Steel Structures, " for optional multi-sided steel pole designs; optional aluminum pole designs; and non-standard designs, required when basic wind speeds or pole base mounting heights at the installation locations are in excess of those shown on the Roadway Illumination Pole (RIP) standard. Manufactures may request that the Department add their submitted show drawings and design calculations to a pre-approved list of optional and non-standard pole design, maintained by the Traffic Operations Division.

Hot-dip galvanize fabricated pole sections and associated parts in accordance with Item 445, "Galvanizing." Punch or drill holes in steel parts or members, when allowed, before galvanizing.

When shown on the plans, paint poles in accordance with the plans for uncoated structures and in accordance with Item 445, "Galvanizing" for galvanized structures.

3. CONSTRUCTION

Perform work in accordance with the details shown on the plans and the requirements of this Item. Permanently mark roadway illumination pole base plates, at a visible location when erected, with the fabrication plant's insignia or trademark. Sample fixtures for testing in accordance with Tex-1110-T.

Use established industry and utility safety practices when installing, relocating, or removing poles or luminaires located near overhead or underground utilities. Consult with the appropriate utility company before beginning work.

Prevent scarring or marring of the poles, luminaires arms, and luminaries. Replace damaged components. Repair damaged galvanizing in accordance with Section 445.3.5., "Repairs." Repair damaged painted areas of a roadway illumination assembly in accordance with Item 441, "Steel Structures" or Item 445, "Galvanizing."

Stake, install, and align each roadway illumination assembly as shown on the plans.

The Engineer may shift an assembly's location, if necessary, to secure a more desirable location or avoid conflict with utilities.

Construct foundations for roadway illumination assemblies in accordance with the Item 416, “Drilled Shaft Foundation,” and the details shown on the plans.

3.1 **Installation.** Furnish and install roadway illumination assembly components in accordance with the details, dimensions, and requirements shown on the plans. Do not use screw-in type foundations. Install anchor bolts and coat anchor bolts threads in accordance with Item 449,”Anchor Bolts.” Erect structures after foundation concrete has attained its design strength as required on the plans and Item 421, “Hydraulic Cement Concrete.” Tighten anchor bolts for poles with shoe bases and concrete traffic barrier base poles in accordance with Item 449, “Anchor Bolts.” Do not place grout between base plate and foundation. Test installed roadway illumination assemblies in accordance with Item 616, “Performance Testing of Lighting Systems.”

3.2 **Relocation.** Relocate roadway illumination assembly components in accordance with the details, dimension, and requirements shown on the plans. Do not use screw-in type foundation. Install existing structures on new foundation in accordance with Section 610.3.1., “Installation.” Do not place grout between base plate and foundation. Test installed roadway illumination assemblies in accordance with Item 616, “Performance Testing of Lighting Systems.”

Disconnect and remove conductors from abandoned circuits. Remove abandoned conduit or ducts to a point 6in. below final grade. Reconnect conduit and ducts to be reused. Replace damaged conduit and ducts. Replace conductors.

Unless otherwise shown on the plans, remove abandoned concrete foundations and replace surfacing in accordance with Section 610.3.3., “Removal.” Do not remove existing concrete bridge lighting brackets.

Furnish and install new internal conductors, fused and unfused connectors, and lamps. Furnish and install new transformer bases that meet AASHTO and plan requirements when relocating transformer base poles. Destroy exiting transformer bases to prevent reuse.

Accept ownership of unsalvageable materials and dispose of in accordance with federal, state, and local regulations.

3.3 **Removal.** Remove roadway illumination assembly components in accordance with established industry and utility safety practices.

Remove transformer bases from transformer base poles. Destroy removed transformer bases to prevent reuse. Remove luminaires and luminaire arms from the pole shaft. Stockpile pole shafts, luminaire arms, and assembly harward at a location designated by the Department. Pole shafts, luminaire arms, and assembly hardware will remain Department property unless otherwise shown on the plans or as directed.

Disconnect and remove conductors from abandoned circuits. Remove abandoned conduit and ducts to a point 6 in below final grade.

Unless otherwise shown on the plans, remove abandoned concrete foundation, including steel, to a point 2ft. below final grade. Backfill the hole with material that is equal in composition and density to the surrounding area. Replace surfacing material with similar material to an equivalent condition. Do not remove existing concrete bridge brackets.

Accept ownership of unsalvageable materials and dispose of in accordance with federal, state, and local regulations.

3.4 **Replace Luminaires.** Remove existing luminaires. Furnish and install luminaires in accordance with the details, dimensions, and requirements shown on the plans. Test installed luminaires in accordance with Item 616, "Performance Testing of Lighting Systems."

4. MEASUREMENT

This Item will be measured as each roadway illumination assembly installed, relocated, or removed; or by each luminaire replaced.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Install Roadway Illumination Assemblies" of the types specified, "Relocate Roadway Illumination Assemblies" of the types specified, or "Replace Luminaires" of the types specified. The Department will pay for electrical energy consumed by the lighting systems.

New drilled shaft foundations will be paid for under Item 416, "Drill Shaft Foundation." New concrete riprap placed around foundations will be paid for under Item 432, "Riprap." New conduit will be paid for under Item 618, "Conduit." New conductors, except the conductors internal to the pole, will be paid for under Item 620, "Electrical Conductors." New duct cable will be paid for under Item 622, "Duct Cable." New ground boxes will be paid for under Item 624, "Ground Boxes." New electrical services will be paid for under Item 628, "Electrical Services."

5.1 **Installation.** This price is full compensation for furnishing, installing, and testing luminaires; furnishing and installing lamps, luminaire arms, brackets, poles, anchor bolt assemblies, templates, internal conductors, and connections;

conducting system performance testing; and materials, equipment, labor, tools, and incidentals.

5.2 **Relocation.** This price is full compensation for salvaging and relocating the existing conduit and duct; removing existing foundations, backfilling, and surface placement; removing, erecting, connecting, and testing illumination assemblies; removing existing conductors; furnishing and installing new anchor bolt assemblies, templates, transformer bases, lamps, connections, and conductors; replacing damaged components; disposing of unsalvageable materials; and materials equipment, labor, tools, and incidentials.

5.3 **Removal.** This price is full compensation for removing, salvaging, disassembling, and stockpiling illumination assemblies; salvaging and relocating existing conduit; removing existing foundations; backfilling and surface placement; splicing existing conductors; disposing of unsalvageable materials; and materials, equipment, labor, tools, and incidentals.

5.4 **Replace Luminaires.** This price is full compensation for removing, salvaging, disassembling, and stockpiling existing luminaires; furnishing and installing new luminaires, connections and conductors internal to the pole; replacing damaged components; disposing of unsalvageable materials; and materials, equipment, labor, tools, and incidentals.

SPECIAL SPECIFICATION 633

BATTERY BACKUP SYSTEM FOR TRAFFIC SIGNAL

633.1. DESCRIPTION:
Furnish, fabricate, assemble or install a Battery Backup System (BBS) for traffic signal including rack mounted power inverters, battery charger, electronic controls, bypass switch, charging management system, battery cables and connectors; and all wiring, hardware and incidentals necessary to form a complete battery backup system including batteries and externally mounted battery case.

633.2. MATERIALS: Furnish new materials in accordance with these specifications, the details shown on the plans, and the following standards:

1. UL 1778 (Underwriter Laboratories) Standard for UPS Equipment.
2. CSA 22.2 (Canadian Standards Association - CUL Equipment).
3. IEC (International Electro-technical Commission) Semiconductor Converter Standards.
4. ISO 9001 Quality Assurance program.
5. IEEE 587, ANSI C62.41/C62.45 Category A&B for Lightning/Surge Protection.

A. General.

The BBS supplier shall provide and install the BBS and the associated components, to be utilized to provide emergency power for the traffic control systems, and associated equipment in the event of a utility power failure, or when the utility power is beyond the "normal" voltage and frequency parameters as programmed within the BBS. The BBS shall be a line-interactive type and provide voltage regulation and power conditioning when using utility power. The transfer from utility power to battery power, and vice versa, shall not interfere with the normal operation of the traffic controller, or any other peripheral devices within the traffic controller assembly. The BBS shall be equipped with a programmable front panel display to allow status of real time events occurring in the power system. The BBS shall be equipped with an RS-232 data port and an Ethernet SNMP interface that can be utilized for programming the flashing mode timer, monitoring the BBS system, and transferring status and event data to a laptop computer, or a remote central location. The BBS shall be equipped with dry contacts that can provide the following monitoring features: 1) Battery On, 2) Low Battery, 3) General alarm, to Indicate out of range line frequency, low output voltage, no temperature probe, overload, batteries not connected, high temperature, low temperature, and BBS failure. The BBS shall be fully compatible with incandescent and LED traffic signal control equipment, pedestrian signals, and camera systems. The BBS shall consist of a rectifier, batteries, solid-state inverter, and wrap around maintenance bypass switch/automatic transfer switch. The wrap around maintenance bypass switch shall allow the removal and replacement of the BBS module without disruption to the traffic signal control equipment. Supplier must have manufactured BBS systems for traffic control applications for 10 or more years.

B. System Description.

1. Components.

The BBS system shall consist of the following major equipment:

a. BBS Module.
- i. Insulated Gate Bipolar Transistor (IGBT) Inverter, or other technology to limit THD current and voltage to 3% or less.
- ii. Diode Bridge + IGBT DC/DC Rectifier.

ii. Functional relationship of equipment including weights, dimensions, and heat dissipation.
iii. Descriptions of equipment to be furnished, including deviations from these specifications.
iv. Detailed layout of customer power and control connections.
v. Detailed installation drawings including all terminal locations delivery.

b. Submittals upon BBS delivery shall include:

i. Shop Drawings. Submit system configurations with single line diagrams, detailed layout of power and control connections, dimensional data and detailed installation drawings including all terminal locations.
ii. Product Data. Provide product data for BBS and battery including catalog sheets and technical data sheets to indicate electrical performance, BBS type, battery type, detailed equipment outlines, weight, dimensions, control and external wiring requirements, heat rejection and air flow requirements.
iii. Owners and technical manual.
iv. Complete set of specifications for all electronic components.
v. Test Report. Submit a copy of factory and field test reports as applicable.

4. Environmental Conditions.

a. The BBS shall be capable of withstanding any combination of the following external environment conditions without mechanical damage, electrical failure or degradation of operating characteristics.

i. Operating ambient temperature: -40 degrees C to +74 degrees C (-40 degrees F to 165 degrees F).
ii. Non-operating and storage ambient temperature: -40 degrees C to +70 degrees C (-40 degrees. F to 158 degrees F).
iii. Operating relative humidity: 5% to 95 %, non-condensing.
iv. Recommended operating relative humidity: 30 % to 95%.
v. Operating altitude: Sea level to 2700 meter (9000ft).

b. Audible acoustical noise. Noise generate by the BBS, when operating under full rated load, at a distance of one meter from any BBS operator surface, shall not exceed 55 dB as measured on the A scale of a standard sound level meter at slow response.

c. Input surge withstand capability. The BBS shall be in compliance with IEEE C62.4 1/C62.45 Category A & B.

5. Warranty. The BBS manufacture shall warrant to the original end user that the Battery Backup System shall be free from defects in material and workmanship under normal use and service for a period of thirty six (36) months from the date of installation.

6. Quality Assurance. The BBS manufacture shall fully and completely test the system to assure compliance with the specifications, before shipment.

C. Product.

g. Efficiency-(84% or Greater)

h. BBS Protection. The BBS shall indicate an overload warning with a flashing alarm LED when the load is between 95% and 105% of the rated output of the BBS. The BBS shall shutdown, and the fault LED shall turn ON, after two minutes of operation in back up mode when the load is between 106% and 115% of the rated output for the BBS, and the fault LED shall turn ON. The fault LED shall clear when the overload is removed and the utility line power returns. The BBS shall shutdown and the fault LED shall turn ON, after one minute of operation in back up mode when the load is greater than 115% of rated output. The fault LED shall clear when the overload is removed and the utility line power returns. The BBS shall disable the back up mode function when operating in line mode if the load exceeds 115% of the rated output for the BBS. The BBS shall display an alarm LED if the battery ambient temperature is greater than 75 degrees Centigrade and disable the back up mode function. The alarm shall clear when the battery ambient temperature is less than 70 degrees Centigrade. The BBS shall display a fault when operating in back up mode and shutdown the inverter if the internal temperature is greater than 110 degrees Centigrade. The fault shall clear when the utility power returns and the internal temperature is less than 90 degrees Centigrade. The BBS shall have output over-voltage protection to electronically shutdown the BBS if the output voltage exceeds 132 volts a.c. The BBS shall disable the battery charger and display an alarm LED if the battery voltage exceeds 59 volts d.c. for two seconds. The alarm shall be cleared and the charger enabled when the battery voltage drops to less than 57 volts D.C. The BBS shall display an alarm LED to indicate the BBS ventilation fan is enabled but not turning.

2. **Components.** BBS module shall be comprised of the following:

a. Hybrid Converter Section. AC input, converter input contactor, converter input fuse, input harmonic filter, and hybrid converter utilizing:

i. High Power Diode Bridge Rectifier

a) General. A high power diode bridge rectifier converts the utility AC input power into regulated DC power that serves as the inverter input and also as dc charge power to the system battery through the chopper/booster. An AC reactor and capacitor shall filter the harmonic content of rectifier input.

b) Input Over-Current Protection. BBS input circuit breaker, converter input contactor, and the input current limit control shall provide rectifier protection against excessive input overload conditions.

c) Step Load Change Operation (0-100%). In the occurrence of a 100% step load change, the BBS Module inverter shall draw power only from the rectifier to provide the required load demand. The charger/booster shall not be utilized and the system batteries will not be cycled at any time during a step load change.

ii. Charger/Booster

a) General. The charger/booster utilizes solid state Pulse Width Modulation (PWM) controlled Insulated Gate Bipolar Transistors (IGBT)

b) Battery Charge Current Limit. Battery charging will be temperature compensated to maximize battery life. The battery charger current of the BBS shall be user programmable for 3, 6, and 10 amps. The battery

ii. Service Functions

a) The BBS shall be capable of performing a self test, locally from the BBS front panel LCD, or remotely via the communication interface. The duration of the self test shall be programmable.
b) The BBS shall be capable of performing a battery test to determine the integrity of the battery system.

3. Mechanical Design.

a. Cabinet Structure (Enclosure)

i. The enclosure shall be .125" thick, aluminum alloy, grade S052-H32, rated as NEMA 3R. The cabinets shall be provided with three point latching systems, a thermostatically controlled fan kit, door lock, continuous piano hinges for doors, and the appropriate louver openings for ventilation. The cabinets shall be constructed to allow a pad-mounted type installation, and capable of being mounted directly adjacent to the existing traffic controller panels.
ii. The BBS shall be installed in a rack mounted configuration, with heavy-duty structures meeting with NEMA standard for floor mounting.
iii. The cabinet shall be equipped with an exterior, weather rated lamp that will be utilized to indicate when normal utility power is not available at the control cabinet. The lamp shall be visible from the street in order to allow service technicians to identify a power loss at the cabinet, and shall be protected to avoid vandalism. Incandescent lamps shall not be utilized.

b. Serviceability. The BBS shall have front access for all servicing adjustment and connections only for maintenance or service. Side access or rear access shall not be accepted. The BBS shall be designed such that its rear can be pressed against the existing traffic controller cabinet.

633.3 CONSTRUCTION

1. Site Preparation.

The UPS provider shall prepare the site for installation of the equipment.

2. Installation.

a. The BBS shall be set in place, wired and connected in accordance with the approved installation drawings and owners/technical manual delivered with equipment. The BBS enclosure will be provided as a stand-alone, pad mounted cabinet that can be mechanically affixed to the existing traffic controller cabinet.
b. The equipment shall be installed in accordance with local codes and manufacturer's recommendation.

3. Field Quality Control.

a. The equipment shall be checked out and started by a customer support representative from the equipment manufacturer. Visual and mechanical inspection of electrical installation, initial BBS startup and operational training shall be performed. A signed service report shall be submitted after equipment is operational.

ITEM 696

RADAR VEHICLE DETECTION DEVICES (RVDD)

696.1. DESCRIPTION: *Furnish and install Radar Vehicle Detection Devices (RVDD), including: Radar Advance Detection Devices (RADD) and/or Radar Presence Detection Devices (RPDD) to detect vehicles on a roadway via processing of radar electromagnetic waves and provides detector outputs to a traffic signal controller or similar device.*

696.2. DEFINITIONS

A. RADAR: Radio detection and ranging. High frequency electromagnetic energy waves used to detect, identify, and determine the range, direction, and/or speed of an object such as a motor vehicle.

B. Radar Vehicle Detection Device (RVDD): Device that emits electromagnetic waves and senses return waves from passing and/or approaching vehicles. The RVDD shall be spatially monostatic; the transmitter and receiver shall be located on the same sensor device.

C. Radar Advance Detection Device (RADD): Device that accurately and continuously detects, tracks, and identifies speed of approaching vehicles simultaneously to an intersection in the selected direction of travel. The RADD is capable of detection as described in section 696.3.A. The RADD shall maintain detection of a vehicle moving within 100 ft. to 500 ft. from the device as programmed by the user.

D. Radar Presence Detection Device (RPDD): Device that accurately and continuously detects and tracks approaching vehicles simultaneously to an intersection in the selected direction of travel. The RPDD is capable of true presence detection as described in section 696.3.B. The RPDD shall maintain detection of a vehicle moving or stopped within a programmed detection zone set up by the user.

E. Interface Module: Device that interfaces with the cabinet detector rack allowing for contact closure to occur on a selected detector channel.

F. Communications Link: The communications connection between the RVDD processor unit and a local area network (LAN) or laptop computer.

G. Detection Accuracy: The measure of the basic operation of a detection system (shows detection when a vehicle is in the detection zone and shows no detection when there is not a vehicle in the detection zone).

H. Passage Detection: The ability of a vehicle detector to detect the passage of a vehicle moving through the zone of detection and to ignore the presence of a vehicle stopped within the zone of detection.

I. Presence Detection: The ability of a vehicle detector to sense that a vehicle, whether moving or stopped, has appeared in its zone of detection.

J. Delay Timing: When selected, applies delayed contact closure to the associated detector channel input. When a vehicle is detected by the RVDS, the delay timing must time out before contact closure is removed from the associated detector channel.

K. **Extension Timing:** When selected, applies additional contact closure to the associated detector channel input. When a vehicle is no longer detected within a detection zone, extension timing must time out before contact closure is removed from the associated detector channel.

696.3. FUNCTIONAL CAPABILITIES

A. Radar Advance Detection Device (RADD) Capabilities and Requirements

1. The RADD shall provide passage detection and contact closure to the interface module for vehicles approaching the intersection (the unit).

2. The RADD shall provide vehicle detection, tracking, and speed of moving vehicles approaching an intersection at a range of 100 feet to 500 feet from the radar sensor.

3. The RADD system software shall be capable of creating multiple detection zones within the detection range and applying conditional logic to the detection zones, allowing contact closure to occur only when logic conditions are achieved by the RADD. The user shall be able to apply logic gating such as: "and", "or" to a detection zone from the software GUI provided with the system. Conditional logic programming will allow the user to control when contact closure occurs to the detector rack interface module.

4. The RADD system software shall be capable of minimum and maximum speed settings to create a desired speed range for contact closure to the detector channel. Vehicles detected within the minimum and maximum speed settings will apply contact closure to the assigned detector channel input.

5. Detection accuracy will be determined by the detection of any moving vehicle or cluster of vehicles within a defined detection zone and within the minimum and maximum speed parameters programmed for the detection zone. With four (4) detection zones programmed, each zone 100 feet in length, a minimum of 95% detection accuracy shall be required for each zone. Detection zones will be set up between 100 feet and 500 feet. Conditional logic for each zone shall be set up in the "or" gate position allowing for contact closure to occur when vehicle speed conditions are met in the detection zone.

6. The RADD shall be capable of delay timing as defined in 696.2.J of this specification. As a minimum the user shall be able to program and select extension timing from 0-25 seconds in one/tenth (0.1) second increments from the GUI provided with the RVDS system.

7. The RADD shall be capable of extension timing as defined in 696.2.K of this specification. As a minimum the user shall be able to program and select extension timing from 0-25 seconds in one/tenth (0.1) second increments from the GUI provided with the RADD system.

8. The RADD shall be capable of adjusting the extension time automatically based on speed of a moving vehicle.

1. The RVDD shall be able to operate in all types of weather conditions including: rain, snow, sleet, ice, fog, and wind blown dust. The RVDD shall be able to operate normally and with no degraded performance when the radar vehicle sensor is encased in a 1/2 inch ice.

2. The RVDD shall be rated to operate in a temperature range from -34°C to 60°C (-30°F to 140°F) at 0 percent to 95 percent relative humidity.

3. The RVDD shall comply with all applicable Federal Communications Commission (FCC) requirements. The manufacturer will provide documentation of compliance with FCC specifications. Each RVDD will be FCC certified under CFR 47, Part 15, Section 15.245 as a field disturbance sensor or Section 15.249 as an intentional radiator. This certification will be displayed on an external label on each device according to the rules set forth by the FCC.

4. The RVDD shall maintain frequency stability without the use of manual tuning elements by the user.

C. Power and Surge Protection

1. Lightening and surge protection will be provided for power connections and communications links to the RVDD meeting or exceeding EN 61000-4-5 class specifications.

D. Software and Communication Requirements

1. The RVDD system software shall utilize a GUI that runs in a Microsoft Windows Mobile and Microsoft Windows XP environment or newer Microsoft operating system. The GUI shall graphically illustrate vehicle movement and directionality when detection is achieved by the RVDD. The software shall be capable of auto configuration upon set up of the RVDD.

2. Programmed parameters from the GUI to the sensor shall be stored in non-volatile memory devices such as Flash RAM or EEPROM within the sensor. The RVDD shall not rely on batter backup or the use of a super capacitor to retain memory.

3. The RVDD shall provide a RS232 serial communications link allowing the user to interface with a laptop computer and operate the GUI. The RS232 serial port shall be full duplex and will support true RTS/CTS hardware handshaking for interfacing to various communications devices.

4. The RVDD shall provide an Ethernet communications link allowing the user to interface the system and operate the GUI via a LAN and using TCP/IP protocol.

5. The RVDD firmware shall be upgradeable by external, local, or remote download via serial or Ethernet ports.

6. The serial and Ethernet communications ports as a minimum will support the following baud rates: 9600, 19200, 38400, 57600, and 115200. The user shall be able to select the desired baud rate from the GUI.

7. The operator shall be able to save configurations settings to a file or reload the configurations settings to the RVDD from a saved file using the GUI.

8. The RPDD software shall allow for a virtual connection option so that the software can be used without connecting to an actual sensor.

- Two conductor count
- Stranded Cable Type
- Bare Copper Material
- 600 Volt Range
- 90°C Temperature Rating
- PVC/Nylon insulation material
- PVC jacketing material
- 40 Amps per conductor

g. Both communication and power conductors may be bundled together in the same cable as long as the above-mentioned conditions are met.

2. **Radar Presence Detection Device (RPDD) Cabling**

a. The RS-485 conductors shall be a twisted pair.

b. The RS-485 conductors shall have nominal capacitance conductor to conductor of less than 71 pF/Ft at 1 KHz.

c. The RS-485 conductors shall have nominal conductor DC resistance of less than 16.5 ohms/ (304.8 m) at 20°C (68°F).

d. The power conductors shall be one twisted pair with nominal conductor DC resistance of less than 11.5 ohms/ (304.8 m) at 20°C (68°F).

e. Each wire bundle or the entire cable shall be shielded with an aluminum/Mylar shield with a drain wire.

f. The cable O.D. shall not exceed 0.4 inches.

g. The cable length shall not exceed 2,000 ft (609.6 m) for the operational baud rate of RS-485 communications (9.6 Kbps).

h. The RVDS shall use 24 VDC and the cable length shall not exceed 500 ft (182.9 m).

i. Both communication and power conductors can be bundled together in the same cable as long as the above-mentioned conditions are met.

696.5. EQUIPMENT: Provide the machinery, tools, and equipment necessary for proper prosecution of the work. All machinery, tools, and equipment used shall be maintained in a satisfactory and workmanlike manner.

3. Repair or full replacement will be required if a RVDD fails to operate as specified under normal operating conditions. Repaired or replaced components of the RVDD will be provided at no cost to COSA. The replaced or repaired units will inherit the remainder of the failed unit's warranty.

4. During the warranty period, technical support shall be available from the supplier via telephone within 4 hours of the time a call is made by a user, and this support shall be available from factory certified personnel or factory certified installers.

5. Ongoing software support by the supplier shall include firmware updates for the RVDD processor unit and external software needed to set up and operate the RVDD system. These updates shall be provided free of charge during the warranty period. The update of the RVDD software shall be tested and approved by COSA before installation.

6. The supplier shall maintain a program for technical support and software updates following expiration of the warranty period. This program shall be made available to COSA in the form of a separate agreement for continuing support.

7. The supplier shall maintain an adequate inventory of parts to support maintenance and repair of the radar system.

696.7. MEASUREMENT: This item will be measured as each RADD or RPDD installed, tested, and made operational including the radar sensor, detector rack interface module, processor units, power and surge protection panel or module, software, serial and Ethernet communication ports, electrical connectors and mounting hardware.

The RVDD communication and power cable(s) will be measured by the linear foot of the cable type furnished (RADD or RPDD)

696.8. PAYMENT: The work performed and materials furnished in accordance with this item and measured as provided under "Measurement" will be paid for at the unit price bid for each item listed in Section 696.9, "Bid Items". These prices are full compensation for furnishing, placing, and testing all materials and equipment, and for all tools, labor, equipment, hardware, operational software packages, supplies, support, personnel training, shop drawings, documentation, and incidentals. A power cable meeting the specifications outlined in Section 696.4 "Materials" shall be included with communication cable and is considered subsidiary to the price of the communication cables.

These prices also include any and all interfaces required for the field and remote communications links along with any associated peripheral equipment, including cables; all associated mounting hardware and associated field equipment; required for a complete and fully functional RVDD system.

Special Specification 4004

Screw-In Type Anchor Foundation

4004.1 DESCRIPTION

Construct screw-in type foundation only for roadside flashing beacon assembly (RFBA), solar-power roadside flashing beacon assembly (SPRFBA) and pedestal poles as required on the plans.

4004.2 MATERIALS

Ensure materials conform to the latest edition of the following TxDOT Standard Specifications:

Item 441 - "Steel Structures,"

Item 442 - "Metal for Structures," and

Item 445 - "Galvanizing."

Provide only new screw-in type foundation, and unless otherwise specified, a minimum 5 ft. in length and 8 in. in diameter pipe with a minimum 13 in. helix. Provide a base plate capable of accommodating four mounting holes to fit a variable bolt circle up to a 17 in. Ensure minimum 12 in. conduit opening is located approximately 12 in. from the base. Provide pipe conforming to ASTM A-53, grade B or equal. Provide base plates conforming to ASTM A-36 or better. Use anchor bolts having minimum yield strength of 36 ksi. Stamp, incise or mark the foundation by other approved means, to show the fabricator's model number, and name or logo. Place this information in a readily seen location. Unless otherwise specifically noted and requested in writing, and subsequently approved by the Engineer, in writing, supply the foundation with the bolts and flat washers needed for attaching the pedestal base to the foundation. Provide seven copies of shop drawings for review and approval prior to ordering materials.

4004.3 CONSTRUCTION METHODS

Fabricate and install screw-in anchors in accordance with the specifications, details and dimensions shown on the plans or as approved in writing. Locate screw-in anchors as shown on the plans except that the Engineer may shift the location, within design guidelines, where necessary to secure a more desirable

location or to avoid conflict with utilities or a very dense soil condition. Unless otherwise shown on the plans, stake all screw-in anchor locations for verification by the Engineer. Install screw-in anchors using power–digging equipment equipped with adapter designed for installing screw-in anchors. Ensure shaft alignment is within a tolerance of ¼ in. per 5 ft. of depth. Install anchors level and the top of the anchor base is either flush to or within no more than 2 in. of the ground level.

4004.4 MEASUREMENT

This item will be measured as each Screw-In Type Anchor Foundation installed in accordance with these specifications, complete and accepted.

4004.4 PAYMENT

Payment for the work performed and materials furnished in accordance with this Item measured as provided under "Measurement" shall be paid at the unit bid price per each Screw-In Type Anchor Foundation. Such unit bid price shall be full compensation for furnishing and installing the Screw-In Type Anchor Foundation, furnishing all tools, labor, equipment and incidentals necessary to complete the work and disposing of excavated material in accordance with federal, state and local laws.

4004.5 BID ITEMS

Item 4004.1 – Furnish and Install Screw-In Type Anchor Foundation – per each

SPECIAL SPECIFICATION 8100

ITS TRAFFIC MONITORING CAMERA

8100.1 DESCRIPTION:

Furnish and install Intelligent Transportation Systems (ITS) Traffic Monitoring Cameras to allow remote monitoring of traffic flows and incidents on arterial streets, intersections, and highways.

8100.2 MATERIALS: Provide components necessary for ITS Traffic Monitoring Camera installation. A ITS Traffic Monitoring Camera installation shall consist of the following components: digital IP camera unit (1), surge protection equipment (1), and all associated equipment required to set up and operate in a field environment including software, Ethernet communications ports, cabling, electrical connectors, and mounting hardware.

Cameras should include all outdoor enclosures and mounting hardware for installation on a standard traffic signal pole. Cameras must support standard definition video with minimum 36X optical zoom, H.264 MJPEG multi-streaming, Day/Night switching and be manufactured to support installation in harsh weather environments. Cameras shall be capable of panning 360° and tilting 180°. No separate encoder shall be required to transmit video to remote location. Cameras must support at a minimum RTP, RTSP, UDP, TCP, IP, IGMPv2, ICMP, ARP protocols. Camera control shall support ONVIF, Pelco-D, or COHU protocols.

8100.3 CONSTRUCTION: Install ITS Traffic Monitoring Camera in accordance with the details shown on the plans and the requirements of this item.

A. Manufacturing and Testing

The ITS Traffic Monitoring Camera shall undergo a rigorous sequence of operational testing to ensure product functionality and reliability

B. Installation and Training

1. When requested by COSA personnel or purchasing agency, the supplier of the ITS Traffic Monitoring Camera shall supervise the installation and testing of the radar equipment.

2. If requested by COSA personnel or purchasing agency, up to two days of training shall be provided to personnel of COSA in the operation, setup, and maintenance of the ITS Traffic Monitoring Camera. Instruction and materials shall be provided for a maximum of 20 persons and shall be conducted at a location selected by COSA. COSA or purchasing agency shall be responsible for the cost of training.

3. Instruction personnel are required to be certified by the equipment manufacturer. The User's Guide is not an adequate substitute for practical, classroom training and formal certification by an approved agency.

4. Formal levels of factory authorized training are required for installers, contractors, and system operators. All training must be certified by the manufacturer.

C. Warranty, Maintenance, and Support

1. The ITS Traffic Monitoring Camera shall be warranted to be free of defects in material and workmanship for a period of 2 years from date of shipment from the supplier's facility. During the warranty period, the supplier shall repair with new or refurbished materials, or replace at no charge, any product containing a warranty defect or fails to operate properly after installation provided the product is returned FOB to the supplier's factory or authorized repair site. Product repair or replaced under warranty by the supplier will be returned with transportation prepaid. This warranty does not apply to products damaged by accident, improper operation, abuse, serviced by unauthorized personnel or unauthorized modification.

2. If an ITS Traffic Monitoring Camera fails with no visible or physical damage to any electronic/electrical component of the system or its wiring, then the unit is considered to have failed under normal operating conditions. A blown fuse or surge protection device failure shall be considered to have failed under normal operating conditions. Acts-of-God will not be accepted as excusable unit failures of the ITS Traffic Monitoring Camera.

3. Repair or full replacement will be required if an ITS Traffic Monitoring Camera fails to operate as specified under normal operating conditions. Repaired or replaced components of the ITS Traffic Monitoring Camera will be provided at no cost to COSA. The replaced or repaired units will inherit the remainder of the failed unit's warranty.

4. During the warranty period, technical support shall be available from the supplier via telephone within 4 hours of the time a call is made by a user, and this support shall be available from factory certified personnel or factory certified installers.

5. Ongoing software support by the supplier shall include firmware updates for the ITS Traffic Monitoring Camera and external software needed to set up and operate the ITS Traffic Monitoring Camera. These updates shall be provided free of charge during the warranty period. The update of the ITS Traffic Monitoring Camera software shall be tested and approved by COSA before installation.\

6. The supplier shall maintain a program for technical support and software updates following expiration of the warranty period. This program shall be made available to COSA in the form of a separate agreement for continuing support.

7. The supplier shall maintain an adequate inventory of parts to support maintenance and repair of the ITS Traffic Monitoring Camera system.

8100.4 **MEASUREMENT:** This item will be measured as each ITS Traffic Monitoring Camera installed, tested, and made operational including the digital IP camera unit, surge protection equipment, and all associated equipment required to set up and operate in a field environment including software, Ethernet communications ports, electrical connectors, and mounting hardware.

The communication and power cable(s) will be measured by the linear foot of the cable type furnished.

8100.5 **PAYMENT:** The work performed and materials furnished in accordance with this item and measured as provided under "Measurement" will be paid for at the unit price bid for each item listed in Section 8001.6, "Bid Items". These prices are full compensation for furnishing, placing, and testing all materials and equipment, and for all tools, labor, equipment, hardware, operational software packages, supplies, support, personnel training, shop drawings, documentation, and incidentals.

DISCLAIMER: The use of this standard is governed by the "Texas Engineering Practice Act". No warranty of any kind is made by TxDOT for any purpose whatsoever. TxDOT assumes no responsibility for the conversion of this standard to other formats or for incorrect results or damages resulting from its use.

FOUNDATION DESIGN TABLE

FDN TYPE	DRILLED SHAFT DIA	REINFORCING STEEL		EMBEDDED DRILLED SHAFT LENGTH-ft ④, ⑤, ⑥			ANCHOR BOLT DESIGN ①				FOUNDATION DESIGN LOAD ②		TYPICAL APPLICATION
		VERT BARS	SPIRAL & PITCH	TEXAS CONE PENETROMETER N blows/ft			ANCHOR BOLT DIA	Fy (ksi)	BOLT CIR DIA	ANCHOR TYPE	MOMENT K-ft	SHEAR Kips	
				10	15	40							
24-A	24"	4- #5	#2 at 12"	5.7	5.3	4.5	¾"	36	12 ¾"	1	10	1	Pedestal pole, pedestal mounted controller.
30-A	30"	8- #9	#3 at 6"	11.3	10.3	8.0	1 ½"	55	17"	2	87	3	Mast arm assembly. (see Selection Table)
36-A	36"	10- #9	#3 at 6"	13.2	12.0	9.4	1 ¾"	55	19"	2	131	5	Mast arm assembly. (see Selection Table) 30' strain pole with or without luminaire.
36-B	36"	12- #9	#3 at 6"	15.2	13.6	10.4	2"	55	21"	2	190	7	Mast arm assembly. (see Selection Table) Strain pole taller than 30' & strain pole with mast arm
42-A	42"	14- #9	#3 at 6"	17.4	15.6	11.9	2 ¼"	55	23"	2	271	9	Mast arm assembly. (see Selection Table)

NOTES:

① Anchor bolt design develops the foundation capacity given under Foundation Design Loads.

② Foundation Design Loads are the allowable moments and shears at the base of the structure.

③ Foundations may be listed separately or grouped according to similarity of location and type. Quantities are for the Contractor's information only.

④ Field Penetrometer readings at a depth of approximately 3 to 5 feet may be used to adjust shaft lengths.

⑤ If rock is encountered, the Drilled Shaft shall extend a minimum of two diameters into solid rock.

⑥ Decimal lengths in Design Table are to allow interpolation for other penetrometer values. Round to nearest foot for entry into Summary Table.

FOUNDATION SUMMARY TABLE ③

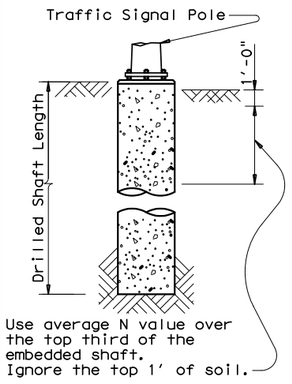
LOCATION IDENTIFICATION	AVG. N BLOW /ft.	FDN TYPE	NO. EA	DRILLED SHAFT LENGTH ⑥ (FEET)				
				24-A	30-A	36-A	36-B	42-A
TOTAL DRILLED SHAFT LENGTHS								

FOUNDATION SELECTION TABLE FOR STANDARD MAST ARM PLUS ILSN SUPPORT ASSEMBLIES (ft)

		FDN 30-A	FDN 36-A	FDN 36-B	FDN 42-A
80 MPH DESIGN WIND SPEED	MAX SINGLE ARM LENGTH	32'	48'		
	MAXIMUM DOUBLE ARM LENGTH COMBINATIONS	24' X 24'			
		28' X 28'			
		32' X 28'	32' X 32'		
			36' X 36'		
			40' X 36'		
			44' X 28'	44' X 36'	
100 MPH DESIGN WIND SPEED	MAX SINGLE ARM LENGTH		36'	44'	
	MAXIMUM DOUBLE ARM LENGTH COMBINATIONS		24' X 24'		
			28' X 28'		
			32' X 24'	32' X 32'	
				36' X 36'	
				40' x24'	40' X 36'
					44' x 36'

EXAMPLE:

1. For 80mph design wind speed, foundation 30-A can support up to a 32' arm with another arm up to 28'
2. For 100mph design wind speed, foundation 36-A can support a single 36' mast arm.

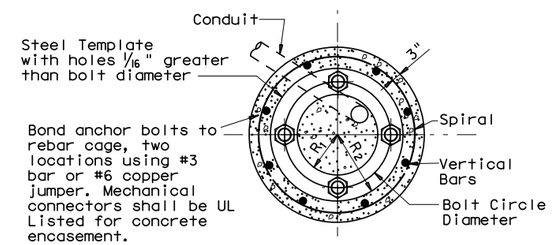


Use average N value over the top third of the embedded shaft. Ignore the top 1' of soil.

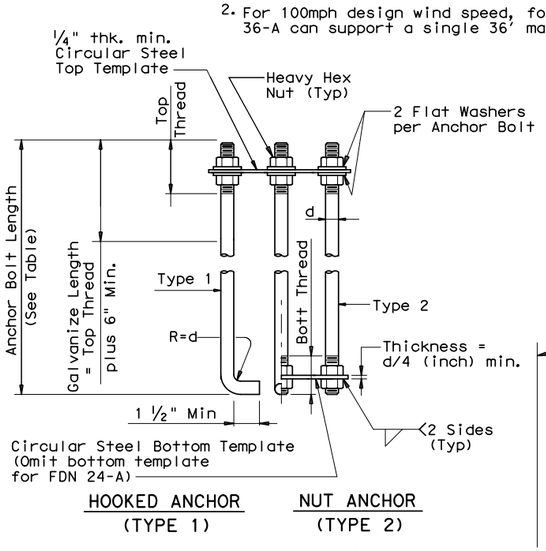
ANCHOR BOLT & TEMPLATE SIZES

BOLT DIA IN.	⑦ BOLT LENGTH	TOP THREAD	BOTTOM THREAD	BOLT CIRCLE	R2	R1
¾"	1'-6"	3"	—	12 ¾"	7 ⅛"	5 ⅝"
1 ½"	3'-4"	6"	4"	17"	10"	7"
1 ¾"	3'-10"	7"	4 ½"	19"	11 ¼"	7 ¾"
2"	4'-3"	8"	5"	21"	12 ½"	8 ½"
2 ¼"	4'-9"	9"	5 ½"	23"	13 ¾"	9 ¼"

⑦ Min dimensions given, longer bolts are acceptable.

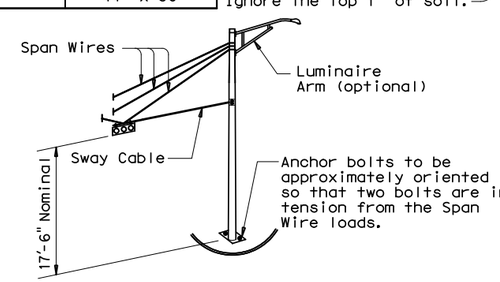


TOP VIEW

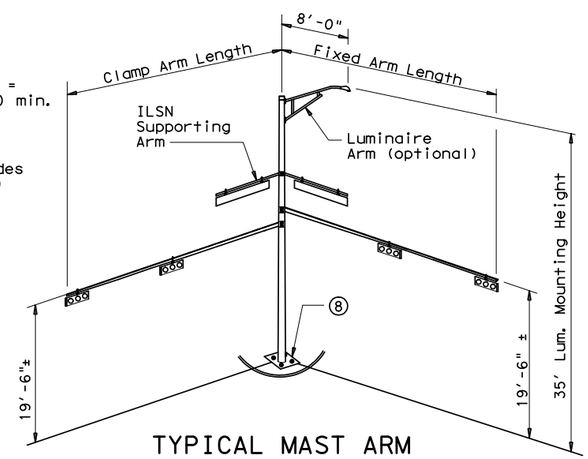


HOOKED ANCHOR (TYPE 1) | NUT ANCHOR (TYPE 2)

ANCHOR BOLT ASSEMBLY

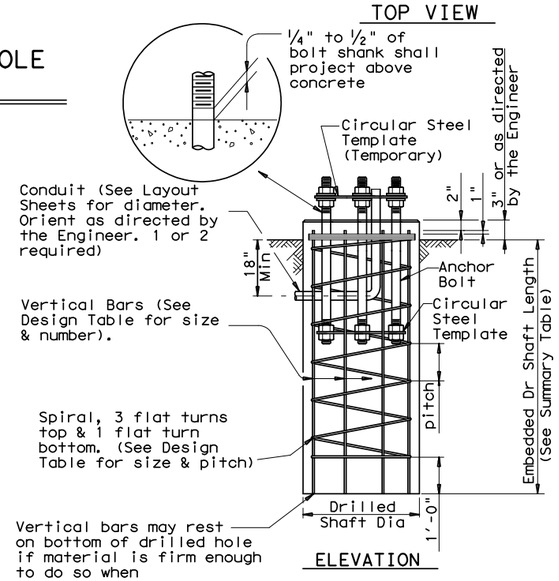


TYPICAL STRAIN POLE ASSEMBLY



⑧ Orient anchor bolts orthogonal with the fixed arm direction to ensure that two bolts are in tension under dead load.

TYPICAL MAST ARM ASSEMBLY



ELEVATION

FOUNDATION DETAILS

GENERAL NOTES:

Design conforms to 1994 AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals and interim revisions thereto.

Reinforcing steel shall conform to Item 440, "Reinforcing Steel".

Concrete shall be Class "C".

Threads for anchor bolts and nuts shall be rolled or cut threads of 8UN series up to 2" in diameter or UNC series for all sizes. Bolts and nuts shall have Class 2A and 2B fit tolerances. Galvanized nuts shall be tapped after galvanizing.

Anchor bolts that are larger than 1" in diameter shall conform to "alloy steel" or "medium-strength mild steel" per Item 449, "Anchor Bolts". Anchor bolts that are 1" in diameter or less shall conform to ASTM A36. Galvanize a minimum of the top end thread length plus 6" for all anchor bolts unless otherwise noted. Exposed washers and exposed nuts shall be galvanized. All galvanizing shall be in accordance with Item 445, "Galvanizing".

Templates and embedded nuts need not be galvanized. Lubricate and tighten anchor bolts when erecting the structure in accordance with Item 449, "Anchor Bolts".

Texas Department of Transportation
Traffic Operations Division

TRAFFIC SIGNAL POLE FOUNDATION

TS-FD-12

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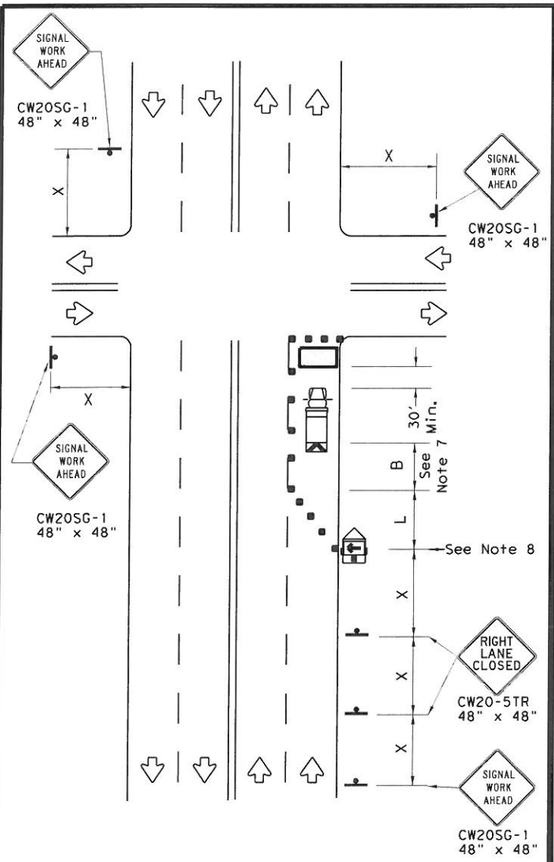
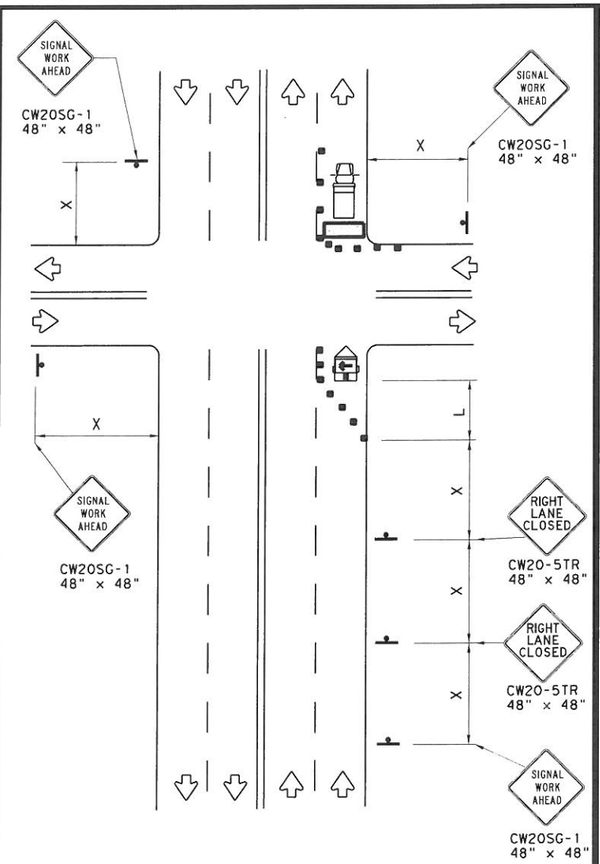


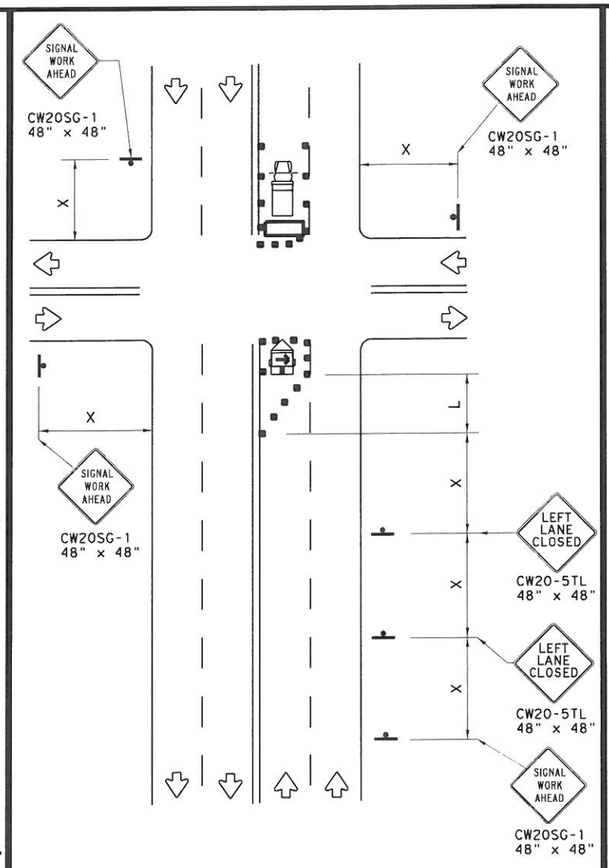
NEAR SIDE LANE CLOSURE

SHORT DURATION OR SHORT TERM STATIONARY



FAR SIDE RIGHT LANE CLOSURE

SHORT DURATION OR SHORT TERM STATIONARY



FAR SIDE LEFT LANE CLOSURE

SHORT DURATION OR SHORT TERM STATIONARY

LEGEND

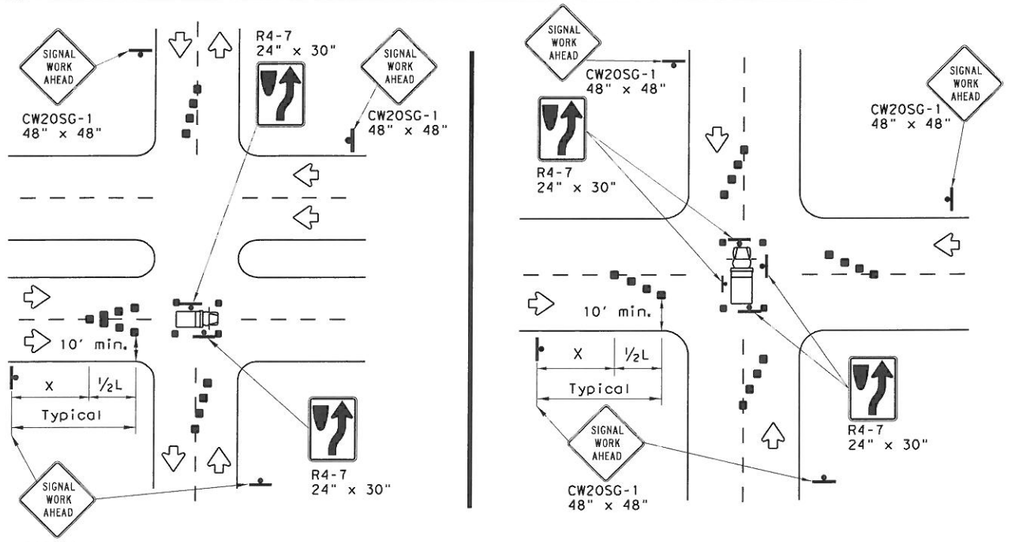
	Type 3 Barricade		Channelizing Devices
	Heavy Work Vehicle		Truck Mounted Attenuator (TMA)
	Trailer Mounted Flashing Arrow Board	M	Portable Changeable Message Sign (PCMS)
	Sign		Traffic Flow
	Flag		Flagger

Posted Speed *	Formula	Minimum Desirable Taper Lengths **			Suggested Maximum Spacing of Channelizing Devices		Minimum Sign Spacing "X" Distance	Suggested Longitudinal Buffer Space "B"
		10' Offset	11' Offset	12' Offset	On a Taper	On a Tangent		
30	$L = \frac{WS^2}{60}$	150'	165'	180'	30'	60'	120'	90'
35		205'	225'	245'	35'	70'	160'	120'
40		265'	295'	320'	40'	80'	240'	155'
45	L = WS	450'	495'	540'	45'	90'	320'	195'
50		500'	550'	600'	50'	100'	400'	240'
55		550'	605'	660'	55'	110'	500'	295'
60		600'	660'	720'	60'	120'	600'	350'
65		650'	715'	780'	65'	130'	700'	410'
70		700'	770'	840'	70'	140'	800'	475'
75		750'	825'	900'	75'	150'	900'	540'

* Conventional Roads Only

** Taper lengths have been rounded off.
L=Length of Taper(FT) W=Width of Offset(FT) S=Posted Speed(MPH)

WORKERS IN BUCKET TRUCKS SHALL NOT WORK ABOVE OPEN LANES OF TRAFFIC.



OPERATIONS IN THE INTERSECTION

SHORT DURATION

GENERAL NOTES

1. The minimum size channelizing device is the 28" cone. 42" Two-piece cones, drums, vertical panels or barricades will be required when the device must be left unattended at night.
2. Obstructions or hazards at the work area shall be clearly marked and delineated at all times.
3. Flaggers and Flagger Symbol (CW20-7) signs may be required according to field conditions.
4. Vehicles parked in roadway shall be equipped with at least two high intensity rotating, flashing, oscillating or strobe type lights.
5. High level warning devices (flag trees) may be used at corners of the vehicle.
6. When work operations are performed on existing signals, the signals may be placed in flashing red mode when approved by the engineer. If existing signals do not have power, All-Way Stop (R1-1 and R1-3P) signs may be implemented when approved by the engineer.
7. For Short-Term Stationary work the buffer space "B" from the above table should be used if field conditions permit. For Short Duration (less than 1 hour) any buffer space provided will enhance the safety of the setup.
8. The arrow board at this location may be omitted for Short Duration work if the work vehicle has an arrow board in operation. As an option, the arrow board may be placed at the end of the taper in the closed lane if space is not available at the beginning of the taper.
9. Signs and devices for the NEAR SIDE LANE CLOSURE may be altered for a left lane closure by using a LEFT LANE CLOSED (CW20-5TL) and adding channelizing devices on the centerline to protect the work space from opposing traffic.

SHEET 1 OF 2

Texas Department of Transportation

Traffic Operations Division Standard

TRAFFIC SIGNAL WORK TYPICAL DETAILS

WZ(BTS-1)-13

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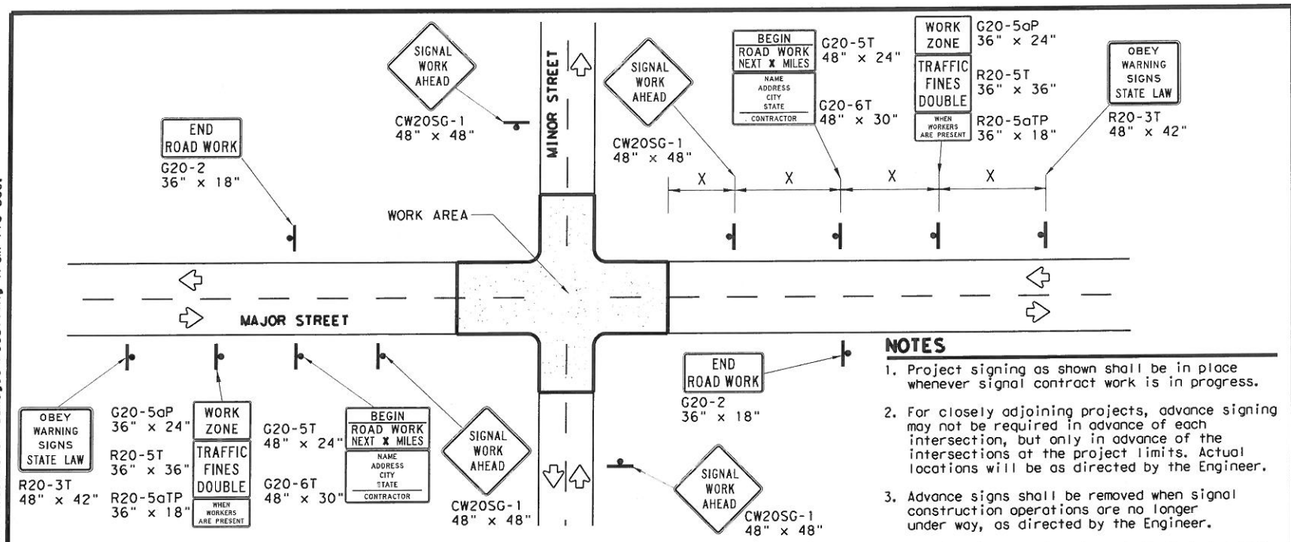


TYPICAL ADVANCE SIGNAL PROJECT SIGNING

FOR LONG TERM and INTERMEDIATE-TERM STATIONARY WORK OPERATIONS

NOTES

1. Project signing as shown shall be in place whenever signal contract work is in progress.
2. For closely adjoining projects, advance signing may not be required in advance of each intersection, but only in advance of the intersections at the project limits. Actual locations will be as directed by the Engineer.
3. Advance signs shall be removed when signal construction operations are no longer under way, as directed by the Engineer.
4. Warning sign spacing shown is typical for both directions.
5. See the Table on sheet 1 of 2 for Typical warning sign spacing.

GENERAL NOTES FOR WORK ZONE SIGNS

1. Signs shall be installed and maintained in a straight and plumb condition.
2. Wooden sign posts shall be painted white.
3. Barricades shall NOT be used as sign supports.
4. Nails shall NOT be used to attach signs to any support.
5. All signs shall be installed in accordance with the plans or as directed by the Engineer.
6. The Contractor shall furnish the sign design shown in the plans or in the "Standard Highway Sign Designs for Texas" (SHSD).
7. The Contractor shall furnish sign supports and substrates listed in the "Compliant Work Zone Traffic Control Device List" (CWZTCD), installed as per the manufacturer's recommendations.
8. Temporary signs that have damaged or cracked substrates and/or damaged or marred reflective sheeting shall be replaced as directed by the Engineer.
9. Identification markings may be shown only on the back of the sign substrate. The maximum height of letters and/or company logos used for identification shall be 1".
10. Damaged wood posts shall be replaced. Splicing wood posts will not be allowed.

DURATION OF WORK

1. Work zone durations are defined in Part 6, Section 6G.02 of the Texas Manual on Uniform Traffic Control Devices (TMUTCD).

SIGN MOUNTING HEIGHT

1. Sign height of Long-term/Intermediate-term warning signs shall be as shown on Figure 6F-1 of the TMUTCD.
2. Sign height of Short-term/Short Duration warning signs shall be as shown on Figure 6F-2 of the TMUTCD.
3. Regulatory signs shall be mounted at least 7 feet, but not more than 9 feet, above the paved surface regardless of work duration.

REMOVING OR COVERING

1. When sign messages may be confusing or do not apply, the signs shall be removed or completely covered, unless otherwise approved by the Engineer.
2. When signs are covered, the material used shall be opaque, such as heavy mil black plastic, or other materials which will cover the entire sign face and maintain their opaque properties under automobile headlights at night without damaging the sign sheeting. Burlap, or heavy materials such as plywood or aluminum shall not be used to cover signs.
3. Duct tape or other adhesive material shall NOT be affixed to a sign face.
4. Signs and anchor stubs shall be removed and holes back filled upon completion of the work.

REFLECTIVE SHEETING

1. All signs shall be retroreflective and constructed of sheeting meeting the requirements of the DMS and color usage table shown on this sheet.

SIGN SUPPORT WEIGHTS

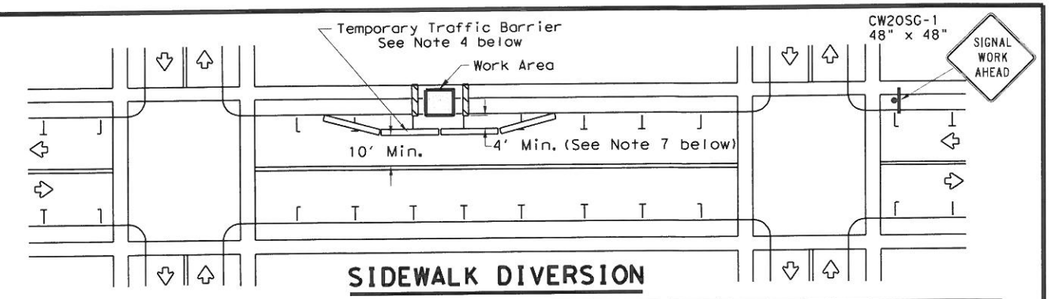
1. Weights used to keep signs from turning over should be sandbags filled with dry, cohesionless material.
2. The sandbags will be tied shut to keep the sand from spilling and to maintain a constant weight.
3. Rock, concrete, iron, steel or other solid objects will not be permitted for use as sign support weights.
4. Sandbags should weigh a minimum of 35 lbs and a maximum of 50 lbs.
5. Sandbags shall be made of a durable material that tears upon vehicular impact. Rubber, such as tire inner tubes, shall not be used.
6. Rubber ballasts designed for channelizing devices should not be used for ballast on portable sign supports. Sign supports designed and manufactured with rubber bases may be used when shown on the CWZTCD list.
7. Sandbags shall only be placed along or laid over the base supports of the traffic control device and shall not be suspended above ground level or hung with rope, wire, chains or other fastners. Sandbags shall be placed along the length of the skids to weigh down the sign support.
8. Sandbags shall NOT be placed under the skid and shall not be used to level sign supports placed on slopes.

LEGEND	
	Sign
	Channelizing Devices
	Type 3 Barricade

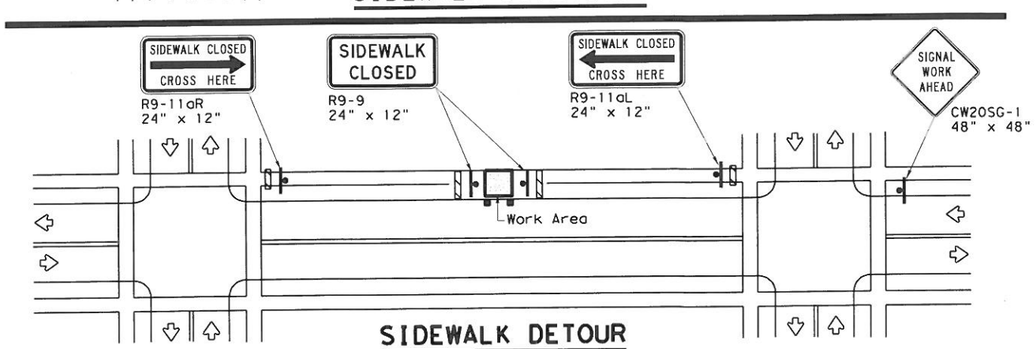
DEPARTMENTAL MATERIAL SPECIFICATIONS	
SIGN FACE MATERIALS	DMS-8300
FLEXIBLE ROLL-UP REFLECTIVE SIGNS	DMS-8310

COLOR	USAGE	SHEETING MATERIAL
ORANGE	BACKGROUND	TYPE B_{FL} OR TYPE C_{FL} SHEETING
WHITE	BACKGROUND	TYPE A SHEETING
BLACK	LEGEND & BORDERS	ACRYLIC NON-REFLECTIVE SHEETING

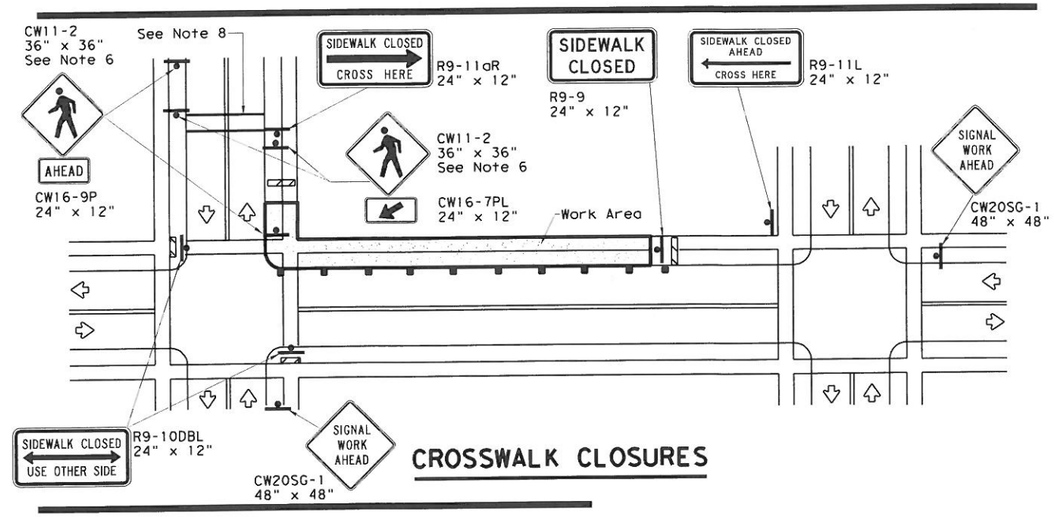
Only pre-qualified products shall be used. A copy of the "Compliant Work Zone Traffic Control Devices List" (CWZTCD) describes pre-qualified products and their sources and may be found at the following web address:
http://www.txdot.gov/txdot_library/publications/construction.htm



SIDEWALK DIVERSION



SIDEWALK DETOUR



CROSSWALK CLOSURES

PEDESTRIAN CONTROL

1. Holes, trenches or other hazards shall be adequately protected by covering, delineating or surrounding the hazard with orange plastic pedestrian fencing or longitudinal channelizing devices, or as directed by the Engineer.
2. "CROSSWALK CLOSURES" as detailed above will require the Engineer's approval prior to installation.
3. R9 series signs shown may be placed on supports detailed on the BC standards or CWZTCD list, or when fabricated from approved lightweight plastic substrates, they may be mounted on top of a plastic drum at or near the location shown.
4. For speeds less than 45 mph longitudinal channelizing devices may be used instead of traffic barriers when approved by the Engineer. Attenuation of blunt ends and installation of water filled devices shall be as per BC(9) and manufacturer's recommendations.
5. Location of devices are for general guidance. Actual device spacing and location must be field adjusted to meet actual conditions.
6. Where pedestrians with visual disabilities normally use the closed sidewalk Detectable Pedestrian Barricades should be used instead of the Type 3 Barricades shown.
7. The width of existing sidewalk should be maintained if practical.
8. Pavement markings for mid-block crosswalks shall be paid for under the appropriate bid items.
9. When crosswalks or other pedestrian facilities are closed or relocated, temporary facilities shall be detectable and shall include accessibility features consistent with the features present in the existing pedestrian facility.

SHEET 2 OF 2

Texas Department of Transportation — Traffic Operations Division Standard

TRAFFIC SIGNAL WORK BARRICADES AND SIGNS

WZ(BTS-2)-13

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