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STATE OF TEXAS
DEPARTMENT OF TRANSPORTATION



PLANS OF PROPOSED
STATE HIGHWAY IMPROVEMENT

PROJECT NO. RMC 6459-93-001

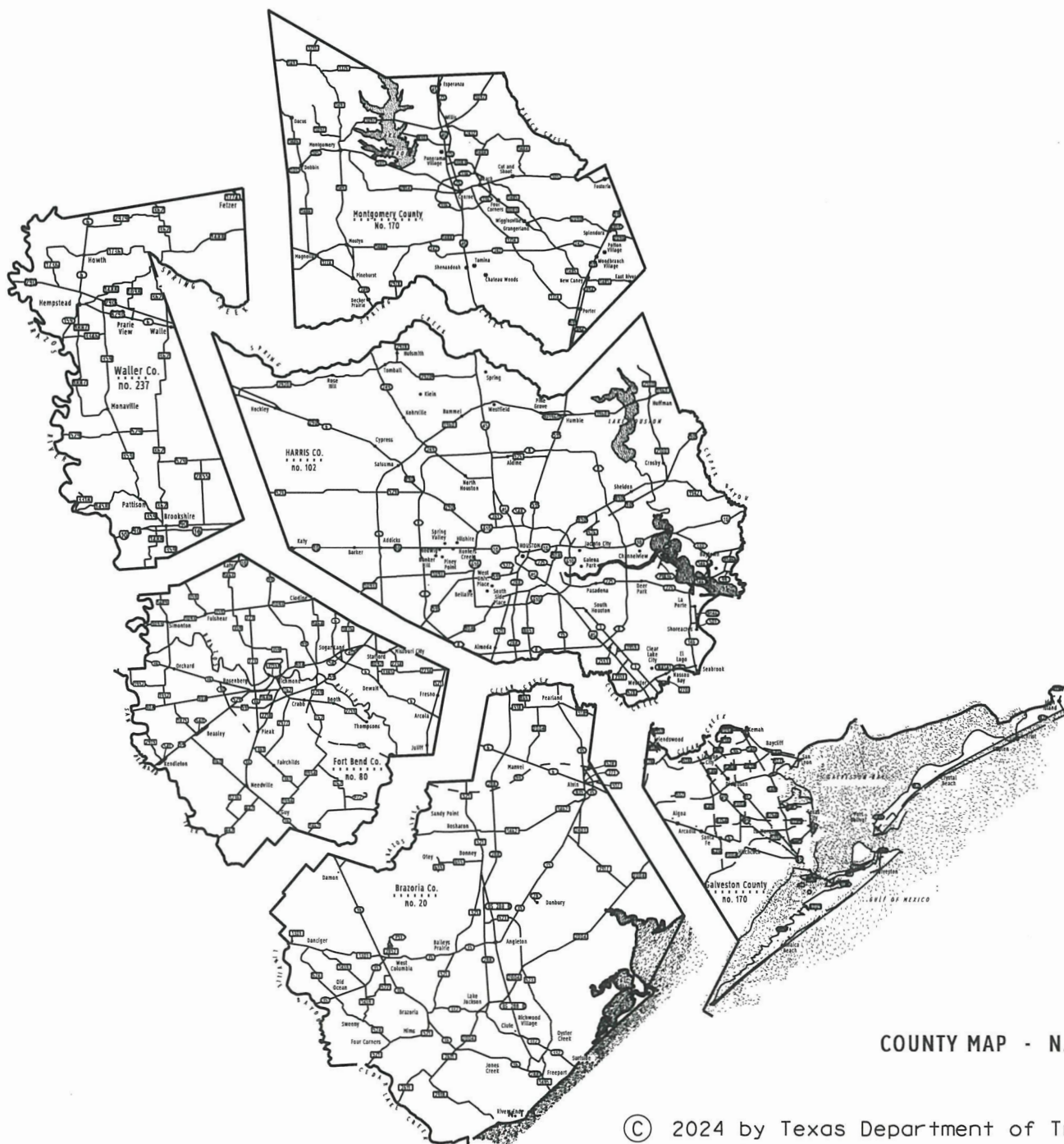
HARRIS, ETC. COUNTY

HIGHWAY NO. I-610, ETC.

FOR MAINTENANCE OF ILLUMINATION SYSTEMS AT VARIOUS LOCATIONS

	DATE	COUNTY	HARRIS, ETC.
PLANS PREPARED	OCT 2023	PROJECT	6459-93-001
LETTING	JUNE 2024	CONTROL	645993001
WORK STARTED		HWY	I-610, etc.
WORK COMPLETED			

DESIGN SPEED - N/A
ADT - VA



COUNTY MAP - N.T.S.

NO EXCEPTIONS
NO RAILROAD CROSSINGS
NO EQUATIONS

SUBMITTED FOR LETTING: 02-20-2024
[Signature]
TRANSPORTATION ENGINEER SUPERVISOR

RECOMMENDED FOR LETTING: 4/20/2024
DocuSigned by:
Melody Galland
DIRECTOR OF MAINTENANCE

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 PLANS OF PROPOSED
 STATE HIGHWAY IMPROVEMENT
 PROJECT NO. RMC 6459-93-001
 FOR MAINTENANCE OF ILLUMINATION
 SYSTEMS AT VARIOUS LOCATIONS

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THE STANDARD SHEETS SPECIFICALLY IDENTIFIED
 HAVE BEEN SELECTED BY ME OR UNDER MY RESPONSIBLE
 SUPERVISION AS BEING APPLICABLE TO THIS PROJECT.

[Handwritten Signature]

P.E. DATE: 02-20-2024

SPECIFICATIONS ADOPTED BY THE TEXAS DEPARTMENT
 OF TRANSPORTATION, NOVEMBER 1, 2014 AND SPECIFICATION ITEMS
 LISTED AND DATED AS FOLLOWS, SHALL GOVERN ON THIS PROJECT.

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FED. RD. DIV. NO.	STATE PROJECT NO.		SHEET NO.
6	RMC 6459-93-001		2
STATE	DIST.	COUNTY	
TEXAS	12	HARRIS	
CONT.	SECT.	JOB	HIGHWAY NO.
6459	93	001	I-610, etc.

Project Number: RMC 645993001 **Sheet**

County: HARRIS, etc. **Control:** 6459-93-001

Highway: I-610, etc.

GENERAL NOTES:

Plans are required. Contractor questions on this project are to be addressed to the following individual(s):

Robbie Pugh
Phone: (713) 802-5571
Email: Robbie.Pugh@txdot.gov

Arnold Trevino
Phone: (713) 866-7101
Email: Atrevino1@txdot.gov

Questions may be submitted via the Letting Pre-Bid Q&A web page. This webpage can be accessed from the Notice to Contractors dashboard located at the following Address:

<https://tableau.txdot.gov/views/ProjectInformationDashboard/NoticetoContractors>

All contractor questions will be reviewed by the Engineer. All questions and any corresponding responses that are generated will be posted through the same Letting Pre-Bid Q&A web page.

The Letting Pre-Bid Q&A web page for each project can be accessed by using the dashboard to navigate to the project you are interested in by scrolling or filtering the dashboard using the controls on the left. Hover over the blue hyperlink for the project you want to view the Q&A for and click on the link in the window that pops up.

This project will be managed by, and request for payment addressed to:

Mr. Arnold Trevino, Traffic Systems Supervisor
6810 Old Katy Road
Houston, Texas 77024
(713) 866-7101

This is a routine maintenance, non-site-specific, "call-out" contract. Plans are required.

A Callout and/or work request may consist of various locations.

Begin physical work within 48 hours of the work notification.

*****Please note: Work may be required at the various maintenance yards within Houston District.**

Notify the Traffic Signal Maintenance Office at (713) 866-7101, by 7:30 a.m., when scheduled work is cancelled for any reason.

The contractor will begin call out work within the required time for each work order. Work orders are expected to be completed per the contract plans within the number of days allowed

General Notes

Sheet A

Project Number: RMC 645993001 **Sheet 3**

County: HARRIS, etc. **Control:** 6459-93-001

Highway: I-610, etc.

for each work order. All call out work orders will have a begin date and number of working days. The contract will begin work within 48 hours of notification for routine call outs, unless otherwise approved by the Engineer. Work will be completed within the required number of working days. The contractor will begin work within 4 hours of notification for emergency callouts and complete within 48 hours, unless otherwise approved by the Engineer. Failure to begin work within the required time and proceed to completion within the required time will result in the assessment of liquidated damages.

Perform work during good weather. If work is damaged by a weather event, the Contractor is responsible for all costs associated with replacing damaged work.

A Pre-Construction meeting will be arranged before operations begin on the contract. This meeting will be arranged by TxDOT personnel. In this meeting, outline proposed work procedures and resent plans for performing the work while providing for the safe passage of traffic at all times.

During the Pre-Construction meeting a begin work date will be determined. For this project, the Contractor will furnish all new materials.

Troubleshooting for this project will be incidental to the various bid Items.

Provide one or more crews seven (7) days a week, 24 hours a day, for duration of the contract.

The Contractor is responsible for acquiring "E-Z tag" for all vehicles requiring access to toll roads. Tolls incurred by the Contractor are incidental to the various bid items.

Replacement of lamps and ballasts performed as a part of a scheduled preventive maintenance of high mast assembly will not be paid for separately.

Where directed, secure all loop lead-in, electrical, communication, pedestrian, or illumination cable, with a lashed cable support. Lashed cable support will be of aluminum or stainless steel, with a 3/4 inch width and 16inch length.

References to manufacturer's trade name or catalog numbers are for the purpose of identification only. Similar materials from other manufacturers are permitted if they are of equal quality, comply with the specifications for this project, and are approved, except for roadway illumination, electrical, and traffic signal items.

Procure permits and licenses, which are to be issued by the City, County, or Municipal Utility District.

General: Traffic Signals

For traffic signal items, use materials from the Pre-Qualified Producers List (located at <http://www.dot.state.tx.us/GSD/purchasing/supps.htm>) and the materials pre-qualified for illumination and electrical items (located at <http://ftp.dot.state.tx.us/pub/txdot-info/cmd/mpl/riaes.pdf>) as shown on the Department's Material Producers List and the Roadway

General Notes

Sheet B

Project Number: RMC 645993001 **Sheet**

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Illumination and Electrical Supplies List. Check the latest links on the Department's website for these lists. No substitutions will be allowed for materials found on these lists.

General: Site Management

Personal vehicles of employees are not permitted to park within the right of way, including sections closed to public traffic. Employees may park on the right of way at the Contractor's office, equipment, and materials storage yard sites.

Assume ownership of debris and dispose of at an approved location. Do not dispose of debris on private property unless approved in writing by the District Engineer.

Do not mix or store materials, or store or repair equipment, on top of concrete pavement or bridge decks unless authorized by the Engineer. Permission will be granted to store materials on surfaces if no damage or discoloration will result.

General: Utilities

At least 72 hours before starting work, make arrangements for locating existing Department-owned above ground and underground fiber optic, communications, power, illumination, and traffic signal cabling and conduit. Do this by calling the Department's Houston District Traffic Signal Operations Office at 713-802-5662, or by e-mailing the Department's Houston District Traffic Signal Operations Office at: HOU-LocateRequest@txdot.gov, to schedule marking of underground lines on the ground. Use caution if working in these areas to avoid damaging or interfering with existing facilities.

Be aware that an operational Computerized Transportation Management System (CTMS) exists within the limits of this project and that the system must remain operational throughout construction. If the Contractor damages or causes damage to this system, repair such damage within 8 hours of occurrence at no cost to the Department. In the event of system damage, notify the Director of Traffic Management Systems at 713-881-3283 within one hour of occurrence. Failure of the Contractor to repair damage to the main fiber optic cable and CCTV cable trunk lines, which convey all corridor information to TranStar, will result in the Contractor being billed for the full cost of emergency repairs.

Before excavating near existing utilities, contact the utility companies or the utility coordinating committee for exact locations to prevent damage or interference with present facilities.

If working near power lines, comply with the appropriate sections of Texas State Law and Federal Regulations relating to the type of work involved.

If the Contractor damages or causes damage (breaks, leaks, nicks, dents, gouges, etc.) to the utility, contact the utility facility owner or operator immediately.

Perform electrical work in conformance with the National Electrical Code (NEC) and Department standard sheets.

General Notes

Sheet C

Project Number: RMC 645993001 **Sheet3A**

County: HARRIS, etc. **Control:** 6459-93-001

Highway: I-610, etc.

Before beginning any underground work, notify the City of Houston's Chief Inspector, Public Works and Engineering, to establish the locations of any existing electrical systems for lighting facilities within the limits of this project.

If overhead or underground power lines need to be de-energized, contact the electrical service provider to perform this work. Costs associated with de-energizing the power lines or other protective measures required are at no expense to the Department.

Install or remove poles and luminaires located near overhead or underground electrical lines using established industry and utility safety practices. Consult the appropriate utility company before beginning such work.

General: Roadway Illumination and Electrical

For roadway illumination and electrical items, use materials from pre-qualified producers as shown on the Construction Division (CST) of the Department's material producers list. Check the latest link on the TxDOT website for this list. The category/item is "Roadway Illumination and Electrical Supplies." No substitutions will be allowed for materials found on this list.

Provide all materials, all labor, tools, and equipment necessary for completion of an operating illumination systems installation and for completion of this contract. All materials must be approved before they are incorporated into the work.

Perform electrical work in conformance with the National Electrical Code (NEC) and Department standard sheets.

The Contractor may make the electrical grounding connections and permissible splices using the thermal fusion process, Cadweld, ThermOweld, or approved equal, instead of bolted connections and splices.

General: Traffic Control and Construction

When design details are not shown on the plans, provide signs and arrows conforming to the latest "Standard Highway Sign Designs for Texas" manual.

Item 5: Control of Work

Submit shop drawings electronically for the fabrication of items as documented in Table 1 below. Information and requirements for electronic submittals can be viewed in the "Guide to Electronic Shop Drawing Submittal" which can be accessed through the following web link, ftp://ftp.dot.state.tx.us/pub/txdot-info/library/pubs/bus/bridge/e_submit_guide.pdf. References to 11 in. x 17 in. sheets in individual specifications for structural items imply electronic CAD sheets.

General Notes

Sheet D

Project Number: RMC 645993001 **Sheet**
County: HARRIS, etc. **Control:** 6459-93-001
Highway: I-610, etc.

Table 1
2014 Construction Specification Required Shop/Working Drawing Submittals - TxDOT Generated Plans

Spec Item No.'s	Product	Submittal Required	Approval Required (Y/N)	Contractor/Fabricator P.E. Seal Required	Reviewing Party	Shop or Working Drawing (Note 1)
610	Roadway Illumination Supports (Non-Standard only, calcs reqd.)	Y	Y	Y	BRG	SD

Notes:
 1. Document flow for Working Drawings differs from Shop Drawings in that Working Drawings must be submitted to the Engineer rather than the Engineer of Record and they are for the information of the Engineer only; an approval stamp and distribution to all project offices is not required.

Key to Reviewing Party

T - Traffic Engineer
Traffic Operations HOU-TrfShpDrwgs@txdot.gov

Item 7: Legal Relations and Responsibilities

This project does not require a U.S. Army Corps of Engineers (USACE) Section 404 Permit before letting, but if a permit is needed during construction, assume responsibility for preparing the permit application. Submit the permit application to the Department's District Environmental Section for approval. Once the permit application is approved, the Department will submit it to the USACE. Assume responsibility for the requested revisions, in coordination with the Department's District Environmental Section.

Maintain the roadway slope stability. Maintaining slope stability is subsidiary to the various bid items.

No significant traffic generator events identified.

If the work is on or in the vicinity of an at-grade railroad crossing, involves incidental work on railroad right of way, or involves construction of a railroad grade separation structure, notify the railroad company's Division Engineer and the Department's Project Engineer at least 30 days before performing any work on the railroad right of way and make arrangements for railroad flaggers unless otherwise shown in the contract. Obtain the required Railroad Right of Entry Permit from the railroad company. Payment of applicable permit fees is the responsibility of the Contractor. Acquiring the Railroad Right of Entry Permit is a lengthy process, allow sufficient time for this.

This project is on a hurricane evacuation route. Provide at the pre-construction meeting a written plan outlining procedures to suspend work, secure the job site, and safely handle traffic through and across the project in the event of a hurricane evacuation.

During the hurricane season (June 1 through November 30), do not close any travel lanes except when the Contractor can demonstrate that he/she can provide labor, equipment, material, a work plan, and quality of work to satisfactorily return all lanes to an open, all-weather travel surface

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County: HARRIS, etc. **Control:** 6459-93-001
Highway: I-610, etc.

within 3 days of receiving written or verbal notice but no later than 3 days before the predicted hurricane landfall. Construction of temporary lanes to an all-weather surface will be paid for in accordance with Article 9.7, "Payment for Extra Work and Force Account Method."

In addition to lane closures, cease work 3 days before the predicted hurricane landfall on or near the roadway that adversely impacts the flow of traffic and reduces the capacity of the highway during an evacuation. Vehicles of the Contractor, subcontractors, or material suppliers will not be allowed to enter or exit the traffic stream, including those for the purpose of material hauling and delivery, and mobilization or demobilization of equipment. When directed, this prohibition will include a reasonable time period for the evacuees to return to their point of origin.

Item 8: Prosecution and Progress

Working days will be computed and charged based on a Calendar Day workweek in accordance with Section 8.3.1.5.

The time increment for the Lane Closure Assessment fee for this project is one hour.

The Lane Closure Assessment Fee is shown on the following table. This fee applies to the Contractor for closures or obstructions that overlap into restricted hour traffic for each hour or portion thereof, per lane, regardless of the length of the lane closure or obstruction. For Restricted Hours subject to Lane Assessment Fee refer to Item, Barricades, Signs and Traffic Handling.

Lane Closure Assessment Fee Table

Roadway (Brazoria County)	Lane Assessment Fee
BS 35C	\$400.00
BS 35E	\$200.00
BS 288B	\$400.00
BS 288B FRD	\$50.00
FM 517	\$300.00
FM 518	\$500.00
FM 521	\$200.00
FM 522	\$100.00
FM 523	\$300.00
FM 524	\$200.00
FM 528	\$400.00
FM 655	\$50.00
FM 865	\$500.00
FM 1128	\$200.00
FM 1301	\$100.00
FM 1459	\$200.00
FM 1462	\$300.00
FM 1495	\$200.00

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FM 2004	\$300.00
FM 2234	\$500.00
FM 2403	\$200.00
FM 2611	\$100.00
FM 2852	\$0.00
FM 2917	\$100.00
FM 2918	\$0.00
SH 6	\$500.00
SH 35	\$500.00
SH 35 FRD	\$300.00
SH 36	\$400.00
SH 288	\$2,000.00
SH 288 FRD	\$500.00
SH 332	\$500.00
SL 274	\$400.00
SS 419	\$0.00
SS 273	\$50.00
SS 28	\$50.00
Roadway (Fort Bend County)	Lane Assessment Fee
FM 359	\$500.00
FM 360	\$100.00
FM 361	\$200.00
FM 442	\$100.00
FM 521	\$500.00
FM 723	\$500.00
FM 762	\$500.00
FM 1092	\$1,000.00
FM 1093	\$500.00
FM 1093 FRD	\$400.00
FM 1462	\$100.00
FM 1463	\$500.00
FM 1464	\$500.00
FM 1489	\$100.00
FM 1640	\$500.00
FM 1875	\$50.00
FM 1876	\$400.00
FM 1952	\$50.00
FM 1994	\$100.00
FM 2218	\$300.00
FM 2234	\$500.00
FM 2759	\$500.00

General Notes

Sheet G

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County: HARRIS, etc. **Control:** 6459-93-001
Highway: I-610, etc.

FM 2919	\$50.00
FM 2977	\$300.00
FM 3155	\$200.00
FM 3345	\$500.00
IH 10	\$2,500.00
IH 10 FRD	\$500.00
IH 69	\$4,500.00
IH 69 FRD	\$500.00
SL 540	\$100.00
SL 541	\$0.00
FS/LP 762	\$300.00
SH 6	\$1,500.00
SH 6 FRD	\$300.00
SH 36	\$500.00
SH 99	\$2,000.00
SH 99 FRD	\$500.00
SS 10	\$300.00
SS 529	\$200.00
US 59	\$500.00
US 59 FRD	\$200.00
US 90	\$300.00
US 90A	\$1,500.00
US 90A FRD	\$400.00
Roadway (Galveston County)	Lane Assessment Fee
FM 188	\$50.00
FM 270	\$500.00
FM 517	\$500.00
FM 518	\$500.00
FM 519	\$200.00
FM 528	\$500.00
FM 646	\$500.00
FM 1266	\$200.00
FM 1764	\$500.00
FM 1764 FRD	\$200.00
FM 1765	\$400.00
FM 2004	\$500.00
FM 2094	\$500.00
FM 2351	\$500.00
FM 3005	\$500.00
FM 3436	\$100.00
IH 45	\$3,500.00

General Notes

Sheet H

Project Number: RMC 645993001

Sheet

County: HARRIS, etc.

Control: 6459-93-001

Highway: I-610, etc.

IH 45 FRD	\$400.00
SS/LP 197	\$200.00
SH 3	\$500.00
SH 6	\$500.00
SH 87	\$500.00
SH 96	\$500.00
SH 124	\$100.00
SH 146	\$1,000.00
SH 146 FRD	\$200.00
FM 168	\$0.00
SH 275	\$300.00
SS 342	\$500.00
Roadway (Harris County)	Lane Assessment Fee
BF 1960 A	\$500.00
BS 146 D	\$100.00
BS 146 E	\$400.00
BS 249 B	\$500.00
BU 90 U	\$500.00
BU 290 H	\$200.00
BU 290 L	\$200.00
FM 270	\$1,000.00
FM 270 FRD	\$0.00
FM 521	\$500.00
FM 525	\$500.00
FM 526	\$500.00
FM 528	\$500.00
FM 529	\$1,000.00
FM 865	\$500.00
FM 1092	\$500.00
FM 1093	\$1,000.00
FM 1485	\$300.00
FM 1488	\$200.00
FM 1876	\$400.00
FM 1942	\$500.00
FM 1959	\$500.00
FM 1960	\$1,000.00
FM 1960 FRD	\$400.00
FM 2100	\$500.00
FM 2100 FRD	\$50.00
FM 2351	\$500.00
FM 2553	\$200.00

General Notes

Sheet I

Project Number: RMC 645993001

Sheet3D

County: HARRIS, etc.

Control: 6459-93-001

Highway: I-610, etc.

FM 2920	\$1,000.00
FM 2978	\$500.00
FS 525	\$300.00
IH 10	\$7,500.00
IH 10 FRD	\$500.00
IH 45	\$6,500.00
IH 45 FRD	\$1,000.00
IH 69	\$6,500.00
IH 69 FRD	\$500.00
IH 610	\$7,000.00
IH 610 FRD	\$500.00
SL 8	\$4,000.00
SL 8 FRD	\$500.00
SHNASA	\$1,000.00
SHNASA FRD	\$300.00
SH 3	\$500.00
SH 6	\$1,500.00
SH 6 FRD	\$500.00
SH 35	\$500.00
SH 35 FRD	\$0.00
SH 99	\$2,000.00
SH 99 FRD	\$500.00
SH 146	\$2,000.00
SH 146 FRD	\$400.00
SH 225	\$3,000.00
SH 225 FRD	\$400.00
SH 249	\$3,000.00
SH 249 FRD	\$500.00
SH 288	\$4,000.00
SH 288 FRD	\$500.00
SL 494	\$300.00
SS 5	\$4,500.00
SS 5 FRD	\$100.00
SS 330	\$1,000.00
SS 330 FRD	\$200.00
SS 501	\$100.00
SS 261	\$500.00
SS 527	\$1,000.00
SS 527 FRD	\$300.00
SS 548	\$1,500.00
US 90	\$1,000.00
US 90 FRD	\$300.00

General Notes

Sheet J

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US 90A	\$2,000.00
US 90A FRD	\$200.00
US 290	\$5,000.00
US 290 FRD	\$500.00
Roadway (Montgomery County)	Lane Assessment Fee
BU 59L	\$400.00
FM 149	\$300.00
FM 830	\$300.00
FM 1097	\$400.00
FM 1314	\$500.00
FM 1375	\$50.00
FM 1484	\$300.00
FM 1485	\$500.00
FM 1486	\$100.00
FM 1488	\$1,000.00
FM 1774	\$500.00
FM 1791	\$50.00
FM 2090	\$300.00
FM 2432	\$300.00
FM 2854	\$300.00
FM 2978	\$500.00
FM 3083	\$400.00
IH 45	\$5,500.00
IH 45 FRD	\$1,000.00
IH 69	\$3,500.00
IH 69 FRD	\$500.00
SL 336	\$500.00
SL 494	\$400.00
SH 75	\$400.00
SH 99	\$1,000.00
SH 99 FRD	\$500.00
SH 105	\$1,000.00
SH 242	\$1,000.00
SH 242 FRD	\$200.00
SH 249	\$500.00
SH 249 FRD	\$400.00
FS/SP 149	\$200.00
Roadway (Waller County)	Lane Assessment Fee
BU 290H	\$300.00
FM 359	\$300.00

General Notes

Sheet K

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County: HARRIS, etc. **Control:** 6459-93-001
Highway: I-610, etc.

FM 362	\$200.00
FM 529	\$200.00
FM 1098	\$300.00
FM 1458	\$100.00
FM 1488	\$300.00
FM 1489	\$200.00
FM 1736	\$50.00
FM 1774	\$200.00
FM 1887	\$50.00
FM 2855	\$200.00
FM 2979	\$0.00
FM 3318	\$0.00
FM 3346	\$50.00
IH 10	\$1,500.00
IH 10 FRD	\$400.00
SH 6	\$500.00
SH 159	\$300.00
US 90	\$300.00
US 290	\$1,500.00
US 290 FRD	\$200.00

Item 421: Hydraulic Cement Concrete

Entrained air is required in all slip formed concrete (bridge rail, concrete traffic barrier, pavement, etc.), but is not required for other structural concrete. Adjust the dosage of air entraining agent for low air content as directed or allowed by the Engineer. If entrained air is provided where not required, do not exceed the manufacturer's recommended dosage.

Item 449: Anchor Bolts

Pipe joint compound, as used in this Item, is an electrically conducting protective thread lubricant compound to be used on the foundation anchor bolts for illuminations poles (Crouse-Hinds TL-2, Oz/Gedney Std, or Thomas & Betts Kopr-Shield).

General Notes

Sheet L

Project Number: RMC 645993001 **Sheet**
County: HARRIS, etc. **Control:** 6459-93-001
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Item 500: Mobilization

This contract consists of Call-Out Mobilization for routine work and Emergency Mobilization for any emergency or unexpected work.

The purpose of this Item is to move personnel, equipment, and supplies to and from the project or vicinity of the project site to begin work or complete work on Contract Items.

This contract will commence upon issuance of a work order by the Engineer. Subsequent work orders will be issued for additional work to be accomplished during the contract.

Mobilization callout will coincide with the work order.

The mobilization "callout" work request may consist of one or more locations.

Failure to complete the mobilization callout work, or a work order within the number of working days specified, will result in liquidated damages for each working day charged over the number of working days specified.

The bonding company will be notified each time liquidated damages begin accruing.

Item 502: Barricades, Signs and Traffic Handling

Traffic Control under this project will be subsidiary to the various bid Items.

All lane closures are considered subsidiary to the various items.

All work and materials furnished with this Item are subsidiary to the pertinent bid Items except:

- Emergency lane closures not associated with other contract work items and performed as directed; payable under Item 0500-6034.
- Truck mounted attenuators payable under Item 6185.
- Law enforcement personnel payable under force account.

Use a traffic control plan for handling traffic through the various phases of the project. Follow the phasing sequence unless otherwise agreed upon by the Area Engineer and the Project Manager. Ensure this plan conforms to the latest "Texas Manual on Uniform Traffic Control Devices" and the latest Barricade and Construction (BC) Standard Sheets. The latest versions of Work Zone Standard Sheets WZ(BTS-1) and WZ(BTS-2) are the traffic control plan for the signal installations.

Use shadow vehicles with Truck Mounted Attenuators (TMA) for lane closures during construction.

*****Please note: Night and/or weekend work may be required for this project.**

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Highway: I-610, etc.

Do not reduce the existing number of lanes open to traffic except as shown on the following time schedule:

One Lane Closure
(INCLUDES ALL ROADWAYS LISTED ON THE LANE CLOSURE
ASSESSMENT FEE TABLE, including, US 59 Fort Bend, IH 10 Fort Bend,
IH 69 Fort Bend, IH 10 Harris, IH 45 Harris, US 69 Harris,
IH 610 Harris, US 69 Montgomery & IH 45 Montgomery)

Day	Daytime Closure Hours	Nighttime Closure Hours	Restricted Hours Subject to Lane Assessment Fee
Monday	9:00 AM – 3:00 PM	12:00 AM – 5:00 AM	3:00 PM – 9:00 PM
Tuesday	9:00 AM – 3:00 PM	9:00 PM – 12:00 AM	5:00 AM – 9:00 AM
		12:00 AM – 5:00 AM	3:00 PM – 9:00 PM
Wednesday	9:00 AM – 3:00 PM	9:00 PM – 12:00 AM	5:00 AM – 9:00 AM
		12:00 AM – 5:00 AM	3:00 PM – 9:00 PM
Thursday	9:00 AM – 3:00 PM	9:00 PM – 12:00 AM	5:00 AM – 9:00 AM
		12:00 AM – 5:00 AM	3:00 PM – 9:00 PM
Friday	9:00 AM – 3:00 PM	9:00 PM – 12:00 AM	5:00 AM – 9:00 AM
		12:00 AM – 5:00 AM	3:00 PM – 9:00 PM
Saturday	9:00 AM – 3:00 PM	9:00 PM – 12:00 AM	5:00 AM – 9:00 AM
		12:00 AM – 5:00 AM	3:00 PM – 9:00 PM
Sunday	9:00 AM – 3:00 PM	9:00 PM – 12:00 AM	5:00 AM – 9:00 AM
		12:00 AM – 5:00 AM	3:00 PM – 9:00 PM

Two Lane Closure
(INCLUDES ALL ROADWAYS LISTED ON THE LANE CLOSURE
ASSESSMENT FEE TABLE, including, US 59 Fort Bend, IH 10 Fort Bend,
IH 69 Fort Bend, IH 10 Harris, IH 45 Harris, US 69 Harris,
IH 610 Harris, US 69 Montgomery & IH 45 Montgomery)

Day	Daytime Closure Hours	Nighttime Closure Hours	Restricted Hours Subject to Lane Assessment Fee
Monday	NONE	7:00 PM – 5:00 AM	5:00 AM – 7 PM
Tuesday	NONE	7:00 PM – 5:00 AM	5:00 AM – 7 PM
Wednesday	NONE	7:00 PM – 5:00 AM	5:00 AM – 7 PM
Thursday	NONE	7:00 PM – 5:00 AM	5:00 AM – 7 PM
Friday	NONE	7:00 PM – 5:00 AM	5:00 AM – 7 PM

Project Number: RMC 645993001 **Sheet**

County: HARRIS, etc. **Control:** 6459-93-001

Highway: I-610, etc.

Day	Daytime Closure Hours	Nighttime Closure Hours	Restricted Hours Subject to Lane Assessment Fee
Saturday	NONE	7:00 PM – 5:00 AM	5:00 AM – 7 PM
Sunday	NONE	7:00 PM – 5:00 AM	5:00 AM – 7 PM

The above times are approved for the traffic control conditions listed. The Area Engineer may approve other closure times if traffic counts warrant. The Area Engineer may reduce the above times for special events.

Law enforcement assistance will be required for this project and is expected to be required for major traffic control changes and lane closures. Coordinate with local law enforcement and arrange for law enforcement as directed or agreed by the Engineer. Before payment will be made, complete the “Daily Report on Law Enforcement Force Account Work” (Form 318), provided by the Department and submit daily invoices that agree with this form for any day during the month in which approved services were provided.

Provide full-time, off-duty, uniformed, certified peace officers, as part of traffic control operations. The peace officers must be able to show proof of certification by the Texas Commission on Law Enforcement Officers Standards. The cost of the officers is paid for on a force account basis.

The number of peace officers and working hours will be determined in advance of the work and approved by the Engineer.

Submit changes to the traffic control plan to the Area Engineer. Provide a layout showing the construction phasing, signs, striping, and signalizations for changes to the original traffic control plan.

Furnish and maintain the barricades and warning signs, including the necessary temporary and portable traffic control devices, during the various phases of construction. Place and construct these barricades and warning signs in accordance with the latest “Texas Manual on Uniform Traffic Control Devices” for typical construction layouts.

Installation and/or removal of Temporary Rumble Strips will be considered incidental to the various bid Items.

Cover work zone signs when work related to the signs is not in progress, or when any hazard related to the signs no longer exists.

Erect temporary signs when exit ramps are closed or moved to new locations during construction.

Cover or remove the permanent signs and construction signs that are incorrect or that do not apply to the current situation for a particular phase.

Use traffic cones for daytime work only. Replace the cones with plastic drums during nighttime hours.

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Sheet3G

County: HARRIS, etc.

Control: 6459-93-001

Highway: I-610, etc.

Replace the overhead signs, informational signs, and exit signs to be removed, with temporary signs providing the correct information to the traveling public. Size the replacement signs and include them in the traffic control plan.

Keep the delineation devices, signs, and pavement markings clean. This work is subsidiary to the Item, “Barricades, Signs, and Traffic Handling.”

Do not mount signs on drums or barricades, except those listed in the latest Barricades and Construction standard sheets.

The Contractor Force Account “Safety Contingency” that has been established for this project is intended to be utilized for work zone enhancements, to improve the effectiveness of the Traffic Control Plan, that could not be foreseen in the project planning and design stage. These enhancements will be mutually agreed upon by the Engineer and the Contractor’s Responsible Person based on weekly or more frequent traffic management reviews on the project. The Engineer may choose to use existing bid items if it does not slow the implementation of enhancement.

Before detouring traffic onto the mainlane shoulders, remove dirt, debris, vegetation, and other deleterious material from the surface of the shoulders. Appropriately sign the detour in an approved manner. This work is subsidiary to the various bid items.

Item 506: Temporary Erosion, Sedimentation and Environmental Controls

The use of hay bales is not permitted as Storm Water Pollution Prevention Plan (SWP3) measures.

The Storm Water Pollution Prevention Plan (SWP3) consists of temporary erosion control measures needed and provided for under this Item. The disturbed area is less than one acre and use of erosion control measures is not anticipated. If physical conditions encountered at the job site require necessary controls, BMP installation, maintenance, and removal will be paid as extra work on a force account basis per Articles 4.4 and 9.7. Since the disturbed area is less than 5 acres, a “Notice of Intent” (NOI) is not required.

Before starting grading operations and during the project duration, place the temporary or permanent erosion control measures to prevent sediment from leaving the right of way.

Implement temporary and permanent erosion control measures to comply with the National Pollution Discharge Elimination System (NPDES) general permit under the Clean Water Act.

Item 610: Roadway Illumination Assemblies

The cost of providing the electrical conductor in the pole foundation or in the pole base to make connections is subsidiary to the roadway illumination assembly. The quantity for payment is the surface distance between locations.

Project Number: RMC 645993001 **Sheet**

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Fabricate steel roadway illumination poles in accordance with the latest Department RIP (Roadway Illumination Poles) Standards. Poles manufactured according to the latest RIP Standards require no shop drawings. Alternate designs to the Department's RIP Standards or the use of aluminum to fabricate poles will require the submission of shop drawings electronically.

Supply anchor bolt assemblies as shown on the RIP standard sheets, unless a larger capacity bolt assembly is required for the 3-second gust wind speed and mounting elevation at the pole installation location.

Item 613: High Mast Illumination Poles

Place the metal beam guard fence before placing the high mast foundation.

Before erecting the high mast poles, notify the Engineer a minimum of 3 working days in advance for scheduling the inspection of each assembled high mast pole and high mast assembly.

Place high mast illumination poles in locations so that the light mounting and support assembly can be lowered and maintained from ground level without interfering with bridges or retaining walls. Notify the Engineer of any such conflicts.

Provide anchor bolts for high mast illumination poles in accordance with the Item, "Anchor Bolts."

Item 614: High Mast Illumination Assemblies

Erect and place in operation high mast illumination poles before removing existing illumination facilities.

The high mast power cable must meet the latest edition of Department Standard sheets, "High Mast Illumination Details" (HMID) and Department Material Specification (DMS) 11021, "High Mast Assembly Kits."

Furnish stainless steel pulley material for the Wire Rope Pulley as shown on the HMID standard.

Provide pre-qualified High-Pressure Sodium (HPS) lamps from the Material Producer List (MPL) of the wattages shown on the plans, shipped and secured within the fixture. No alternatives are allowed.

Item 616: Performance Testing of Lighting Systems

The illumination plans provide for a complete illumination system installed, connected, tested, and ready for operation.

After satisfactory completion of tests, place the new lighting fixtures in operation. Final acceptance will be made after the fixtures operate satisfactorily for a minimum period of 14 days. The 14-day test period is included in the allowed working days.

General Notes

Sheet Q

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Sheet3H

County: HARRIS, etc.

Control: 6459-93-001

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Assume responsibility for the new lighting fixtures during the test period. Make adjustments or repairs as required and repair defects or damage at no expense to the Department.

Item 618: Conduit
Item 620: Electrical Conductors
Item 628: Electrical Services

If the specifications for electrical items require UL-listed products, this means UL-listed or CSA-listed.

Item 618: Conduit

When backfilling bore pits, ensure that the conduit is not damaged during installation or due to settling backfill material. Compact select backfill in 3 equal lifts to the bottom of the conduit; or if using sand, place it 2 in. above the conduit. Ensure backfill density is equal to that of the existing soil. Prevent material from entering the conduit.

Construct bore pits a minimum of 5 ft. from the edge of the base or pavement. Close the bore pit holes overnight.

Unless otherwise shown on the plans, install underground conduit a minimum of 24 in. deep. Install the conduit in accordance with the latest National Electrical Code (NEC) and applicable Department standard sheets. Place conduit under driveways or roadways a minimum of 24 in. below the pavement surface.

If using casing to place bored conduit, the casing is subsidiary to the conduit.

If placing the conduit under existing pavement to reach the service poles, bore the conduit in place and extend it a minimum distance of 5 ft. beyond the edge of shoulder or the back of curb.

Where PVC, duct cable, and HDPE conduit 1 in. and larger is allowed and installed per Department standards, provide a PVC elbow in place of the galvanized rigid metal elbow required by the Electrical Details standards. Ensure the PVC elbow is of the same schedule rating as the conduit to which it is connected. Use only a flat, high tensile strength polyester fiber pull tape to pull conductors through the PVC conduit system.

Remove conductor and conduit to be abandoned to 1 ft. below the ground level. This work is subsidiary to the various bid items.

Item 620: Electrical Conductors

Test each wire of each cable or conductor after installation. Incomplete circuits or damage to the wire or the cable are cause for immediate rejection of the entire cable being tested. Remove and replace the entire cable at no expense to the Department. Also test the replacement cable after installation.

General Notes

Sheet R

Project Number: RMC 645993001 **Sheet**

County: HARRIS, etc. **Control:** 6459-93-001

Highway: I-610, etc.

When pulling cables or conductors through the conduit, do not exceed the manufacturer's recommended pulling tensions. Lubricate the cables or conductors with a lubricant recommended by the cable manufacturer.

For both transformer and shoe-base type illumination poles, provide double-pole breakaway fuse holders as shown on the Department's Construction Division (CST) material producers list. Check the latest link on the Department's website for this list. The category is "Roadway Illumination and Electrical Supplies." The fuse holder is shown on the list under Items 610 and 620. Provide 10 Amp time delay fuses.

Ensure that circuits test clear of faults, grounds, and open circuits.

Split bolt connectors are allowed only for splices on the grounding conductors.

For Roadside Flashing Beacon Assemblies (Item 685) and Pedestal Pole Assemblies (Item 687) within the project, provide single-pole breakaway disconnects as shown on the Construction Division (CST) material producers list. Check the latest link on the Department's website for this list. The category is "Roadway Illumination and Electrical Supplies." The fuse holder is shown on the list under Item 685. For underground (hot) conductors, install a breakaway connector with a dummy fuse (slug). Provide dummy fuse (slug). For grounded (neutral) conductors, install a breakaway connector with a white colored marking and a permanently installed dummy fuse (slug).

For electrical licensing and electrical certification requirements for this project, see Item 7 of the Standard Specifications and any applicable special provisions to Item 7.

Item 624: Ground Boxes

The ground box locations are approximate. Alternate ground box locations may be used as directed, to avoid placing in sidewalks or driveways.

Ground metal ground box covers. Bond the ground box cover and ground conductors to a ground rod located in the ground box and to the system ground.

Ground the existing metal ground box covers as shown on the latest standard sheet ED (4)-14.

During construction and until project completion, provide personnel and equipment necessary to remove ground box lids for inspection. Provide this assistance within 24 hours of notification.

Construct concrete aprons in accordance with the latest standard sheet ED (4)-14. Make the depth of the concrete apron the same as the depth of the ground box, except for Type 1 and Type 2 ground boxes. For Type 1 or Type 2 ground boxes, construct the concrete apron in accordance with details shown on the "Ground Box Details Installations" standard.

General Notes

Sheet S

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Sheet3I

County: HARRIS, etc.

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Item 628: Electrical Services

Verify and coordinate the electrical service location with the engineering section of the appropriate utility district or company.

Identify the electrical service pole with an address number assigned by the Utility Service Provider. Provide 2-in. numerals visible from the highway. Provide numbers cut out aluminum figures nailed to wood poles or painted figures on steel poles or service cabinets.

Item 656: Foundations for Traffic Control Devices

Excavating and disposing of surplus materials for lighting standard foundations are subsidiary to the roadway illumination assembly foundation. Dispose of surplus excavated material. Use rigid metal conduit (RMC) for stub-outs in foundation and concrete structures. These stub-outs are subsidiary to the drilled shaft foundations.

Using ready mix concrete for sign foundations is optional.

Item 690: Maintenance of Traffic Signals

Installation of Electrical Service will be paid under Item 690-6020; repair, replace or modify an electrical service assembly in accordance with Item 628, "Electrical Services"; as shown on the plans or as directed.

Mount any or all of the following on an electrical service support assembly: conduit, weather head, load center, meter base, lightning protection, wiring, and associated hardware.

Installation of Conduit by Trenching will be paid under Item 690-6002; install, replace, remove, or modify conduits in accordance with Item 618, "Conduit"; as shown on the plans, or as directed.

Item 6000: Illumination Maintenance

For this project, the Contractor will furnish all new materials.

Fuse will include but be limited to, slow blow/time lag, dual element slow blow, or fast acting fuses.

Troubleshooting for this project will be incidental to the various bid Items.

Safety Switch is equal to the Non-Fused Disconnect Underpass Switch.

Item 6000-6051 - Scheduled Preventive Maintenance of High Mast Assembly will consist of, but may not be limited to the following Items:

- Inspecting and filling gearbox lubrication reservoir.
- Lubricating grease fittings.
- Adjusting brake mechanism to proper torque.

General Notes

Sheet T

Project Number: RMC 645993001 **Sheet**

County: HARRIS, etc. **Control:** 6459-93-001

Highway: I-610, etc.

- Inspecting cable drum.
- Inspecting all wire rope and cables for deterioration or wear.
- Inspecting safety lanyard.
- Lowering ring and inspecting mechanism.
- Inspecting all foundation anchor bolts, nuts, and washers.
- Inspecting welds around baseplate and ground sleeve for visible cracks.
- Preparing and touching-up rust spots with cold galvanizing spray.
- Replacing lamps and cleaning fixtures as directed.
- Replacing ballasts as directed.
- Replacing aviation warning (obstruction) lamps as directed.
- Inspecting electrical system.
- Repairing shorts or open circuits as directed.
- Raising ring to proper position.

Replacement of lamps and ballasts performed as a part of "scheduled preventive maintenance of high mast assembly" will not be paid for separately.

Item 6000-6170 - Scheduled Preventive Maintenance (Illumination Systems) will consist of, but may not be limited to the following Items;

- Inspect proper functionality of lights operated by service (bad photocell or trip breaker). Notify in writing of additional repairs needed (stolen wire or knock down)
- Inspect all foundations and spray herbicide around all ground areas (includes service, ground boxes, single poles and high mast).
- Inspect all poles T-bases and ground boxes (clean out dirt and debris inside and out, add duct sealant as needed). Notify in writing if bases and lids are broken or cracked.
- Inspect and clean all wall pack lights (underpass lights).
- Inspect and touch-up rust spots with cold galvanizing spray.
- Inspecting mechanism while lowering ring.
- Inspect and adjust brake mechanism to proper torque.
- Inspect all welds around baseplate and ground sleeve for visible cracks.
- Inspect all wire ropes and cables for deterioration or wear.
- Inspect safety lanyard.
- Inspect all lamps and cleaning fixtures as directed.
- Inspect all aviation warning (obstruction) lamps as directed.
- Inspect all wiring inside poles and on top of ring.
- Inspecting and filling gearbox lubrication reservoir.
- Inspect all lubricating grease fittings (grease as needed).
- Inspect and raise ring to proper position.
- Inspect all T-bases hand-hole cover and replace as needed (add duct sealant).
- Inspect shorts or open circuits as directed.
- Inspect ballast as directed.
- Inspect electrical system.

General Notes

Sheet U

Project Number: RMC 645993001

Sheet3J

County: HARRIS, etc.

Control: 6459-93-001

Highway: I-610, etc.

FOR CONTRACTOR'S INFORMATION ONLY

Connector, Liquid Tight for Flexible Conduit ¾" or ½" is subsidiary to conduit.

Item 6185: Truck Mounted Attenuator (TMA) and Trailer Attenuator (TA)

A shadow vehicle with Truck Mounted Attenuators (TMAs) or Trailer Attenuators (TAs) is required as shown on the appropriate Traffic Control Plan (TCP) sheets. TMAs/TAs must meet the requirements of the Compliant Work Zone Traffic Control Device List.

Level 3 Compliant TMAs are required for this project.

Trailer Attenuators are allowed to be used on this project.

A total of one (1) shadow vehicle with a TMA/TA is required for the work with the exception of Pavement Marking Operations. The Contractor is responsible for determining if one or more of these operations will be ongoing at the same time to determine the total number of TMAs/TAs needed on the project.

A total of three (3) shadow vehicles with a TMA/TA are required for Pavement Marking Operations. The Contractor is responsible for determining if one or more of these operations will be ongoing at the same time to determine the total number of TMAs/TAs needed on the project.

In addition to the shadow vehicles with TMAs/TAs that are specified as being required on the TCP layout sheets for this project, provide additional shadow vehicles with TMAs/TAs as shown on the TCP Standard sheets. The Contractor is responsible for determining if one or more of these operations will be ongoing at the same time to determine the total number of TMAs/TAs needed on the project.

General Notes

Sheet V



CONTROLLING PROJECT ID 6459-93-001

DISTRICT Houston
HIGHWAY IH0610

COUNTY Harris

Estimate & Quantity Sheet

CONTROL SECTION JOB				6459-93-001		TOTAL EST.	TOTAL FINAL
PROJECT ID				A00205647			
COUNTY				Harris			
HIGHWAY				IH0610			
ALT	BID CODE	DESCRIPTION	UNIT	EST.	FINAL		
	500-6033	MOBILIZATION (CALLOUT)	EA	30.000		30.000	
	500-6034	MOBILIZATION (EMERGENCY)	EA	3.000		3.000	
	610-6010	REMOVE RD IL ASM (U/P)	EA	100.000		100.000	
	610-6107	IN RD IL (U/P) (TY 2) (250W EQ) LED	EA	200.000		200.000	
	628-6001	RELOCATE ELECTRICAL SERVICES	EA	25.000		25.000	
	628-6002	REMOVE ELECTRICAL SERVICES	EA	25.000		25.000	
	690-6002	INSTALL OF CONDUIT BY TRENCHING	LF	1,000.000		1,000.000	
	690-6020	INSTALL OF ELECTRICAL SERVICE	EA	30.000		30.000	
	6000-6001	INSTALL ABOVE-GROUND CONDUIT	LF	400.000		400.000	
	6000-6003	REPLACE ABOVE-GROUND CONDUIT	LF	5,000.000		5,000.000	
	6000-6004	INSTALL UNDERGROUND CONDUIT	LF	400.000		400.000	
	6000-6006	REPLACE UNDERGROUND CONDUIT	LF	3,550.000		3,550.000	
	6000-6008	REMOVE CONDUCTOR	LF	30,000.000		30,000.000	
	6000-6012	REPLACE TRAY CABLE	LF	10,000.000		10,000.000	
	6000-6016	INSTALL ELECTRICAL SPLICE	EA	2,000.000		2,000.000	
	6000-6020	ROAD BORE	LF	2,000.000		2,000.000	
	6000-6026	REPLACE ROADWAY ILLUM ASSEMBLY (LED)	EA	100.000		100.000	
	6000-6032	REPLACE UNDERPASS LUMINAIRE (LED)	EA	50.000		50.000	
	6000-6041	REPLACE LUMINAIRE FIXTURE (LED)	EA	350.000		350.000	
	6000-6042	REPLACE HIGH MAST LUMINAIRES	EA	35.000		35.000	
	6000-6044	REPLACE LUMINAIRE ARMS	EA	5.000		5.000	
	6000-6053	REPLACE TIMBER SERVICE POLE	EA	5.000		5.000	
	6000-6057	INSTALL GROUND BOX W/APRON	EA	45.000		45.000	
	6000-6059	INSTALL FOUNDATION	EA	20.000		20.000	
	6000-6060	REMOVE FOUNDATION	EA	20.000		20.000	
	6000-6061	REPLACE TRANSFORMER BASE	EA	20.000		20.000	
	6000-6062	REPLACE TRANSFORMER BASE COVER	EA	30.000		30.000	
	6000-6063	REPLACE HAND HOLE COVER	EA	15.000		15.000	
	6000-6064	INSTALL GROUND ROD	EA	5.000		5.000	
	6000-6068	REPLACE FUSED DISCONNECT	EA	20.000		20.000	
	6000-6082	REPLACE FUSE	EA	2,000.000		2,000.000	
	6000-6084	REPLACE BREAKAWAY FUSE HOLDER	EA	500.000		500.000	
	6000-6087	REPLACE CONTROL TRANS (HIGH MAST)	EA	5.000		5.000	
	6000-6088	REPLACE CONTROL TRANS (ELECT SERVICE)	EA	1.000		1.000	
	6000-6091	REPLACE AVIATION WARNING FIXTURE	EA	80.000		80.000	
	6000-6092	REPLACE AVIATION WARNING LAMP	EA	200.000		200.000	
	6000-6093	REPLACE HAND-OFF-AUTO SWITCH	EA	25.000		25.000	

DISTRICT	COUNTY	CCSJ	SHEET
Houston	Harris	6459-93-001	4



CONTROLLING PROJECT ID 6459-93-001

DISTRICT Houston
HIGHWAY IH0610

COUNTY Harris

Estimate & Quantity Sheet

CONTROL SECTION JOB				6459-93-001		TOTAL EST.	TOTAL FINAL
PROJECT ID				A00205647			
COUNTY				Harris			
HIGHWAY				IH0610			
ALT	BID CODE	DESCRIPTION	UNIT	EST.	FINAL		
	6000-6094	REPLACE CONTACTOR	EA	20.000		20.000	
	6000-6095	REPLACE METER BASE	EA	5.000		5.000	
	6000-6099	REPLACE CIRCUIT BREAKER	EA	30.000		30.000	
	6000-6100	REPLACE FLEX POWER CABLE OR CORD	LF	400.000		400.000	
	6000-6101	REPLACE TWIST LOCK CONNECTOR	EA	80.000		80.000	
	6000-6102	REPLACE SAFETY LANYARD	LF	25.000		25.000	
	6000-6103	RAISE AND LOWER RING (HIGH MAST LIGHT)	EA	500.000		500.000	
	6000-6109	REPLACE PHOTOCELL	EA	100.000		100.000	
	6000-6110	INSTALL SAFETY SWITCH	EA	7.000		7.000	
	6000-6149	REPLACE HIGH MAST WINCH	EA	2.000		2.000	
	6000-6150	REPLACE WIRE ROPE PULLEY	EA	50.000		50.000	
	6000-6151	REPLACE ELECTRICAL CABLE PULLEY	EA	2.000		2.000	
	6000-6159	INSTALL CONTROL TRANS (HIGH MAST)	EA	2.000		2.000	
	6000-6160	REPLACE HIGH MAST LUMINAIRES (LED)	EA	25.000		25.000	
	6000-6161	INSTL HIGH MAST FIXTURE (LED)	EA	500.000		500.000	
	6000-6162	REMOVE HIGH MAST ILLUM FIXTURE	EA	1,000.000		1,000.000	
	6000-6163	INSTALL LED SHIELDS	EA	100.000		100.000	
	6000-6164	INSTALL AVIATION WARNING FIXTURE (LED)	EA	100.000		100.000	
	6000-6165	LED SHIELDS FOR HIGH MAST FIXTURES	EA	100.000		100.000	
	6000-6167	REPLACE AVIATION WARNING FIXTURE (LED)	EA	300.000		300.000	
	6000-6168	REMOVE LED SHIELDS	EA	100.000		100.000	
	6000-6169	REMOVE HPS SHIELDS	EA	50.000		50.000	
	6000-6170	SCHED PREVENT MAINT (ILLUM SYS)	EA	500.000		500.000	
	6154-6001	ALUMINUM ELECTRICAL COND (#4 XHHW)	LF	80,000.000		80,000.000	
	6185-6002	TMA (STATIONARY)	DAY	5.000		5.000	
	6185-6005	TMA (MOBILE OPERATION)	DAY	48.000		48.000	



DISTRICT	COUNTY	CCSJ	SHEET
Houston	Harris	6459-93-001	4A



PLANS OF PROPOSED STATE HIGHWAY IMPROVEMENT

PROJECT NO. RMC 6459-93-001
 HARRIS, etc., COUNTY HIGHWAY NO.: I-610, etc.
 PREVENTIVE MAINTENANCE FORM (ILLUMINATION SYSTEMS)

PREVENTIVE MAINTENANCE FORM (ILLUMINATION SYSTEMS)

LOCATION _____ DATE _____ CONTRACTOR _____
 COUNTY _____ CONTROL _____ SECTION _____ ORDER NO. _____
 TYPE _____ DETAIL _____ FUNCTION _____ CLASS _____

	PREVENTIVE MAINTENANCE	CONTRACTOR	TXDOT
1	INSPECT PROPER FUNCTIONALITY OF LIGHTS OPERATED BY SERVICE (BAD PHOTOCCELL OR TRIP BREAKER). NOTIFY IN WRITING OF ADDITIONAL REPAIRS NEEDED (STOLEN WIRE OR KNOCK DOWN)		
2	INSPECT ALL FOUNDATIONS AND SPRAY HERBIDICE AROUND ALL (INCLUDES SERVICE, GROUND BOXES, SINGLE POLES AND HIGH MAST).		
3	INSPECT ALL POLE T-BASES AND GROUND BOXES (CLEAN OUT DIRT AND DEBRIS). NOTIFY IN WRITING IF BASES AND LIDS ARE BROKEN OR CRACKED. ADD DUCT SEALANT AS NEEDED.		
4	INSPECT AND CLEAN ALL WALL PACK LIGHTS (UNDERPASS LIGHTS).		
5	INSPECT AND TOUCH-UP RUST SPOTS WITH COLD GALVANIZING SPRAY		
6	INSPECTING MECHANISM WHILE LOWERING RING		
7	INSPECT AND ADJUST BRAKE MECHANISM TO PROPER TORQUE.		
8	INSPECT ALL WELDS AROUND BASEPLATE AND GROUND SLEEVE FOR VISIBLE CRACKS.		
9	INSPECTING ALL WIRE ROPE AND CABLES FOR DETERIORATION OR WEAR		
10	INSPECTING SAFETY LANYARD		
11	INSPECT ALL LAMPS AND CLEANING FIXTURES AS DIRECTED.		
12	INSPECT ALL AVIATION WARNING (OBSTRUCTION) LAMPS AS DIRECTED.		
13	INSPECT ALL WIRING INSIDE POLES AND ON TOP OF RING.		
14	INSPECTING ALD FILLING GEARBOX LUBRICATION RESEVOIR		
15	INSPECT ALL LUBRICATING GREASE FITTINGS (GREASE AS NEEDED).		
16	INSPECT AND RAISE RING TO PROPER POSITION.		
17	INSPECT ALL T-BASES HAND-HOLE COVER AND REPLACE AS NEEDED (ADD DUCT SEALANT).		
18	INSPECT SHORTS OR OPEN CIRCUITS AS DIRECTED.		
19	INSPECT BALLAST AS DIRECTED		
20	INSPECT ELECTRICAL SYSTEM		

COMMENTS _____

PREVENTIVE MAINTENANCE FORM ILLUMINATION (SERVICE)

STATE		DISTRICT		COUNTY	
TEXAS		12		HARRIS	
CONTROL	SECTION	JOB	HIGHWAY NO.		
6459	93	001	I-610, etc.		

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DATE: FILE:

GENERAL NOTES FOR ALL ELECTRICAL WORK

1. The location of all conduits, junction boxes, ground boxes, and electrical services is diagrammatic and may be shifted to accommodate field conditions.
2. Provide new and unused materials. Ensure that all materials and installations comply with the applicable articles of the National Electrical Code (NEC), TxDOT standards and specifications, National Electrical Manufacturers Association (NEMA), and are listed by Underwriters Laboratories (UL) or a Nationally Recognized Testing Lab (NRTL). NRTLs such as Canadian Standard Association (CSA), Intertek Testing Services NA Inc., or FM Approvals LLC can be considered equivalent to UL. Where reference is made to NEMA listed devices, International Electrotechnical Commission (IEC) listed devices will not be considered an acceptable equal to a NEMA listed device. Acceptable devices may have both a NEMA and IEC listing. Faulty fabrication or poor workmanship in any material, equipment, or installation is justification for rejection. Replace or reinstall rejected material or equipment at no additional cost to the Department.
3. Miscellaneous nuts, bolts and hardware, except for high strength bolts, may be stainless steel when plans specify galvanized, provided the bolt size is 1/2 in. or less in diameter.
4. Provide the following test equipment as required by the Engineer to confirm compliance with the contract and the NEC: voltmeter, ammeter, megohm meter (1000 volt DC), ground resistance tester, torque wrenches, and torque screwdrivers. Ensure all equipment has been properly calibrated within the last year. Provide calibration certification to the Engineer upon request. Operate test equipment during inspection as requested by the Engineer.
5. Install grounding as shown on the plans and in accordance with the NEC. Ensure all metallic conduits; metal poles; luminaires; and metal enclosures are bonded to the equipment grounding conductor. Provide stranded bare copper or green insulated grounding conductors. Ground rods, connectors, and bonding jumpers are subsidiary to the various bid items.
6. When required by the Engineer, notify the Department in writing of materials from the Material Producers List (MPL) intended for use on each project. Prequalified materials are listed on the MPL on TxDOT's website under "Roadway Illumination and Electrical Supplies." No substitutions will be allowed for materials on this list.

CONDUIT

A. MATERIALS

1. Provide conduit, junction boxes, fittings, and hardware as per TxDOT Departmental Material Specification (DMS) 11030 "Conduit" and Item 618 "Conduit" of TxDOT's "Standard Specifications For Construction And Maintenance Of Highways, Streets, And Bridges," latest edition. Provide conduits listed under Item 618 on the MPL under "Roadway Illumination and Electrical Supplies." Provide conduit types according to the descriptive code or as shown on the plans. Do not substitute other types of conduits for those shown. Provide liquidtight flexible metal conduit (LFMC) when flexible conduit is called for on galvanized steel rigid metallic conduit (RMC) systems. Provide liquidtight flexible nonmetallic conduit (LFNC) when flexible conduit is called for on polyvinyl chloride (PVC) systems.
2. Provide galvanized steel RMC for all exposed conduits, unless otherwise shown on the plans. Properly bond all metal conduits.
3. Unless otherwise shown on the plans, provide junction boxes with a minimum size as shown in the following table, which applies to the greatest number of conductors entering the box through one conduit with no more than four conduits per box. When a mixture of conductor sizes is present, count the conductors as if all are of the larger size. For situations not applicable to the table, size junction boxes in accordance with NEC.


AWG	3 CONDUCTORS	5 CONDUCTORS	7 CONDUCTORS
#1	10" x 10" x 4"	12" x 12" x 4"	16" x 16" x 4"
#2	8" x 8" x 4"	10" x 10" x 4"	12" x 12" x 4"
#4	8" x 8" x 4"	10" x 10" x 4"	10" x 10" x 4"
#6	8" x 8" x 4"	8" x 8" x 4"	10" x 10" x 4"
#8	8" x 8" x 4"	8" x 8" x 4"	8" x 8" x 4"

4. Junction boxes with an internal volume of less than 100 cu. in. and supported by entering raceways must have threaded entries or hubs identified for the intended purpose and supported by connection of two or more rigid metal conduits. Secure conduit within 3 ft. of the enclosure or within 18 in. of the enclosure if all conduit entries are on the same side. Mechanically secure all junction boxes with an internal volume greater than 100 cu. inches.
5. Provide hot dipped galvanized cast iron or sand cast aluminum outlet boxes for junction boxes containing only 10 AWG or 12 AWG conductors. Do not use die cast aluminum boxes. Size outlet boxes according to the NEC.
6. Do not use intermediate metal conduit (IMC) or electrical metallic tubing (EMT) unless specifically required by the plan sheets. When EMT is called for, provide junction boxes made from galvanized steel sheeting, listed and approved for outdoor use, unless otherwise noted on the plans. Size all galvanized steel junction boxes in accordance with the NEC. Provide junction boxes for IMC conduit systems that meet the same requirements for junction boxes used with RMC systems.
7. Provide PVC junction boxes intended for outdoor use on PVC conduit systems, unless otherwise noted on the plans.

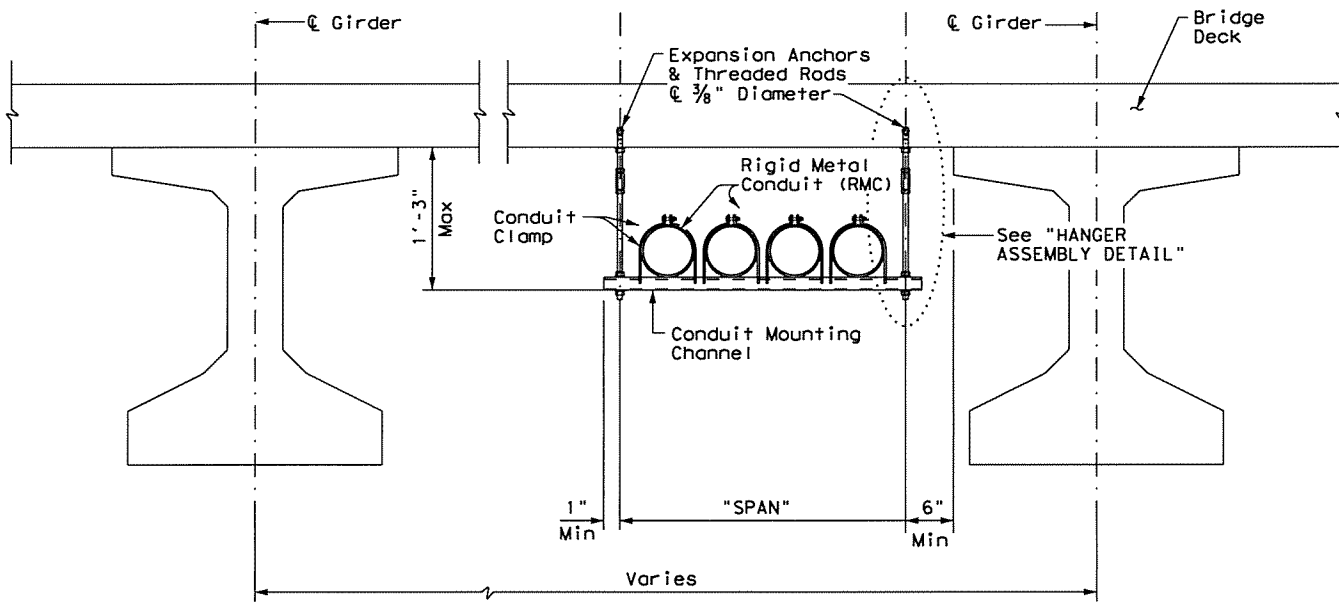
8. Provide PVC elbows in PVC conduit systems, unless otherwise shown on the plans. Use only a flat, high tensile strength polyester fiber pull tape for pulling conductors through the PVC conduit system. When galvanized steel RMC elbows are specifically called for in the plans and any portion of the RMC elbow is buried less than 18 in., ground the RMC elbow by means of a grounding bushing on a rigid metal extension. Grounding of the rigid metal elbow is not required if the entire RMC elbow is encased in a minimum of 2 in. of concrete. PVC extensions are allowed on these concrete encased rigid metal elbows. RMC or PVC elbows are subsidiary to various bid items.
9. When required, provide High-Density Polyethylene (HDPE) conduit with factory installed internal conductors according to Item 622 "Duct Cable." At the Contractor's request and with approval by the Engineer, substitute HDPE conduit with no conductors for bored schedule 40 or schedule 80 PVC conduit bid under Item 618. Ensure bored HDPE substituted for PVC is schedule 40 and of the same size PVC called for in the plans. Ensure the substituted HDPE meets the requirements of Item 622, except that the conduit is supplied without factory-installed conductors. Make the transition of the HDPE conduit to PVC (or RMC elbow when required) at the bore pit. Provide conduit of the size and schedule as shown on the plans. Do not extend substituted conduit into ground boxes or foundations. Provide PVC or galvanized steel RMC elbows as called for at all ground boxes and foundations.
10. Use two-hole straps when supporting 2 in. and larger conduits. On electrical service poles, properly sized stainless steel or hot dipped galvanized one-hole standoff straps are allowed on the service riser conduit.

B. CONSTRUCTION METHODS

1. Provide and install expansion joint conduit fittings on all structure-mounted conduits at the structure's expansion joints to allow for movement of the conduit. In addition, provide and install expansion joint fittings on all continuous runs of galvanized steel RMC conduit externally exposed on structures such as bridges at maximum intervals of 150 ft. When requested by the project Engineer, supply manufacturer's specification sheet for expansion joint conduit fittings. Repair or replace expansion joint fittings that do not allow for movement at no additional cost to the Department. Provide the method of determining the amount of expansion to the Engineer upon request. Do not use LFMC or LFNC as a substitute for the required expansion conduit fittings.
2. Space all conduit supports at maximum intervals of 5 ft. Install conduit spacers when attaching metal conduit to surface of concrete structures. See "Conduit Mounting Options" on ED(2). Install conduit support within 3 ft. of all enclosures and conduit terminations.
3. Do not attach conduit supports directly to pre-stressed concrete beams except as shown specifically in the plans or as approved by the Engineer.
4. Unless otherwise shown on the plans, jack or bore conduit placed beneath existing roadways, driveways, sidewalks, or after the base or surfacing operation has begun. Backfill and compact the bore pits below the conduit per Item 476 "Jacking, Boring, or Tunneling Pipe or Box" prior to installing conduit or duct cable to prevent bending of the connections.
5. When placing conduit in the sub-grade of new roadways, backfill all trenches with excavated material unless otherwise noted on the plans. When placing conduit in the sub-base of new roadways, backfill all trenches with cement-stabilized base as per requirements of Items 110 "Excavation", 400 "Excavation and Backfill for Structures", 401 "Flowable Backfill", 402 "Trench Excavation Protection", and 403 "Temporary Special Shoring."
6. Provide and place warning tape approximately 10 in. above all trenched conduit as per Item 618.
7. During construction, temporarily cap or plug open ends of all conduit and raceways immediately after installation to prevent entry of dirt, debris and animals. Temporary caps constructed of durable duct tape are allowed. Tightly fix the tape to the conduit opening. Clean out the conduit and prove it clear in accordance with Item 618 prior to installing any conductors.
8. Ensure conduit entry into the top of any enclosure is waterproof by installing conduit sealing hubs or using boxes with threaded bosses. This includes surface mounted safety switches, meter cans, service enclosures, auxiliary enclosures and junction boxes. Grounding bushings on water tight sealing hubs are not required.
9. Fit the ends of all PVC conduit terminations with bushings or bell end fittings. Provide and install a grounding type bushing on all metal conduit terminations.
10. Install a bonding jumper from each grounding bushing to the nearest ground rod, grounding lug, or equipment grounding conductor. Ensure all bonding jumpers are the same size as the equipment grounding conductor. Bonding of conduit used as a casing under roadways for duct cable is not required, if the duct extends the full length through the casing.
11. At all electrical services, install a 6 AWG solid copper grounding electrode conductor.
12. Place conduits entering ground boxes so that the conduit openings are between 3 in. and 6 in. from the bottom of the box. See the ground box detail on sheet ED(4).
13. Seal ends of all conduits with duct seal, expandable foam, or by other methods approved by the Engineer. Seal conduit immediately after completion of conductor installation and pull tests. Do not use duct tape as a permanent conduit sealant. Do not use silicone caulk as a conduit sealant.
14. File smooth the cut ends of all mounting strut and conduit. Before installing, paint the field cut ends of all mounting strut and RMC (threaded or non-threaded) with zinc rich paint (94% or more zinc content) to alleviate overspray. Use zinc rich paint to touch up galvanized material as allowed under Item 445 "Galvanizing." Do not paint non-galvanized material with a zinc rich paint as an alternative for materials required to be galvanized.

 Texas Department of Transportation		Traffic Operations Division Standard	
<h2 style="margin: 0;">ELECTRICAL DETAILS CONDUITS & NOTES</h2> <h3 style="margin: 0;">ED(1)-14</h3>			
FILE:	ed1-14.dgn	DN:	CR:
© TxDOT	October 2014	CONT	SECT
REVISIONS	6459 93	JOB	HIGHWAY
DIST	COUNTY	1-610, etc.	SHEET NO.
6459	6		

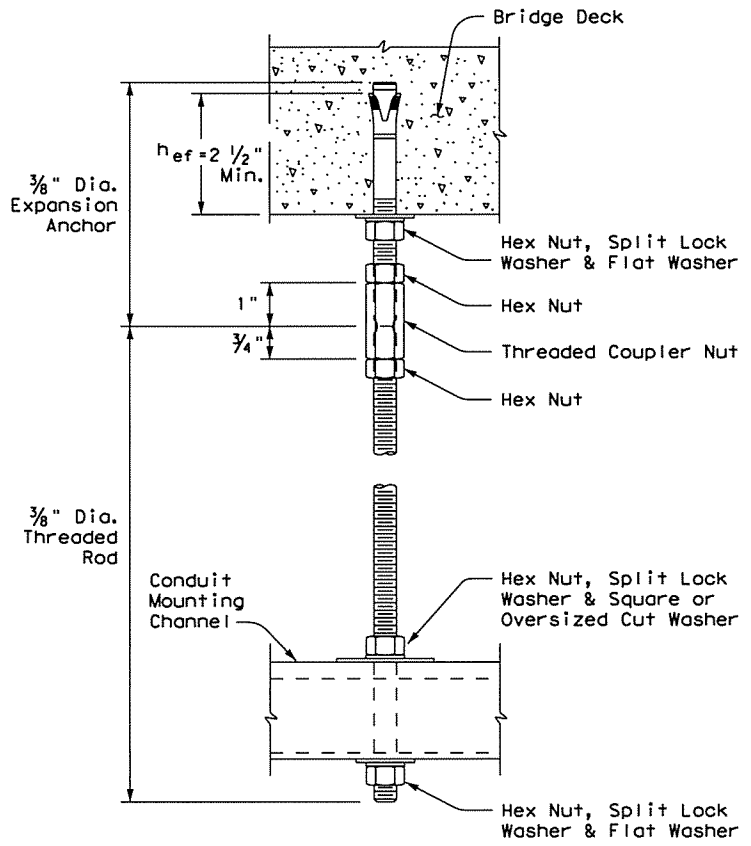
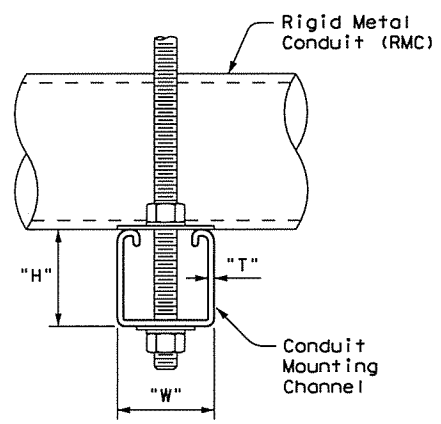
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CONDUIT HANGING DETAIL

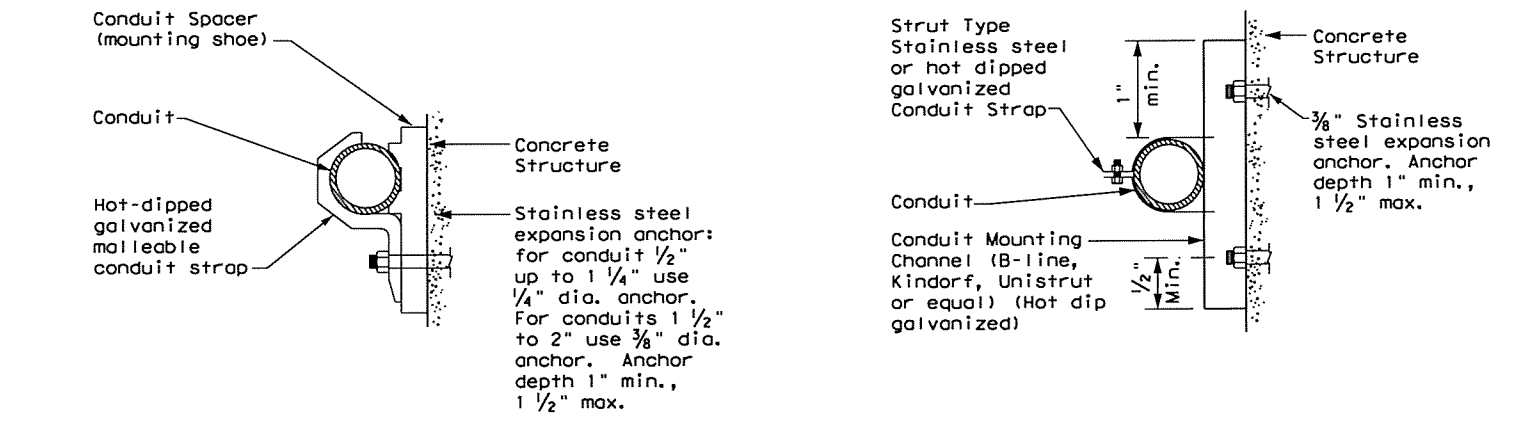
CONDUIT MOUNTING CHANNEL		
"SPAN"	"W" x "H"	"T"
less than 2'	1 5/8" x 1 3/8"	12 Ga.
2'-0" to 2'-6"	1 5/8" x 1 5/8"	12 Ga.
>2'-6" to 3'-0"	1 5/8" x 2 1/16"	12 Ga.

Channels with round or short slotted hole patterns are allowed, if the load carrying capacity is not reduced by more than 15%.



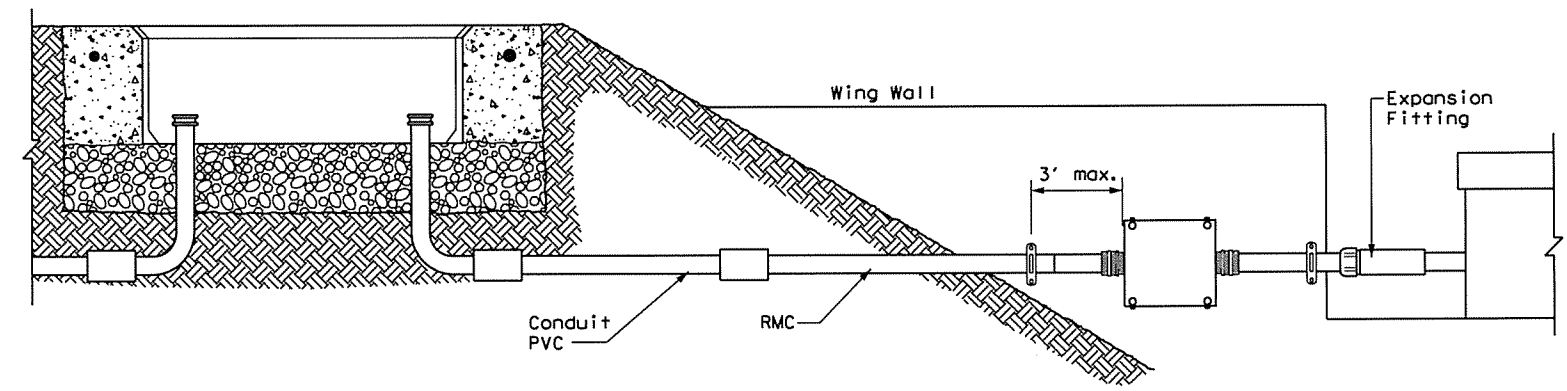
HANGER ASSEMBLY DETAIL

ELECTRIC CONDUIT TO BRIDGE DECK ATTACHMENT



CONDUIT MOUNTING OPTIONS

Attachment to concrete surfaces
See ED(1)B.2



TYPICAL CONDUIT ENTRY TO BRIDGE STRUCTURE DETAIL

EXPANSION ANCHOR NOTES FOR BRIDGE DECK ATTACHMENT

1. Use torque controlled mechanical expansion anchors that are approved for use in cracked concrete by the International Code Council, Evaluation Service (ICC-ES). The chosen anchor product shall have a designated ICC-ES Evaluation Report number, and its approval status shall be maintained on the ICC-ES website under Division 031600 for Concrete Anchors.
2. Unless otherwise approved by the Engineer: do not use adhesive anchors; do not use expansion anchors that are not included in the ICC-ES approval list; and do not use expansion anchors that are only approved for use in uncracked concrete.
3. Use anchors manufactured with stainless steel expansion wedges. Anchors manufactured with carbon steel expansion wedges are not allowed. Anchor bodies can be either zinc-plated carbon steel or stainless steel. For application in marine environment, both the anchor body and expansion wedge shall be stainless steel.
4. Install anchors as shown on the plans and in accordance with the anchor manufacturer's published installation instructions. Arrange a field demonstration test to evaluate the procedures and tools. The test shall be witnessed and approved by the Engineer prior to furnishing anchors on the structure.
5. Prior to hole drilling, use rebar locator to ensure clearing of existing deck strands or reinforcement. Install anchors to ensure a minimum effective embedment depth, (h_{ef}), as shown. Increase (h_{ef}) as needed to ensure sufficient thread length for proper torquing and tightening of anchors.
6. Use anchors of minimum 1600 Lbs tensile capacity (minimum of steel, concrete breakout, and concrete pullout strengths as determined by ACI 318 Appendix D) at the required minimum embedment depth (h_{ef}). No lateral loads shall be introduced after conduit installation.

		Traffic Operations Division Standard	
<h2>ELECTRICAL DETAILS</h2> <h2>CONDUIT SUPPORTS</h2> <h3>ED(2) - 14</h3>			
FILE: ed2-14.dgn	DW: TxDOT	CK: TxDOT	HW: TxDOT
© TxDOT October 2014	CONT	SECT	JOB
REVISIONS	6459	93	001
	DIST	COUNTY	SHEET NO.
	HOU	HARRIS, etc.	7

DATE: FILE:

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ELECTRICAL CONDUCTORS

A. MATERIAL INFORMATION

1. Provide Type XHHW insulated conductors in accordance with Departmental Material Specification (DMS) 11040 "Conductors" and Item 620 "Electrical Conductors." Provide conductors as listed on the Material Producers List (MPL) on the Department web site under "Roadway Illumination and Electrical Supplies" Item 620. Color code insulated conductors in conformance with the NEC. Identify grounded (neutral) conductors with white insulation. Identify grounding conductors (ground wires) with green insulation or bare conductors. Identify ungrounded (hot) conductors with any color insulation except green, white, or gray. Keep color scheme consistent throughout the wiring system. Identify conductors 6 American Wire Gauge (AWG) and smaller by continuous color jacket. Identify electrical conductors 4 AWG and larger by continuous color jacket or by colored tape. When identifying conductors with colored tape, mark at least 6 in. of the conductor's insulation with half laps of tape.
2. Provide a solid copper 6 AWG grounding electrode conductor to bond the electrical service equipment to the concrete encased grounding electrode or the ground rod at the service location. Connect the grounding electrode conductor to the ground rod with a UL listed connector in accordance with DMS 11040. Connect the grounding electrode conductor to the concrete encased grounding electrode as shown in the plans.
3. Where two or more circuits are present in one conduit or enclosure, permanently identify the conductors of each branch circuit by attaching a non-metallic tag around both circuit conductors at each accessible location. Provide tags with two straps, large enough to indicate circuit number, letter, or other identification as shown in the plans. Print circuit identification on the tag with a permanent marker.
4. Use listed compression or screw type pressure connectors, terminal blocks, or split bolt connectors for splicing as specified in DMS 11040. Use hot melt adhesive tape to fill the gap and seal the ends of heat shrink tubing. Provide UL listed gel-filled insulating splice covers. Splicing materials, insulating materials, breakaway disconnects, splice covers, and fuse holders are subsidiary to various bid items.

B. CONSTRUCTION METHODS

1. Use only a flat, high tensile strength polyester fiber pull tape for pulling conductors through the conduit system. After installing conductors in conduit, perform conductor pull test. If a conductor cannot be freely pulled, make any needed alterations or repairs at no additional cost to the department. Perform insulation resistance tests in accordance with Item 620. Coordinate with the Engineer to witness the tests.
2. Leave 2 ft. minimum, 3 ft. maximum length for each conductor up to the splice in ground boxes. Leave 3 ft. minimum, 4 ft. maximum length of conductor in ground boxes when pulled through with no splice. Leave 1 ft. minimum, 1.5 ft. maximum length of conductor at enclosures, weatherheads and pole bases.
3. Make splices only in junction boxes, ground boxes, pole bases, or electrical enclosures and use only listed compression or screw type pressure connectors, terminal blocks, or split bolt connectors. Insulate splices with heavy wall heat shrink tubing or gel-filled insulating splice covers to provide a watertight splice. Overlap conductor insulation with heat shrink tubing a minimum of 2 in. past both sides of the splice. Where heat shrink tubing may not shrink sufficiently to provide a watertight seal around the individual conductors, prior to heating the tubing, increase the diameter of the conductor insulation using hot melt adhesive tape to provide a watertight seal between the individual conductors and the heat shrink tubing. Ensure the tape extends past the heat shrink tubing. Use hot melt adhesive tape to fill the gap and seal the ends of heat shrink tubing. Heat shrink tubing that appears to have been burned, or overheated, is considered defective and must be replaced.
4. Size and install gel-filled insulating splice covers according to manufacturer's specifications when used in place of heat shrink tubing.
5. Wire nuts with factory applied waterproof sealant may be used for 8 AWG or smaller conductors in above ground junction boxes, but not in pole bases or ground boxes. Install wire nuts in an upright position to prevent the accumulation of water.
6. Support conductors in illumination poles with a J-hook at the top of the pole.
7. When terminating conductors, remove the insulation and jacketing material without nicking the individual strands of the conductor. Conductors with nicked individual conductor strands or removed strands will be considered damaged.
8. Replace conductors and cables that are damaged beyond repair or that fail an insulation resistance test at no additional cost to the department.
9. Do not repair damaged conductors with duct tape, electrical tape, or wire nuts. Use only approved splicing methods.
10. Do not terminate more than one conductor under a single connector, unless the connector is rated for multiple conductors. Do not exceed the pressure connector's listing for maximum number and size of conductors allowed.
11. Install breakaway connectors on conductors bid under Item 620 whenever those conductors pass through a breakaway support device. Follow manufacturer's instructions when terminating conductors to breakaway connectors. Properly torque threaded connections. Proper terminations are critical to the safe operation of breakaway devices. Trim waterproofing boots on breakaway connectors to fit snugly around the conductor to ensure waterproof connection. Only one conductor may enter a single opening in a boot. Provide waterproof boots with the correct number of openings. Leave unused openings factory sealed. Use prequalified breakaway connectors as shown on the MPL.

12. Provide and install a separate stranded equipment grounding conductor (EGC) in all conduits that contain circuit wiring of 50 volts or more. Unless shown elsewhere, size the EGC to be the same size as the largest current carrying conductor contained in the conduit. Ensure all EGCs are bonded together at every accessible location. For traffic signal installations, provide a minimum size 8 AWG EGC. The EGC is paid for under Item 620.

C. TEMPORARY WIRING

1. Install temporary conductors and electrical equipment in accordance with the NEC article "Temporary Installations" and Department standard sheets.
2. Provide a ground fault circuit interrupter (GFCI) for power outlets for portable electrical equipment, power tools, ice machines, ice storage bins and refrigerators located outdoors at grade. GFCI may be any one of the following: molded cord and plug set, receptacle, or circuit breaker type.
3. Use listed wire nuts with factory applied sealant for temporary wiring where approved.
4. Enclose conductor splices within a listed enclosure or ground box, or ensure the splices are more than 10 ft. above grade vertically and more than 5 ft. horizontally from any metal structure. Where installing temporary conductors in areas subject to vehicle traffic or mobile construction equipment, ensure the vertical clearance to ground is at least 18 ft. when measured at the lowest point. Ground messenger wires that support power conductors in conformance with the NEC.
5. Protect and when necessary repair any existing electrical conduits uncovered during the construction process in a timely manner and in conformance with the NEC.

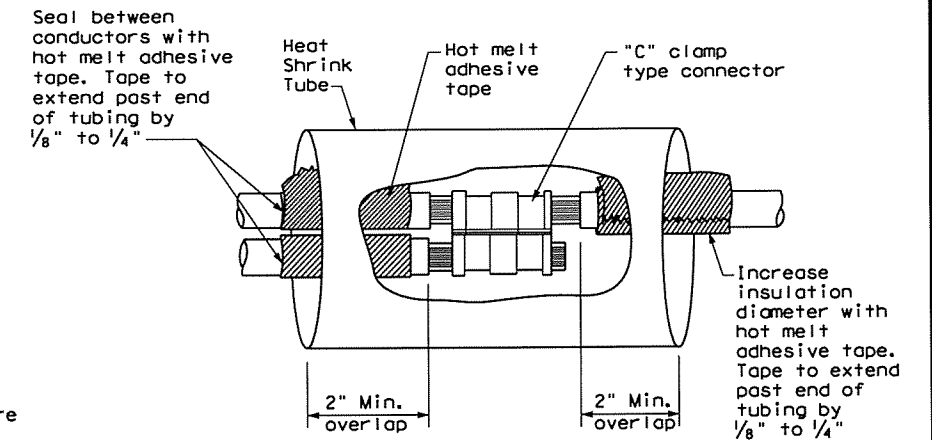
GROUND RODS & GROUNDING ELECTRODES

A. MATERIAL INFORMATION

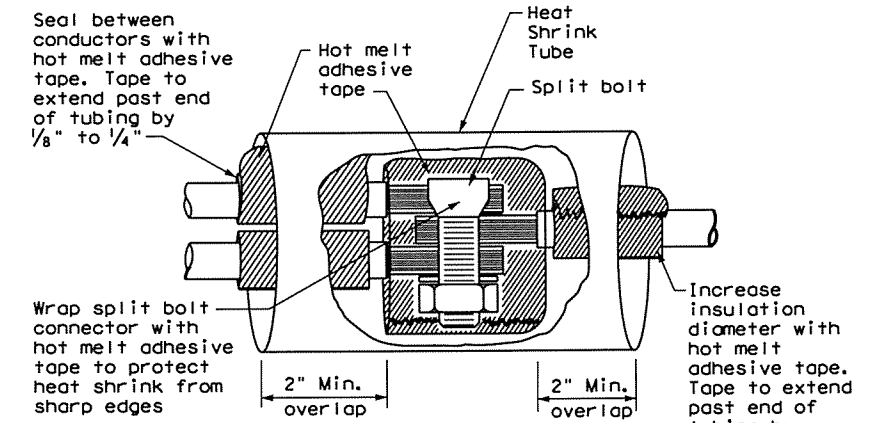
1. Provide and install a grounding electrode at electrical services. Provide ground rods according to DMS 11040 and the plans. Larger diameter or longer length rods may be called for in some specific locations, see the individual plans sheets. Concrete encased electrodes may be called for in specific locations including electrical service, see individual plan sheets.

B. CONSTRUCTION METHODS

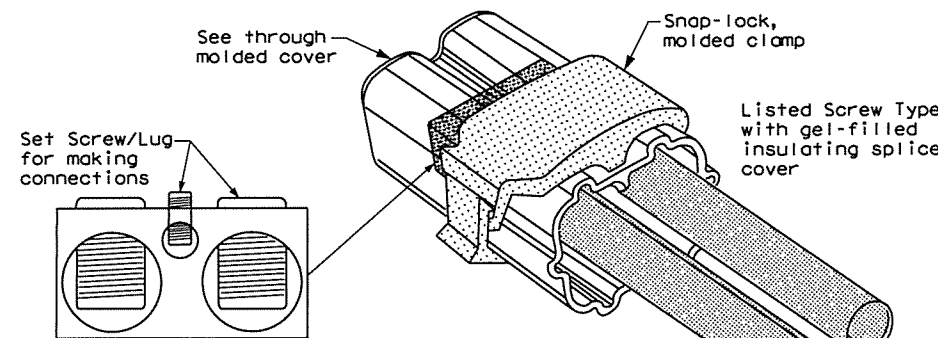
1. Furnish auxiliary ground rods for lightning protection and install in soil, concrete, or both, as called for in the plans. For ground rods installed in concrete, ensure the connection of the conductor to the ground rod is readily accessible for inspection or repairs. For ground rods installed in soil, ensure that the upper end is between 2 to 4 in. below finished grade.
2. Do not place ground rods in the same drilled hole as a timber pole.
3. Install ground rods so the imprinted part number is at the upper end of the rod.
4. Remove all non-conductive coatings such as concrete splatter from the rod at the clamp location.
5. Route all conductors as short and straight as possible for connection to lightning protection ground rods. When a bend is required, ensure a minimum radius bend of four inches for these conductors.
6. Unless otherwise called for in the plans, protect grounding electrode conductors with non-metallic conduit. When protecting grounding electrode conductors with metal conduit, provide and install a grounding type bushing and properly sized bonding jumper on each end of the metal conduit.
7. Written authorization is required before installing a ground rod in a horizontal trench for rocky soil or a solid rock bottom.



**SPLICE OPTION 1
Compression Type**



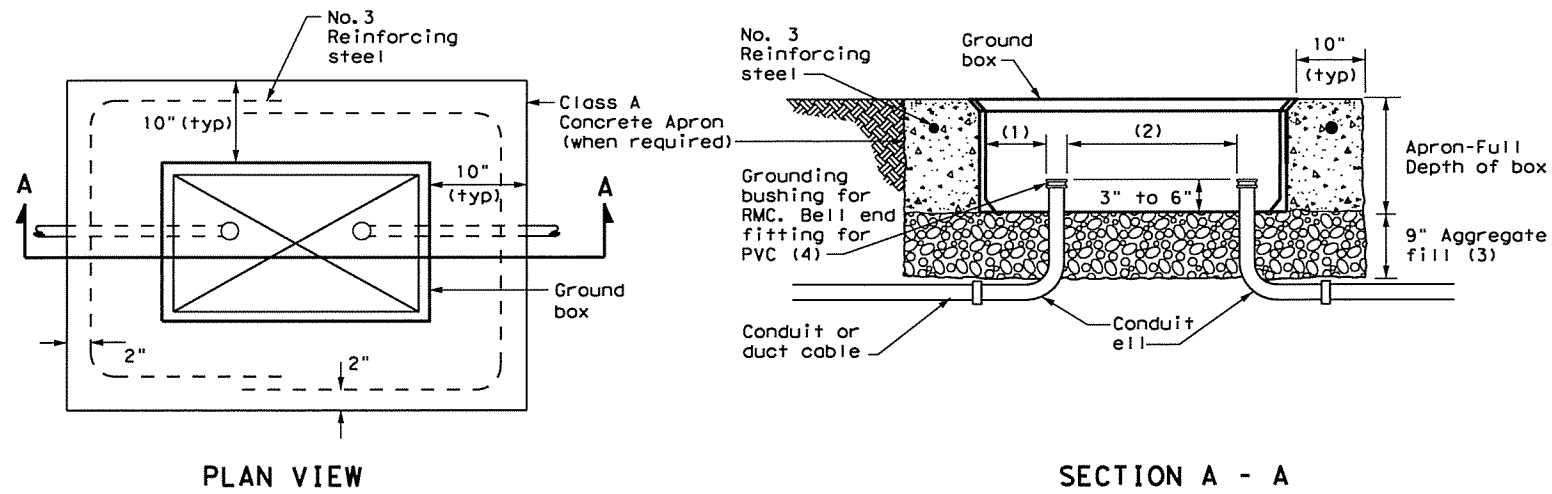
**SPLICE OPTION 2
Split Bolt Type**



**SPLICE OPTION 3
Listed Screw Type**

Texas Department of Transportation				Traffic Operations Division Standard	
<h2>ELECTRICAL DETAILS CONDUCTORS</h2> <h3>ED(3) - 14</h3>					
FILE:	ed3-14.dgn	DW:	TxDOT	CK:	TxDOT
© TxDOT	October 2014	CONT:	6459	SECT:	93
REVISIONS		JOB:	001	HIGHWAY	
		DIST:	HARRIS, etc.	I-610, etc.	
		COUNTY:	HARRIS, etc.	SHEET NO.	
				8	

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APRON FOR GROUND BOX

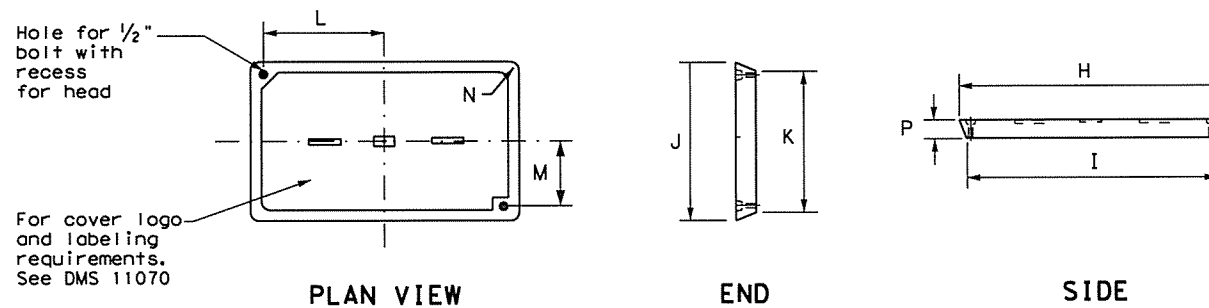
- (1) Uniformly space ends of conduits within the ground box. Position ends of conduits so that ground box walls do not interfere with the installation of grounding bushings or bell end fittings.
- (2) Maintain sufficient space between conduits to allow for proper installation of bushing.
- (3) Place aggregate under the box, not in the box. Aggregate should not encroach on the interior volume of the box.
- (4) Install a grounding bushing on the upper end of all RMC terminating in a ground box. Ground RMC elbows when any part of the elbow is less than 18 in. below the bottom of the ground box. Install a PVC bushing or bell end fitting on the upper end of all PVC conduits terminating in a ground box.

GROUND BOX DIMENSIONS

TYPE	OUTSIDE DIMENSIONS (INCHES)		
	Width	Length	Depth
A	12	23	11
B	12	23	22
C	16	29	11
D	16	29	22
E	12	23	17

GROUND BOX COVER DIMENSIONS

TYPE	DIMENSIONS (INCHES)							
	H	I	J	K	L	M	N	P
A, B & E	23 1/4	23	13 3/4	13 1/2	9 7/8	5 1/8	1 3/8	2
C & D	30 1/2	30 1/4	17 1/2	17 1/4	13 1/4	6 3/4	1 3/8	2



GROUND BOX COVER

GROUND BOXES

A. MATERIALS

1. Provide polymer concrete ground boxes measuring 16x30x24 in. (WxLxD) or smaller in accordance with Departmental Material Specification (DMS) 11070 "Ground Boxes" and Item 624 "Ground Boxes."
2. Provide Type A, B, C, D, and E ground boxes as shown in the plans, and as listed on the Material Producers List (MPL) on the Department web site under "Roadway Illumination and Electrical Supplies," Item 624.

3. Ensure ground box cover is correctly labeled in accordance with DMS 11070.

4. Provide larger ground boxes in accordance with Item 624 and as shown in the plans.

B. CONSTRUCTION METHODS

1. Remove all gravel and dirt from conduit. Cap all conduits prior to placing aggregate and setting ground box. Provide Grade 3 or 4 coarse aggregate as shown in Table 2 of Item 302 "Aggregates for Surface Treatments." Ensure aggregate bed is in place and at least 9 inches deep, prior to setting the ground box. Install ground box on top of aggregate.
2. Cast ground box aprons in place. Reinforcing steel may be field bent. Ensure the depth of concrete for the apron extends from finished grade to the top of the aggregate bed under the box. Ground box aprons, including concrete and reinforcing steel, are subsidiary to ground boxes when called for by descriptive code.
3. Keep bolt holes in the box clear of dirt. Bolt covers down when not working in ground boxes.
4. Install all conduits and ells in a neat and workmanlike manner. Uniformly space conduits so grounding bushings and bell end fittings can easily be installed.
5. Temporarily seal all conduits in the ground box until conductors are installed.
6. Permanently seal conduits immediately after the completion of conductor installation and pull tests. Permanently seal the ends of all conduits with duct seal, expandable foam, or other method as approved. Do not use duct tape as a permanent conduit sealant. Do not use silicone caulk as a sealant.
7. When a ground rod is present in a ground box, bond all equipment grounding conductors together and to the ground rod with listed connectors.
8. When a type B or D ground box is stacked to meet volume requirements, it is allowable to cut an appropriately sized hole for conduit entry in the side wall at least 18 inches below grade.
9. If an existing ground box in the contract has a metal cover, bond the cover to the equipment grounding conductor with a 3 ft. long stranded bonding jumper the same size as the grounding conductor. The bonding jumper is subsidiary to various bid items. Verify existing ground boxes with metal covers are shown on the plans, with notes fully describing the work required.
10. If other ground boxes with metal covers are within the project limits but are not part of the contract, the Engineer may direct the Contractor to bond the metal covers, identifying the specific boxes in writing. This work will be paid for separately.
11. Bond metal ground box covers to the grounding conductor with a tank ground type lug.

		Traffic Operations Division Standard	
ELECTRICAL DETAILS GROUND BOXES			
ED(4) - 14			
FILE: ed4-14.dgn	DN: TxDOT	CK: TxDOT	DW: TxDOT
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REVISIONS			HIGHWAY: I-610, etc.
DIST: HOU	COUNTY: HARRIS, etc.	SHEET NO.: 9	

ELECTRICAL SERVICES NOTES

1. Provide new materials. Ensure installation and materials comply with the applicable provisions of the National Electrical Code (NEC) and National Electrical Manufacturers Association (NEMA) standards. Ensure material is Underwriters Laboratories (UL) listed. Provide and install electrical service conduits, conductors, disconnects, contactors, circuit breaker panels, and branch circuit breakers as shown on the Electrical Service Data chart in the plans. Faulty fabrication or poor workmanship in material, equipment, or installation is justification for rejection. Where manufacturers provide warranties and guarantees as a customary trade practice, furnish these to the State.
2. Provide electrical services in accordance with Electrical Details standard sheets, Departmental Material Specification (DMS) 11080 "Electrical Services," DMS 11081 "Electrical Services-Type A," DMS 11082 "Electrical Services-Type C," DMS 11083 "Electrical Services-Type D," DMS 11084 "Electrical Services-Type T," DMS 11085 "Electrical Services-Pedestal (PS)", and Item 628 "Electrical Services" of the Standard Specifications. Provide electrical service types A, C, and D, as listed on the Material Producers List (MPL) on the Department web site under "Roadway Illumination and Electrical Supplies," Item 628. Provide other service types as detailed on the plans.
3. Provide all work, materials, services, and any incidentals needed to install a complete electrical service as specified in the plans.
4. Coordinate with the Engineer and the utility provider for metering and compliance with utility requirements. Primary line extensions, connection charges, meter charges, and other charges by the utility company to provide power to the location are paid for in accordance with Item 628. Get approval for the costs associated with these charges prior to engaging the utility company to do the work. Consult with the utility provider to determine costs and requirements, and coordinate the work as approved.
5. The enclosure manufacturer will provide Master Lock Type 2 with brass tumblers keyed #2195 for all custom electrical enclosures. Installing Contractor is to provide Master Lock #2195 Type 2 with brass tumblers for "off the shelf" enclosures. Master Lock #2195 keys and locks become property of the State. Unless otherwise approved, do not energize electrical service equipment until locks are installed.
6. Enclosures with external disconnects that de-energize all equipment inside the enclosure do not need a dead front trim. Protect incoming line terminations from incidental contact as required by the NEC.
7. When galvanized is specified for nuts, screws, bolts or miscellaneous hardware, stainless steel may be used.
8. Provide wiring and electrical components rated for 75°C. Provide red, black, and white colored XHHW service entrance conductors of minimum size 6 American Wire Gauge (AWG). Identify size 6 AWG conductors by continuous color jacket. Identify electrical conductors sized 4 AWG and larger by continuous color jacket or by colored tape. Mark at least 6 inches of the conductor's insulation with half laps of colored tape, when identifying conductors. Ensure each service entrance conductor exits through a separately bushed non-metallic opening in the weatherhead. The lengths of the conductors outside the weatherhead are to be 12 inches minimum, 18 inches maximum, or as required by utility.
9. All electrical service conduit and conductors attached to the electrical service including the riser or the elbow below ground are subsidiary to the electrical service. For an underground utility feed, all service conduit and conductors after the elbow, including service conduit and conductors for the utility pole riser when furnished by the Contractor, will be paid for separately.
10. Provide rigid metal conduit (RMC) for all conduits on service, except for the 1/2 in. PVC conduit containing the electrical service grounding electrode conductor. Size the service entrance conduit as shown in the plans. Ensure conduit for branch circuit entry to enclosure is the same size as that shown on the layout sheets for branch circuit conduit. Extend all rigid metal conduits a minimum of 6 inches underground and then couple to the type and schedule of the conduit shown on the layout for that particular branch circuit. Install a grounding bushing on the RMC where it terminates in the service enclosure.
11. Use of liquidtight flexible metal conduit (LFMC) is allowed between the meter and service enclosure when they are mounted 90 to 180 degrees to each other. Size the LFMC the same size as service entrance conduit. LFMC must not exceed 3 feet in length. Strap LFMC within 1 foot of each end. LFMC less than 12 inches in length need not be strapped. Each end of LFMC must have a grounding bushing or be terminated with a grounding fitting. The LFMC must contain a grounded (neutral) conductor. Ensure any bend in LFMC never exceeds 180 degrees. A pull test is required on all installed conductors, with at least six inches of free conductor movement demonstrated to the satisfaction of the Engineer.
12. Ensure all mounting hardware and installation details of services conform to utility company specifications.
13. For all electrical service enclosures listed under Item 628 on the MPL, the UL 508 enclosure manufacturers will prepare and submit a schematic drawing unique to each service. Before shipment to the job site, place the applicable laminated schematic drawings and the laminated plan sheet showing the electrical service data chart used to build the enclosure in the enclosure's data pocket. The installing contractor will copy and laminate the actual project plan sheets detailing all equipment and branch circuits supplied by that service. The laminated plan sheets are to be placed in the service enclosure's document pocket. Reduce 11 in. x 17 in. plan sheets to 8 1/2 in. x 11 in. before laminating. If the installation differs from the plan sheets, the installing contractor is to redline plan sheets before laminating.
14. When providing an "Off The Shelf" Type D or Type T service, provide laminated plan sheets detailing equipment and branch circuits supplied by that service. Reduce 11 in. x 17 in. plan sheets to 8 1/2 in. x 11 in. before laminating. Deliver these drawings before completion of the work to the Engineer, instead of placing in enclosure that has no door pocket.
15. Do not install conduit in the back wall of a service enclosure where it would penetrate the equipment mounting panel inside the enclosure. Provide grounding bushings on all metal conduits, and terminate bonding jumpers to grounding bus. Grounding bushings are not required when the end of the metal conduit is fitted with a conduit sealing hub or threaded boss, such as a meter base hub.

SERVICE ASSEMBLY ENCLOSURE

1. Provide threaded hub for all conduit entries into the top of enclosure.
2. Type galvanized steel (GS) enclosures may be used for Type C panelboards and for Type D and T services that do not use an enclosure mounted photocell or lighting contactor. Provide GS enclosures in accordance with DMS 11080, 11082, 11083, and 11084.
3. Provide aluminum (AL) and stainless steel (SS) enclosures for Types A, C, and D in accordance with DMS 11080, 11081, 11082, 11083, and 11084. Do not paint stainless steel.
4. Provide pedestal service (PS) enclosures in accordance with ED(9) and DMS 11080 and 11085. Do not provide GS pedestal services. If GS is shown in the PS descriptive code, provide an AL enclosure.

MAIN DISCONNECT & BRANCH CIRCUIT BREAKERS

1. Field drill flange-mounted remote operator handle if needed, to ensure handle is lockable in both the "On" and "Off" positions.
2. When the utility company provides a transformer larger than 50 KVA, verify that the available fault current is less than the circuit breaker's amperes interrupting capacity (AIC) rating and provide documentation from the electric utility provider to the Engineer.

PHOTOELECTRIC CONTROL

1. Provide photocell as listed on the MPL. Move, adjust, or shield the photocell from stray or ambient night time light to ensure proper operation. Mount photocell facing north when practical. Mount top of pole photocells as shown on Top Mounted Photocell Detail.

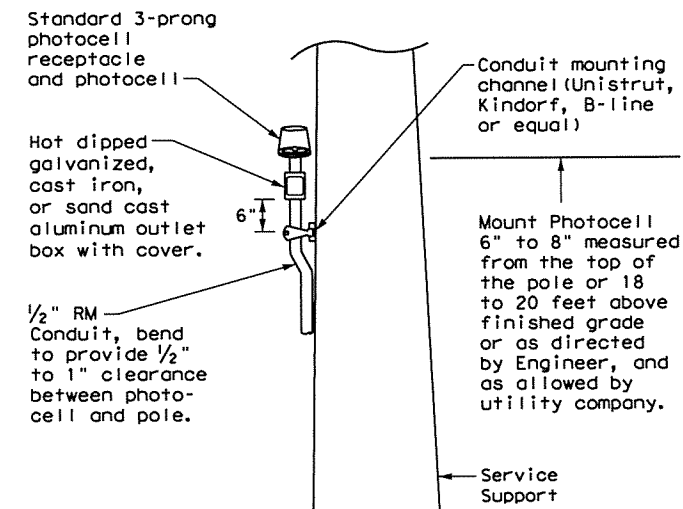
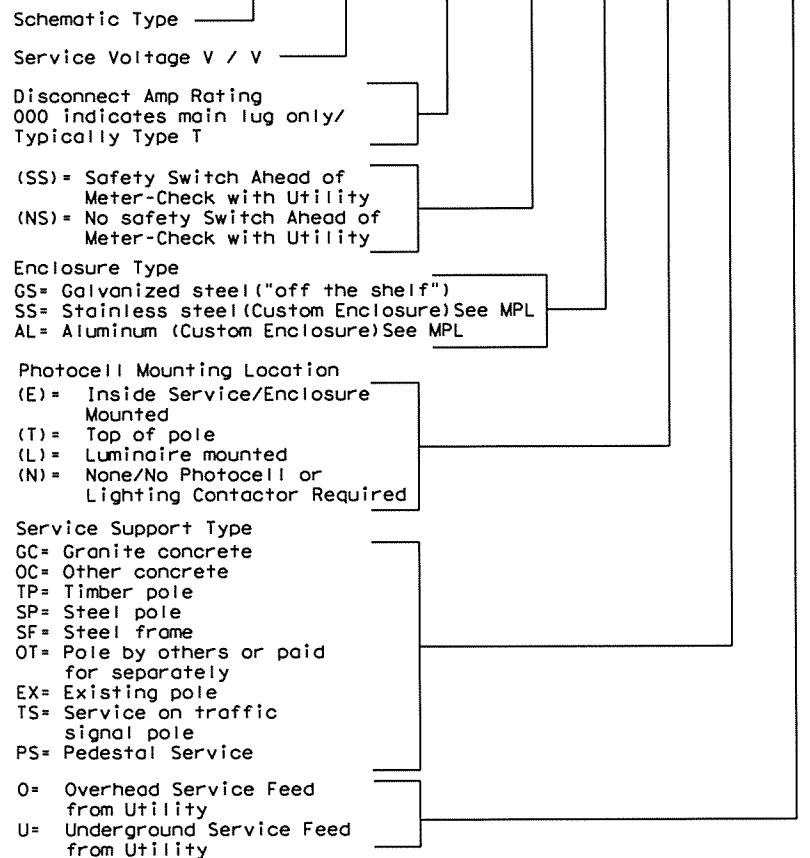
* ELECTRICAL SERVICE DATA												
Elec. Service ID	Plan Sheet Number	Electrical Service Description	Service Conduit **Size	Service Conductors No./Size	Safety Switch Amps	Main Ckt. Bkr. Pole/Amps	Two-Pole Contractor Amps	Panelbd/ Loadcenter Amp Rating	Branch Circuit ID	Branch Ckt. Bkr. Pole/Amps	Branch Circuit Amps	KVA Load
SB 183	289	ELC SRV TY A 240/480 100(SS)AL (E)SF (U)	2"	3/#2	100	2P/100	100	N/A	Lighting NB	2P/40	26	28.1
									Lighting SB	2P/40	25	
									Underpass	1P/20	15	
NB Access	30	ELC SRV TY D 120/240 060(NS)SS (E)TS (O)	1 1/4"	3/#6	N/A	2P/60		100	Sig. Controller	1P/30	23	5.3
							30		Luminaires	2P/20	9	
									CCTV	1P/20	3	
2nd & Main	58	ELC SRV TY T 120/240 000(NS)GS (N)SP (O)	1 1/4"	3/#6	N/A	N/A	N/A	70	Flashing Beacon 1	1P/20	4	1.0
									Flashing Beacon 2	1P/20	4	

* Example only, not for construction. All new electrical services must have electrical service data chart specific to that service as shown in the plans.

** Verify service conduit size with utility. Size may change due to utility meter requirements. Ensure conduit size meets the National Electrical Code.

EXPLANATION OF ELECTRICAL SERVICE DESCRIPTIVE CODE

ELEC SERV TY X XXX/XXX XXX (XX) XX (X) XX (X)



TOP MOUNTED PHOTOCELL

Install conduit strap maximum 3 feet from box. 5 foot maximum spacing between straps supporting conduit.

Texas Department of Transportation Traffic Operations Division Standard

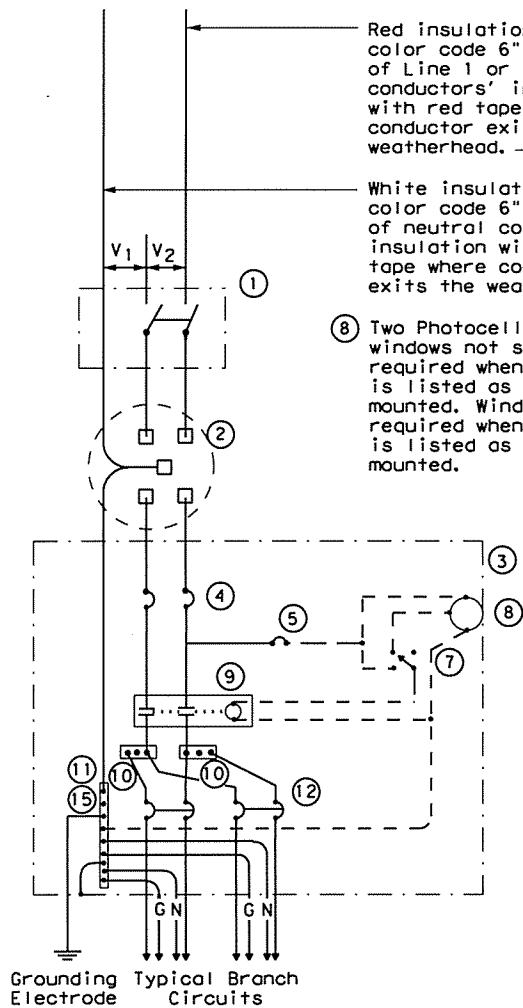
ELECTRICAL DETAILS SERVICE NOTES & DATA

ED(5) - 14

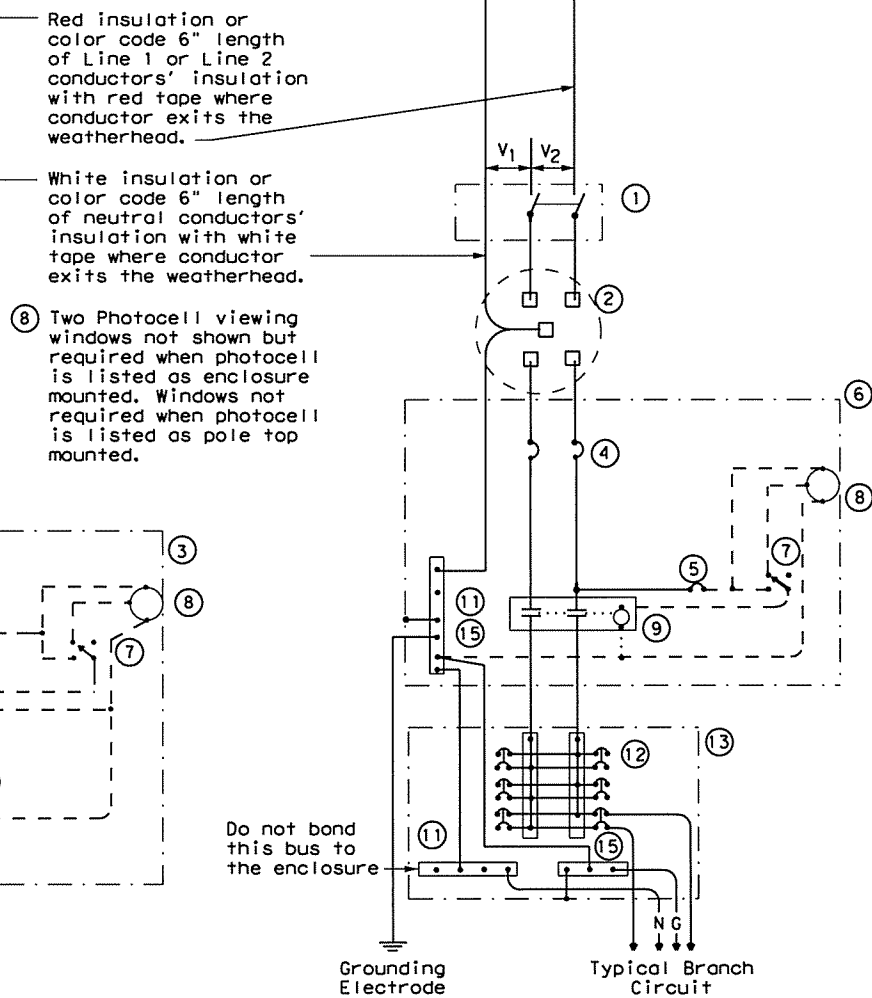
FILE#	ed5-14.dgn	DN#	TxDOT	CK#	TxDOT	DN#	TxDOT	CK#	TxDOT
©	TxDOT	October	2014	CONT	SECT	JOB	HIGHWAY		
REVISIONS		6459	93	001	I-610, etc.				
		DIST	COUNTY	SHEET NO.					
		HOU	HARRIS, etc.		10				

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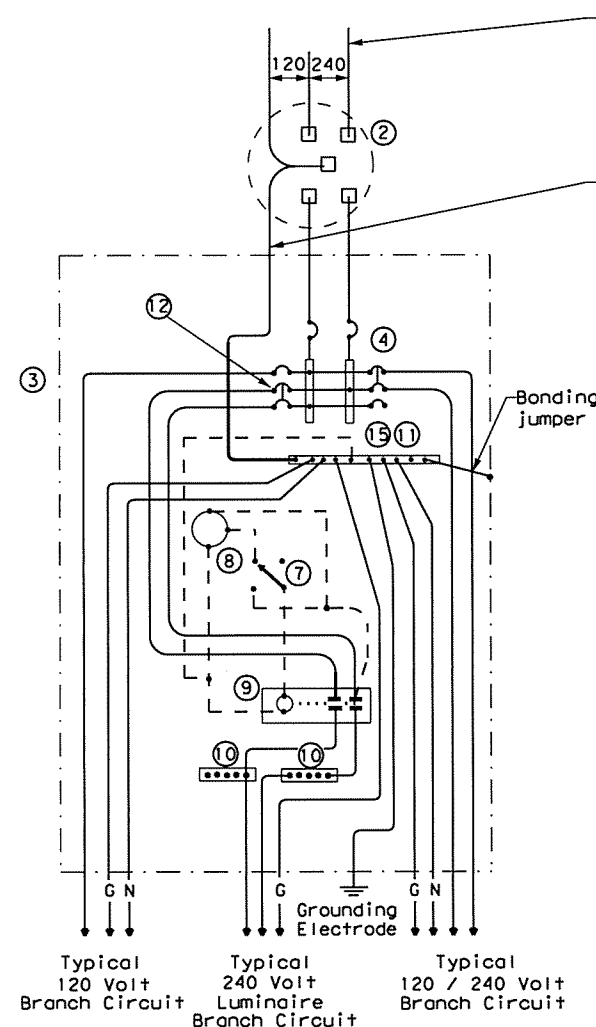
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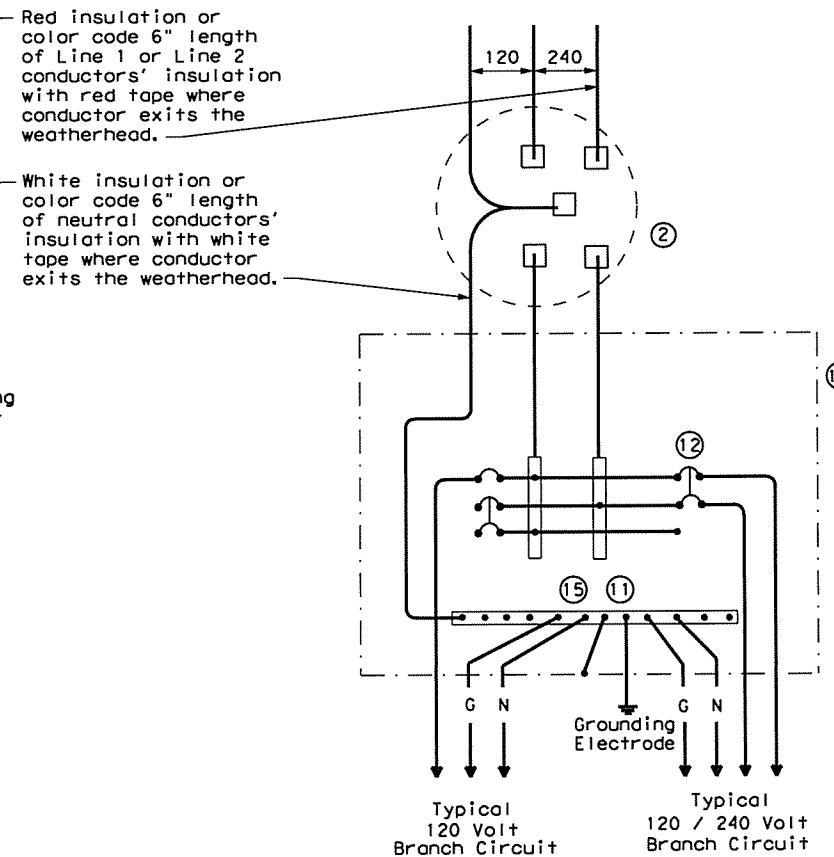
**SCHEMATIC TYPE A
THREE WIRE**



**SCHEMATIC TYPE C
THREE WIRE**



**SCHEMATIC TYPE D - CUSTOM
120/240 VOLTS - THREE WIRE**



**SCHEMATIC TYPE T
120/240 VOLTS - THREE WIRE**
Galvanized steel - "Buy Off The Shelf" only. When required install photocell top of the pole or on luminaire only, no lighting contractor will be installed.

WIRING LEGEND	
————	Power Wiring
-----	Control Wiring
—N—	Neutral Conductor
—G—	Equipment grounding conductor-always required

SCHEMATIC LEGEND	
1	Safety Switch (when required)
2	Meter (when required-verify with electric utility provider)
3	Service Assembly Enclosure
4	Main Disconnect Breaker (See Electrical Service Data)
5	Circuit Breaker, 15 Amp (Control Circuit)
6	Auxiliary Enclosure
7	Control Station ("H-O-A" Switch)
8	Photo Electric Control (enclosure-mounted shown)
9	Lighting Contactor
10	Power Distribution Terminal Blocks
11	Neutral Bus
12	Branch Circuit Breaker (See Electrical Service Data)
13	Separate Circuit Breaker Panelboard
14	Load Center
15	Ground Bus

		Traffic Operations Division Standard	
ELECTRICAL DETAILS SERVICE ENCLOSURE AND NOTES			
ED(6) - 14			
FILE: ed6-14.dgn	DN: TxDOT	CK: TxDOT	DW: TxDOT
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REVISIONS	6459	93	001
	DIST	COUNTY	1-610, etc.
	HOU	HARRIS, etc.	SHEET NO. 11

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SUPPORT TYPE STEEL POLE (SP) AND STEEL FRAME (SF)

1. Provide steel pole and steel frame supports as per TxDOT Departmental Material Specification (DMS) 11080 "Electrical Services." Mount all equipment and conduit on 12 gauge galvanized steel or stainless steel channel strut, 1 1/2 in. or 1 5/8 in. wide by 1 in. up to 3 3/4 in. deep Unistrut, Kindorf, B-line or equal. Bolt or weld all channel and hardware to vertical members as approved. Do not stack channel. File smooth and paint field cut ends of all channel with zinc-rich paint before installing.
2. Provide poles for overhead service with an eyebolt or similar fitting for attachment of the service drop to the pole in conformance with the electric utility provider's specifications.
3. Provide and install galvanized 3/4 in. x 18 in. x 4 in. (dia. x length x hook length) anchor bolts for underground service supports. Provide and install galvanized 3/4 in. x 56 in. x 4 in. anchor bolts for overhead service supports. Ensure anchor bolts have 3 in. of thread, with 3 1/4 in. to 3 1/2 in. of the exposed anchor bolt projecting above finished foundation. Provide and install leveling nuts for all anchor bolts.
4. Bond one of the anchor bolts to the rebar cage with 6 AWG bare stranded copper conductor. Use listed mechanical connectors rated for embedment in concrete. See Inset B.
5. Furnish and install rigid metallic elts in all steel pole and steel frame foundations for all conduits entering the service from underground.
6. Use class C concrete for foundations. Ensure reinforcing steel is Grade 60 with 3" of unobstructed concrete cover.
7. Drill and tap steel poles and frames for 1/2 in. X 13 UNC tank ground fitting. For steel pole service supports, provide and install tank ground fitting 4 in. to 6 in. below electrical service enclosure. Provide properly sized hole through the bottom of the enclosure for the service grounding electrode conductor. Ensure electrical service grounding electrode conductor is as short and straight as possible from the enclosure to the tank ground fitting. For steel frame service supports, provide and install tank ground fitting on steel frame post. Install service grounding electrode conductor in a non-metallic conduit or tubing from the enclosure to the steel frame post. Connect electrical service grounding electrode conductor to the tank ground fitting. See steel frame and steel pole details and Inset A for more information. Size service entrance conduit and branch circuit conduit as shown in the plans. For underground conduit runs from the electrical service, extend RMC from the service enclosure to an RMC elbow, and then connect the schedule type and size of conduit shown in the plans. Provide and install grounding bushings where RMC terminates in the enclosure. Grounding bushings are not required when RMC is fitted into a sealing hub or threaded boss.
8. If Steel pole or frame is painted, bond each separate painted piece with a bonding jumper attached to a topped hole.
9. Provide 1/4" - 20 machine screws for bonding. Do not use sheet metal screws. Remove all non-conductive material at contact points. Terminate bonding jumpers with listed devices. Install minimum size 6 AWG stranded copper bonding jumpers. Make up all threaded bonding connections wrench tight.
10. Avoid contact of the service drop and service entrance conductors with the metal pole to prevent abrasion of the insulated conductors.
11. Shop drawings are not required for service support structure unless specifically stated elsewhere or directed by the Engineer.

White insulation or color code 6" of neutral conductor's insulation with white tape where conductor exits weatherhead.

Red insulation or color code 6" length of Line 1 or Line 2 conductor's insulation with red tape where conductor exits the weatherhead. Conductor slack length, 12" min., 18" max.

2" to 6" 4" (typ.)

RMC

Service Enclosure

Inset A

Channel bracket or other arrangement approved by the Engineer. (Kindorf, Unistrut, B-line or equal.)

Inset B

60" TYP.

2"

Class "C" concrete

RMC

PVC

24 Dia. x 60" depth foundation 4-#5 reinforcing bars and #2 spiral (typ.) at 6" pitch

20' measured from grade. Circumstances may require the electrical service support to be taller than the 20" shown, check with utility before installing.

Point of attachment of service drop to be below weatherhead.

Conduit support spacing, 3' max from the ends, and 5' in between unless otherwise called for by the utility.

Top of weatherhead to be 2" to 6", 4" typical below the top of pole.

White insulation or color code 6" of neutral conductor's insulation with white tape where conductor exits weatherhead.

Red insulation or color code 6" length of Line 1 or Line 2 conductor's insulation with red tape where conductor exits the weatherhead. Conductor slack length, 12" min., 18" max.

Meter

Service Enclosure

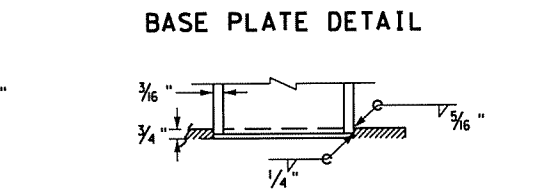
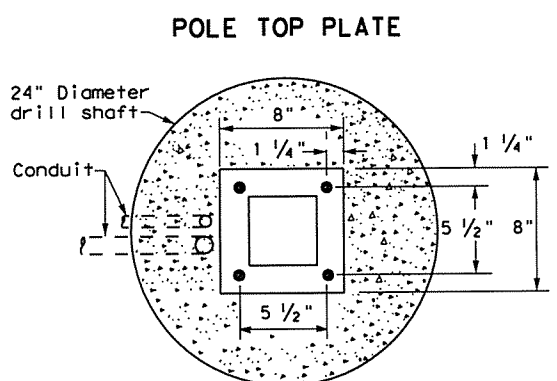
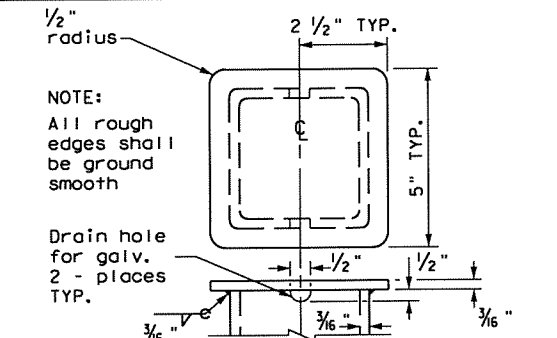
Inset A

Inset B

18" Min.

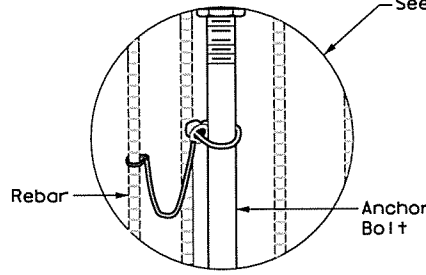
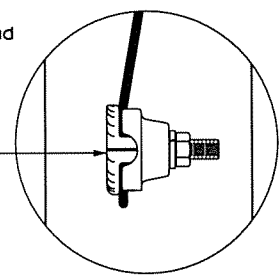
PVC

24 dia. X 60" foundation 4-#5 reinforcing bars and #2 spiral at 6" pitch (typ.)



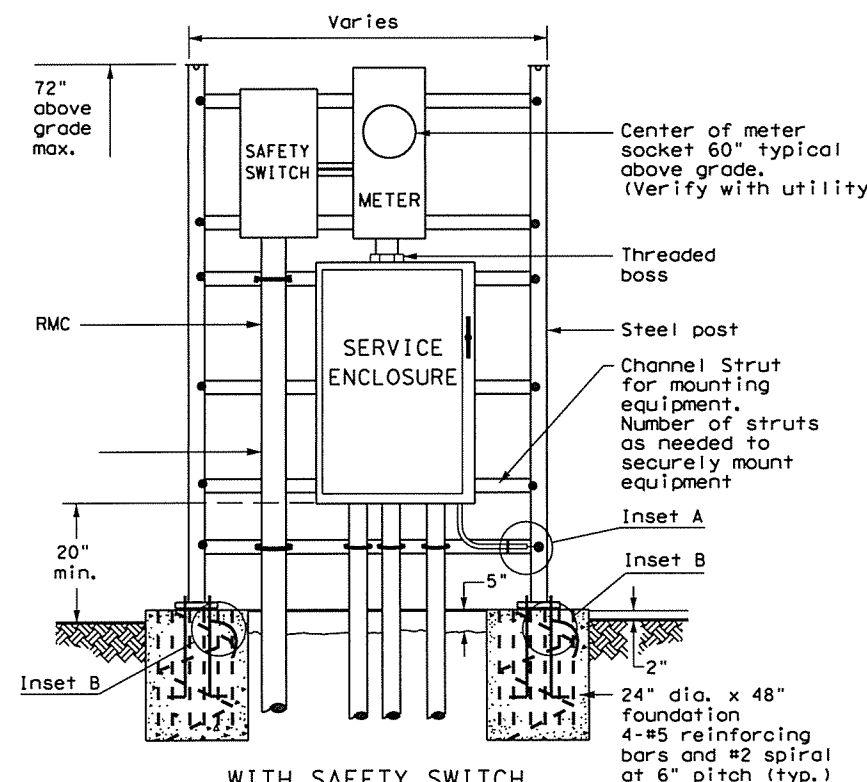
WITH SAFETY SWITCH
WITHOUT SAFETY SWITCH
SERVICE SUPPORT TYPE SP (O) - OVERHEAD SERVICE

Drill, top, and thread 1/2" X 13 UNC. Install tank ground fitting, connect electrical service grounding electrode conductor. See Note 7.

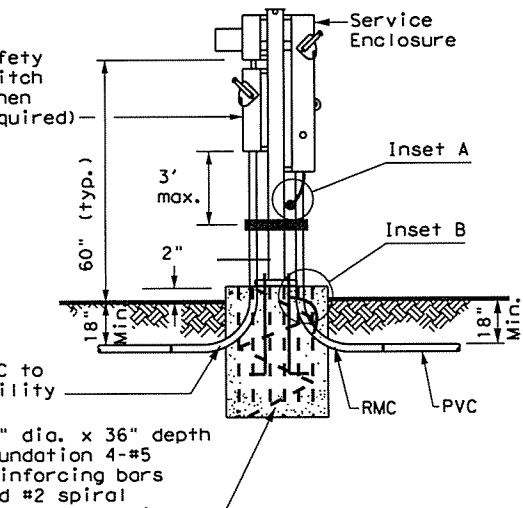
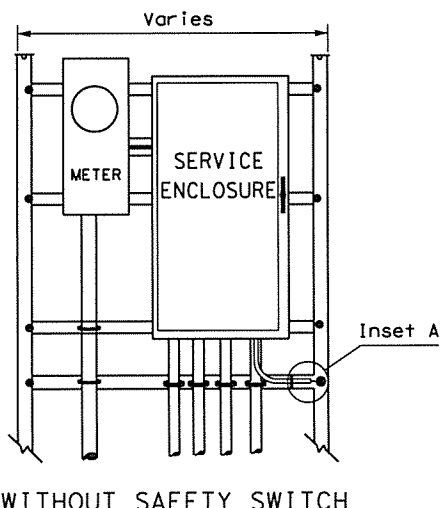


FRONT VIEW
INSET A

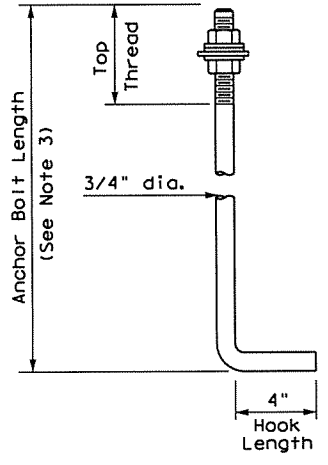
INSET B



WITH SAFETY SWITCH
WITHOUT SAFETY SWITCH
FRONT VIEW
SERVICE SUPPORT TYPE SF (U) - UNDERGROUND SERVICE

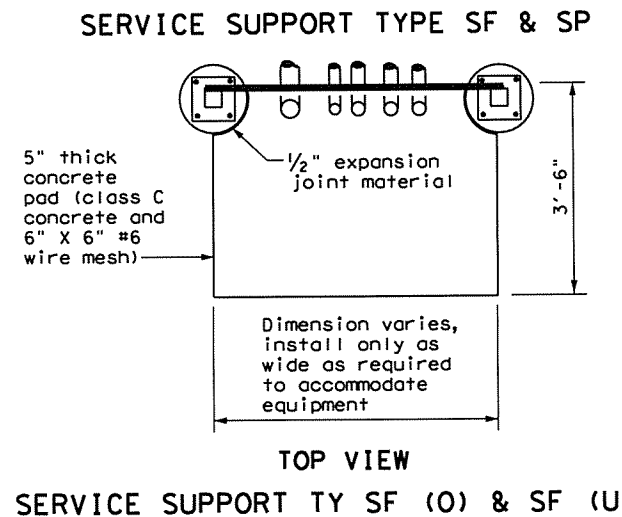


WITH SAFETY SWITCH



HOOKED ANCHOR DETAIL

SERVICE SUPPORT TYPE SP (U) - UNDERGROUND SERVICE



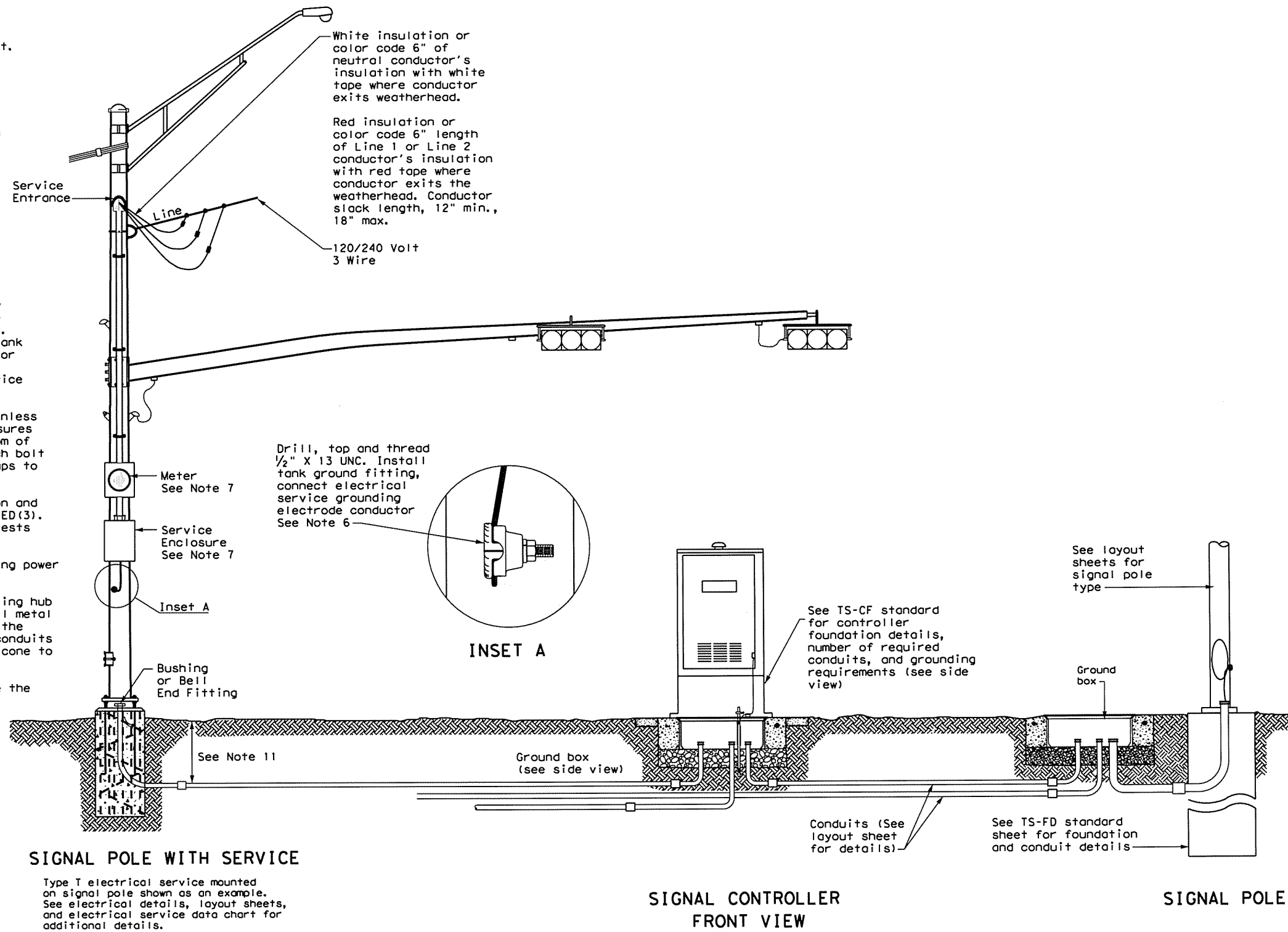
SERVICE SUPPORT TYPE SF (O) & SF (U)

Texas Department of Transportation Traffic Operations Division Standard				
ELECTRICAL DETAILS SERVICE SUPPORT TYPES SF & SP ED(7) - 14				
FILE: ed7-14.dgn	DN: TxDOT	CK: TxDOT	DR: TxDOT	CR: TxDOT
© TxDOT October 2014	CONT: 6459	SECT: 93	JOB: 001	HIGHWAY: I-610, etc.
REVISIONS:	DIST: HOU	COUNTY: HARRIS, etc.	SHEET NO. 12	

TRAFFIC SIGNAL NOTES

1. Do not pass luminaire conductors through the signal controller cabinet.
2. Include an equipment grounding conductor in all conduits throughout the electrical system. Bond all exposed metal parts to the grounding conductor.
3. Provide roadway luminaires, when required, in accordance with the material and construction sections of Item 610, "Roadway Illumination Assemblies," except for performance testing of luminaires. Test installed roadway luminaires for proper operation as a part of the associated traffic signal system test.
4. If internally illuminated street name signs are approved for use, ground the fixture to the pole with a 12 AWG green XHHW conductor.
5. Bond anchor bolts to rebar cage in two locations using #3 bars or 6 AWG stranded copper conductors. Use listed mechanical connectors rated for embedment in concrete. See TXDOT standard TS-FD for further details.
6. Drill and tap signal poles for 1/2 in. X 13 UNC tank ground fitting. Provide and install tank ground fitting 4 in. to 6 in. directly below electrical service enclosure. Provide properly sized hole through the bottom of the enclosure for the service grounding electrode conductor. Connect the electrical service grounding electrode conductor to the tank ground fitting. Ensure electrical service grounding electrode conductor is as short and straight as possible from the enclosure to the tank ground fitting. See Inset A detail for further information. Size service entrance conduit and branch circuit conduit as shown in the plans.
7. Mount electrical service enclosure and meter to signal pole with stainless steel bands. Ensure bands are a minimum width of 3/4 in. Secure enclosures to bands using two-bolt brackets. Install brackets near top and bottom of each enclosure. Install properly sized stainless steel washers on each bolt in the enclosure. Band or drill and tap properly sized stand-off straps to signal pole for attaching conduit.
8. Conduct pull tests and insulation resistance tests on all illumination and power conductors as required in Item 620 "Electrical Conductors" and ED(3). To prevent electronics damage, do not conduct insulation resistance tests on traffic signal cables after termination.
9. Lock all enclosures and bolt down all ground box covers before applying power to the signal installation.
10. Terminate conduits entering the top of enclosures with a conduit-sealing hub or threaded boss such as meter hub. Install a grounding bushing on all metal conduits not connected to conduit-sealing hub or threaded boss. Bond the grounding bushing to the ground bus with a bonding jumper. Seal all conduits entering enclosures with duct seal or expanding foam. Do not use silicone to seal conduit ends.
11. For all conduits, ensure the burial depth is a minimum of 18". Ensure the minimum burial depth for conduit placed under a roadway is 24".

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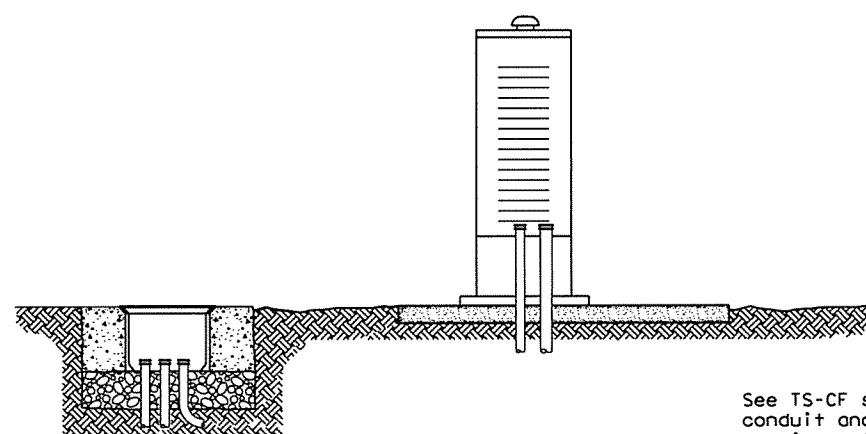


SIGNAL POLE WITH SERVICE

Type T electrical service mounted on signal pole shown as an example. See electrical details, layout sheets, and electrical service data chart for additional details.

SIGNAL CONTROLLER FRONT VIEW

SIGNAL POLE



SIGNAL CONTROLLER SIDE VIEW

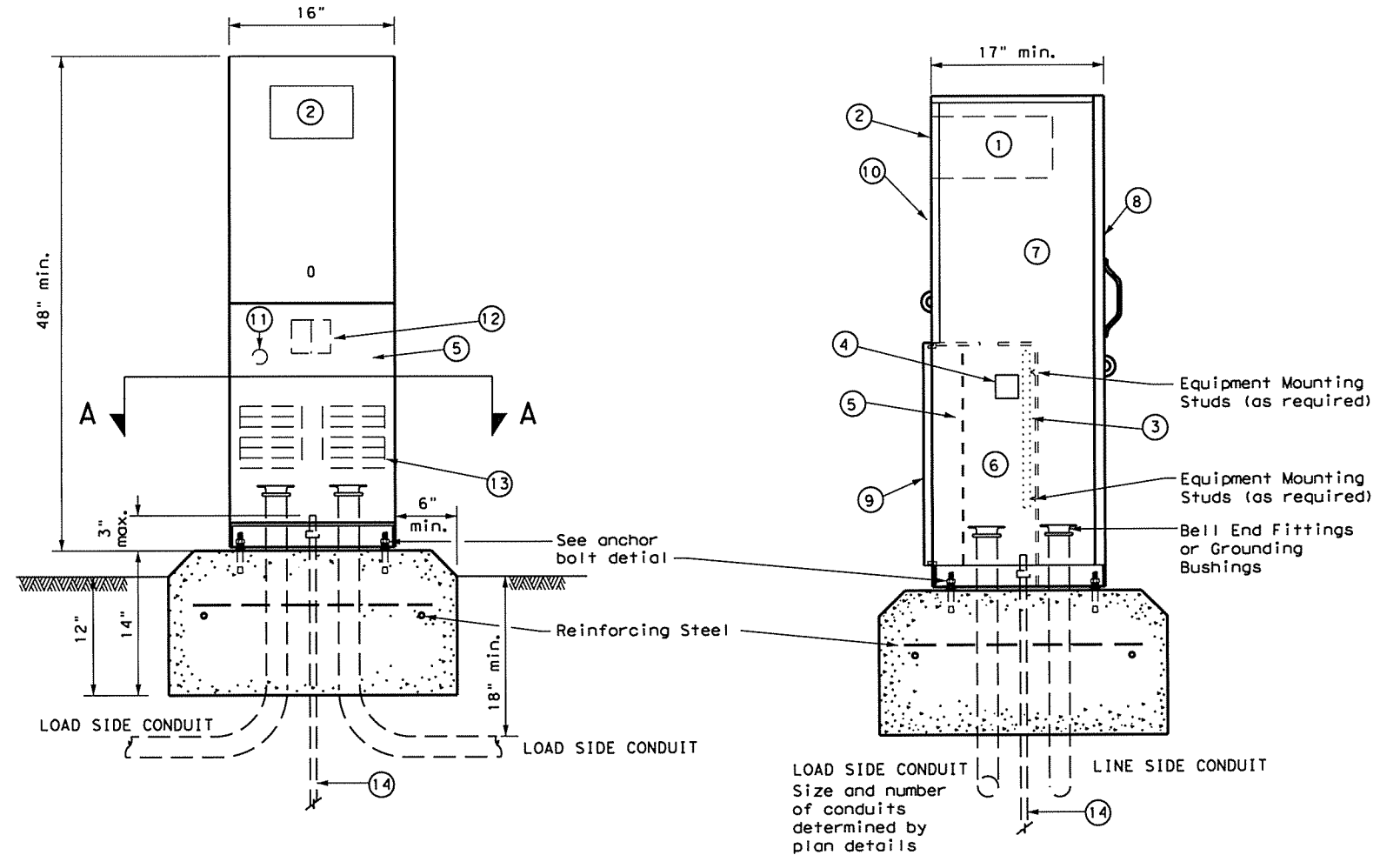
See TS-CF standard for conduit and grounding requirements. See layout sheets for ground box locations and any additional conduits that are required.

		Traffic Operations Division Standard	
ELECTRICAL DETAILS TYPICAL TRAFFIC SIGNAL SYSTEM DETAILS			
ED(8) - 14			
FILE: ed8-14.dgn	DN: TxDOT	CK: TxDOT	DR: TxDOT
© TxDOT October 2014	CONT: 6459	SECT: 93	JOB: 001
REVISTONS	DIST: HOU	COUNTY: HARRIS, etc.	SHEET NO.: 13

DATE: FILE:

PEDESTAL SERVICE NOTES

1. Manufacture pedestal electrical services in accordance with Departmental Material Specifications (DMS) 11080 "Electrical Services", 11085 "Electrical Services-Pedestal (PS)" and Item 628 "Electrical Services." Provide pedestal electrical services as listed on the Material Producers list (MPL) on the Department's web site under "Roadway Illumination and Electrical Supplies," Item 628. Ensure all mounting hardware and installation details of services meet utility company specifications. Contact the local utility company for approval of pedestal details prior to installing the electrical pedestal service. Submit any changes required by the utility company prior to manufacturing the pedestal enclosure.
2. When a meter socket is required, provide a socket with a minimum 100 amp rating that complies with local utility requirements.
3. Provide Class A or C concrete for pedestal service foundations in accordance with Item 420, "Concrete Substructures," except that concrete will not be paid for directly but is considered subsidiary to Item 628.
4. Provide #4 reinforcing steel for foundations in accordance with Item 440, "Reinforcement for Concrete."
5. Install 1/2 in. X 2 1/16 in. minimum length concrete single expansion type anchors for mounting pedestal enclosure to foundation. Anchor location to match mounting holes in each corner of enclosure. Secure each of the four corners of the pedestal enclosure to the anchors in the foundation with a 1/2 in. galvanized or stainless steel machine thread bolt, a properly sized locknut and a flat washer.
6. Finish top of concrete foundation in a neat and workmanlike manner. If leveling washers are used, ensure no more than 1/8 in. gap at any corner. Do not exceed a maximum dip or rise in the foundation of 1/8 in. per foot. When properly installed, ensure the top of the service enclosure is level front to back and side to side within 1/4 in. Repair rocking or movement of the service enclosure at no additional cost to the department.
7. Do not use liquidtight flexible metal conduit (LFMC) on pedestal type services.
8. Ensure all elbows in the foundation are sized as per utility provider's conduit requirements for underground conduit and feeders. PVC extensions may be installed provided the ends of the rigid metal conduits are more than 2 in. below the top of the concrete foundation. Where extension conduits are metal, grounding bushings must be installed with a bonding jumper properly terminated.

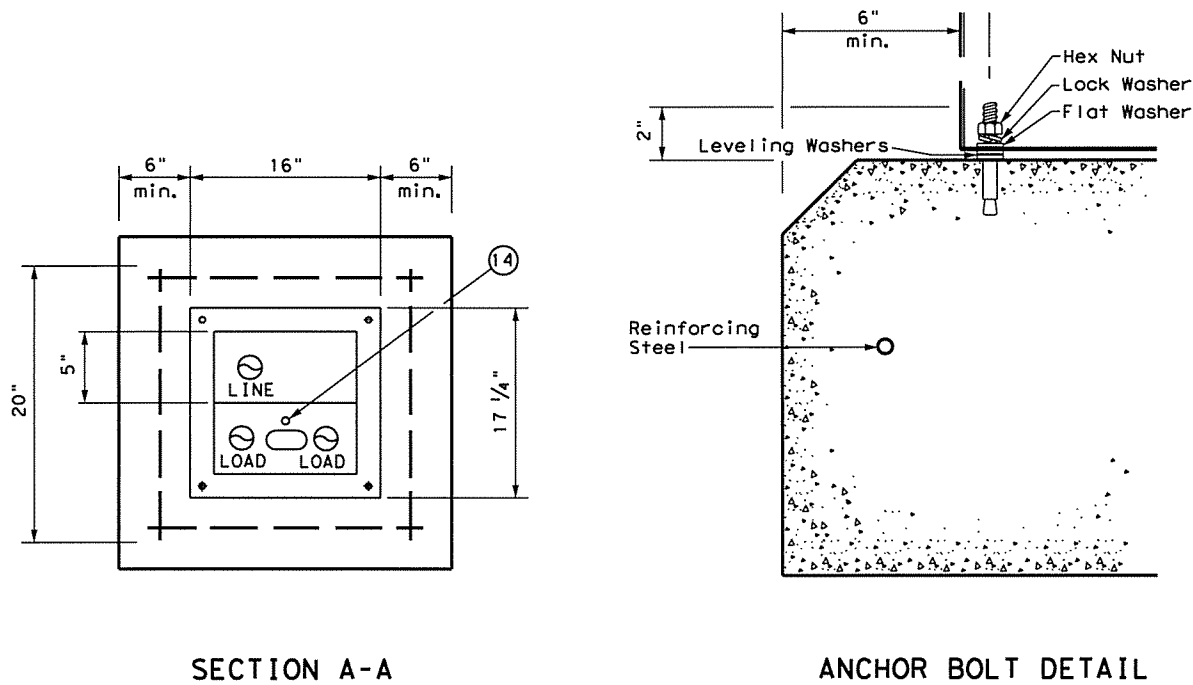


FRONT VIEW

SIDE VIEW

TYPE C shown, TYPE A similar except that TYPE A shall have individual circuit breakers (CB) mounted on an equipment mounting panel. CB Handles shall protrude through hinged deadfront trim.

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SECTION A-A

ANCHOR BOLT DETAIL

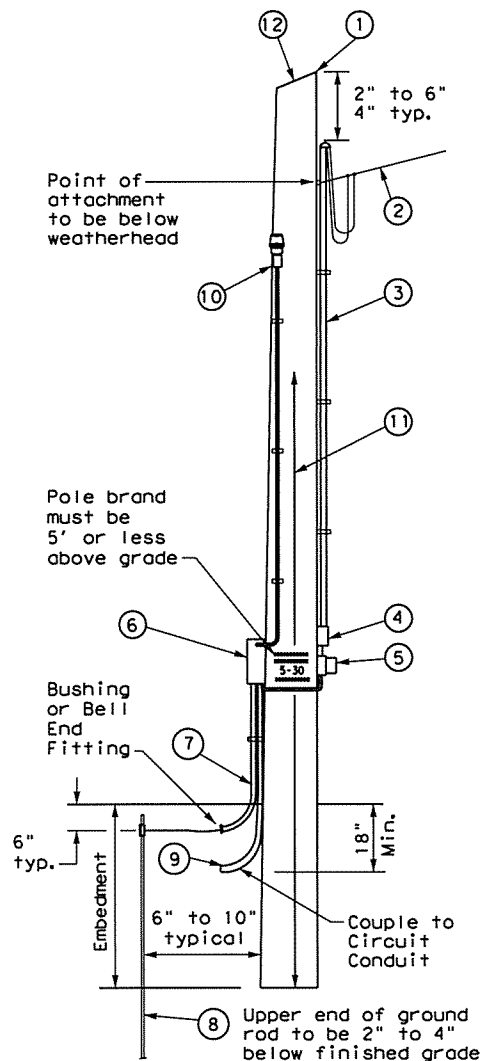
LEGEND	
1	Meter Socket, (when required)
2	Meter Socket Window, (when required)
3	Equipment Mounting Panel
4	Photo Electric Control Window, (When required)
5	Hinged Deadfront Trim
6	Load Side Conduit Trim
7	Line Side Conduit Area
8	Utility Access Door, with handle
9	Pedestal Door
10	Hinged Meter Access
11	Control Station (H-O-A Switch)
12	Main Disconnect
13	Branch Circuit Breakers
14	Copper Clad Ground Rod - 5/8" X 10'

		Traffic Operations Division Standard	
ELECTRICAL DETAILS ELECTRICAL SERVICE SUPPORT PEDESTAL SERVICE TYPE PS			
ED(9) - 14			
FILE: ed9-14.dgn	DN: TxDOT	CK: TxDOT	DW: TxDOT
© TxDOT October 2014	CONT: 6459	SECT: 93	JOB: 001
REVISIONS		HIGHWAY: I-610, etc.	
		DIST: HOU	COUNTY: HARRIS, etc.
		SHEET NO.: 14	

TIMBER POLE (TP) SERVICE SUPPORT NOTES

1. Ensure electrical service support is a class 5 treated timber pole as per Item 627 "Treated Timber Poles." Embed timber pole to depth required in Item 627.
2. Conduit and electrical conductors attached to the electrical service pole and underground within 12 in. of service pole are not paid for directly but are subsidiary to the electrical service.
3. Install pole-top mounted photocell (T) on north side of pole, or in service enclosure (E) as required. See Electrical Service Data chart in plan set.
4. Gain pole as required to provide flat surface for each channel. Gain timber pole to 5/8 in. max. depth and 1 7/8 in. max. height. Gain pole in a neat and workmanlike manner.
5. Mount meter and service equipment on stainless steel or galvanized channel (Unistrut, Kindorf, or equal). Provide channel sized 1 in. to 3 3/4 in. maximum depth, and 1/2 in. to 1 3/8 in. maximum width. File smooth the cut ends of galvanized channel and paint with zinc rich paint before installing on pole. Secure each channel section to timber pole with two galvanized or SS lag bolts, 1/4 in. minimum diameter by 1 1/2 in. minimum length. Use a galvanized or SS flat washer on each lag bolt. Do not stack channel.
6. When excess length must be trimmed from poles, trim from the top end only.

- ① Class 5 pole, height as required
- ② Service drop from utility company (attached below weatherhead)
- ③ Service conduit (RMC) and service entrance conductors - One Red, One Black, One White (See Electrical Service Data)
- ④ Safety switch (when required)
- ⑤ Meter (when required)
- ⑥ Service enclosure
- ⑦ 6 AWG bare grounding electrode conductor in 1/2 in. PVC to ground rod - extend 1/2 in. PVC 6 in. underground.
- ⑧ 5/8 in. x 8 ft. Copper clad ground rod - drive ground rod to a depth of 2 in. to 4 in. below grade.
- ⑨ RMC same size as branch circuit conduit.
- ⑩ See pole-top mounted photocell detail on ED(5).
- ⑪ When required by the serving utility provide bare 6 AWG copper conductor. Run wire from pole top to butt wrap or copper butt plate. Protect conductor with non-conductive material to a height of 8 ft. above finished grade.
- ⑫ When required by utility, cut top of pole at an angle to enhance rain run off.

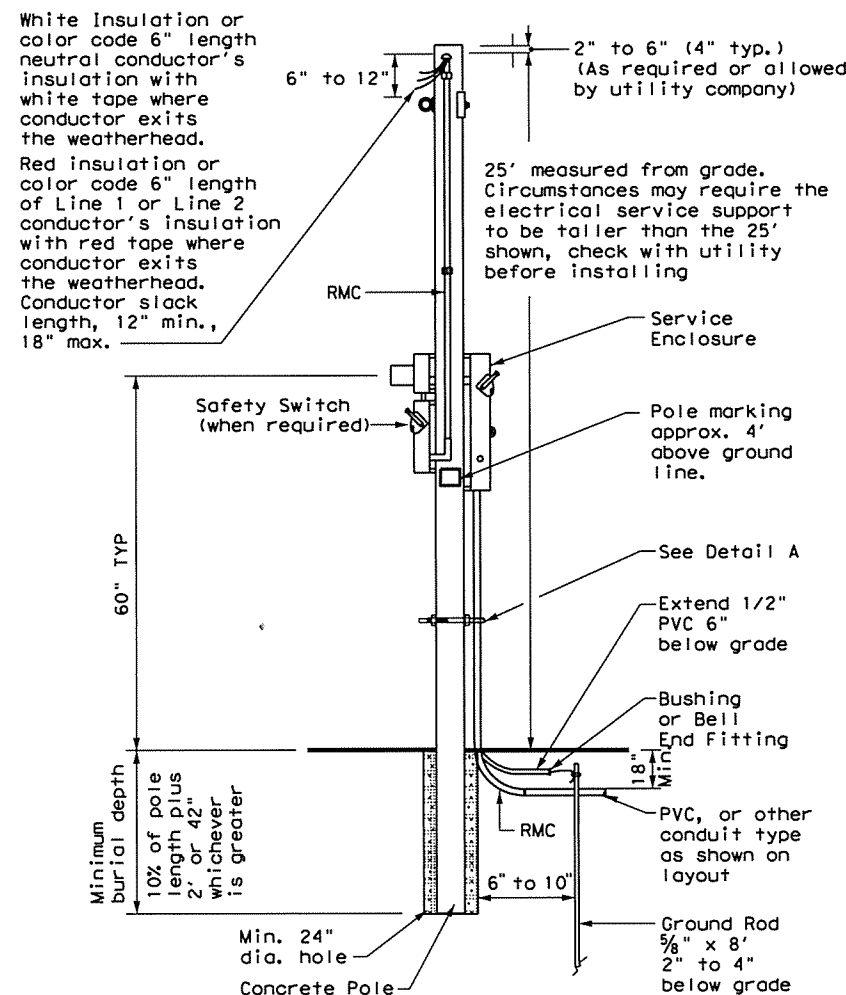


SERVICE SUPPORT TYPE TP (O)

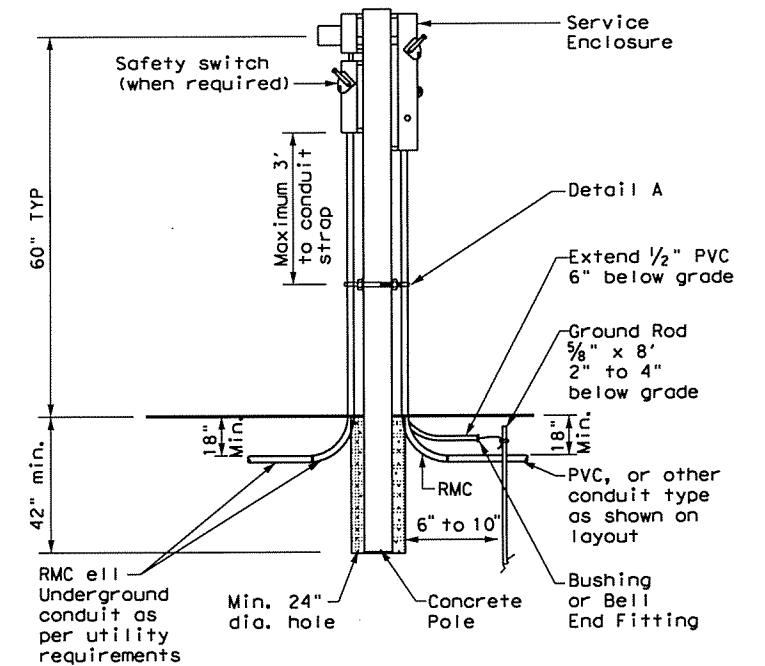
GRANITE CONCRETE (GC) & OTHER CONCRETE (OC) NOTES

Ensure electrical service support structures bid as type Granite Concrete (GC) or Other Concrete (OC) meet the following requirements.

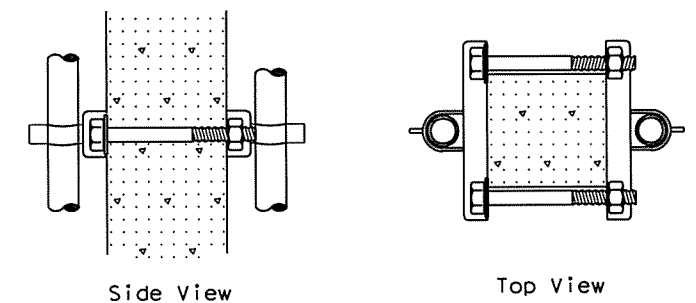
1. Provide GC and OC poles that meet the requirements of DMS 11080 "Electrical Services."
2. Provide prestressed concrete poles suitable for direct embedment into the ground without special foundations.
3. Verify poles are marked as required on DMS 11080. Location of marking should be approximately 4' above final grade. Use the two-point pickup locations when handling pole in horizontal position, and one-point pickup location for use in raising the pole to a vertical position. These marks are small but conspicuous.
4. Embed poles 42 in. or 10% of the length plus 2 ft., whichever is greater.
5. Ensure all installation details of services are in accordance with utility company specifications.
6. Install a one point rack or eye bolt bracket 6 inches to 12 inches below the weatherhead as an overhead service drop anchoring point for the electric utility.
7. Furnish and install galvanized or stainless steel channel strut 1 1/2 in. or 1 5/8 in. wide by 1 in. up to 3 3/4 in. deep (Unistrut, Kindorf, B-line or equal). Attach channel strut with stainless steel concrete anchors (max. 1" depth), square U-bolts or back to back channel strut with long bolts, or other secure mounting as approved by the Engineer. Ensure bolts are galvanized in accordance with ASTM A153. Do not stack channel struts.
8. Backfill the holes thoroughly by tamping in 6 in. lifts. After tamping to grade, place additional backfill material in a 6 inch high cone around the pole to allow for settling. Use material equal in composition and density to the surrounding area. Backfilling will not be paid for directly but is subsidiary to various bid items.



CONCRETE SERVICE SUPPORT Overhead (O)



CONCRETE SERVICE SUPPORT Underground (U)



DETAIL A

See Note 7. Before installing channel that has been cut, file sharp edges and paint with zinc-rich paint. Ensure there is no paint splatter on the pole.

		Traffic Operations Division Standard	
ELECTRICAL DETAILS SERVICE SUPPORT TYPES GC, OC, & TP			
ED(10) - 14			
FILE: ed10-14.dgn	DN: TxDOT	CK: TxDOT	DR: TxDOT
© TxDOT October 2014	CONT: 6459	SECT: 93	JOB: 001
REVISIONS	COUNTY		HIGHWAY
	HOU		1-610, etc.
	HARRIS, etc.		SHEET NO. 15

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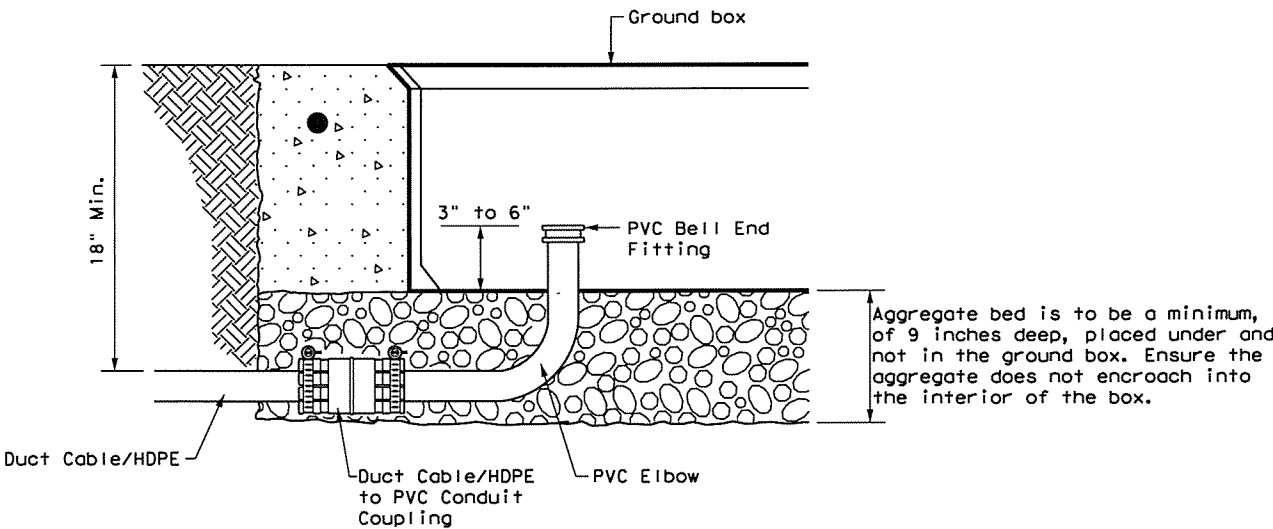
DATE: FILE:

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DATE: FILE:

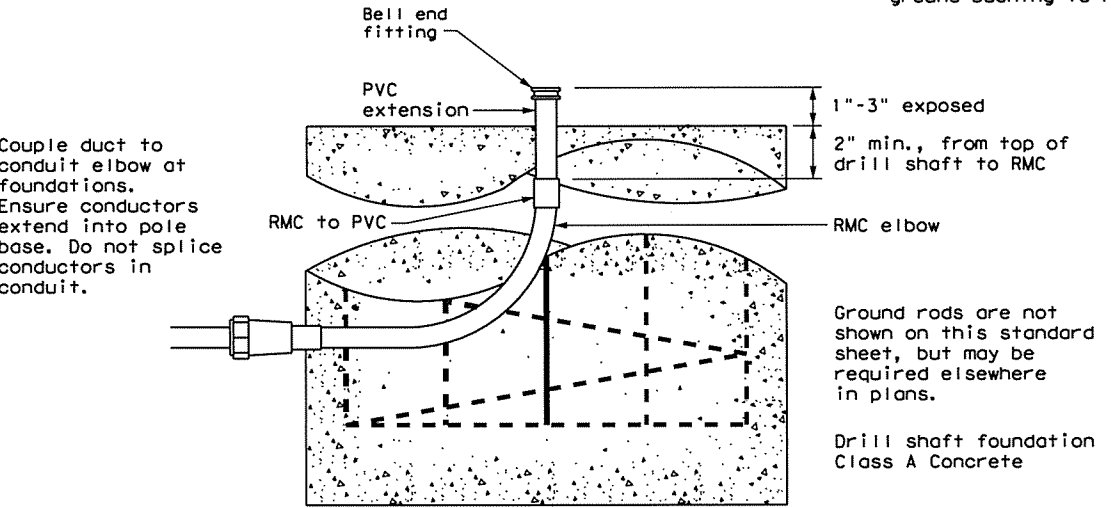
DUCT CABLE & HDPE CONDUIT NOTES

1. Provide duct cable in accordance with Departmental Material Specification (DMS) 11060 "Duct Cable" and Item 622 "Duct Cable." Provide duct cable as listed on the Material Producer List (MPL) on the Department web site under "Roadway Illumination and Electrical Supplies" Item 622.
2. Provide High-Density Polyethylene (HDPE) conduit in accordance with DMS 11060 and Item 618, "Conduit." Provide HDPE as listed on the MPL on the Department web site under "Roadway Illumination and Electrical Supplies," Item 618.
3. Supply duct cable with a minimum 2 in. diameter, unless otherwise shown in the plans. Provide duct cable and HDPE conduit as shown by descriptive code or on the plans. Bend duct cable and HDPE conduit as recommended by the manufacturer, with a minimum bending radius of 26 in. for 2 in. duct. Follow manufacturers' recommendations when handling duct cable and HDPE conduit reels and during installation of duct cable and HDPE conduit.
4. Do not splice conductors within duct cable or HDPE conduit. Couple duct cable and HDPE entering a ground box or foundation to a PVC elbow. When galvanized steel RMC elbows are called for in the plans and any portion of the RMC elbow is buried less than 18" from possible contact, ground the RMC elbow.
5. Furnish and install duct cable with factory installed conductors, sized as shown in the plans and as required by the National Electrical Code (NEC). The NEC contains specific requirements for duct cable in Article, "Nonmetallic Underground Conduit with Conductors: Type NUCC."
6. When conduit casing is called for in the plans, extend duct cable or HDPE conduit through the conduit casing in one continuous length without connection to the casing.
7. Seal the ends of duct cable or HDPE conduit with duct seal, expandable foam, or other approved method after completing the pull tests required by Item 622.
8. Provide minimum cover of 24 in. under roadways, 18 in. in other locations, or as shown on the plans.
9. Furnish and install listed fittings to couple duct cable or HDPE conduit to other types of conduit. Duct cable and HDPE conduit may be field-threaded and spliced with PVC or RMC threaded couplings; connected with listed tie-wrap fittings; connected using listed coupling made of HDPE with stainless steel external banding clamps and locking rings; connected with approved electrofusion conduit couplings; or connected using an approved chemical fusion method using an epoxy or adhesive specifically designed for HDPE couplings and connectors all installed in accordance with their manufacturer's instructions. Do not use PVC glue on HDPE. Do not use water pipe fittings, or connect conduit with heat shrink tubing.

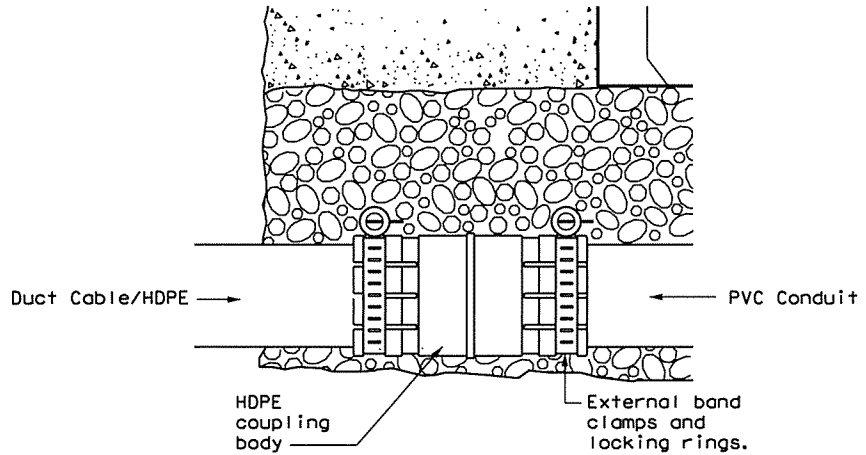


DUCT CABLE/HDPE AT GROUND BOX

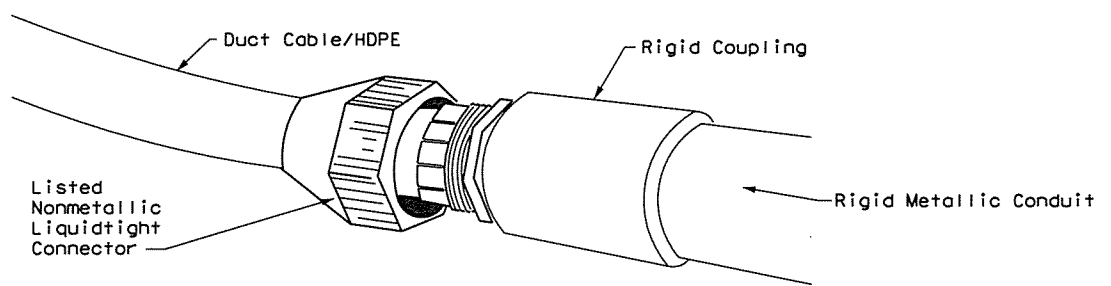
When the upper end of an RMC Ell does not enter the ground box, it may be extended with a SCH-40 PVC conduit nipple and bell end, provided there is a minimum of 18" of cover over all parts of the elbow. If not, a rigid extension and ground bushing is required.



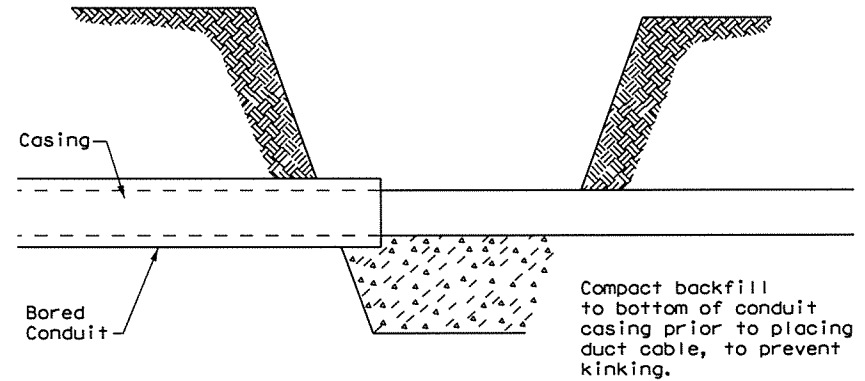
DUCT CABLE / HDPE AT FOUNDATION



DUCT CABLE/HDPE TO PVC



DUCT CABLE/HDPE TO RMC



BORE PIT DETAIL

		Traffic Operations Division Standard	
ELECTRICAL DETAILS DUCT CABLE/ HDPE CONDUIT			
ED(11)-14			
FILE: ed11-14.dgn	DN: TxDOT	CK: TxDOT	DR: TxDOT
© TxDOT October 2014	CONT: 6459	SECT: 93	JOB: 001
REVISIONS:	DIST: HOU	COUNTY: HARRIS, etc.	SHEET NO.: 16

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BATTERY BOX GROUND BOXES NOTES

A. MATERIALS

1. Provide polymer concrete or fiberglass reinforced plastic (FRP) battery box ground box and cover in accordance with Departmental Material Specification (DMS) 11071 "Battery Box Ground Boxes." Battery box will accommodate up to 4 batteries, each measuring 8 in. x 13.5 in. x 10 in. (W x L x D). Label battery box ground box cover in accordance with DMS 11071.

2. Supply a marine grade batteries with covers. Secure the marine grade batteries with covers to the stainless steel rack in the bottom of the ground box with tie down straps.

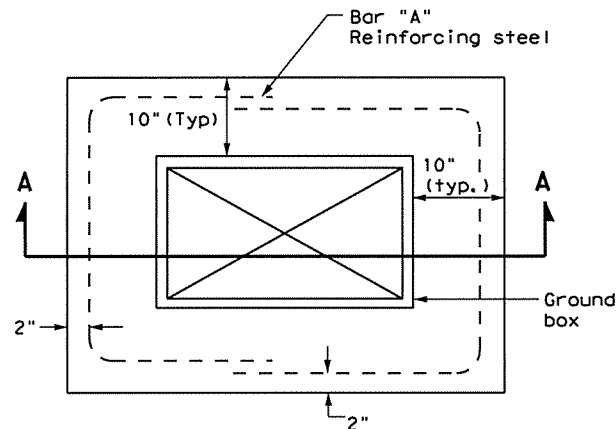
B. CONSTRUCTION METHODS

1. Ensure conduit entry will not interfere with placement of the batteries in the battery box ground box.

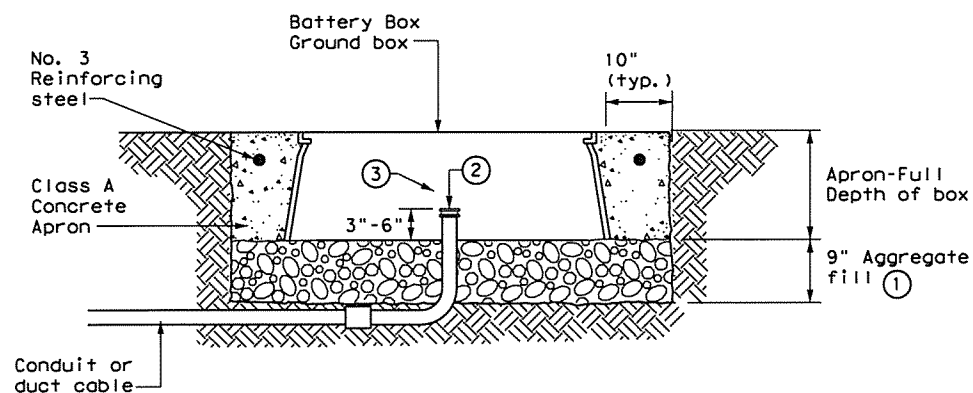
2. Remove all gravel and dirt from conduit. Cap all conduits prior to placing aggregate and setting battery box ground box. Provide Grade 3 or 4 coarse aggregate as shown on Table 2 of Item 302 "Aggregates for Surface Treatments." Ensure the aggregate bed is in place and is a minimum of 9 in. deep prior to setting the box. Install battery box ground box on top of aggregate.

3. Cast battery box aprons in place. Reinforcing steel may be field bent. Ensure the depth of concrete for the apron extends from finished grade to the top of the aggregate bed under the box. Battery box ground box aprons, including concrete and reinforcing steel, are subsidiary to battery box ground boxes when called for by descriptive code.

4. Bolt covers down when not working in battery box ground boxes. Keep bolt holes in the box clear of dirt.

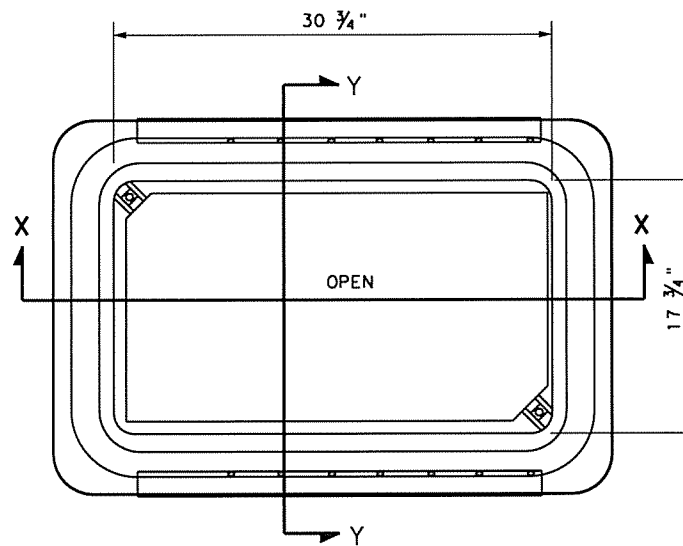


PLAN VIEW

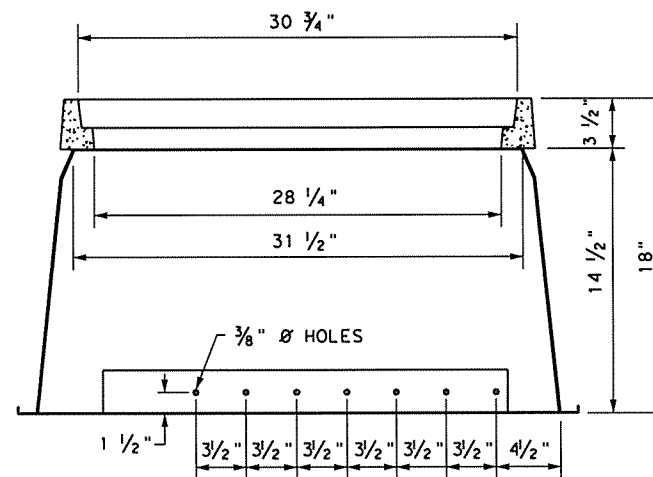


**SECTION A - A
APRON FOR BATTERY BOX GROUND BOXES**

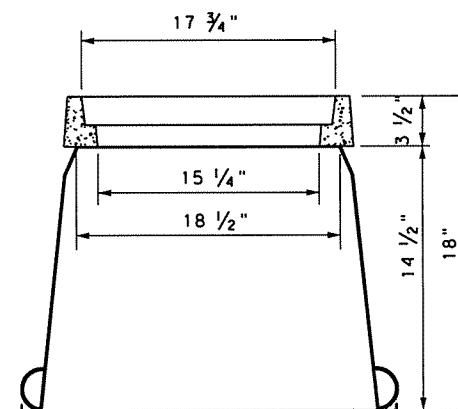
- ①
- ②
- ③



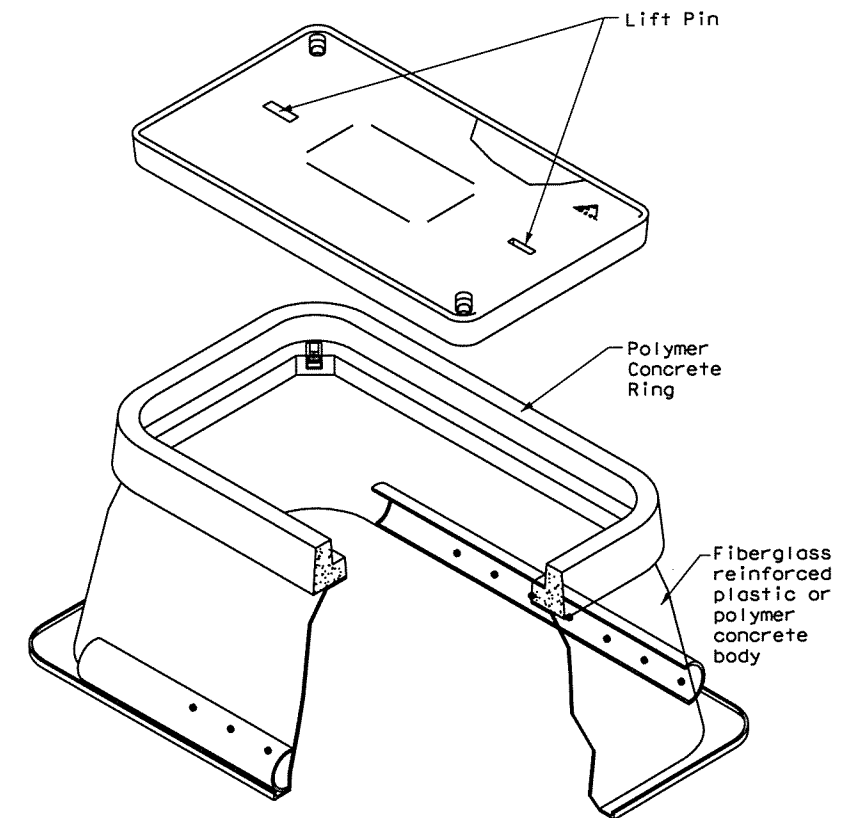
BATTERY BOX TOP VIEW



SECTION X-X



SECTION Y-Y



		Traffic Operations Division Standard	
ELECTRICAL DETAILS BATTERY BOX GROUND BOXES			
ED(12)-14			
FILE: ed12-14.dgn	DN: TxDOT	CK: TxDOT	OW: TxDOT
© TxDOT October 2014	CONT	SECT	JOB
REVISIONS	6459	93	001
	DIST	COUNTY	SHEET NO.
	HOU	HARRIS, etc.	17

DATE: FILE:

ROADWAY ILLUMINATION ASSEMBLY NOTES

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- Details apply to roadway lighting installations bid or referenced under Item 610, "Roadway Illumination Assemblies." Provide, furnish, and install all other materials not shown on the plans which may be necessary for complete and proper construction. Where manufacturers provide warranties or guarantees as a customary trade practice, furnish to the State such warranties or guarantees.
- The locations of poles and fixtures may be shifted by the Engineer to accommodate local conditions. Install or remove poles and luminaires located near overhead electrical lines using established industry and utility safety practices and in accordance with laws governing such work. Consult with the appropriate utility company prior to beginning such work.
- Provide new and unused materials. Ensure that all materials and installations comply with the applicable articles of the National Electrical Code (NEC), TxDOT standards and specifications, National Electrical Manufacturers Association (NEMA), and are listed by Underwriters Laboratories (UL) or a Nationally Recognized Testing Lab (NRTL). NRTLs such as Canadian Standard Association, Intertek Testing Services NA Inc., or FM Approvals LLC can be considered equivalent to UL. Faulty fabrication or poor workmanship in any material, equipment, or installation is justification for rejection.
- Provide Roadway Illumination Light Fixtures as per TxDOT Departmental Material Specification (DMS) 11010, Item 610, and as shown on the Material Producers List (MPL) for Roadway Illumination and Electrical Supplies.
- Fabricate steel roadway illumination poles in accordance with Roadway Illumination Poles (RIP) standards and Item 610. Poles fabricated according to RIP standards do not require shop drawing submittals.
 - Alternate designs to RIP standards or the use of aluminum to fabricate poles will require the submission of shop drawings electronically. For instructions on submitting shop drawings electronically see "Guide to Electronic Shop Drawing Submittal" on the TxDOT web site.
 - Limitations on use of the RIP standard: The RIP standard details were developed for installations in locations where the 3-second gust basic maximum wind speed is 110 mph, and where the elevation of the base of the pole is less than (i.e. not more than) 25' above the elevation of the surrounding terrain, in accordance with the "AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals," 6th Edition (2013) of the AASHTO Design Specifications. For poles to be installed in regions where the maximum basic wind speed exceeds 110 mph or to be mounted more than 25' above the surrounding terrain, provide poles meeting the following requirements:
 - Submittals. Following the electronic shop drawing submittal process (see Guide to Electronic Shop Drawing Submittal on the TxDOT web site), submit to the Engineer for approval fabrication drawings and calculations for the poles, sealed by a Texas licensed professional engineer (P.E.).
 - Luminaire Structural Support Requirements. Provide light poles, arms, and anchor bolt assemblies with a 25 year design life to safely resist dead loads, ice loads and the required basic wind speeds at the location of installation in accordance with the 6th edition (2013) of the AASHTO Design Specifications. For transformer base poles, include transformer base and connecting hardware in calculations and shop drawing submittals. Structurally test all transformer bases to resist the theoretical plastic moment capacity of the pole. Submit certification of the plastic moment load test and FHWA breakaway requirement test of the model of base being furnished with the shop drawings. Show breakaway base model number, manufacturer's name, and logo on shop drawings. Include on manufacturer's shop drawings the ASTM designations for all materials to be used.
- For both transformer and shoe-base type illumination poles, provide and install double-pole breakaway fuse holders as specified by DMS-11040. Breakaway fuse holders are listed on the MPL for Roadway Illumination and Electrical Supplies under Items 610 & 620. Provide 10 amp time delay fuses for breakaway connectors in light poles, or inside the light fixture for underpass luminaires. In each pole, connect luminaires to the breakaway connector with continuous stranded 12 AWG copper conductors as listed on the MPL. Bond all equipment grounding conductors together and to the ground lug in the transformer base or hand hole.
- Tighten anchor bolts for shoe base, concrete traffic barrier base, and bridge mount roadway illumination poles, in accordance with Item 449.
- Install T-Base with following procedure:
 - Anchor Bolt Tightening.
 - Coat the threads of the anchor bolts with electrically conductive lubricant.
 - Place the T-base over the anchor bolts. Foundation must be level and flat. The maximum permissible gap under any one corner of the t-base is 1/8" before nuts are tightened.
 - Coat the bearing surfaces of the nuts and washers with electrically conductive lubricant. Install (1) 1/2" hold down washer, (1) lock washer, and (1) nut on each anchor bolt. Turn the nuts onto the bolts so that each is hand-tight against the washer.
 - Using a torque wrench, tighten each nut to 150 ft-lb. Uniform contact is required between the foundation and the T-base in the corner regions of the T-base, and all corner gaps must be closed after applying torque. If a gap still exists after torquing to 150 ft-lbs, continue torquing each bolt incrementally until gap is closed or maximum allowable torque of 250 ft. pound is reached, whichever comes first. If 250 ft-lbs is not enough to close the gap the foundation must be leveled. Gaps along the straight sides of the T-bases and the foundation are permissible. Ensure that no high point of contact occurs between the straight sides of the T-base and the foundation.
 - Check top of T-base for level. If not level then foundation must be leveled.
 - Top Bolt Procedure
 - Erect pole over T-base with crane. Coat bolts, nuts, washers, and lock washers with electrically conductive lubricant.

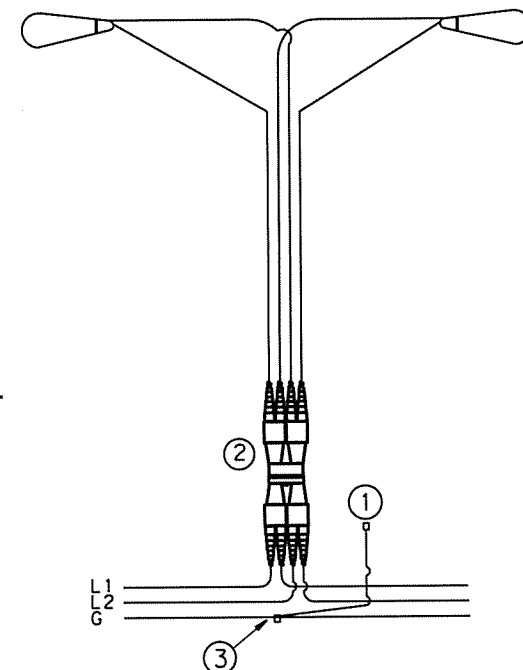
- Install bolts and 1/2" connecting washers from the inside of the T-base, thread up through the pole base. Install flat washers, lock washers and nuts snug tight according to Item 447, "Structural Bolting."
 - Tighten each nut to 150 ft-lb. using a torque wrench.
- c. Level and Plumb
- Ensure pole is plumb and mast arm is perpendicular to the roadway according to plans to within 5 degrees.
- Construct luminaire pole foundations in accordance with Item 416, "Drilled Shaft Foundations," and TxDOT standard sheet RID(2).
 - Provide and install underpass luminaires in accordance with Item 610, DMS-11010, and TxDOT standard sheet RID(3). Typical luminaire size for underpass luminaires is 150W HPS or 150W EQ LED.
 - Mount luminaires on arms level as shown by the luminaire level indicator.
 - Orient luminaires perpendicular to the roadway intended to be lit unless otherwise shown on the plans.

Wiring Diagram Notes:

- Use 1/2 in. -13 UNC threaded, copper or tin-plated copper, pole bonding connector, sized appropriately for conductors, bonded to T-base, or use ground lug in handhole as available.
- Use pre-qualified two-pole breakaway connectors for all luminaire pole installations. For luminaires fed by a circuit with a neutral conductor, use double pole breakaway connectors with the neutral side unfused and marked white.
- Split Bolt or other connector.

Decorative LED Lighting Notes:

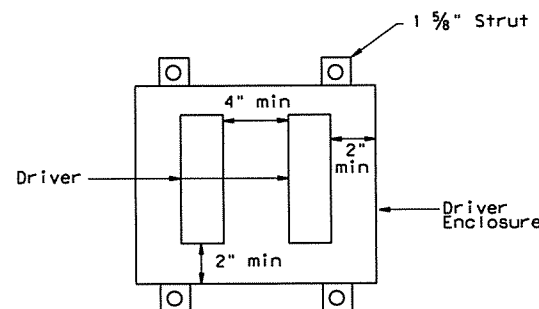
- LED Drivers in Remote Outdoor enclosures (for drivers that do not include an enclosure as part of a factory assembly):
 - Provide NEMA 3R outdoor enclosure or as approved.
 - Install enclosure at least 12" above ground or other horizontal surface. Mount vertically or on ceiling, and avoid direct sun where possible.
 - Install drivers with at least 2 inches of space from enclosure walls.
 - For multiple drivers in an enclosure, provide at least 4 inches side to side and 1 inch end to end from other drivers or electronic equipment
 - For drivers mounted on back wall of enclosure, mount enclosure on 1 5/8" strut or other standoff to dissipate heat, or mount driver to side of the enclosure or to the metal cover.
 - Provide remote drivers with a maximum of 100 watts
 - Provide drivers with documentation of 100,000 hr lifetime at Tcase of 65C or higher.



L1, L2 = Hot Conductors
G = Grounding Conductor

TYPICAL WIRING DIAGRAM

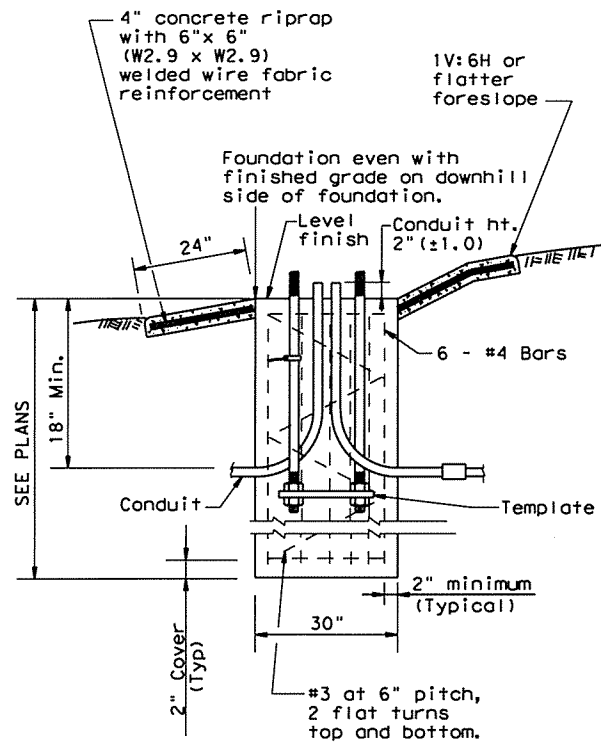
LUMINAIRES SERVED AT 480V ON 240/480 VOLT SERVICE OR LUMINAIRES SERVED AT 240V FOR 120/240 VOLT SERVICE.



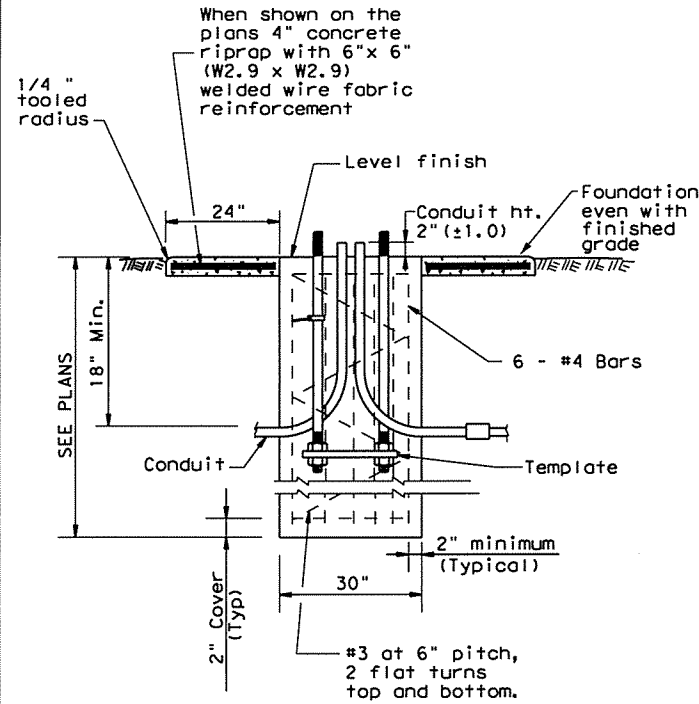
Driver Spacing In Remote Enclosure

				Traffic Safety Division Standard	
<h1>ROADWAY ILLUMINATION DETAILS</h1> <h2>RID(1)-20</h2>					
FILES:	rid1-20.dgn	DN:	CK:	DN:	CK:
© TxDOT	January 2007	CONT	SECT	JOB	HIGHWAY
REVISIONS		6459	93	001	1-610, etc.
7-17		DIST	COUNTY		SHEET NO.
12-20		HOU	HARRIS, etc.		18

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SECTION A-A
SHOWING SLOPED GRADE



SECTION A-A
SHOWING CONSTANT GRADE

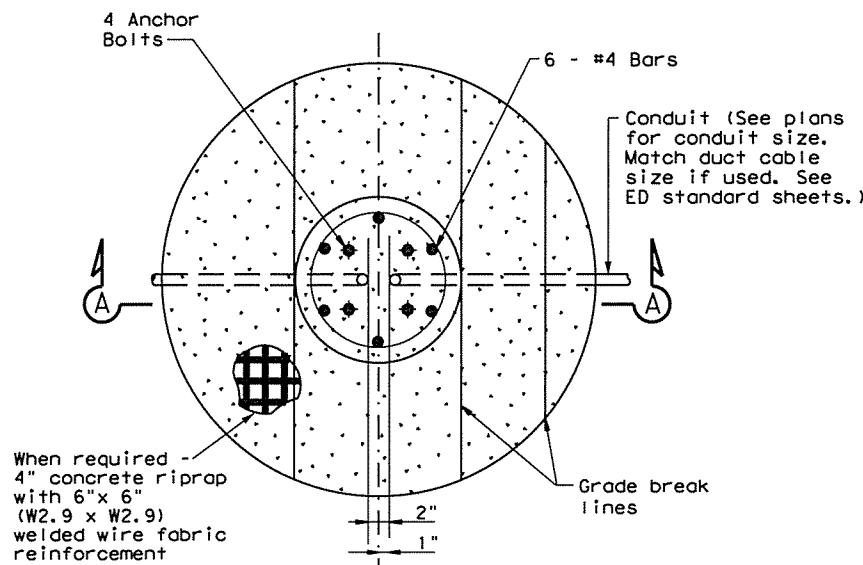
TABLE 1			
ANCHOR BOLTS			
POLE MOUNTING HEIGHT	BOLT CIRCLE		ANCHOR BOLT SIZE
	Shoe Base	T-Base	
<40 ft.	13 in.	14 in.	1 in. x 30 in.
40-50 ft.	15 in.	17 1/4 in.	1 1/4 in. x 30 in.

TABLE 2			
RECOMMENDED FOUNDATION LENGTHS (See note 1)			
MOUNTING HEIGHT	TEXAS CONE PENETROMETER N Blows/ft		
	10	15	40
<20 ft.	6'	6'	6'
>20 ft. to 30 ft.	8'	6'	6'
>30 ft. to 40 ft.	8'	8'	6'
>40 ft. to 50 ft.	10'	8'	6'

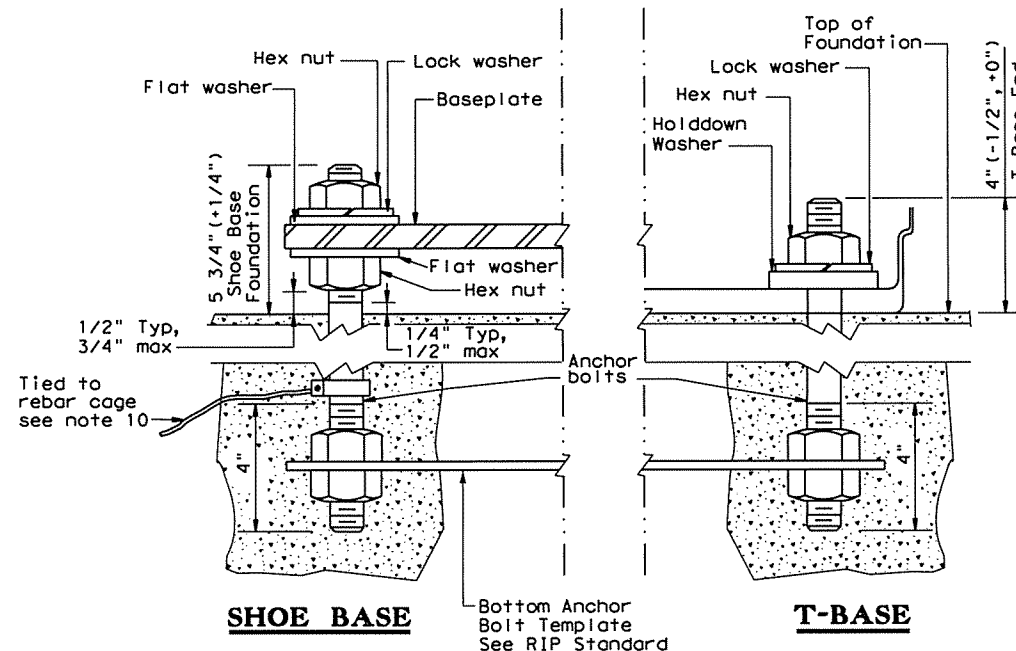
TABLE 3		
PAY QUANTITY OF RIPRAP PER FOUNDATION (Install only when shown on the plans)		
Foundation Diameter	RIPRAP DIAMETER	RIPRAP (CONC) (CL B)
30 in.	78 in.	0.35 CY

GENERAL NOTES:

- "Recommended Foundation Lengths" table is for information purposes only. Foundation lengths shall be as shown on the plans, or as directed by the Engineer. Foundations will be paid for under Item 416, "Drilled Shaft Foundations," unless otherwise shown on the plans.
- Erect roadway illumination assembly poles plumb and true. Form and level the top 6" of the foundation so the pole will be plumb. Use leveling nuts to plumb shoe base poles. Do not use shims or leveling nuts under transformer bases. Do not grout between baseplate and the foundation.
- Ensure Class 2A and 2B fit for anchor bolts and nuts. Tap and chase nuts after galvanizing. Anchor bolt body with rolled threads need not be full size.
- Use appropriate class of concrete as specified in Items 416 and 432. Concrete for riprap may be upgraded to Class C at no extra cost to the Department.
- Place riprap around the foundation when called for elsewhere in the plans. Riprap will be paid for under Item 432.
- Locate breakaway roadway illumination assemblies as shown in the placement table, unless otherwise dimensioned on the plans. Protect non-breakaway illumination assemblies from vehicular impact (i.e. 2.5 ft. behind guard rail or mounted on traffic barrier), or located outside the clear zone, except that 2.5 ft. from curb face is minimum desired for light poles on city streets, 45 mph or less. See Roadway Design Manual for further information.
- Use 4 hold down and 4 connecting washers on transformer base poles as recommended by the manufacturer and supplied with base.
- Install a minimum of 2 conduits in each foundation. See lighting layout sheets for locations of foundations with more than 2 conduits. Cap unused conduits in foundations on both ends.
- Conduit location in foundations is critical for breakaway devices. Place conduits 2 in. apart on centerline as shown.
- Bond anchor bolt to rebar cage with #6 bare stranded copper conductor. Use listed mechanical connectors rated for embedment in concrete. The bonded steel in the foundation creates a concrete encased grounding electrode which replaces the ground rod.
- Grade earthwork around T-base foundations even with the finished grade as shown in Section A-A to ensure proper function of the breakaway device. Use riprap on T-base foundations that are located on sloped grades, and as shown on the plans for level grades.



FOUNDATION DETAIL



ANCHOR BOLT DETAIL

TABLE 4	
BREAKAWAY POLE PLACEMENT (See note 6)	
ROADWAY FUNCTIONAL CLASSIFICATION	** POLE OFFSET (DISTANCE TO FACE OF TRANSFORMER BASE)
Freeway Mainlanes (roadway with full control of access)	15 ft. (minimum and typical) from lane edge
All curbed, 45 mph or less design speed	2.5 ft. minimum (15 ft. desirable) from curb face
All others	10 ft. minimum*(15 ft. desirable) from lane edge

* or as close to ROW line as is practical

** provide 2/5 of the luminaire mounting height behind the pole for "falling area" to prevent encroachment on the other travel lanes. See design guidelines.

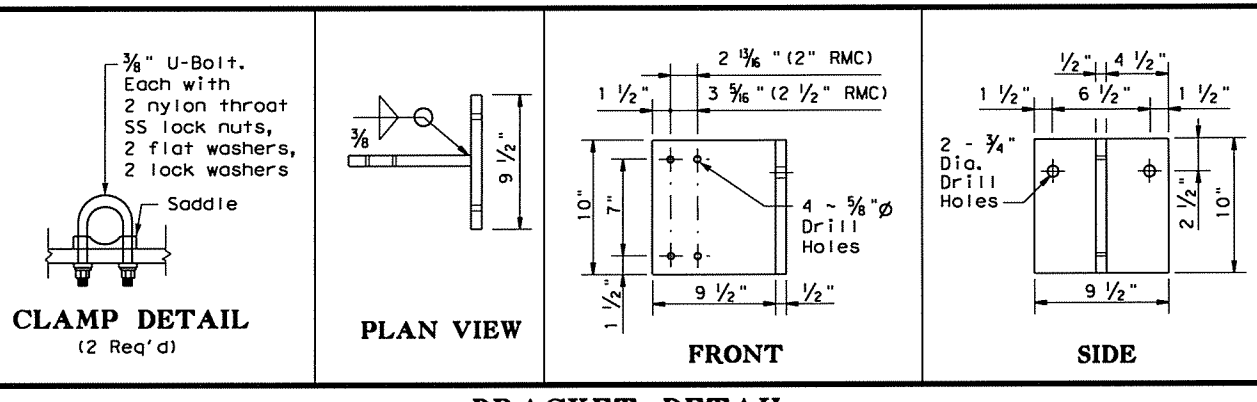
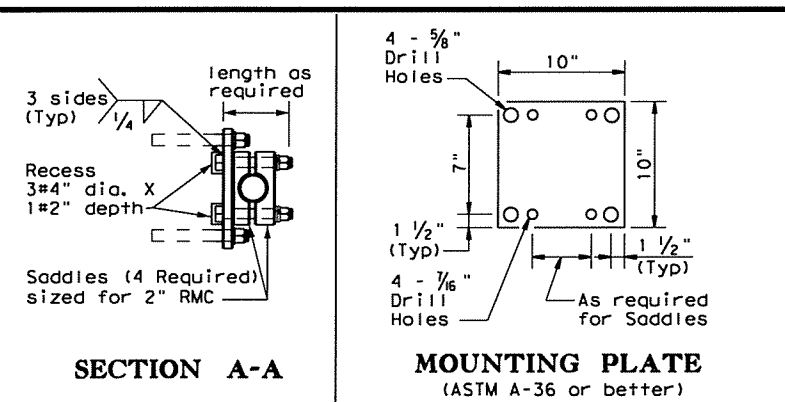


ROADWAY ILLUMINATION DETAILS (RDWY ILLUM FOUNDATIONS)

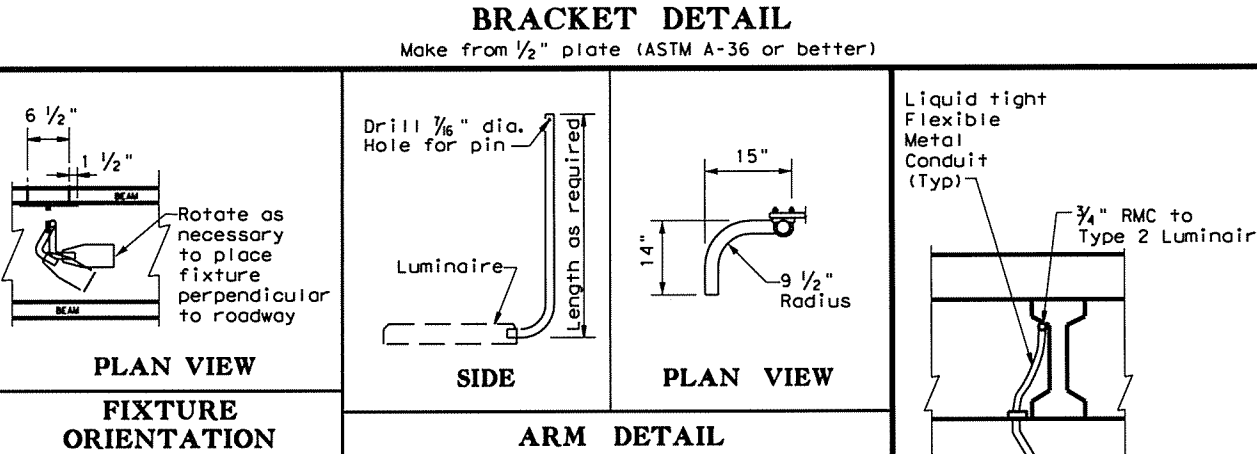
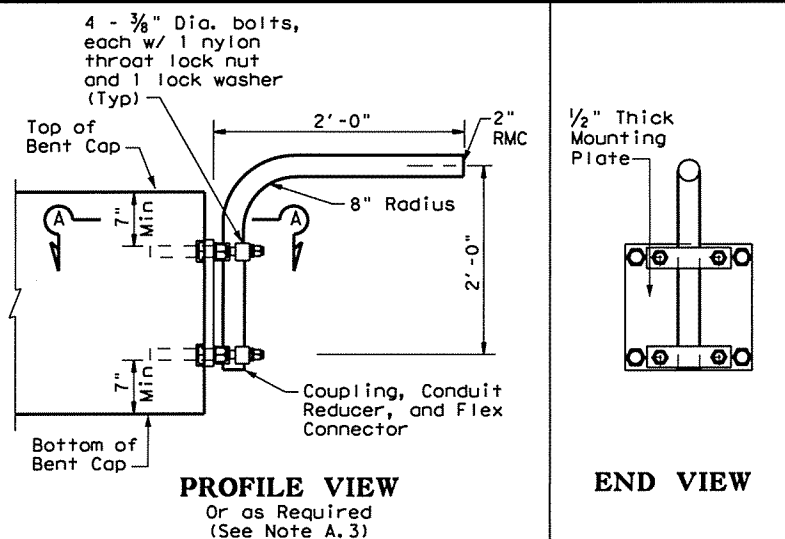
RID(2) -20

FILE: rid2-20.dgn	DN:	CK:	DN:	CK:
© TxDOT January 2007	CONT	SECT	JOB	HIGHWAY
REVISIONS				
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7-17	DIST		COUNTY	SHEET NO.
12-20	HOU		HARRIS, etc.	19

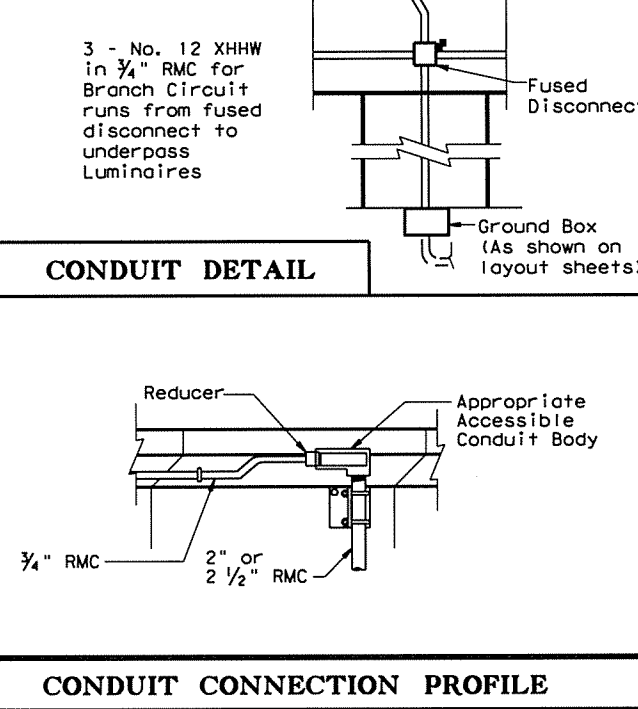
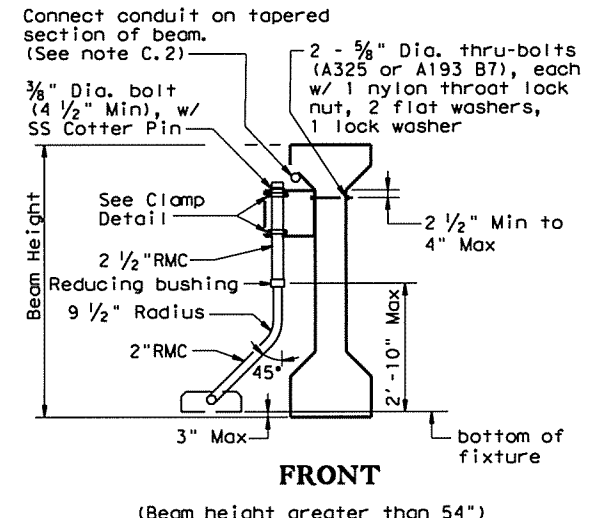
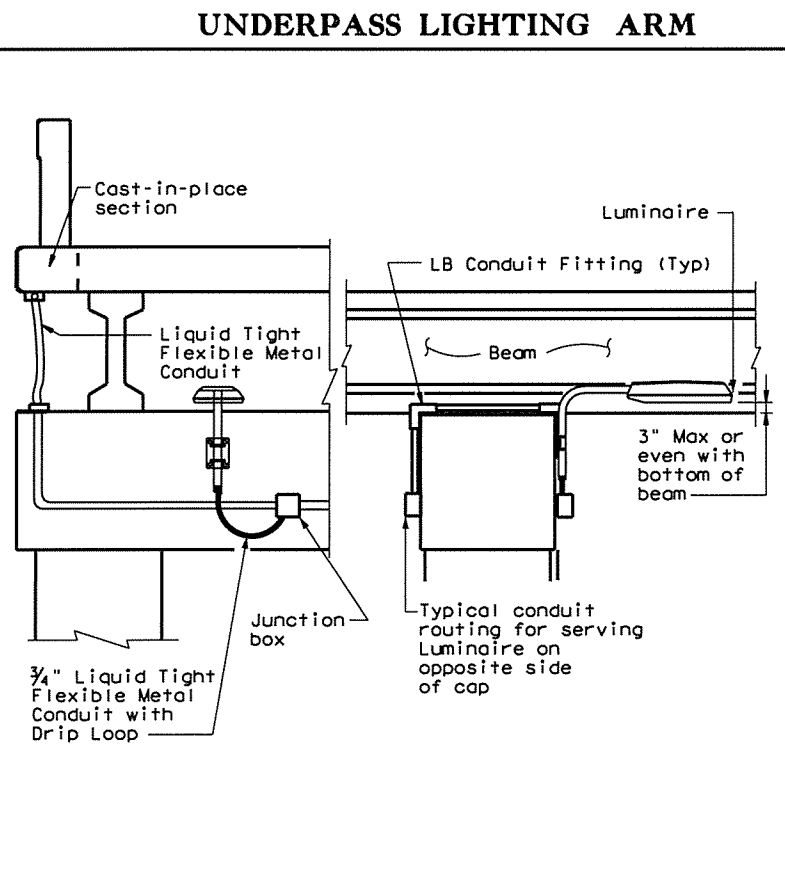
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- GENERAL NOTES:**
- ALL 150 watt HPS and 150 watt equivalent LED Luminaires
 - Luminaire locations, conduit and conductor sizes and routing are typical and diagrammatic only. See project layout sheets for specific details.
 - Conduit will be paid for under Item 618, "Conduit" and conductors will be paid for under Item 620, "Electrical Conductors," unless otherwise shown on the plans.
 - Adjust conduit in saddles to place fixture height and orientation as required. See fixture orientation detail and plans. Where practicable, place luminaires so the bottom of luminaire is above the bottom of the beam, maximum of 3 in. (See detail UNDERPASS LIGHTING ARM TYPE 2)
 - Except as noted, galvanize all structural steel and exposed bolts, nuts, and washers in accordance with Item 445 "Galvanizing".
 - Fabrication of brackets and support arms will not be paid for directly but is subsidiary to Item 610, "Roadway Illumination Assemblies."
 - Install a heavy duty NEMA 3R fused disconnect or breaker enclosure rated at 30 amps and 480 volts to switch underpass luminaires as shown on plans, with at least one per bridge circuit. Install 20 amp time-delay fuses or inverse-time circuit breakers. Mount disconnect or breaker enclosure 10 ft. (min) above grade on columns or bent caps as approved by the Department. Modify disconnect to allow padlocking in the "ON" and "OFF" positions. Padlocks and disconnect switches or circuit breakers for underpass fixtures will not be paid for directly but are subsidiary to the various bid items of the contract.
 - Conduit on columns, caps, and slab is shown surface mounted. For new columns and caps, embed PVC conduit in concrete. Bond and ground metal junction boxes and conduit.



- B. TYPE 1**
- Provide 2 in. rigid metal conduit (2.375" O.D., 0.146" wall) for Type 1 arm shaft.
 - Use $\frac{3}{8}$ in. stainless steel bolt or stud non-epoxy type expansion anchors for concrete for Type 1 mounting. Except as noted, provide an allowable 2650 lbs minimum pull-out force (after consideration of adjustment factors for edge distance and bolt spacing) for each anchor. Install each anchor to the embedment depth recommended by the manufacturer.
 - Attach conduit to plate with 4 saddles, four - $\frac{3}{8}$ in. diameter bolts, nylon throat lock nuts, and lock washers.



- C. TYPE 2**
- Provide 2 in. rigid metal conduit (2.375" O.D., 0.146" wall) or provide a combination of 2 $\frac{1}{2}$ in. (2.875" O.D., 0.193" wall) and 2 in. (2.375" O.D., 0.146" wall) rigid metal conduits with a reducing bushing as beam height stipulated for Type 2 arm shaft. Field cutting and threading will be permitted. Paint cut and threaded areas with zinc rich paint after conduit is connected to adjacent fitting.
 - Connecting conduit may be strapped to tapered section only of precast beams as shown. Anchor as approved by the Engineer. Maximum anchor depth is 1 in.
 - Indiscriminate drilling into precast concrete beams may result in reduced beam strength. Use drilling location and method as directed by the Engineer. See Location of Underpass Lighting Mounting Bracket detail. The locations shown in the table are such that reinforcing strands will not be damaged.

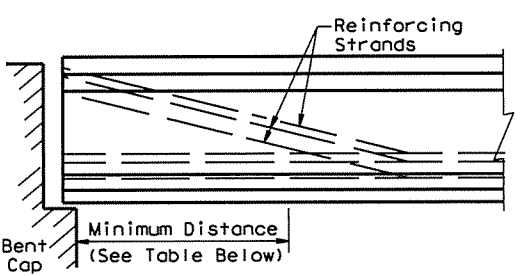
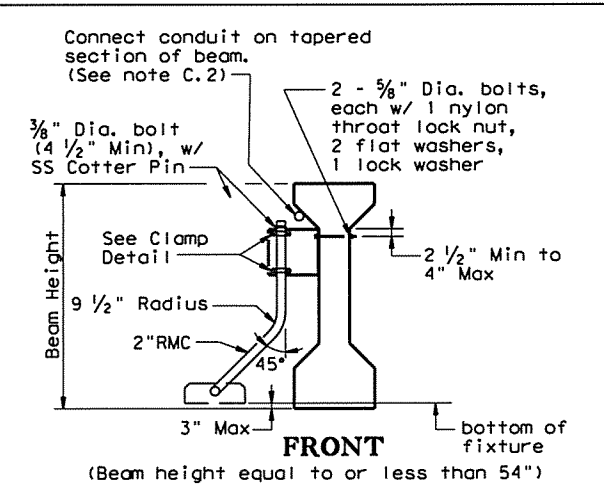
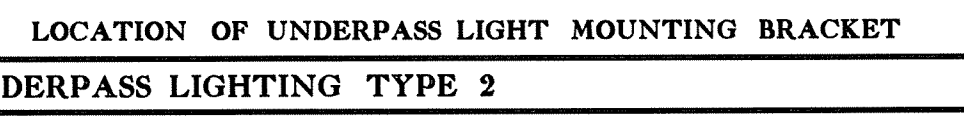
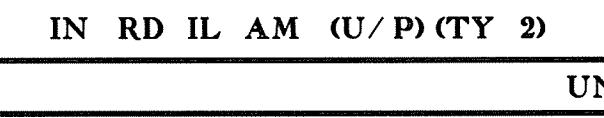
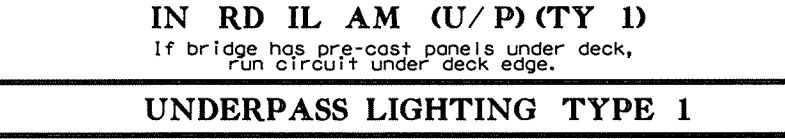


TABLE 5

LOCATION OF UNDERPASS LIGHT MOUNTING BRACKET

SPAN LENGTH	MINIMUM DISTANCE
≤ 50'	10'-0"
50' - 70'	15'-0"
70' - 90'	20'-0"
> 90'	25'-0"

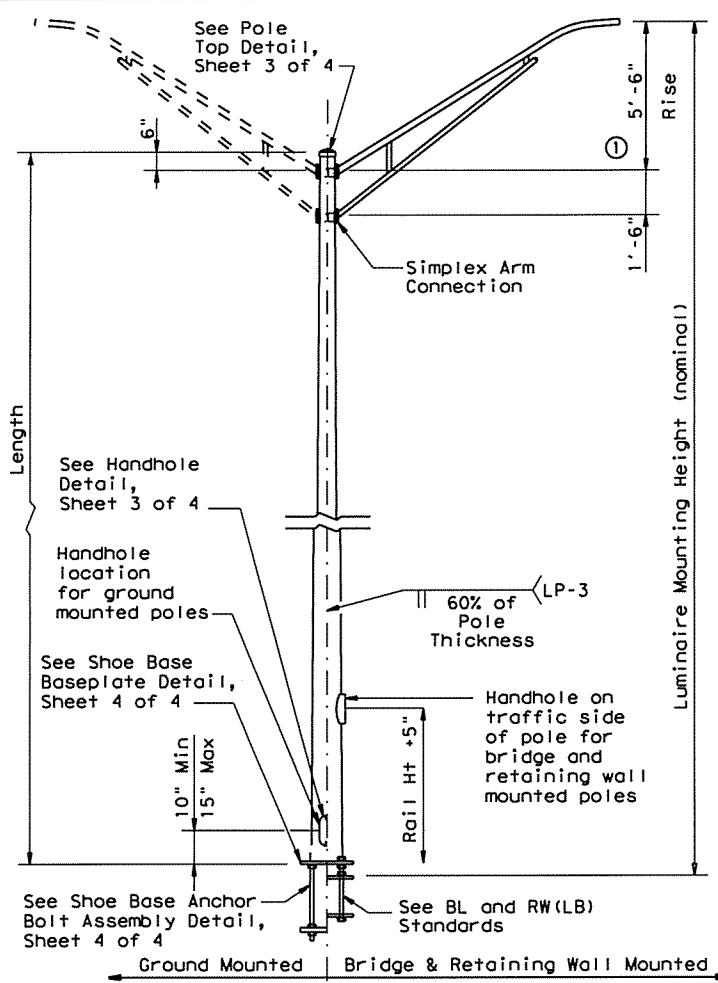
Texas Department of Transportation
ROADWAY ILLUMINATION DETAILS
 (UNDERPASS LIGHT FIXTURES)
RID(3)-20



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7-17	DIST	COUNTY	SHEET NO.	
12-20	HOU	HARRIS, etc.	20	

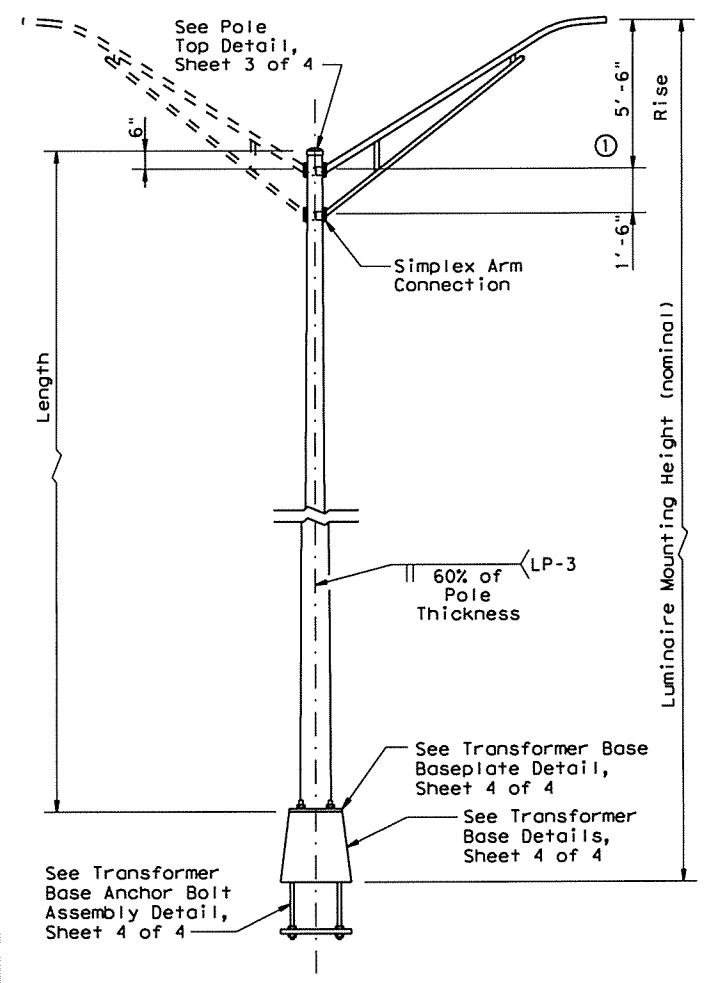
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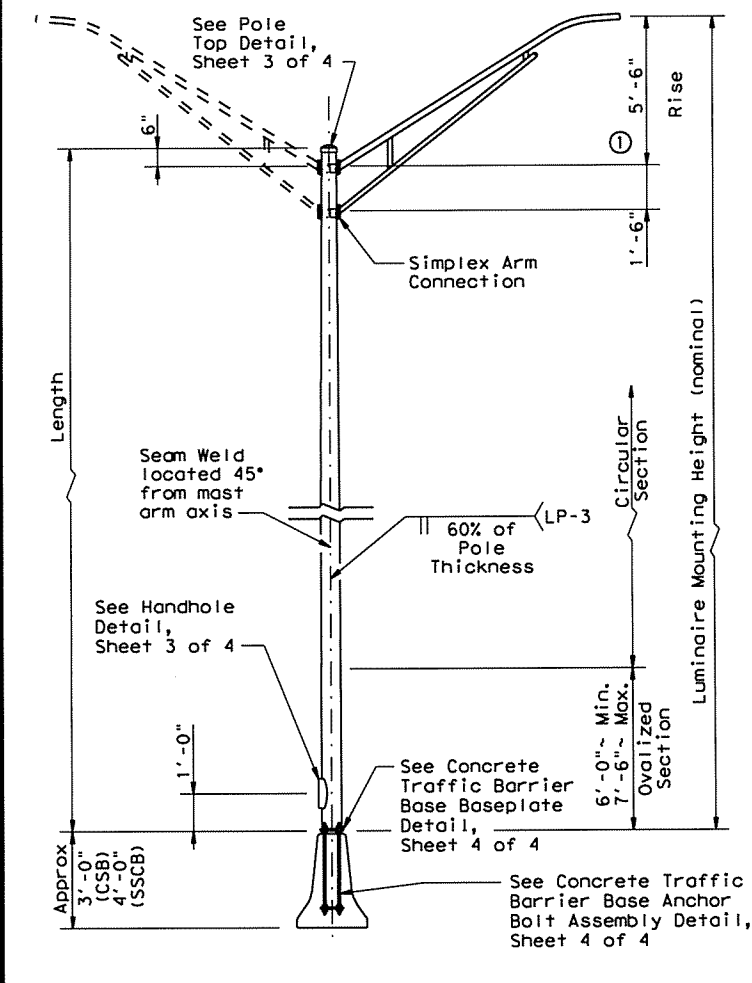
SHOE BASE POLE

SHOE BASE POLE					
Luminaire Mounting Height (Nominal) (ft)	Base Diameter (in)	Top Diameter (in)	Length (ft)	Pole Thickness (in)	Design Moment (K-ft)
20.00	7.00	4.90	15.00	0.1196	7.1
30.00	7.50	4.00	25.00	0.1196	13.2
31.00-39.00	8.00	4.36-3.24	26.00-34.00	0.1196	20.7
40.00	8.50	3.60	35.00	0.1196	20.7
50.00	10.50	4.20	45.00	0.1196	30.3



TRANSFORMER BASE POLE

TRANSFORMER BASE POLE					
Luminaire Mounting Height (Nominal) (ft)	Base Diameter (in)	Top Diameter (in)	Length (ft)	Pole Thickness (in)	Design Moment (K-ft)
20.00	7.00	5.11	13.50	0.1196	7.1
30.00	7.50	4.21	23.50	0.1196	13.2
31.00-39.00	8.00	4.57-3.45	24.50-32.50	0.1196	20.7
40.00	8.50	3.81	33.50	0.1196	20.7
50.00	10.00	3.91	43.50	0.1196	30.3



CONCRETE TRAFFIC BARRIER BASE POLE

CONCRETE TRAFFIC BARRIER BASE POLE (CSB/SSCB)						
Luminaire Mounting Height (Nominal) (ft)	Base Diameter (in)	Top Diameter (in)	Length (ft)	Pole Thickness (in)	Design Moment (K-ft)	
					About C of Rail	Perp. to Rail
28.00	9.00	5.78	23.00	0.1196	10.3	13.2
38.00	9.00	4.38	33.00	0.1196	16.6	20.8
48.00	10.50	4.48	43.00	0.1345	25.1	30.5

GENERAL NOTES:

- Designs conform to AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, 6th Edition (2013) and Interim Revisions thereto. Design 3-Second Gust Wind Speed equals 110 mph with a 1.14 gust factor. A wind importance factor of 0.80 is applied to adjust the wind speed to a 25 year recurrence interval. Design moments listed in tables assume base of pole is 25' above natural ground level.
- Structures are designed to support two 12' luminaire mast arms and luminaires. Mast arms are designed to support a 60-pound luminaire having an effective projected area of 1.6 square feet.
- Fabrication shall be in accordance with the Specifications and with the details, dimensions, and weld procedures shown herein. Do not submit shop drawings for roadway illumination pole assemblies fabricated in accordance with the details, dimensions, and weld procedures shown herein. Weld references call for preapproved weld procedures which the Fabricator must obtain prior to fabrication. Materials, fabrication tolerances, and shipping practices shall meet the requirements of these sheets and the Specifications. In the absence of specified fabrication tolerances, dimensions shall be within the tolerances generally obtainable in normal fabrication practice.
- For mounting heights between values shown in the tables, use base diameter and thickness values for the larger height.
- Unless otherwise noted, all steel parts shall be galvanized in accordance with Item 445, "Galvanizing."
- Steel poles shall be fabricated in accordance with Item 441, "Steel Structures." Longitudinal seam welds for pole sections shall have 60% minimum penetration. All welding shall be in accordance with AWS D1.1, Structural Welding Code-Steel.
- Two-section poles joined by circumferential welds will not be permitted, unless otherwise shown on the plans. Poles may be fabricated in two sections and field-assembled by the lap-joint method. The two sections shall telescope together with a lap length of not less than 1-1/2 times the shaft diameter at the lap joint.
- Alternate material equal to or better than material specified may be substituted with the approval of the Engineer.
- Lubricate and tighten anchor bolts, when erecting shoe base poles and concrete traffic barrier base poles, in accordance with Item 449, "Anchor Bolts."
- All poles, except Transformer Base Poles, shall have hand holes with reinforcing frames and covers. For ground mounted shoe base poles, hand holes shall be placed 90 degrees to mast arm unless otherwise noted on the plans. For poles mounted on a concrete traffic barrier with one luminaire arm, hand holes shall be located 180 degrees from luminaire arm. For poles mounted on a concrete traffic barrier with two luminaire arms, all hand holes shall be on the same side of the barrier. For poles mounted on a bridge lighting bracket or a retaining wall lighting bracket, hand hole shall be on traffic side of the pole, at a height that will clear the barrier.
- The finished pole shall have a smooth, uniform finish free of pits, blisters, or other defects. Scratched, chipped, and other damaged galvanized areas on poles and mast arms shall be repaired in accordance with Item 445, "Galvanizing."
- Pole length is based on a 5'-6" luminaire arm rise. 4 ft. luminaire arms have a 2'-6" rise. A pole with 4 ft. luminaire arms will have an actual mounting height 3'-0" less than the nominal mounting height. Increasing the pole length to meet the nominal mounting height is allowed, but unnecessary unless otherwise directed by the engineer.
- Erect transformer base poles in accordance with sheet RID(1).

MATERIAL DATA

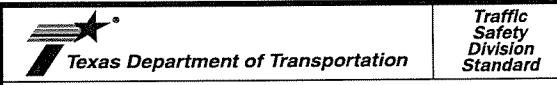
COMPONENT	ASTM DESIGNATION	MIN. YIELD (ksi)
Pole Shaft (0.14"/ft. Taper)	A572 Gr 50, A595 Gr A, A1011 HSLAS Gr 50 Cl 2 ③, or A1008 HSLAS Gr 50 Cl 2	50
Base Plate and Handhole Frame	A572 Gr.50, or A36	36
T-Base Connecting Bolts	F3125 Gr A325	92
Anchor Bolts	F1554 Gr 55, A193-B7 or A321	55 105
Anchor Bolt Templates	A36	36
Heavy Hex (H.H.) Nuts	A194 Gr 2H, or A563 Gr DH	
Flat Washers	F436	

NOTES:

- 2'-6" rise for 4 ft. luminaire arms.
- Before ovalized as shown on Concrete Traffic Barrier Base Baseplate details, Sheet 4 of 4.
- A1011 SS Gr 50 may be used instead of HSLAS, provided the material meets the elongation requirements for HSLAS.

POLE ASSEMBLY FABRICATION TOLERANCES TABLE

DIMENSION	TOLERANCE
Shaft length	+1"
I.D. of outside piece of slip fitting pieces	+1/8", -1/16"
O.D. of inside piece of slip fitting pieces	+1/32", -1/8"
Shaft diameter: other	+3/16"
Out of "round"	1/4"
Straightness of shaft	±1/4" in 10 ft
Twist in multi-sided shaft	4° in 50 ft
Perpendicular to baseplate	1/8" in 24"
Pole centered on baseplate	±1/4"
Location of Attachments	±1/4"
Bolt hole spacing	±1/16"

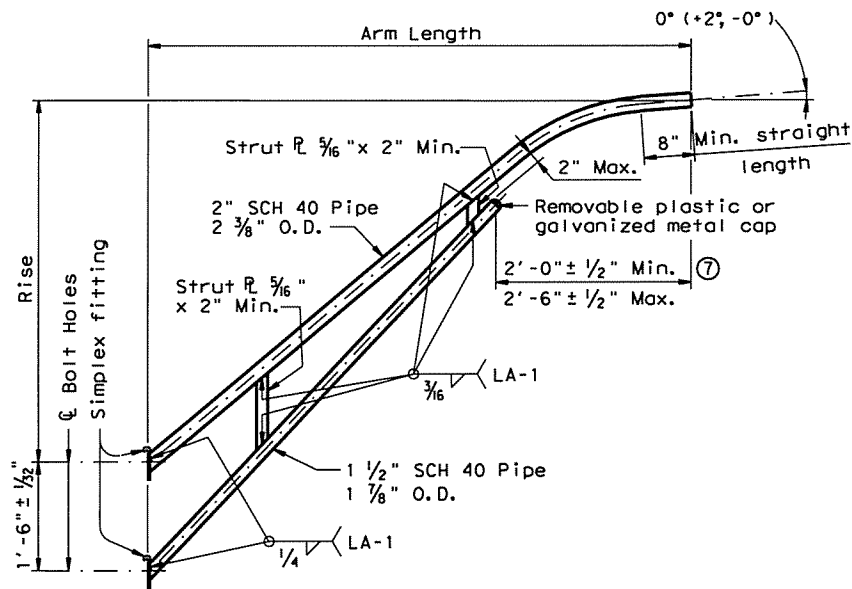


ROADWAY ILLUMINATION POLES RIP(2)-19

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© TxDOT January 2007	CONT: 6459	SECT: 93	JOB: 001	HIGHWAY: I-610, etc.	SHEET NO. 22
REVISIONS	DIST: HOU	COUNTY: HARRIS, etc.			

DATE: FILE:

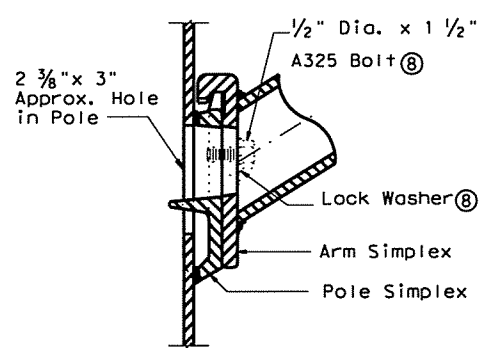
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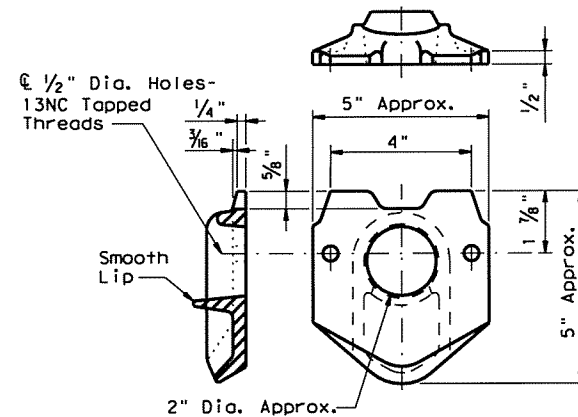
LUMINAIRE ARM

LUMINAIRE ARM DIMENSIONS		
Nominal Arm Length	Arm Length	Rise
4'-0"	3'-6"	2'-6"
6'-0"	5'-6"	5'-6"
8'-0"	7'-6"	5'-6"
10'-0"	9'-6"	5'-6"
12'-0"	11'-6"	5'-6"

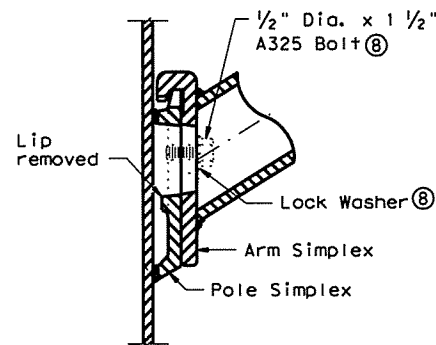
ARM ASSEMBLY FABRICATION TOLERANCES TABLE	
DIMENSION	TOLERANCE
Arm Length	±1"
Arm Rise	±1"
Deviation from flat	1/8" in 12"
Spacing between holes	±1/32"



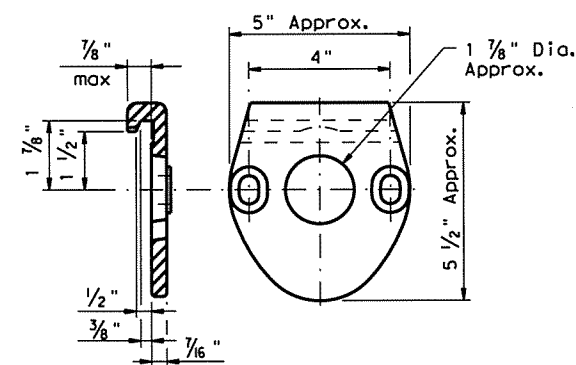
UPPER SIMPLEX FITTING
(Gusset not shown for clarity)



POLE SIMPLEX DETAIL



LOWER SIMPLEX FITTING
(Gusset not shown for clarity)



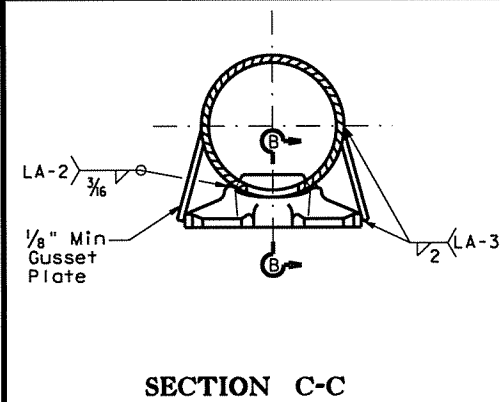
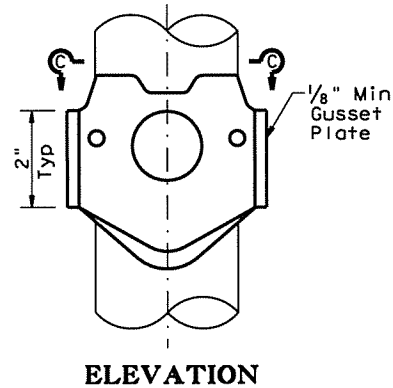
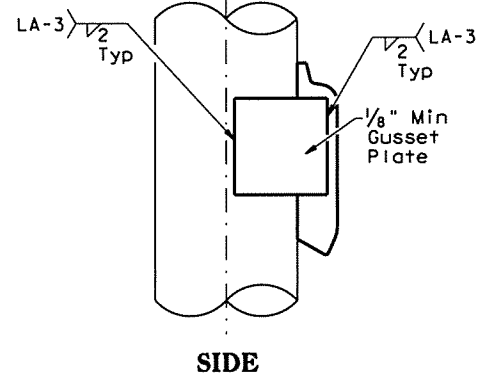
ARM SIMPLEX DETAIL

NOTES:

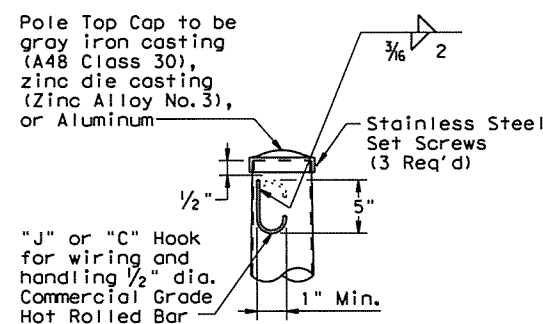
- ④ Any of the materials listed for plates may be used where the drawings do not specify a particular ASTM designation.
- ⑤ A576 must be suitable for forging and also meet minimum tensile strength of 65 ksi, minimum yield of 35 ksi, and elongation in 2 inches of 22 percent.
- ⑥ A572, A1008 HSLAS-F, and A1011 HSLAS-F materials may have higher yield strengths but shall not have less elongation than the grade indicated.
- ⑦ Dimensional limits are given to show acceptable variation in design. All of a Fabricator's production of a particular arm length shall have the same dimensions within specified tolerances.
- ⑧ Each pole simplex fitting shall be supplied with 2 bolts and 2 lock washers of the size specified. The bolts and lock washers shall be secured to the pole with the other hardware items called for in the plans.
- ⑨ Proposed deviations in arm simplex dimensions or materials must be submitted to the Department for approval.
- ⑩ A welded handhole frame is permissible. Maximum of two (2) CJP weld splices is allowed.

MATERIALS

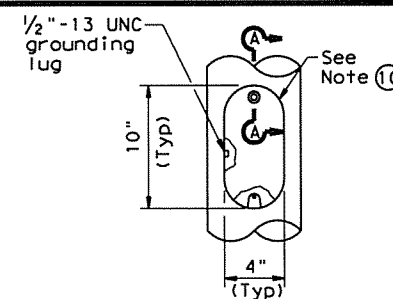
Pole or Arm Simplex	ASTM A27 Gr 65-35 or Gr 70-36, A148 Gr 80-50, A576 Gr 1021 ⑤, or A36 (Arm only)
Arm Pipes	ASTM A53 Gr A or B, A500 Gr B, A501, A 1008 HSLAS-F Gr 50 ⑥, or A1011 HSLAS-F Gr 50 ⑥
Arm Struts and Gusset Plates ④	ASTM A36, A572 Gr 50 ⑥, or A588
Misc.	ASTM designations as noted



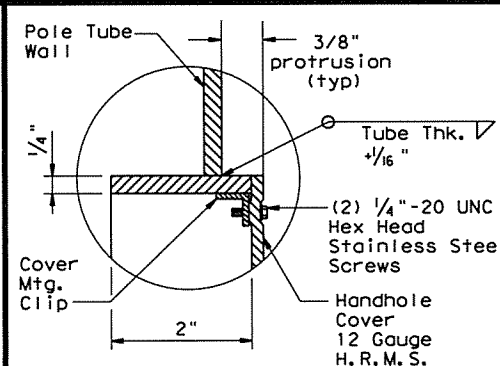
SIMPLEX ATTACHMENT DETAIL



POLE TOP



ELEVATION



SECTION A-A

HANDHOLE

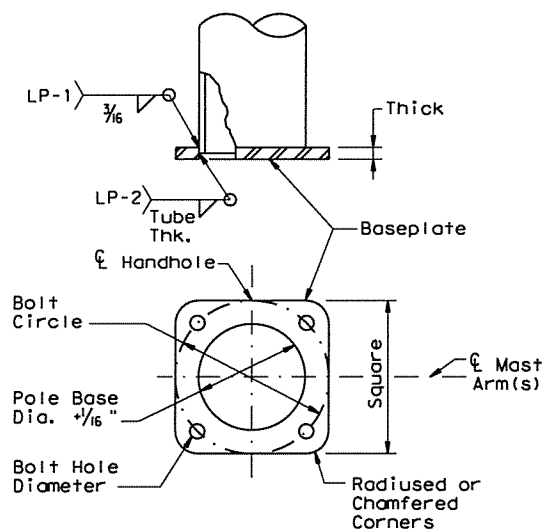
SHEET 3 OF 4



ROADWAY ILLUMINATION POLES
RIP (3) - 19

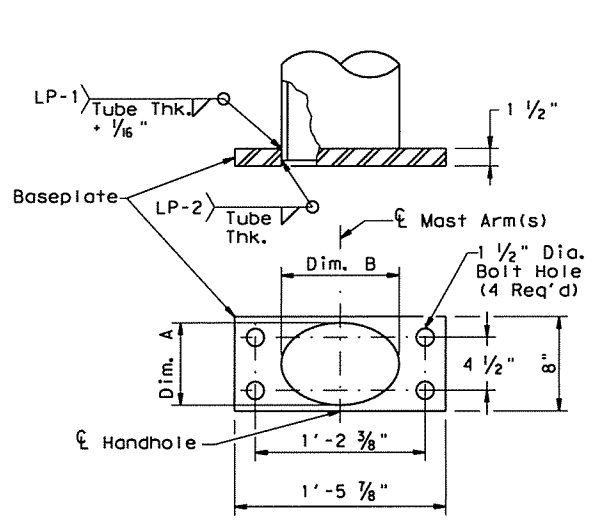
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7-17	DIST	COUNTY	SHEET NO.	
12-19	HOU	HARRIS, etc.	23	

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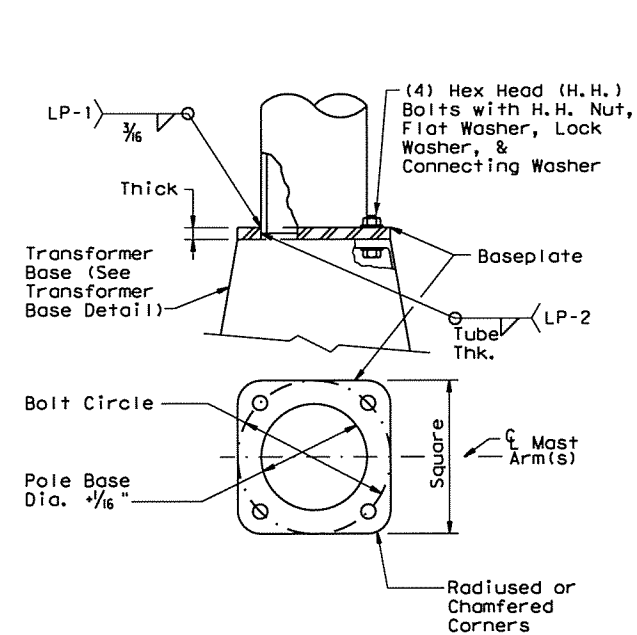
SHOE BASE BASEPLATE

SHOE BASE BASEPLATE TABLE				
MOUNTING HEIGHTS (nominal)	BOLT CIRCLE	SQUARE	THICK	BOLT HOLE DIAMETER
20' - 39'	13"	13"	1 1/4"	1 1/4"
40'	15"	15"	1 1/4"	1 1/2"
50'	15"	15"	1 1/2"	1 1/2"



CONCRETE TRAFFIC BARRIER BASE BASEPLATE

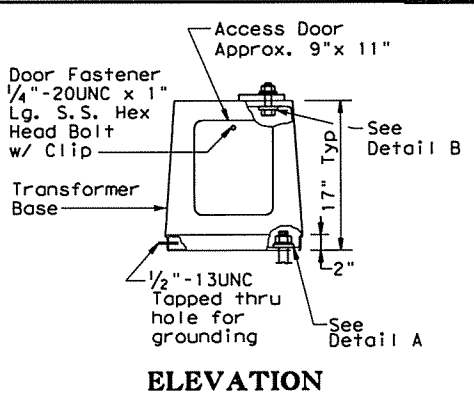
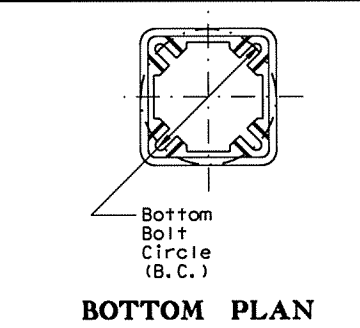
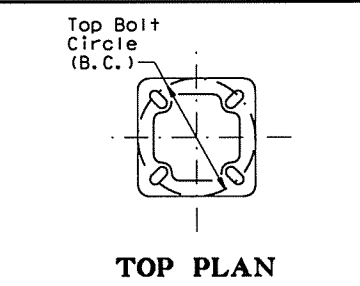
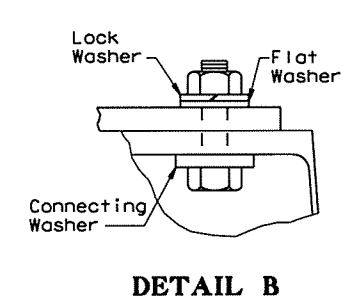
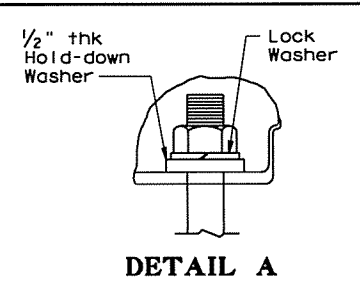
CONCRETE TRAFFIC BARRIER BASE BASEPLATE TABLE			
MOUNTING HEIGHTS (nominal)	POLE DIA. (1)	DIM. A	DIM. B
28' - 38'	9"	7" ± 1/4"	10" ± 1/4"
48'	10 1/2"	7" ± 1/4"	13" ± 1/4"



TRANSFORMER BASE BASEPLATE

TRANSFORMER BASE BASEPLATE TABLE						
MOUNTING HEIGHTS (nominal)	BOLT CIRCLE	SQUARE	THICK	CONNECTING BOLT DIA.	BOLT HOLE DIAMETER	TRANSFORMER BASE TYPE
20' - 39'	13"	13"	1 1/4"	1"	1 1/4"	A
40'	15"	15"	1 1/4"	1 1/4"	1 1/2"	B
50'	15"	15"	1 1/2"	1 1/4"	1 1/2"	B

TRANSFORMER BASE TABLE		
TYPE	TOP B.C.	BTM. B.C.
A	13"	14"
B	15"	17 1/4"



TRANSFORMER BASE DETAILS

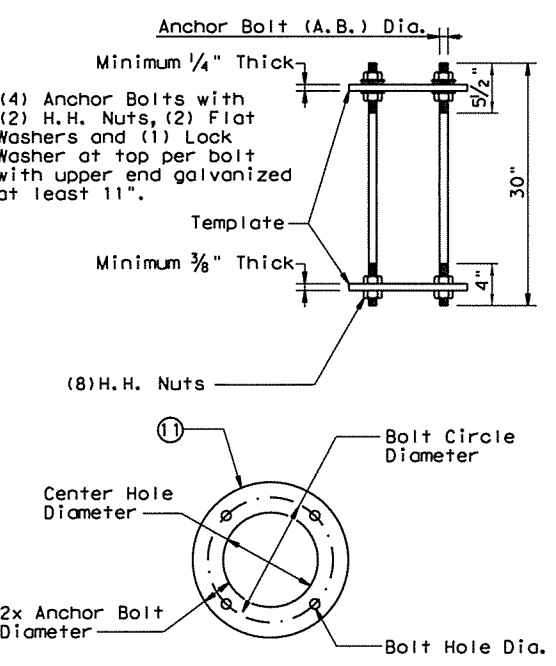
GENERAL NOTES:

- For mounting heights between those shown in the table, use the values in the table for the larger mounting height.
- All breakaway bases shall meet the breakaway requirements of the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, 6th Edition (2013) and Interim Revisions thereto, and shall have been tested by FHWA-approved methods. All bases shall have been structurally tested to resist 150% of the design moment.
- Transformer bases shall be cast from aluminum, ASTM B108 or B26 Alloy 356.0-T6, or other material approved by the Engineer. Four Hex Head (H.H.) bolts with four H.H. nuts, four lock washers, four flat washers, and connecting and hold-down washers as recommended by the manufacturer, galvanized to ASTM A153 Class C or D, or B695 Class 50, shall be provided with each transformer base for connecting the pole. Bolts shall be ASTM A325 or approved equal. Nuts shall be ASTM A563 grade DH galvanized.
- Bases shall be stamped, incised or by other approved permanent means, marked to show fabricator's name or logo, and model number. Such information shall be placed in a readily seen location, inside or outside the base, but shall not be placed on the door.
- Doors for transformer bases shall be made of plastic, fiberglass or other non-metallic material approved by the Engineer and shall be attached with stainless steel screws or bolts. Transformer bases shall be cleaned by grit blast cleaning after heat treatment. Certification by the manufacturer of heat treatment shall be furnished with transformer bases. The certification shall show the metal alloy and temper and that the base meets those requirements, chemical and physical. The certification shall also show the material ASTM specification. Transformer bases shall be cast with a removable tab bar for material testing. Some bars may have been removed by the manufacturer for testing.

NOTES:

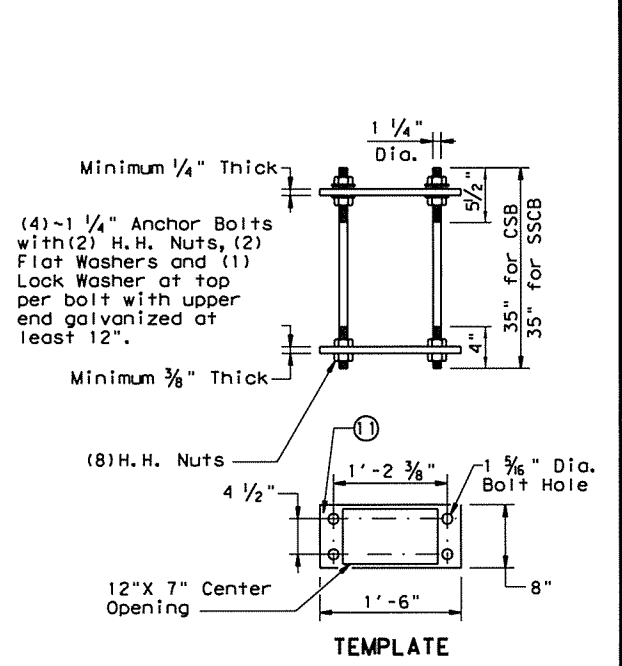
- (1) Anchor Bolt Templates do not need to be galvanized.
- (2) Pole diameter before ovalized.

ANCHOR BOLT FABRICATION TOLERANCES TABLE	
DIMENSION	TOLERANCE
Length	± 1/2"
Threaded length	± 1/2"
Galvanized length (if required)	- 1/4"



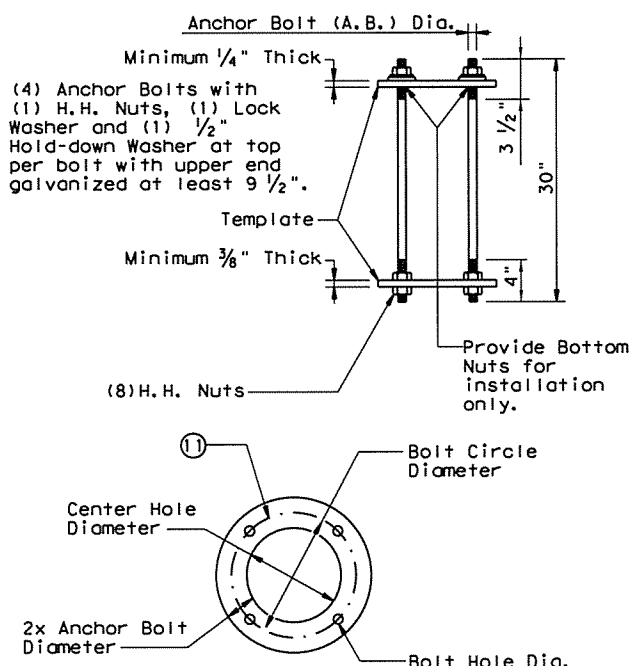
SHOE BASE ANCHOR BOLT ASSEMBLY

SHOE BASE ANCHOR BOLT ASSEMBLY TABLE				
MOUNTING HEIGHTS (nominal)	A.B. Dia.	BOLT CIRCLE DIAMETER	CTR. HOLE DIAMETER	BOLT HOLE DIAMETER
20' - 39'	1"	13"	11"	1 1/16"
40' - 50'	1 1/4"	15"	12 1/2"	1 5/16"



CONCRETE TRAFFIC BARRIER BASE ANCHOR BOLT ASSEMBLY

TRANSFORMER BASE ANCHOR BOLT ASSEMBLY TABLE				
MOUNTING HEIGHTS (nominal)	A.B. Dia.	BOLT CIRCLE DIAMETER	CTR. HOLE DIAMETER	BOLT HOLE DIAMETER
20' - 39'	1"	14"	12"	1 1/16"
40' - 50'	1 1/4"	17 1/4"	14 3/4"	1 5/16"



TRANSFORMER BASE ANCHOR BOLT ASSEMBLY



**ROADWAY ILLUMINATION POLES
RIP(4) - 19**

FILE: rip-19.dgn	DN:	CK:	DW:	CK:
© TxDOT January 2007	COM: 6459	SECT: 93	JOB: 001	HIGHWAY: I-610, etc.
7-17	DIST: HOU	COUNTY: HARRIS, etc.	SHEET NO.: 24	

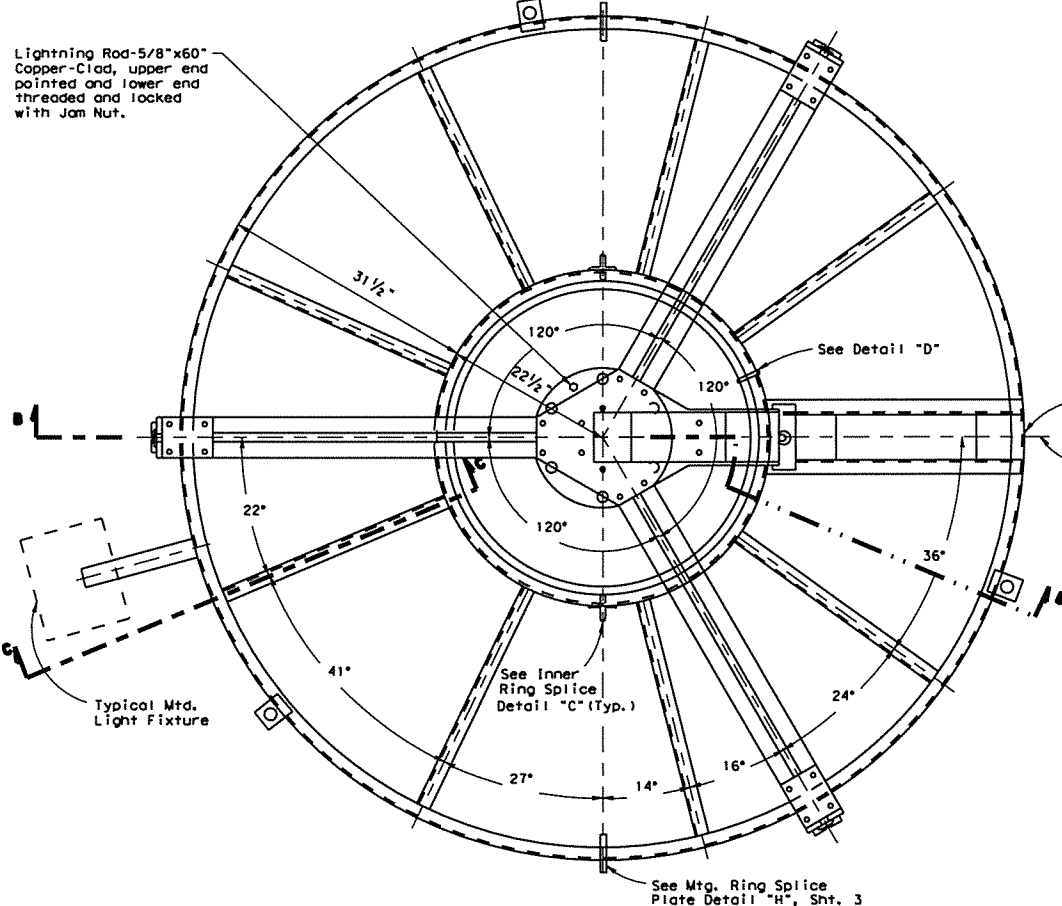
DATE: FILE:

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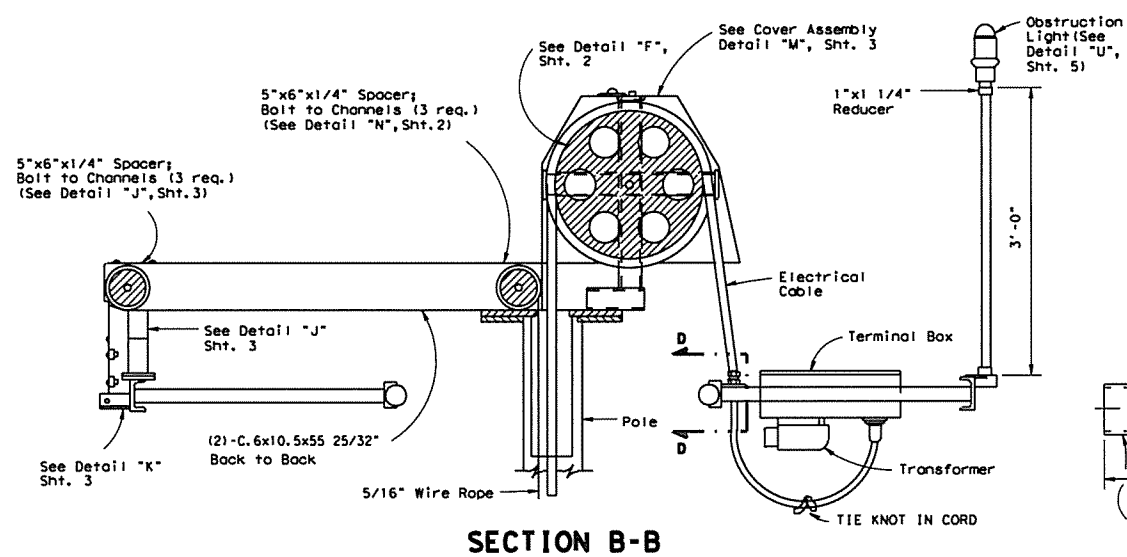
NOTES:

1. Pole, Ring, and Ring Support shall be assembled and erected so that Reference Line is parallel to center line of roadway or as shown on "Lighting Layouts" sheets.
2. Fixture Placement on ring shall provide a min. Clearance of 7" between Fixtures.

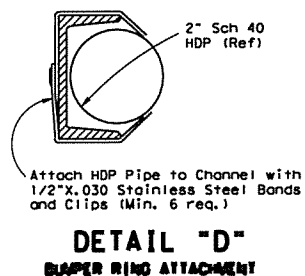
Lightning Rod-5/8"x60" Copper-Clad, upper end pointed and lower end threaded and locked with Jam Nut.



LIGHT MOUNTING RING & SUPPORT ASSEMBLY

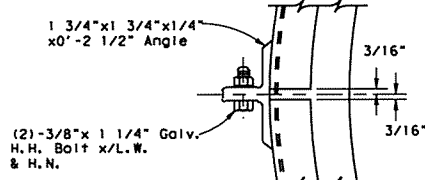


SECTION B-B

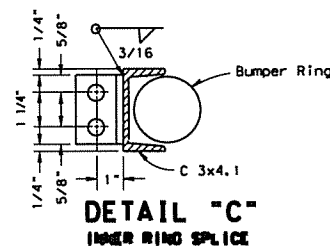


Handhole Located on Reference Line. See Lighting Layout.

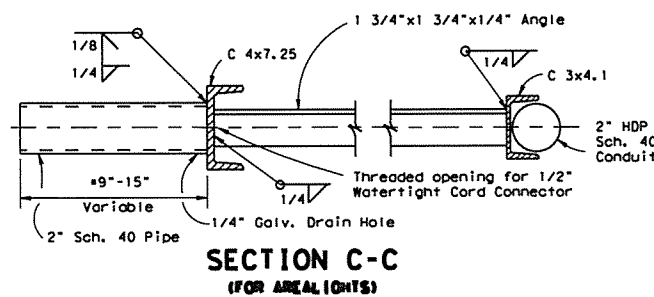
Reference Line (See Light Setting Diagrams)



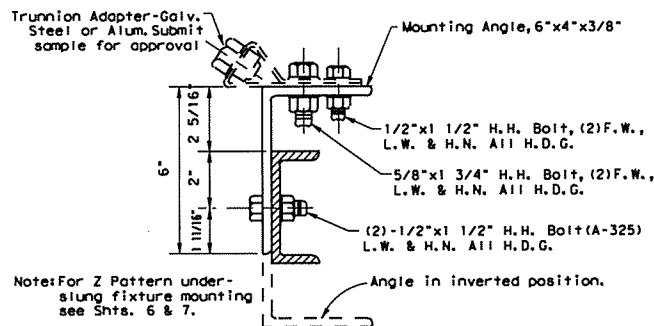
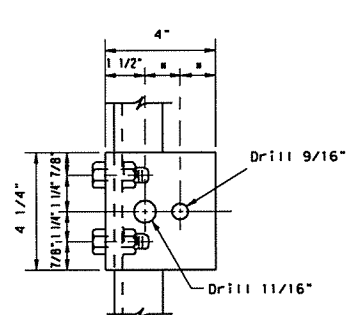
PLAN



Note: Tenon Length to be Determined by Fixture Used and Required Clearance.

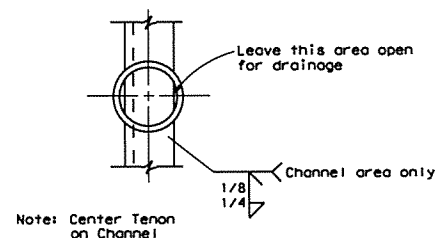


As required by Trunnion Adapter supplied.

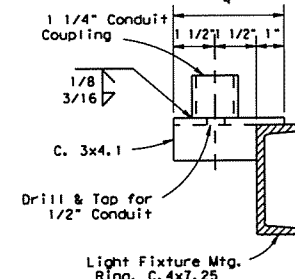
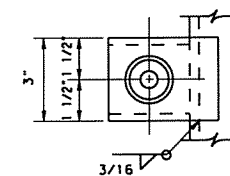
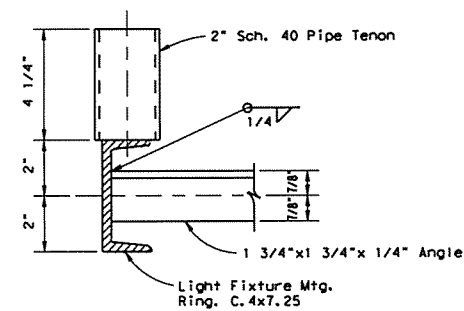


SECTION C-C
(FOR TRUNNION MOUNT)

NOTE: Provide S.S. or galv. cable safety lanyard for Light Fixture when Trunnion Mount is used.

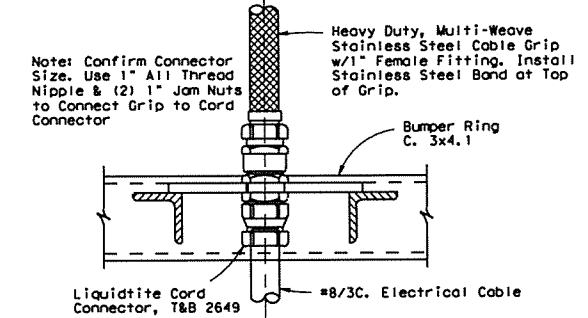
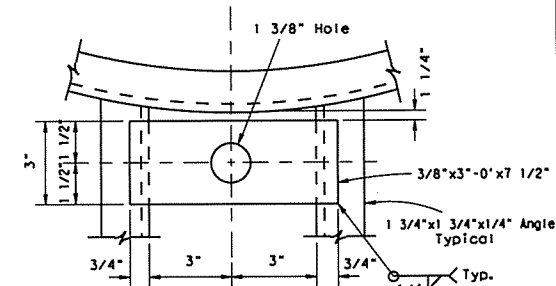


SECTION C-C
(FOR FLOODLIGHTS)



DETAIL "E"

(CONDUIT ATTACHMENT FOR OBSTRUCTION LIGHTS, TYPICAL (3) PLACES)



SECTION D-D

NOTE: COVER CORD WITH HEAT SHRINK TUBING FROM CABLE GRIP TO WITHIN ONE INCH OF GRIP TO CONNECTOR TRANSITION PRIOR TO INSTALLING CABLE GRIP.

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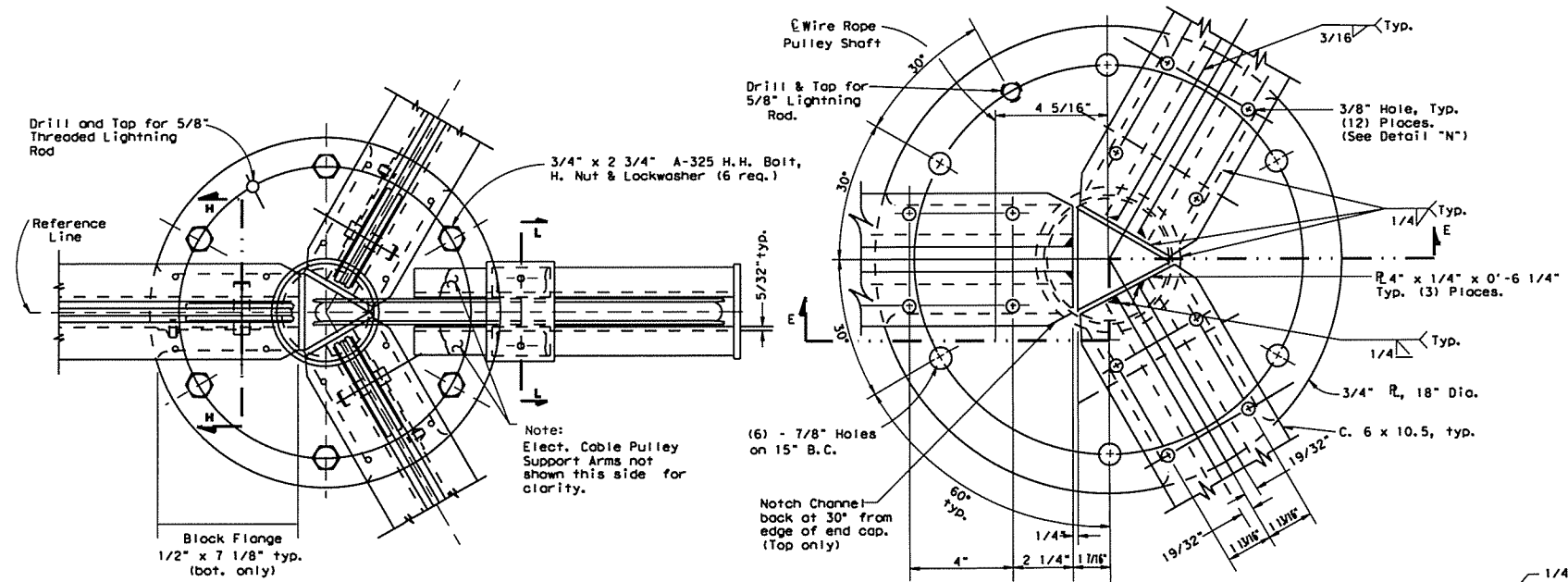
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5-87	4-96	DIST	COUNTY	SHEET NO.	
10-1-87		HOU	HARRIS, etc.	25	

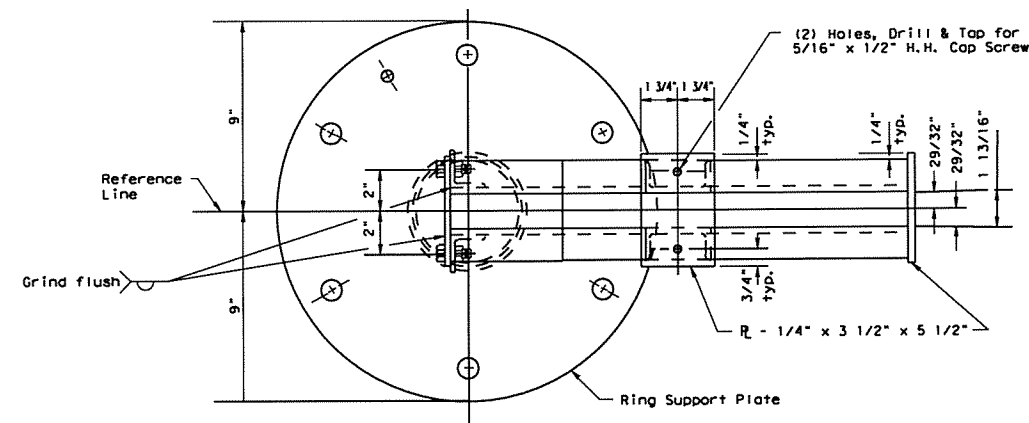
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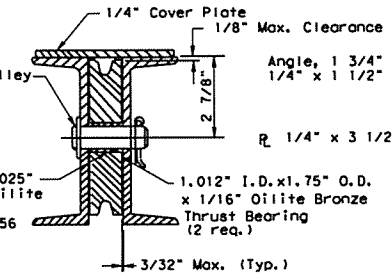


PLAN VIEW

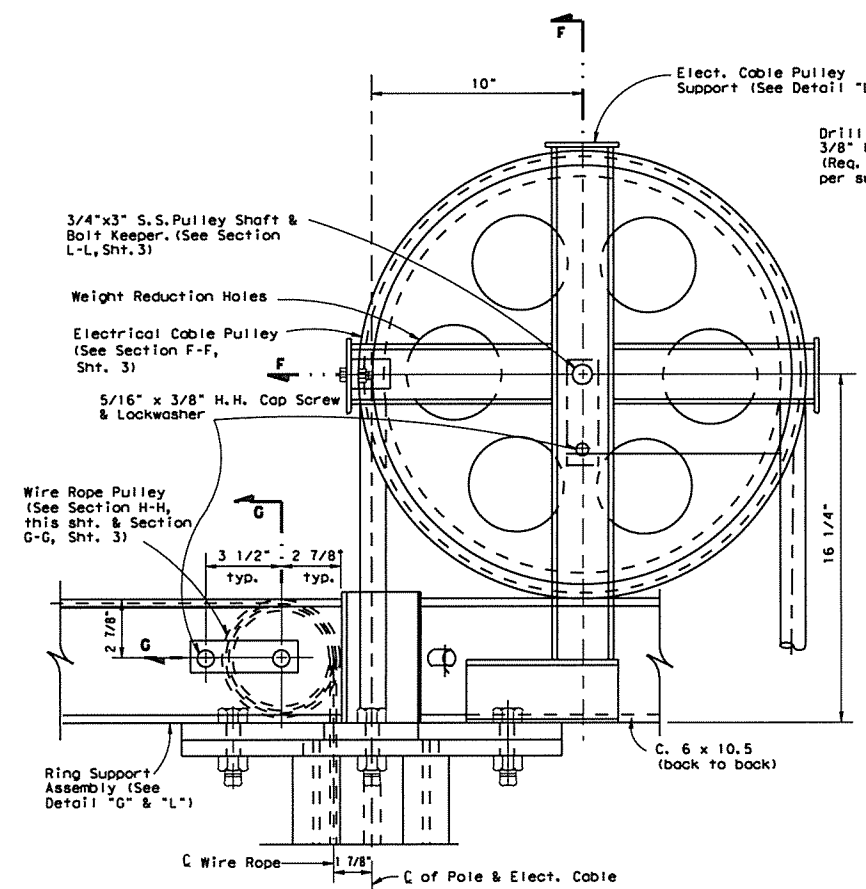
**DETAIL "G"
TOP PLATE CONNECTION
(LESS ELECT. CABLE PULLEY SUPPORT)
(SEE DETAIL "L")**



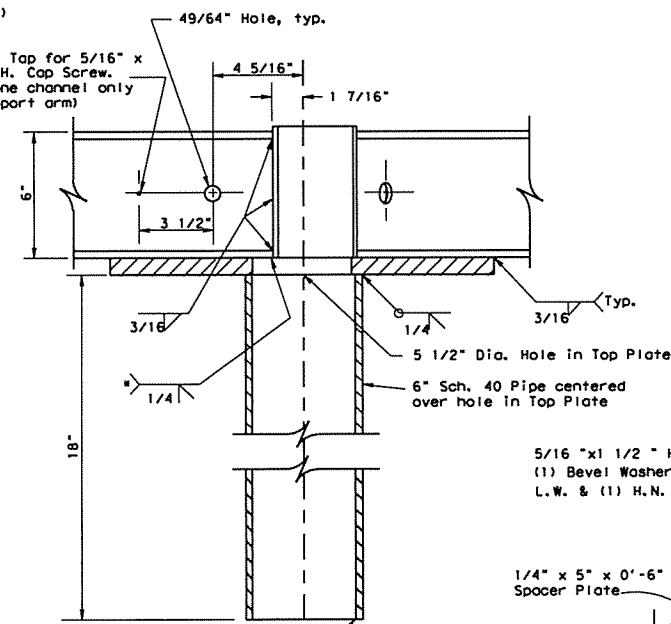
PLAN VIEW



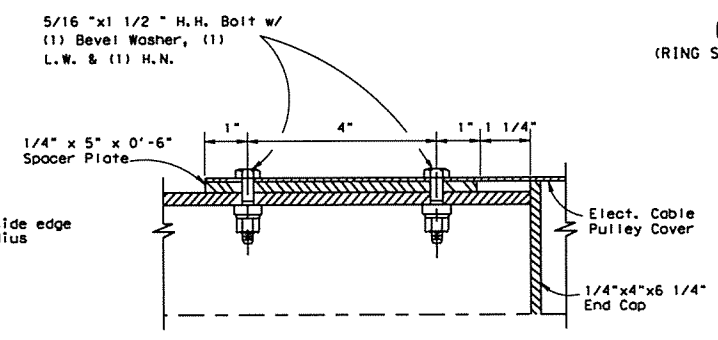
**SECTION "H-H"
PULLEY MOUNTING FOR
RING SUPPORT ARMS**



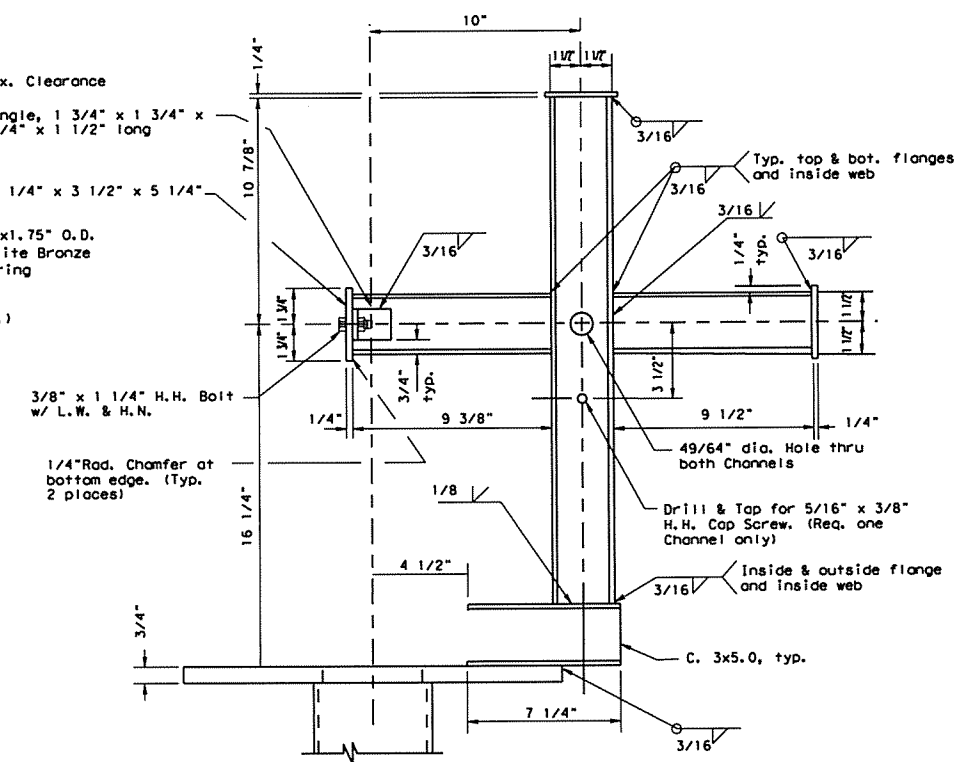
**DETAIL "F"
RING SUPPORT ASSEMBLY
(NEAR SIDE SUPPORT ARM & ELECT. CABLE
PULLEY COVER NOT SHOWN FOR CLARITY)**



SECTION "E - E"



DETAIL "N"



**DETAIL "L"
ELECT. CABLE PULLEY SUPPORT
(RING SUPPORT ARMS NOT SHOWN FOR CLARITY)**

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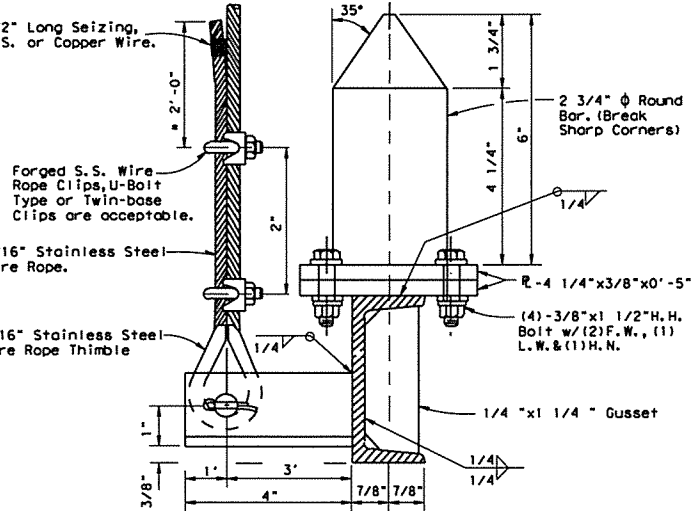
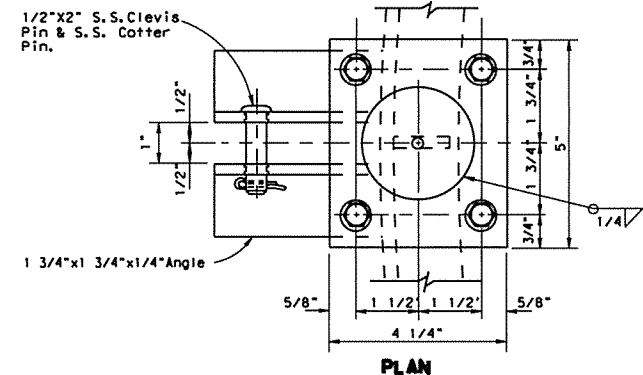
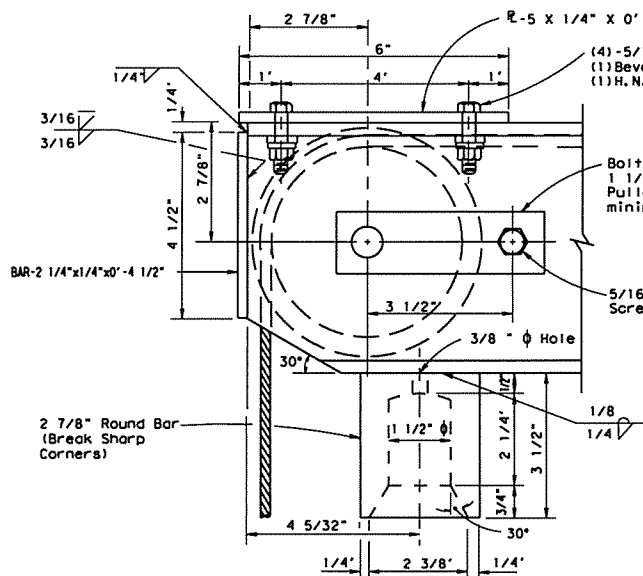
HIGH MAST
 ILLUMINATION
 DETAILS

HMID (2) - 03

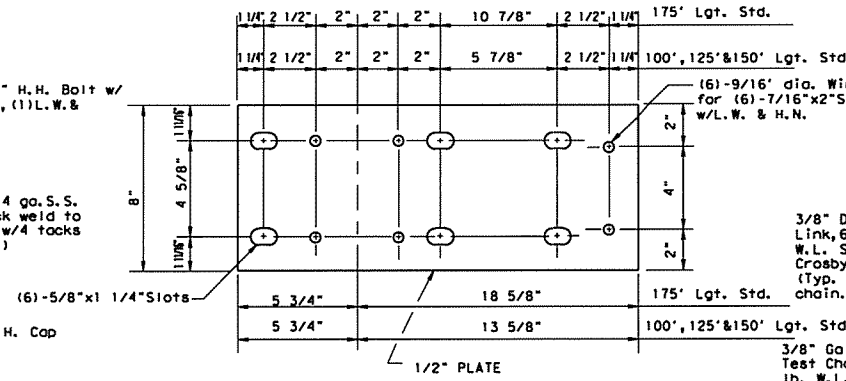
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5-87					
12-87					
		DIST	COUNTY		SHEET NO.
		HOU	HARRIS, etc.		26

DATE: FILE:

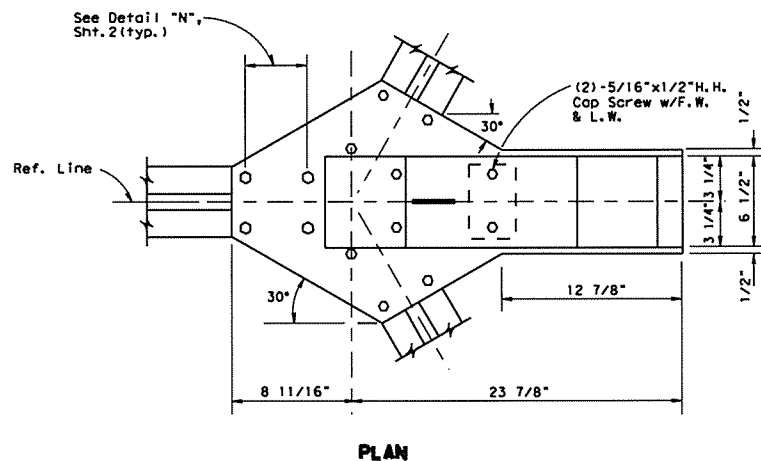
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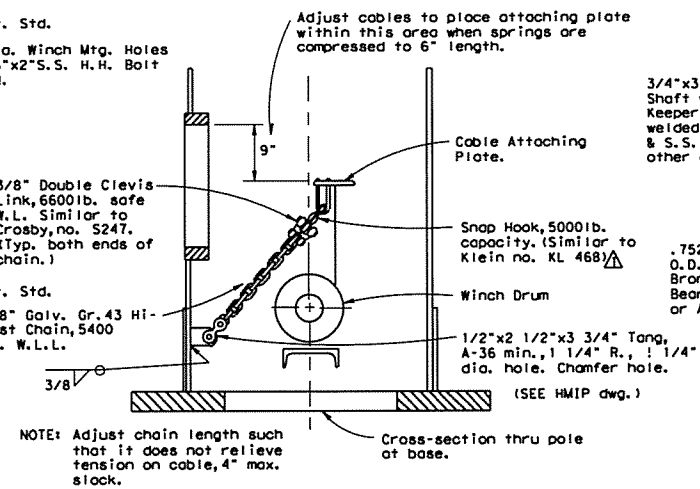
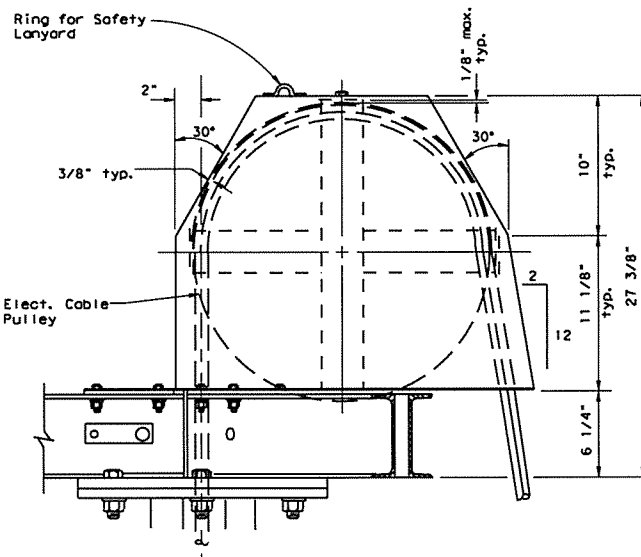
* EXTRA 2'-0" of wire cable to be attached to ring with SS Bands as directed by Engineer.



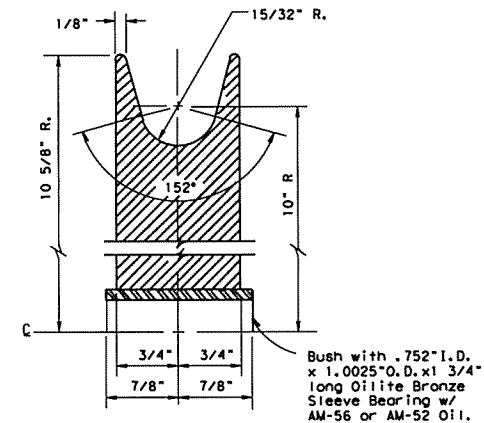
NOTE: Dimensions may vary-Verify with winch manufacturer.



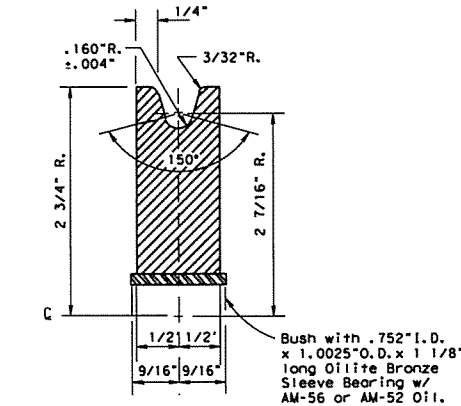
NOTE: Cover to be 14 ga. galv. sht. metal or 0.10" anodized aluminum sheet.



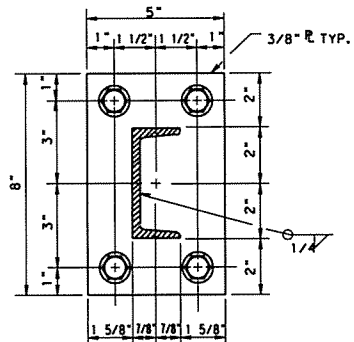
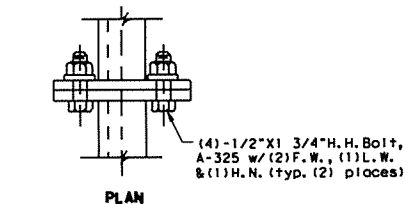
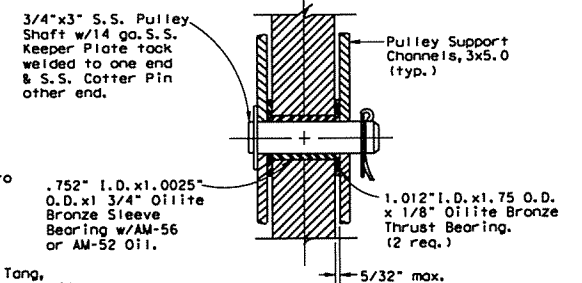
NOTE: Adjust chain length such that it does not relieve tension on cable, 4" max. slack.



(Pulley material to be aluminum alloy, Type 356-T6 or equal)



(Pulley material to be plated steel or Stainless Steel)



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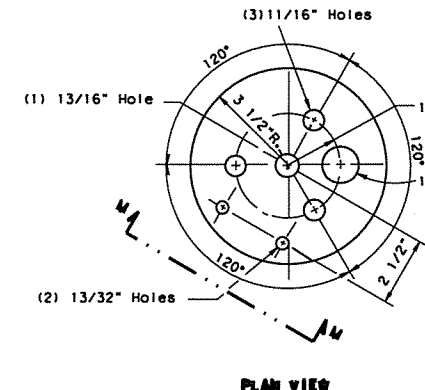
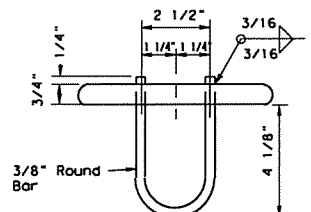
HIGH MAST ILLUMINATION DETAILS

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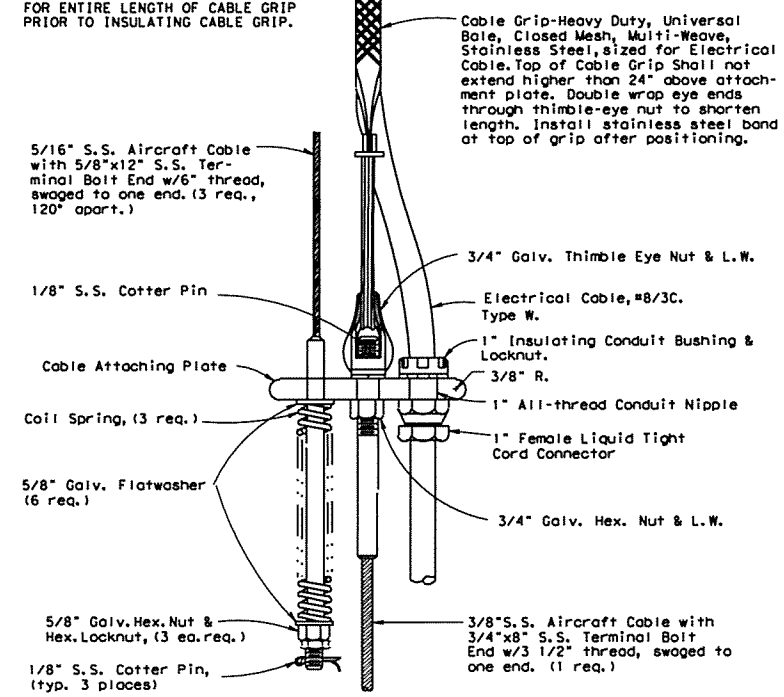
REVISIONS		DATE	BY	CHK	APP
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5-10-86		4-96			
10-87					
10-88					

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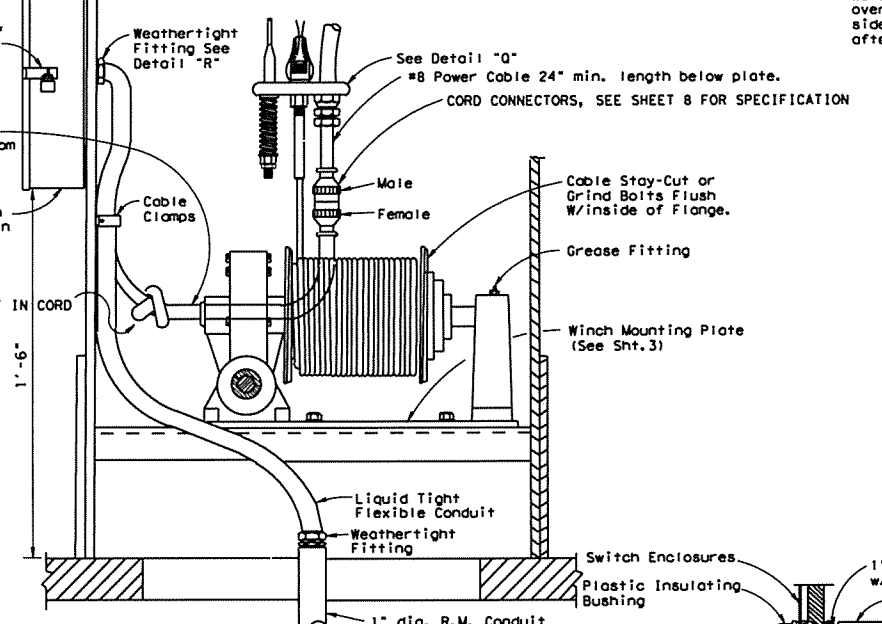
COVER CABLE WITH HEAT SHRINK TUBING FOR ENTIRE LENGTH OF CABLE GRIP PRIOR TO INSULATING CABLE GRIP.



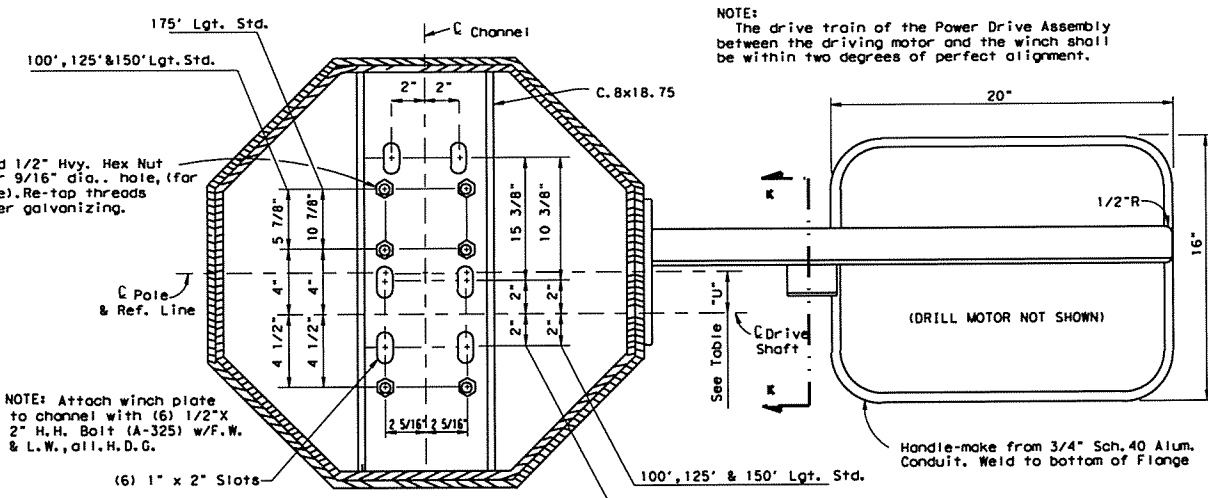
DETAIL "O"
(CABLE ATTACHING PLATE)

NOTE: 3/8" Cable for this Project shall be 19x7 Rotation Resistant per Sheet 9.

50 A 480V. Circuit Breaker, NEMA 4 for total lamp watts exceeding 9000, 30A, 480V. Circuit Breaker, NEMA 4 for 9000 or less total lamp watts. Enclosure shall be stainless steel, 14 ga., weatherproof with full length vertical door hinge, welded hasp, lock and two sets of keys. Hinge pin shall be tack-welded to prevent removal. Lock(Master# 2195) and keys shall be furnished by the contractor and shall be the same type as used for the service enclosures. Enclosure dimensions shall be approx. 20" high x 9" wide x 5" deep. Attach enclosure with (4) 1/4" S.S. Bolts & Nuts w/ 1/4" Spacers Breakers are to be mounted on a dielectric mounting board or high voltage insulating paper.



SECTION J-J
(WINCH ASSEMBLY)

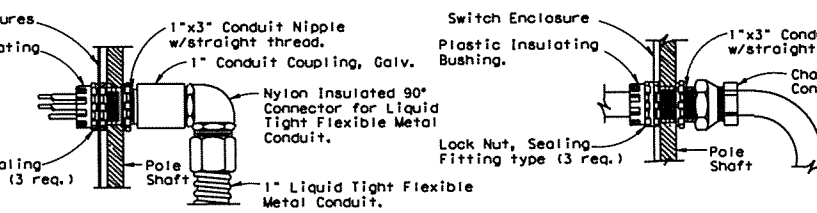


DETAIL "P"
(WINCH MOUNTING CHANNEL)
Dimensions may vary-verify with winch manufacturer.

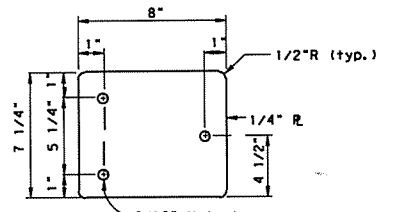
NOTE: The drive train of the Power Drive Assembly between the driving motor and the winch shall be within two degrees of perfect alignment.

TABLE OF "U" DIMENSIONS

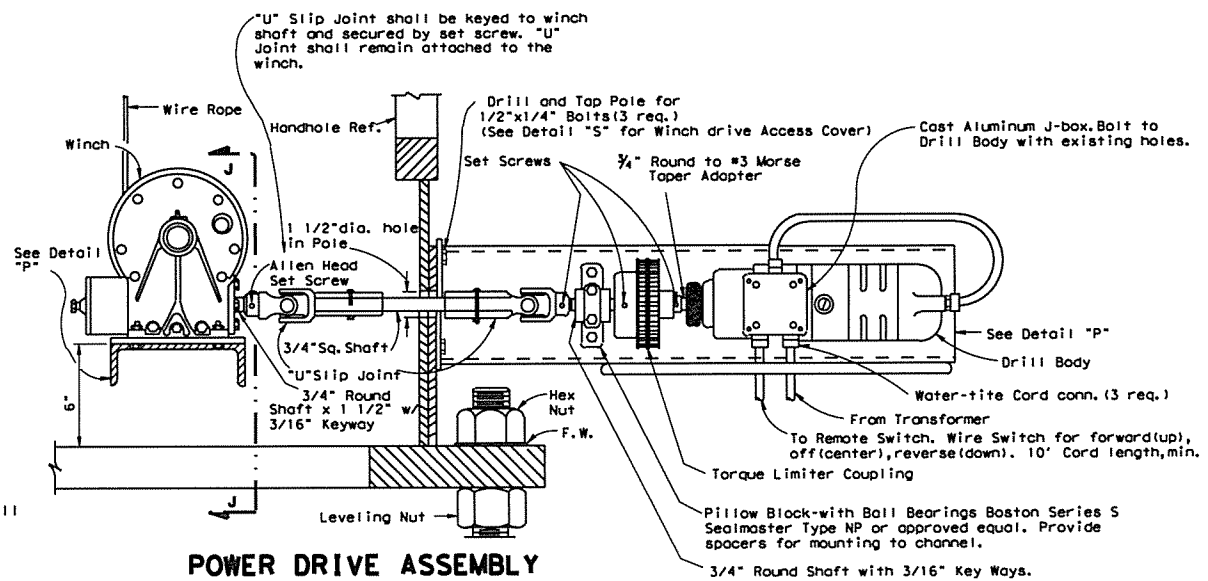
Pole Ht. Ft.	8 Sided 80 MPH	8 Sided 100 MPH	12 Sided 80 MPH	12 Sided 100 MPH
100	3 1/2"	3 1/2"	2 1/2"	2 1/2"
125	3 1/2"	3 1/2"	2 1/2"	2 1/2"
150	3 1/2"	3 1/2"	2 1/2"	2 1/2"
175	4 1/2"	4 1/2"	3 1/2"	3 1/2"



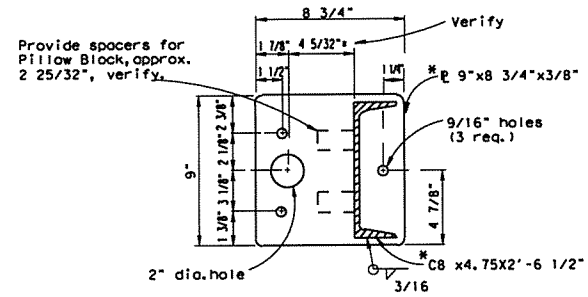
DETAIL "R"
ENCLOSURE ENTRANCES



DETAIL "S"
(WINCH DRIVE ACCESS COVER)



POWER DRIVE ASSEMBLY



SECTION K-K
(DRILL MOTOR MOUNTING PLATE)
* Make from 6061-T6 Aluminum

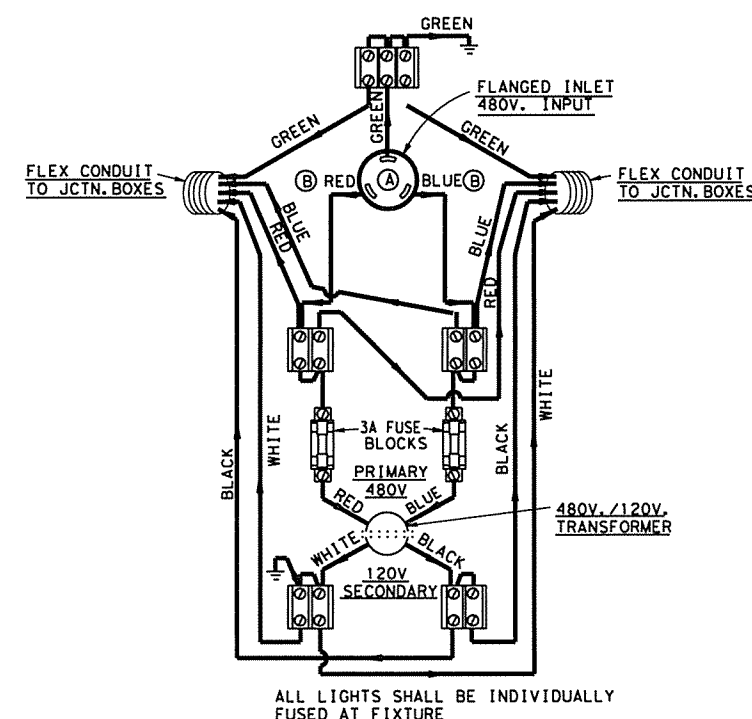
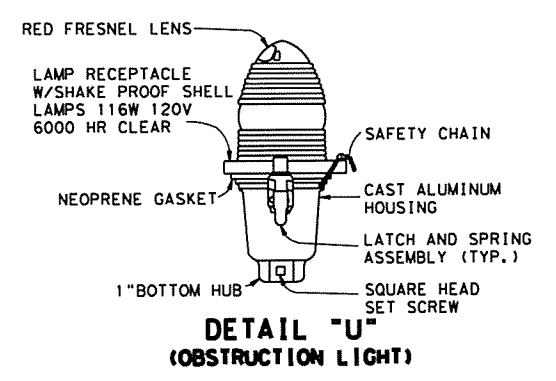
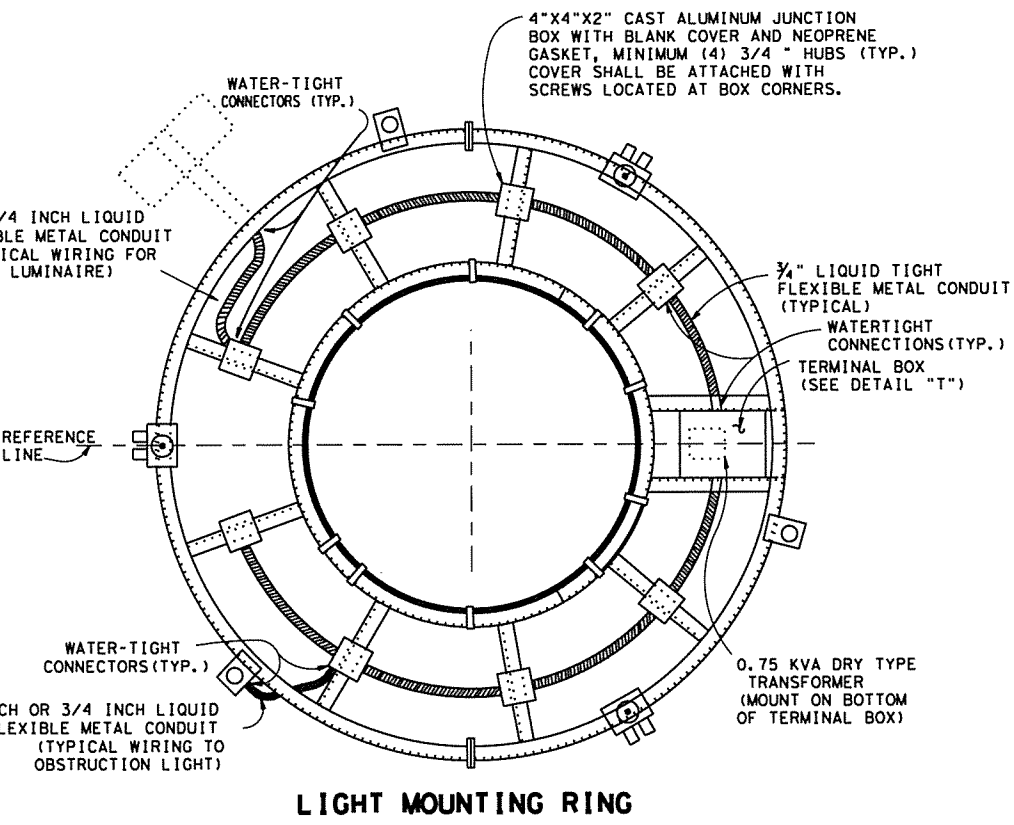
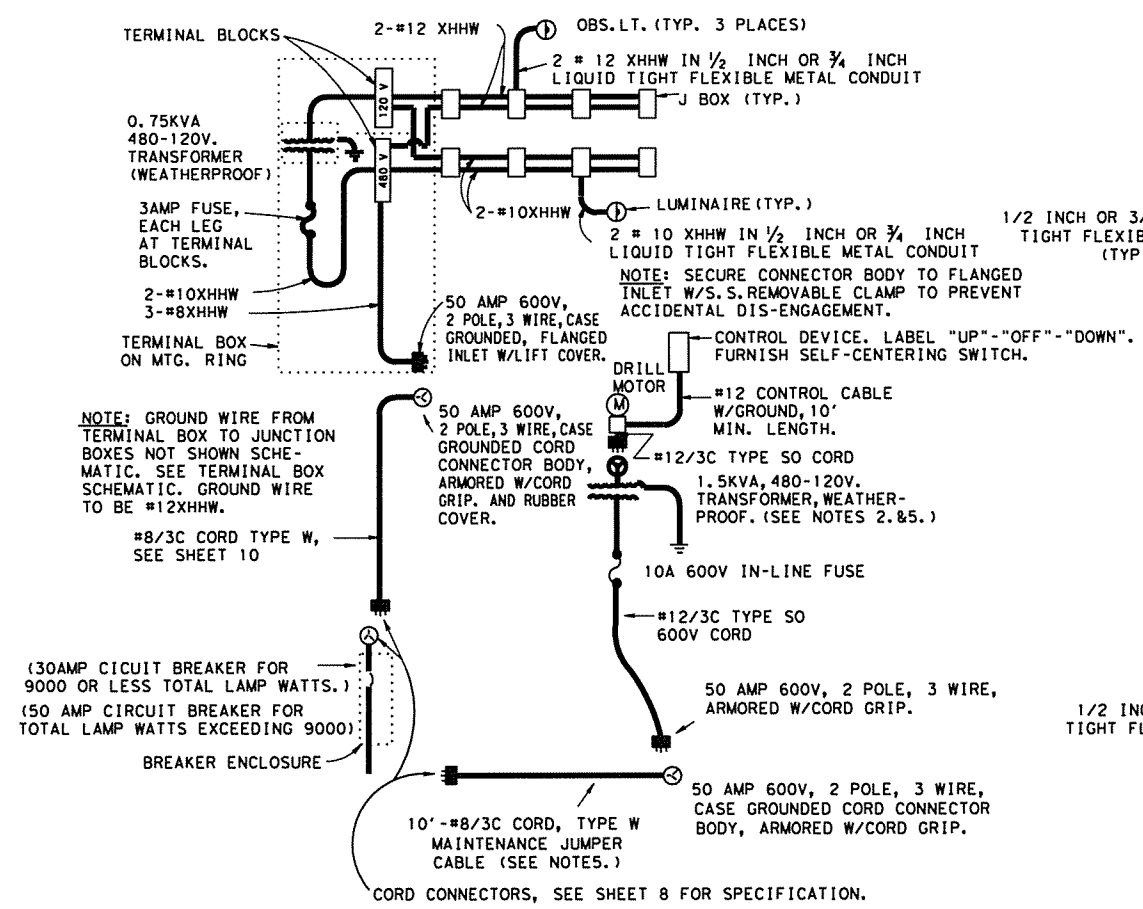
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HIGH MAST ILLUMINATION DETAILS

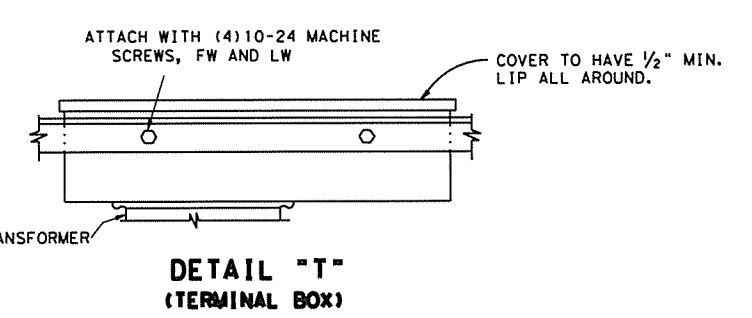
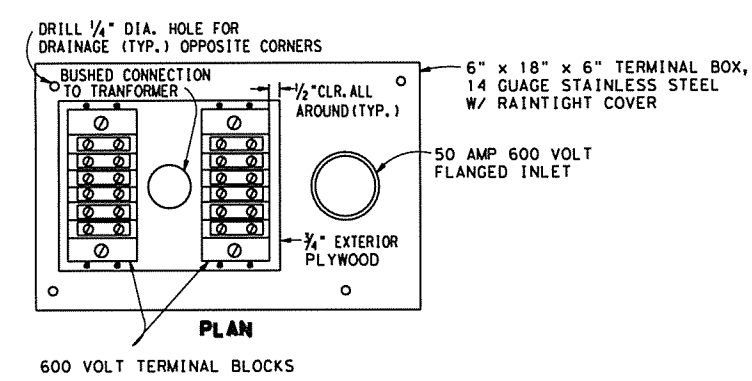
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5-86	12-87	4-96			I-610, etc.
12-3-86	10-93				COUNTY
12-8-86	10-93				SHEET NO.
					HOU HARRIS, etc.

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- NOTES:
1. OBSTRUCTION LIGHTS COLOR CODE: FROM SECONDARY SIDE OF TRANSFORMER THROUGH-OUT-CIRCUIT TO SOCKET, WHITE-NEUTRAL, BLACK-LOAD.
 2. POWER SUPPLY CORD TO FLANGED INLET: GREEN-GROUND, WHITE LINE, BLACK LINE. FROM FLANGED INLET (A) TO TERMINAL BLOCKS: GREEN-GROUND, RED LINE, BLUE-LINE. FROM THERE ON ALL 480V. CIRCUIT WIRES TO BE RED AND BLUE TO JUNCTION BOXES.
 3. WIRE SIZE FROM POWER SUPPLY TO TERMINAL BLOCKS SHALL BE #8 AWG-SEE (C).
 4. WIRE SIZE FROM TERMINAL BLOCKS TO JUNCTION BOXES SHALL BE #12 AWG.
 5. MOUNT TERMINAL BLOCKS ON 3/4" EXTERIOR GRADE PLYWOOD.
 6. FOR 2-WIRE, 480V. SERVICE, OMIT FUSE IN GROUNDED CONDUCTOR IN LEADS TO TRANSFORMER.



- NOTES:
1. PLUGS, CONNECTOR BODIES AND FLANGED INLETS AT CORD TO RING CONNECTION SHALL BE "TWIST LOCK" TYPE, 3-PRONG, RATED 50 AMPS AT 600V, AND 20 AMPS FOR 120 V. 50 AMP CONNECTORS SHALL BE 3 WIRE CASE GROUNDED, ARMORED, WITH CORD GRIP, 20 AMP CONNECTOR SHALL BE 3 WIRE GROUNDING WITH CORD GRIP, NEMA TYPE L5-20.
 2. PROVIDE HANDLE ON 1.5KVA TRANSFORMER FOR PORTABILITY. (SEE ONE-LINE SCHEMATIC)
 3. CIRCUIT BREAKERS SHALL BE ITE #E43B030 OR #E43B050, SQUARE "D" #FAL24030 S/N OR #FAL24050 S/N, OR EQUAL.
 4. CONDUIT ENTRIES INTO TERMINAL BOX SHALL BE INTO THE SIDE OF THE BOX.
 5. A MINIMUM OF ONE (1) MAINTENANCE JUMPER CABLE SHALL BE SUPPLIED FOR EACH PROJECT. SUPPLY ONE (1) PORTABLE TRANSFORMER FOR EACH POWER DRIVE UNIT REQUIRED FOR PROJECT.

Texas Department of Transportation

 Traffic Operations Division

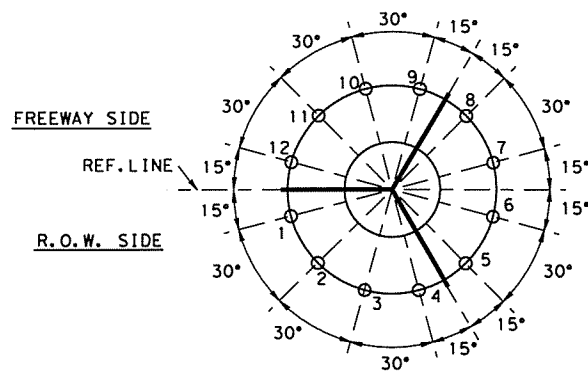
HIGH MAST ILLUMINATION DETAILS

HMID (5) -03

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6-87	REVISIONS	CONT	SECT	JOB	HIGHWAY
11-87	4-96	6459	93	001	1-610, etc.
10-88		DIST		COUNTY	SHEET NO.
10-93		HOU		HARRIS, etc.	29

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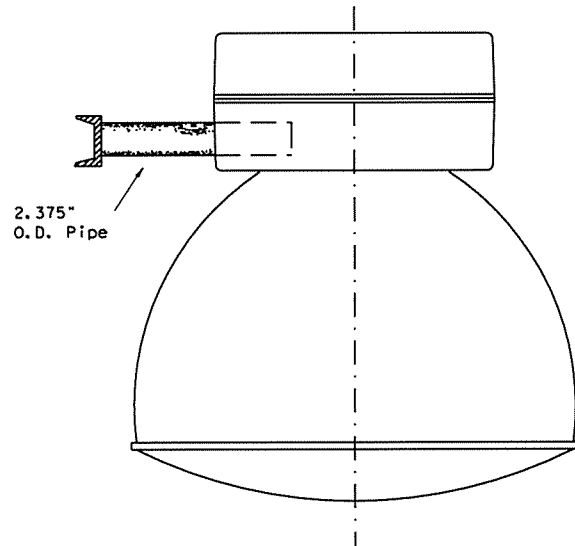
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12-LIGHT SETTING

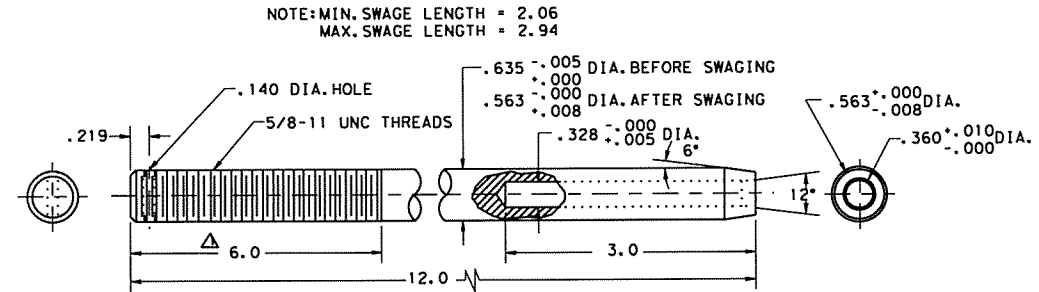
LUMINAIRE LOCATIONS

NOTE: AIRCRAFT OBSTRUCTION LIGHT LOCATIONS NOT SHOWN. THREE ARE REQUIRED LOCATED APPROX. 120° APART. LOCATIONS WILL VARY DEPENDENT ON THE LIGHT SETTING USED.



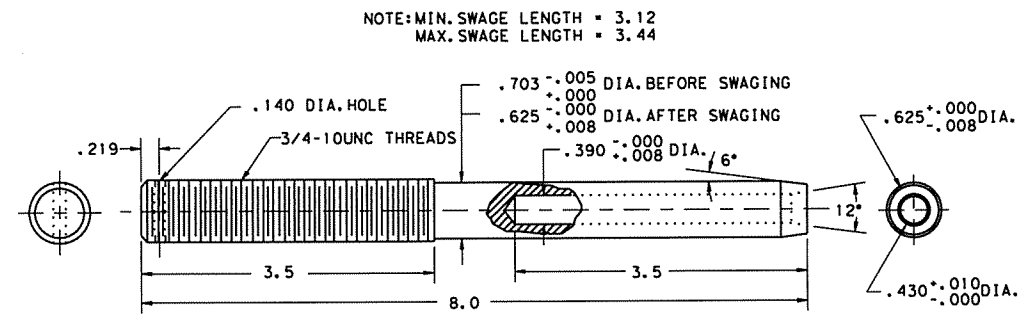
**AREALIGHT MOUNTING ASSEMBLY
(SYMMETRIC AND ASYMMETRIC)**

NOTES: IF ASYMMETRIC FIXTURES ARE USED, THE REFRACTORS SHALL BE ORIENTED TO PROPERLY ILLUMINATE THE ADJACENT ROADWAYS. ORIENTATION SHALL BE AS SHOWN IN PLANS.



NOTE: MIN. SWAGE LENGTH = 2.06
MAX. SWAGE LENGTH = 2.94

TERMINAL FOR 3/8" WIRE ROPE
MATERIAL: STAINLESS STEEL, TYPE 303SE OR 304
WITH 115,000 P.S.I. MAX. ULTIMATE TENSILE STRENGTH.



NOTE: MIN. SWAGE LENGTH = 3.12
MAX. SWAGE LENGTH = 3.44

TERMINAL FOR 3/8" WIRE ROPE
MATERIAL: STAINLESS STEEL, TYPE 303SE OR 304
WITH 115,000 P.S.I. MAX. ULTIMATE TENSILE STRENGTH.

GENERAL NOTES:

- AFTER FINAL AIMING HAS BEEN COMPLETED AND APPROVED BY THE ENGINEER, FIXTURES MUST BE LOCKED IN POSITION. CONTRACTOR MUST SUBMIT PROPOSED LOCKING SCHEME WITH THE FIXTURE SUBMITTAL. (FLOODLIGHTS ONLY).

3/03 Revision
 Removed obsolete diagrams and updated drawings.

Texas Department of Transportation
 Traffic Operations Division

**HIGH MAST
ILLUMINATION
DETAILS**

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1. AREA LIGHTING (Bid under Item 614, "High Mast Illumination Assemblies")

- A. Area lighting shall be symmetric or asymmetric, as shown on the descriptive code. The number and wattage of the fixtures on each pole shall be as shown on the lighting layouts. The lighting pattern for symmetric fixtures shall be IES Type V; for asymmetric fixtures, it shall be IES Type II, III, or IV.
- B. All luminaires shall be pre-qualified before installation. A sample of each type of luminaire to be considered for pre-qualification shall be submitted to TxDOT's Traffic Operations Division - Traffic Engineering Section (TRF-TE).

Traffic Operations Division - TE
Texas Department of Transportation
125 East 11th Street
Austin, TX 78701-2483

Sample luminaires are non-returnable. A list of pre-qualified luminaires may be obtained by contacting TRF-TE. In addition, luminaires will be sampled and tested in accordance with Item 614. Luminaires that inconsistently pass testing or that are inconsistent with published photometric information will be removed from the pre-qualified list at the discretion of the Engineer. Once a fixture has been approved, no changes shall be made in any material or manufacturing methods without prior approval of the Department. Unapproved changes will result in rejection of all fixtures.

- C. Symmetric and Asymmetric fixtures shall meet the following requirements unless otherwise approved by the Engineer:

1. Luminaire Construction

- a) The luminaire housing shall be formed, cast or drawn from low copper aluminum and shall be free of cracks and excessive porosity. Formed aluminum shall have a minimum thickness of 0.090, and shall have all seams welded. The minimum thickness of cast parts shall be as approved by the Engineer. Nuts, screws, and washers shall be made of Type 316 stainless steel. The housing shall be marked with minimum 2" letters to indicate the photometric type as being either A, B, C, or S as specified. Marking shall be permanent and shall be by stencil or stick on labels similar to "wattage" label on cobra heads. Wattage label will not be required on high mast fixtures. The fixture housing shall be constructed separate from the fixture reflector.
- b) Fixtures shall be natural aluminum in color or shall be painted gray.
- c) The slipfitter shall securely attach the luminaire to the tenon on the ring assembly with a minimum of 2 bolts and clamp. A positive means of vertical adjustment shall be provided.
- d) For optical assemblies with lenses, reflectors shall be polished aluminum with Alzak or equal coating and shall not be painted. The optic assembly shall be sealed. The lens shall be tempered glass or prismatic glass, either flat or sag. The optic assembly shall be provided with a resilient seamless or sonically welded silicone rubber gasket, and constructed so that a positive seal against weather and other contaminants will be maintained. The latches shall be stainless steel, spring loaded, and hand operated (2 latches minimum, 3 attachment points), and shall provide a positive means of maintaining closure of the luminaire.
- e) For optical assemblies without lenses, optical assembly shall consist of an open ventilated borosilicate glass reflector. The reflecting prisms shall be protected from dirt depreciation by a spun on hermetically sealed aluminum cover. There shall be no glass lens/refractor on this optical assembly.
- f) Asymmetric fixtures shall have field rotatable optics with accurate degree of rotation markings. Reflector shall have "house side" and "street side" markings.
- g) The socket shell shall be nickel plated and shall be rigidly attached to a high grade porcelain mogul base, which shall extend and enclose the metal shell. A locking means shall be incorporated in the shell of the socket to positively resist the removal of the lamp. This locking means shall be a spring loaded center tip. Lamp socket shall be non-adjustable and shall be riveted, welded, or otherwise permanently installed. Lamps shall be held securely in the proper position with a lamp support.
- h) The terminal block shall use nickel plated brass connectors.
- i) Fixture weight including ballast shall not exceed 80 pounds, and effective projected area (EPA) shall not exceed 2.62 square feet.
- j) The Contractor may be responsible for fixture testing costs. See TxDOT's "Manual of Testing Procedures," Chapter 11 - "Traffic Systems and Illumination," TEX-1110-T - "Sampling Lighting Assemblies," at <http://manuals.dot.state.tx.us/dynaweb/>.

2. Photometrics

- a) The Contractor shall submit a computer generated light level array of the area to be lighted by high mast poles. All computer generated arrays shall have 400 watt fixtures derated to 40,000 lumens per lamp.
- b) The Type "A" 400 watt asymmetric fixture shall be IES cutoff. The Department will use the measured photometric data of sampled fixtures to run the following tests on a computer simulation:

- (1) When mounted in the level position, 50 ft. above the midpoint and 20 ft outside of either long side of a rectangular area measuring 340 ft. by 50 ft., the fixture shall pass the following tests:

- (a) The fixture shall provide a measured minimum intensity of 0.15 horizontal foot-candles at any point on the surface of this area.
- (b) The fixture shall provide a measured maximum to minimum light ratio, based on horizontal foot-candles, of less than 25.
- (c) The fixture shall provide an average measured intensity of 0.6 horizontal foot-candles on the surface area.

- (2) When mounted in the level position, 50 ft. above the midpoint and 20 ft outside of either long side of a rectangular area measuring 260 ft. by 30 ft., the fixture shall provide a measured minimum intensity of 0.30 horizontal foot-candles at any point on the surface of this area.

- c) The Type "B" 400 watt asymmetric fixture shall be IES cutoff. The Department will use the measured photometric data of sampled fixtures to run the following tests on a computer simulation:

- (1) When mounted in the level position, 50 ft. above the midpoint and 20 ft outside of either long side of a rectangular area measuring 260 ft. by 65 ft., the fixture shall pass the following tests:

- (a) The fixture shall provide a measured minimum intensity of 0.15 horizontal foot-candles at any point on the surface of this area.
- (b) The fixture shall provide a measured maximum to minimum light ratio, based on horizontal foot-candles, of less than 25.
- (c) The fixture shall provide an average measured intensity of 0.6 horizontal foot-candles on the surface area.

- (2) When mounted in the level position, 50 ft. above the midpoint and 20 ft outside of either long side of a rectangular area measuring 200 ft. by 40 ft., the fixture shall provide a measured minimum intensity of 0.30 horizontal foot-candles at any point on the surface of this area.

- d) The Type "C" 400 watt asymmetric fixture shall be IES cutoff. The Department will use the measured photometric data of sampled fixtures to run the following tests on a computer simulation:

- (1) When mounted in the level position, 50 ft. above the midpoint and 20 ft. outside of either long side of a rectangular area measuring 220 ft. by 80 ft., the fixture shall pass the following tests:

- (a) The fixture shall provide a measured minimum intensity of 0.15 horizontal foot-candles at any point on the surface of this area.
- (b) The fixture shall provide a measured maximum to minimum light ratio, based on horizontal foot-candles, of less than 25.
- (c) The fixture shall provide an average measured intensity of 0.6 horizontal foot-candles on the surface area.

- (2) When mounted in the level position, 50 ft. above the midpoint and 20 ft. outside of either long side of a rectangular area measuring 160 ft. by 50 ft., the fixture shall provide a measured minimum intensity of 0.30 horizontal foot-candles at any point on the surface of this area.

- e) The Type "S" 400 watt Symmetric fixture shall be IES cutoff. The Department will use the measured photometric data of sampled fixtures to run the following tests on a computer simulation:

- (1) When mounted in the level position at 50 foot mounting height, the fixture shall provide the minimum light levels as shown below:

- (a) 0.15 horizontal foot-candles within a 130 foot radius.
- (b) 0.30 horizontal foot-candles within a 100 foot radius.
- (c) 0.50 horizontal foot-candles within a 60 foot radius.

3. Ballasts

- a) All ballasts shall be isolated-winding lag-type magnetic regulators designed to operate 400 watt high pressure sodium lamps rated 480 volts. Ballasts shall be capable of starting lamps at an ambient temperature of -20 degrees F. Ballast wiring shall include a grounding terminal bonded to metal housing. Ballasts shall be fused with a 5 amp time-delay fuse in an insulated fuse holder. Fuse holders shall be internal to the housing. Ballast wiring to the terminal board shall be through a quick-disconnect plug. Windings shall be made from copper wire.

- b) When the circuit voltage indicated on the plans is applied, the ballast input wattage during fluctuations of the test voltage of +10% and -10% shall not exceed 552 watts for a 400 watt HPS lamp.

3/03 Revision

Revised Area Lighting Requirements

 Texas Department of Transportation
Traffic Operations Division

HIGH MAST ILLUMINATION DETAILS

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- c) During fluctuation of the line voltage of +10% or -10%, the lamp wattage fluctuation shall not exceed a total of 20%. Ballast shall maintain lamp wattage between 280 and 475 watts for a 400 watt HPS lamp.
- d) The power factor of any ballast when tested at the circuit voltage indicated in the plans shall not be less than 90% at any point in life. Ballast factor shall be between .95 and 1.0.
- e) The electronic starting aid shall provide a starting pulse with an amplitude of 2500 volts minimum, 4000 volts maximum. The pulse width shall be a minimum of 0.8 microseconds at 2250 volts. The pulse shall occur when the open-circuit voltage is equal to or greater than 90 percent of peak open-circuit voltage. Pulse repetition rate shall be a minimum of one per cycle and pulse current shall be a minimum of 0.18 amperes. Electronic starting aids shall be replaceable without the use of tools. The starting aid shall discontinue to pulse when the lamp starts. Starter shall sense an inoperative or missing HPS lamp and automatically shut down luminaire to protect ballast after 10 minutes.
- f) Ballasts shall permanently and clearly indicate the following: lamp type, catalog number, voltage rating, connection diagram, and manufacturer. Capacitors in all luminaires shall be non-PCB type.

4. Lamps

- a) All lamps shall be new and of recent manufacture.
- b) Lamps shall be high pressure sodium and shall meet ANSI C78 requirements. Lamps shall be the type that extinguish at the end of usable lamp life and remain extinguished without cycling. 400 watt lamps shall contain less than 4.0 mg of mercury. Lamps shall be lead free and shall pass the Federal Toxic Characteristic Leachate Procedure (TCLP). Lamp shall be Osram-Sylvania LU400/Eco Plus. No alternatives will be approved.
- c) 400 watt high pressure sodium lamps shall have average initial lumens of 50000 and average rated life of 24000 hours.

2. GENERAL

- A. All material shall be in accordance with the applicable sections of the NEC. All conduit and conductors shall be in accordance with the materials and construction methods requirements of Items 618 and 620. Heat shrink tubing for use with cable grips and cable splicing shall meet the requirements of Item 620.
- B. Where stainless steel bands are called for on the HMID sheets, stainless steel hose clamps may be provided. Stainless steel bands and stainless steel hose clamps shall be provided with stainless steel clips or stainless steel screws.
- C. Obstruction Lights
 - 1. When obstruction lights are required by layout sheets, summary sheets or general notes, the entire high mast assembly shall be controlled by an FAA approved photocell mounted inside the service enclosure. Ring mounted luminaires shall be controlled by up to 4 additional ring mounted photocells, with each photocell controlling up to 3 fixtures. Photocells shall meet the following requirements:
 - a) All photocells shall consist of a photoelectric cell, an internal lightning arrester, and a relay or bimetallic switch mounted inside a weather proof enclosure with standard 3-prong twist lock photocell plug and receptacle. The enclosure shall be made of poly-acrylic with clear acrylic window. Enclosure chassis shall be molded thermosetting plastic. The photocell shall have an arrester rated 2.0kV sparkover with 5000 amps follow-through. Relay or switch shall be time delay type with normally closed contacts. Photocell shall be rated a minimum of 1800 VA.
 - b) Service enclosure mounted photocell (FAA photocell) shall turn on at light levels below 35 foot-candles and off at levels above 58 foot-candles, in accordance with FAA requirements. This photocell shall be rated for operation at 240 volts. A permanent placard shall be installed on the inside of the service enclosure door to indicate that an FAA approved photocell is required.
 - c) High mast assembly ring mounted photocells (one foot-candle photocells) shall turn on at light levels below 1.0 (plus or minus 0.5) foot-candle, and shall turn off at 2 foot-candles higher than this level. These photocells shall be rated for operation at 480 volts. Photocells shall be mounted upright on the terminal box or on various junction boxes around the ring as approved by the Engineer. Conduit entries shall not be made into the top of the terminal box or junction boxes. The Contractor shall submit mounting details to the Engineer for approval.
 - 2. When obstruction lights are not required, eliminate the 3 obstruction light fixtures, 3 mounting posts, 480/120 volt transformer, 120 volt wiring, and 3 mounting post support connections shown on detail "E", sheet 1.

- D. The male cord connector on the lower end of the Type W cord running up the pole, the female cord connector for the Type W cord running to the circuit breaker enclosure and the male connector on the maintenance jumper shall meet the following or approved equal specifications:
 - 1. Arrow Hart pin and sleeve watertight connectors UL listed, catalog numbers AH330C7W and AH330P6W.
 - 2. Bryant watertight pin and sleeve connectors UL listed, catalog numbers 330C6W and 330P6W.

- 3. Hubble pin and sleeve connectors UL listed, catalog numbers HBL330C7W and HBL 330P7W.
- 4. The male connector for use with the Type W maintenance jumper shall be a pin and sleeve connector of one of the above types. The Contractor shall attach a 50 amp twist lock receptacle to the opposite end of the maintenance jumper to match the flange mounted plug on the ring and the portable transformer.
- 5. The Contractor shall make a brochure submittal on the cord connectors.
- E. When shown on the plans, spill light shall be restricted to less than 0.15 horizontal footcandles.
- F. The Contractor shall provide shop drawings for high mast illumination assemblies in accordance with this Item and Item 441. An Engineer licensed in the State of Texas shall seal the shop drawings.

3. TESTING

- A. Fixtures, lamps and ballasts will be sampled and tested in accordance with the Department "Manual of Testing Procedures" except as noted in these specifications.
- B. Ballasts and fixtures will be tested using a reference lamp.
- C. The Department will bear the cost of all testing of equipment that complies with the specification requirements. However, the source of supply of fixtures and ballasts must be approved as required in Article 6.1 of the Standard Specifications. Such approval will be contingent on the supplier agreeing to bear the cost of testing any equipment that fails to comply with the specification requirements listed in this specification.
- D. All other equipment will be tested in accordance with Item 614 of the Standard Specifications and Materials and Test Division Test Standards.
- E. After High Mast Assembly has been completely assembled, the Engineer may require Contractor to fully lower and raise each high mast ring one time to demonstrate proper operation of the lowering mechanism, or may require the ring to be lowered for ring or fixture inspection. If any malfunction occurs, the problem shall be corrected at the Contractor's expense and the lowering test will be repeated.

4. MOUNTING RING AND SUPPORT ASSEMBLY

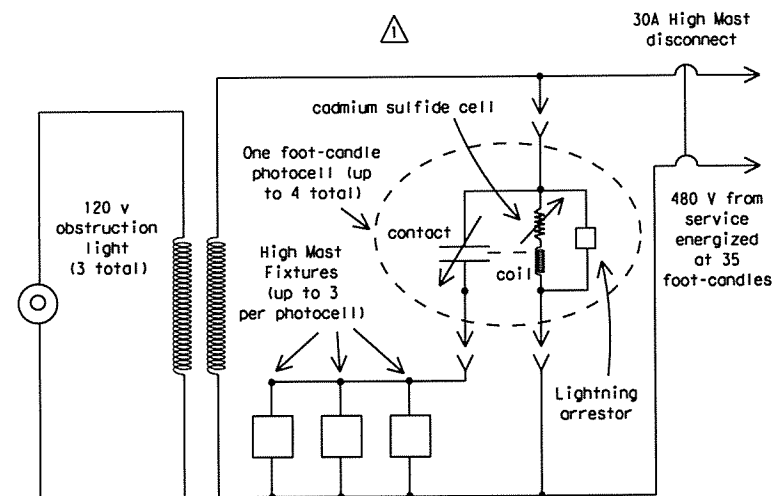
- A. Ring and support assembly shall be fabricated from steel having a minimum yield strength of 36 KSI.
- B. Cover assemblies, fittings and miscellaneous parts shall be as outlined on the plans.
- C. All hardware shall be hot-dipped galvanized per ASTM A153 or shall be stainless steel, unless noted otherwise on the plans.

5. WINCH

- A. Housing shall be high tensile strength die-cast silicon aluminum. Cable drum shall be fabricated from seamless steel tubing with stamped steel flanges and shall be hot-dipped galvanized. Drum shall have a minimum diameter of 4.5 inches. Drum shall be keyed to drum shaft. Drum and flanges shall be sized so that, when the fixture mounting ring is in the raised position, the cable including one full layer will fill the drum to no more than two-thirds of full capacity. Drum shaft shall be ground from stainless steel and mounted on lubricated bronze bearings with seals. Wormgear shall be made of nickel-bronze and worm shaft shall be high-strength stress-proofed steel, ground and polished and supported by tapered roller bearings.
- B. Gear ratio shall be 36:1 with safe hoisting capacity of not less than 4000 pounds.
- C. Winch shall incorporate adjustable automatic brake to assure positive load suspension. Brake shall be multiple disc with friction plates running in oil bath and one-direction clutch which operates only when load is suspended or lowered. Winch shall not have throw-out clutch.
- D. Any winch that is operated without oil shall be considered damaged and shall be replaced by the contractor at the contractor's expense.

6. WIRE ROPE AND TERMINALS

- A. 5/16 and 3/8 wire rope shall be 19x7 Rotation Resistant IWRC stainless steel. 19x7 rotation resistant wire rope shall meet the construction requirements of Fed. Spec. RR-W-410D, Type IV, class 2, modified for stainless steel with a nominal breaking strength of 11,100 lbs. All wire rope shall be pre-formed and factory lubricated. Wire rope shall meet the requirements of the applicable specification except where modified by this specification. Quality Assurance testing shall be the responsibility of the manufacturer and shall meet recognized wire rope industry standards. No special tensile or torsion testing will be required. Mill Test Reports shall be furnished.
- B. Winch cable shall be of sufficient length to leave a minimum of one full layer of cable on the drum when the fixture mounting ring is in the full down position.
- C. Wire rope terminals shall be stainless steel, solid stud type as shown on Sheet 7. All terminals shall be drilled for cotter pin. Material to be 303 SE or 304 stainless steel with a maximum tensile strength of 115,000 p.s.i. Mill Test Reports shall be furnished.



One foot-candle photocell keeps High Mast fixtures off when FAA photocell energizes circuit at 35 foot-candles. Fixtures come on when sun goes down at 1 foot-candle.

One Foot-candle PhotoCell Schematic

Use on ring when obstruction lights are installed and FAA photocell is installed in electrical service.

3/03 Revision

- ▲ Revised General requirements; add diagram
- ▲ Revised Wire Rope and Terminals

Texas Department of Transportation
Traffic Operations Division

HIGH MAST ILLUMINATION DETAILS

HMID (8) -03

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D. All terminals shall be proof-tested by the manufacturer to 40% of rated strength of the wire rope. Each terminal shall be identified by manufacturer's logo permanently incised on terminal. Manufacturer shall furnish certification of tests. Contractor shall also furnish one sample of each size of terminal with 5 ft. of wire rope for load tests by the State. Samples tested must withstand test load not less than 100% of rated breaking strength of wire rope. If sample fails test, all terminals of same size will be rejected.

E. Wire rope shall be delivered from the manufacturer on a reel.

7. SPRINGS

A. Provide three steel springs as shown on plans.

B. Springs shall have an uncompressed length of approximately 8 inches and shall compress 3 inches under 700-pound load.

C. Springs shall contain approximately 19 total coils with ID of 0.875 and OD of 1.375 inches. Ends shall be closed and ground. Springs shall be zinc-plated.

D. Springs shall be made from 1/4" diameter oil-tempered MB Steel treated for overstress. Springs shall not develop permanent set from 3-inch compression.

8. ELECTRICAL POWER CABLE

A. Power cable shall be No. 8 AWG three-conductor round Type W, rated 90 degrees C, 600 volt or 2000 volt. Each conductor shall be tinned copper and shall consist of 133 strands. Insulation shall be ethylene propylene rubber. Jacket shall be chlorosulfonated polyethylene (CSPE), with glass fiber or nylon reinforcing mesh between two layers of CSPE. Nominal diameter shall be 0.91". Filler shall be rubber compound or other approved non-hygroscopic compound. Jacket shall be Hypalon Power Flex 90, with no substitutions allowed.

9. POWER DRIVE ASSEMBLY (ONE ONLY THIS CONTRACT UNLESS OTHERWISE SHOWN ELSEWHERE ON THE PLANS)

A. Drive Motor

1. Drive motor shall be 1-1/4" heavy-duty reversible portable electric drill modified as shown on plans.

2. Shall have a minimum of 6 radial ball bearings, one thrust bearing, and one needle bearing.

3. Shall have No. 3 Morse Taper socket.

4. Shall be designed for 115 volt 60 Hertz single phase operation 250 RPM at no load.

5. Shall be designed for continuous rated duty of 160 RPM and 15 amperes at 115 volts with delivery of 33-pound-feet of torque. Drill motor to be operated only at low speed range. (i.e. 150 to 160 RPM)

6. Shall develop 240 pound-feet of torque at stalled rotor condition.

B. Torque Limiter Coupling

1. Torque limiter coupling shall consist of standard torque limiter with Type A sprocket center member coupled to a Type B sprocket by an ASA double strand roller chain. Type A sprocket shall be chrome-plated.

2. Coupling shall have torque capacity minimum of 15 pound-feet and a maximum of 55 pound-feet.

3. Limiter section of coupling shall consist of integral hub and pressure plate, two friction facings, sintered iron bushing, pilot plate, disk spring, lock washer and hex adjustment nut. All major components except spring and friction facings shall be cadmium-plated with dichromate treatment.

4. Type A center sprocket shall have ground face (63 micro-inch) and shall be run-in for 4 minutes at approximately 60 RPM at a torque setting 70% to 80% of spring rating. Contractor shall provide written certification that run-in has been accomplished.

5. The torque limiter coupling shall, after run-in, be set to a torque limit of 35 pound-feet or as directed by the Engineer. The proper setting of the coupling shall be demonstrated to the Engineer.

C. Universal Joints

1. Shall be slip-type with 4-inch barrel. A grease fitting shall be so located in the spider that all caps and needle bearings may be adequately serviced. The assembly shall be disassembled and zinc-plated, then reassembled and properly lubricated.

2. Shall have a minimum torque rating of 1270 inch-pounds at 200 RPM.

3. Shall have set screw and keyed coupling as shown on plans.



10. CONSTRUCTION METHODS

A. Fabrication

1. Fabrication and welding shall be in accordance with Item 441, "Steel Structures".

2. All holes supporting pulley shafts shall be drilled (not punched) prior to galvanizing.

3. All component parts shall be galvanized where galvanizing is applicable, after fabrication.

4. Galvanizing on all parts which have become scratched, chipped or otherwise damaged shall be thoroughly cleaned and the cleaned area painted with two coats of zinc dust-zinc oxide paint conforming to the requirements of repair compounds meeting Federal Specification TT-P-641 b.

5. Mounting rings and ring support assemblies shall be fabricated with the use of jigs that have been inspected and approved by Material and Test Division personnel prior to their usage.

6. The fabricator shall submit his proposed welding procedures in accordance with Item 441, "Steel Structures".

B. Installing Wire Rope

1. Extreme care shall be used to prevent wire rope from kinking, nicking, or from sustaining other damage during installation. Rope shall not be installed by pulling from flat coil, but shall be carefully unrolled its full length or placed on a horizontal axis and unreel according to wire rope industry standards.

2. For right lay rope, the rope shall be attached to the drum on the end opposite the winch gear train, and wound on drum so that the free end of the rope comes off the backside of the drum during normal operation of the winch. Rope must be unreel carefully as stated above. Care must be taken to insure that all layers lay full and tight on drum.

3. Installation of all wire rope shall be accomplished only under direct supervision of the Engineer or his authorized representative. Contractor shall not remove wire rope from manufacturer's reel until authorized by the Engineer. Installation of wire rope on winch shall be in accordance with the above and accepted industry practice. Installation of the three hoist cables shall be made from the top end of the pole and as directed by the Engineer or his representative.

C. Installing Wire Rope Clips

1. Turn back approx. 2' 3" of rope, measured from the top of thimble. Apply seizing to pigtail end of wire rope prior to cutting to length. See detail "K", Sheet 3. Apply first clip approx. 3" from the dead end of the wire rope with U-bolt over dead end and live end in clip saddle. Tighten nuts evenly to 30 pound-feet of torque, or as recommended by manufacturer.

2. Install second clip as near loop as possible, take out slack and torque nuts evenly to 30 pound-feet or as recommended by manufacturer.

3. After final erection and assembly of the pole and high mast assembly, retighten nuts to required torque.

D. Installing Light Ring and Luminaires

1. Prior to mounting luminaires to the light ring, Contractor shall ensure the ring is level. Luminaires shall be mounted level on the light ring. Luminaires shall be oriented as shown on plans.

3/03 Revision



Revised Construction Methods.

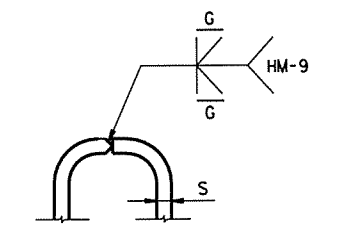
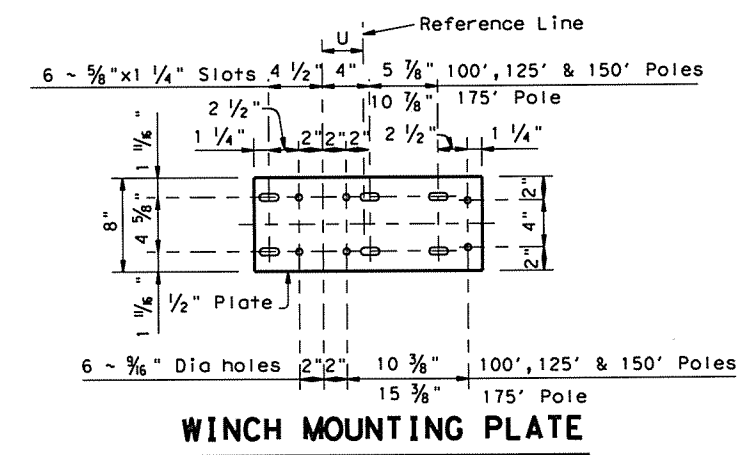
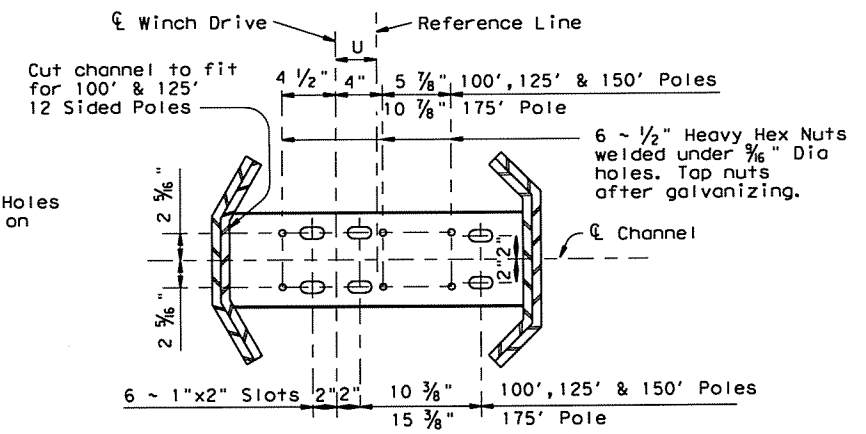
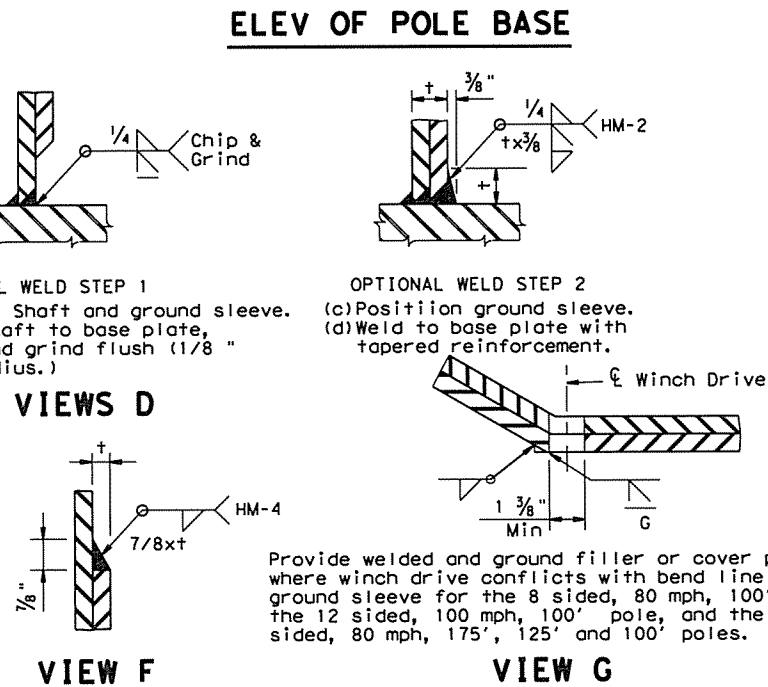
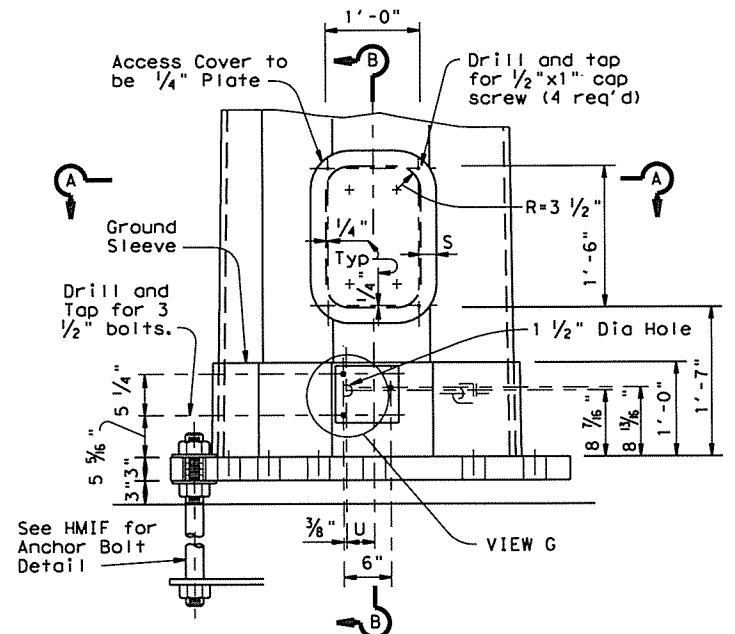
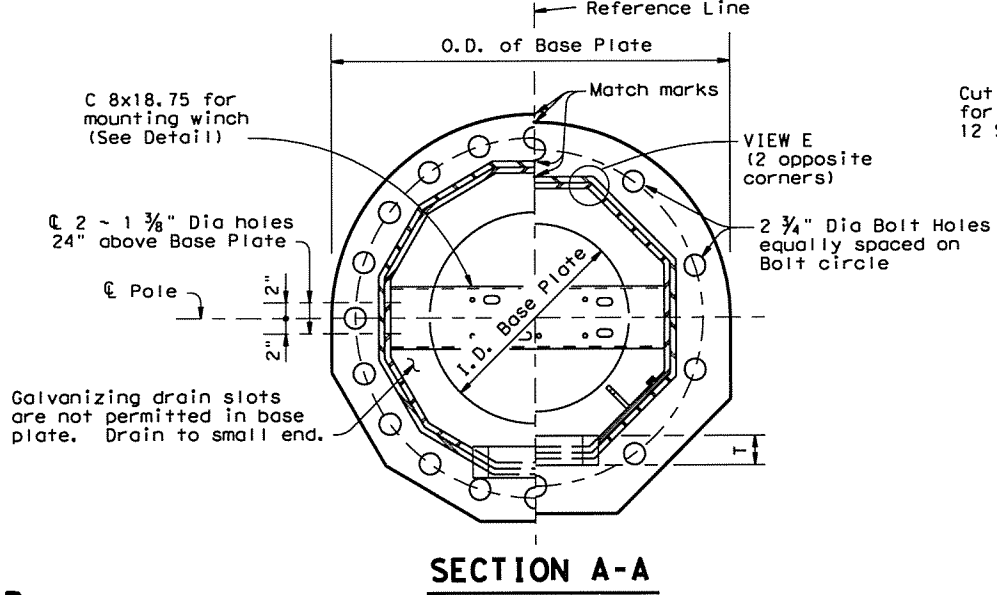
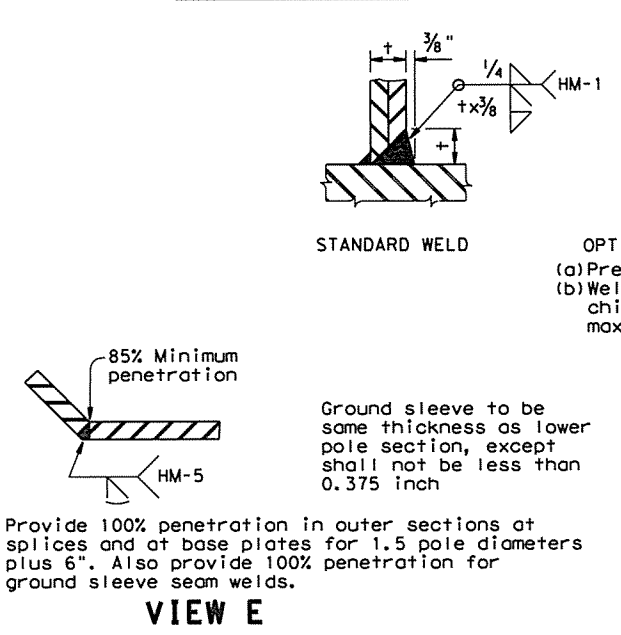
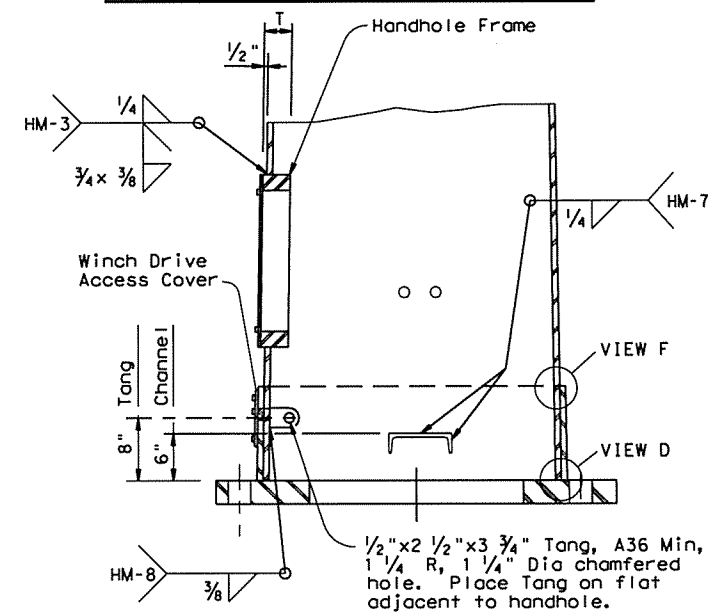
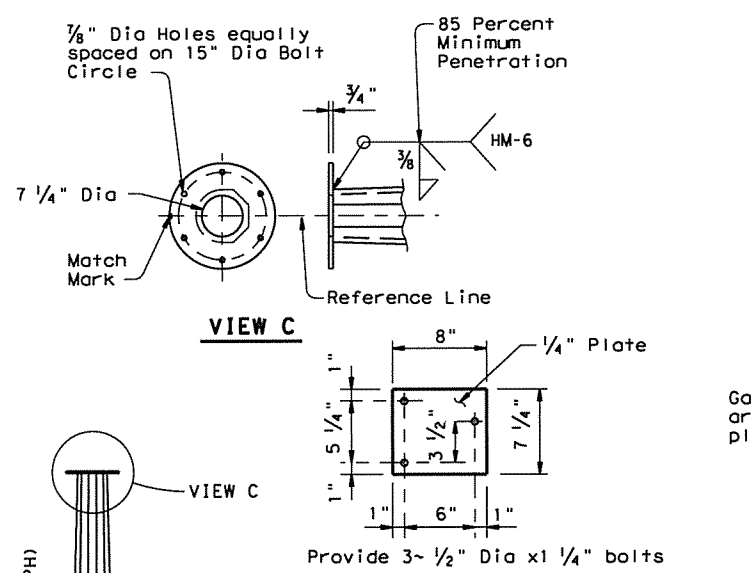
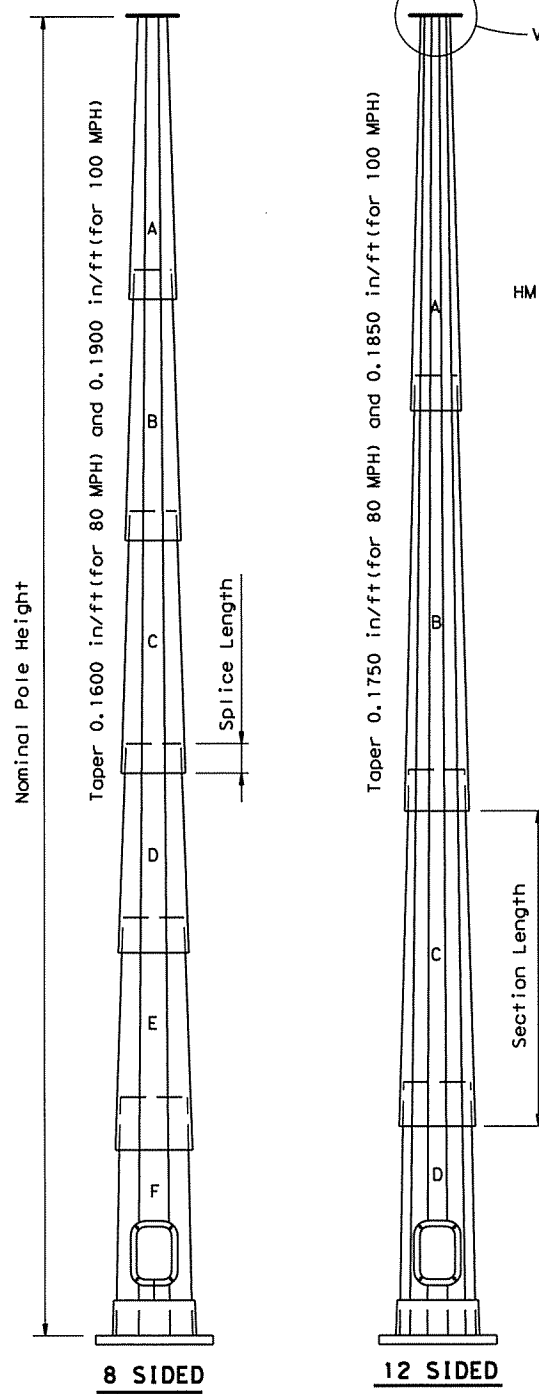
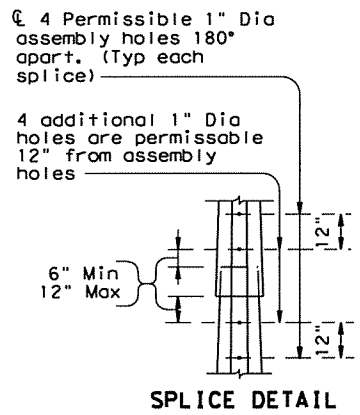
Texas Department of Transportation
Traffic Operations Division

**HIGH MAST
ILLUMINATION
DETAILS**

HMID (9) -03

© TxDOT January 1986		DN: TxDOT	CK: TxDOT	DW: TxDOT	CK: TxDOT
10-93	REVISIONS	CONT	SECT	JOB	HIGHWAY
10-95		6459	93	001	I-610, etc.
4-96		DIST	COUNTY	SHEET NO.	
3-03		HOU	HARRIS, etc.	33	

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A bent and welded handhole frame is permissible. Heating, bending, and finish grinding must be approved with the HM-9 weld procedure.

SHEET 1 OF 2

		Traffic Operations Division Standard	
HIGH MAST ILLUMINATION POLES 100' - 125' - 150' - 175'			
HMIP(1)-16			
FILE: hmip-16.dgn	DATE: August 1995	CONT: 6459	SECT: 93
© TxDOT August 1995 REVISIONS		JOB: 001 HIGHWAY: I-610, etc.	
5-98	8-16	DIST: HOU	COUNTY: HARRIS, etc.
		SHEET NO. 34	

DATE: FILE:

77A

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TABLE OF VARIABLE POLE DIMENSIONS												
Ht (ft)	Section	8 SIDED POLE					12 SIDED POLE					
		Diameter (Inches)		Thickness (inches)	Length (feet)	Splice (inches)	Diameter (Inches)		Thickness (inches)	Length (feet)	Splice (inches)	
		Bottom	Top				Bottom	Top				
80 MPH DESIGNS	175	A	13.083	7.750	.250	33.33	19	16.792	7.750	.250	51.67	24
		B	17.792	12.205	.375	34.92	25	24.858	15.817	.313	51.67	36
		C	22.250	16.583	.375	35.42	32	32.625	23.583	.313	51.67	48
		D	25.375	20.948	.438	27.67	36	36.250	31.175	.375	29.00	~
		E	28.375	23.895	.500	28.00	41					
		F	31.250	26.703	.500	28.42	~					
80 MPH DESIGNS	150	A	13.083	7.750	.250	33.33	19	16.792	7.750	.250	51.67	24
		B	17.792	12.205	.375	34.92	25	24.858	15.817	.313	51.67	36
		C	22.250	16.583	.375	35.42	32	32.625	23.583	.313	51.67	~
		D	25.375	20.948	.438	27.67	36					
		E	28.375	23.895	.500	28.00	~					
80 MPH DESIGNS	125	A	13.083	7.750	.250	33.33	19	16.792	7.750	.250	51.67	24
		B	17.792	12.205	.375	34.92	25	24.858	15.817	.313	51.67	36
		C	22.250	16.583	.375	35.67	32	28.250	23.583	.313	26.67	~
		D	25.375	20.948	.438	27.67	~					
100 MPH DESIGNS	100	A	13.083	7.750	.250	33.33	19	16.792	7.750	.250	51.67	24
		B	17.792	12.205	.375	34.67	25	24.625	15.817	.313	50.33	~
		C	22.250	16.583	.375	35.67	~					
100 MPH DESIGNS	175	A	14.208	7.875	.313	33.33	20	17.433	7.875	.375	51.67	25
		B	19.792	13.142	.375	35.00	28	25.747	16.173	.438	51.75	37
		C	25.250	18.473	.438	35.67	36	33.750	24.176	.438	51.75	49
		D	29.000	23.680	.500	28.00	42	37.375	31.995	.500	29.08	~
		E	32.625	27.210	.563	28.50	47					
		F	36.125	30.631	.563	28.92	~					
100 MPH DESIGNS	150	A	14.208	7.875	.313	33.33	20	17.433	7.875	.375	51.67	25
		B	19.792	13.142	.375	35.00	28	25.747	16.173	.438	51.75	37
		C	25.250	18.473	.438	35.67	36	33.750	24.176	.438	51.75	~
		D	29.00	23.680	.500	28.00	42					
		E	32.625	27.210	.563	28.50	~					
100 MPH DESIGNS	125	A	14.208	7.875	.313	33.33	20	17.433	7.875	.375	51.67	25
		B	19.792	13.142	.375	35.00	28	25.747	16.173	.438	51.75	37
		C	25.250	18.473	.438	35.67	36	29.125	24.176	.438	26.75	~
		D	29.00	23.680	.500	28.00	~					
100 MPH DESIGNS	100	A	14.208	7.875	.313	33.33	20	17.433	7.875	.375	51.67	25
		B	19.792	13.142	.375	35.00	28	25.500	16.173	.375	50.42	~
		C	25.250	18.473	.438	35.67	~					

Diameters are measured across the flats.

TABLE OF VARIABLE BASE DIMENSIONS							
Ht (ft)	O.D. (inches)	I.D. (inches)	Bolt Cir (inches)	No. Bolts	S (inches)	T (inches)	U (inches)
80 MPH DESIGNS							
8 SIDED POLE							
175'	47	22	41	16	2.00	3.75	4.50
150'	44	18	38	12	2.00	4.00	3.50
125'	41	16	35	8	2.00	4.50	3.50
100'	37	14	31	6	2.00	5.00	3.50
12 SIDED POLE							
175'	50	24	44	12	1.75	3.50	3.50
150'	47	22	41	10	1.75	3.50	2.50
125'	42	18	36	8	1.75	3.75	2.50
100'	38	13	32	6	1.75	4.00	2.50
100 MPH DESIGNS							
8 SIDED POLE							
175'	52	27	46	20	1.75	3.50	4.50
150'	49	23	43	16	1.75	4.00	3.50
125'	45	21	39	12	1.75	4.50	3.50
100'	40	17	34	10	1.75	4.50	3.50
12 SIDED POLE							
175'	52	27	46	16	1.75	3.25	3.50
150'	50	25	44	12	1.75	3.50	2.50
125'	46	22	40	10	1.75	3.75	2.50
100'	42	19	36	6	1.75	4.00	2.50

NOTE: Base Plate may be round or with 8 or 12 equal segments matching the pole.


GENERAL NOTES:

- Design conforms to AASHTO 1994 Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals and Interim Revisions thereto. The Design Wind Speed is 80 mph or 100 mph.
- The required design height and wind speed shall be as shown elsewhere in the plans.
- Each pole section, top flange plate and base plate shall be permanently marked on the reference line. The required mark locations are shown on the baseplate, top plate, and foundation plan details. These marks shall be used in pole assembly and erection alignment. The reference line and anchor bolt orientation shall be parallel to roadway centerline unless otherwise shown on Lighting Layouts.

MATERIALS	
Polygonal Shafts Ground Sleeves	ASTM A709 Grade 50 A572 Grade 50 ① ②
Base Plate and Handhole Frame	ASTM A709 Grade 50 A572 Grade 50 ① A633 Grade C ①
Miscellaneous Steel	ASTM A36 or equal

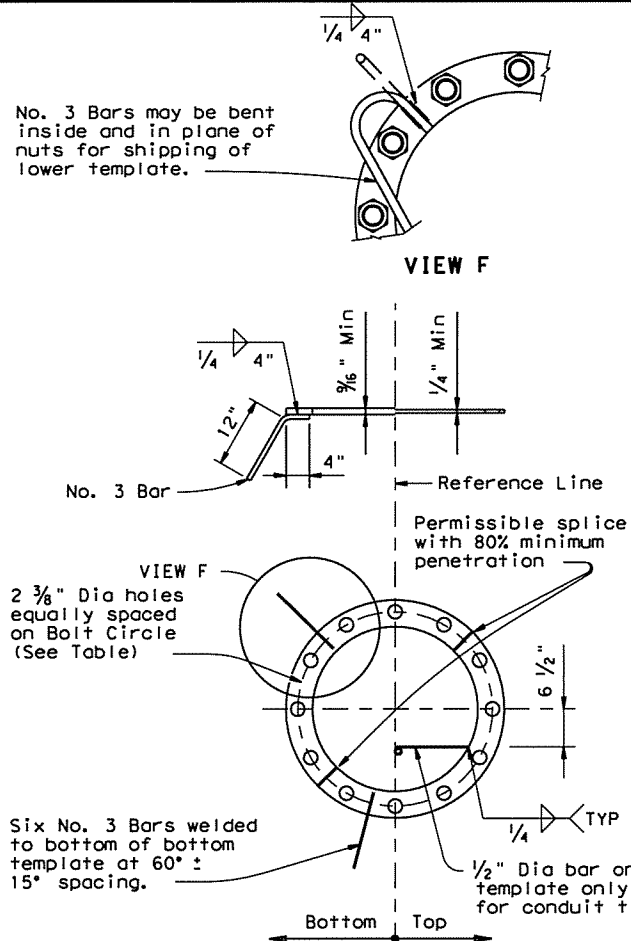
- ASTM A572 and A633 may have higher yield strength but shall not have less elongation than the grade indicated.
- The silicon content of all steel shall be controlled to ensure high quality galvanizing and to avoid discoloration.

SHEET 2 OF 2

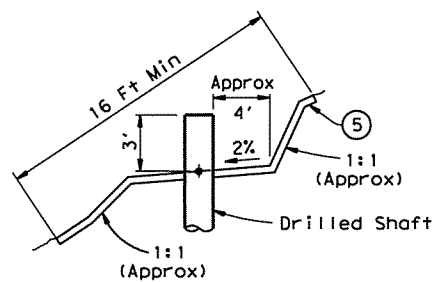
		Traffic Operations Division Standard	
HIGH MAST ILLUMINATION POLES 100' - 125' - 150' - 175'			
HMIP (2) - 16			
FILE: hmip-16.dgn	DN:	CK:	DW:
© TxDOT August 1995	CONT	SECT	JOB
REVISIONS	6459	93	001
5-98	DIST	COUNTY	SHEET NO.
8-16	HOU	HARRIS, etc.	35

DATE:
FILE:

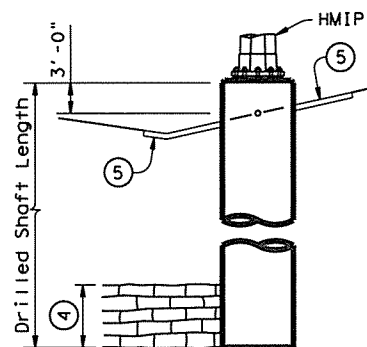
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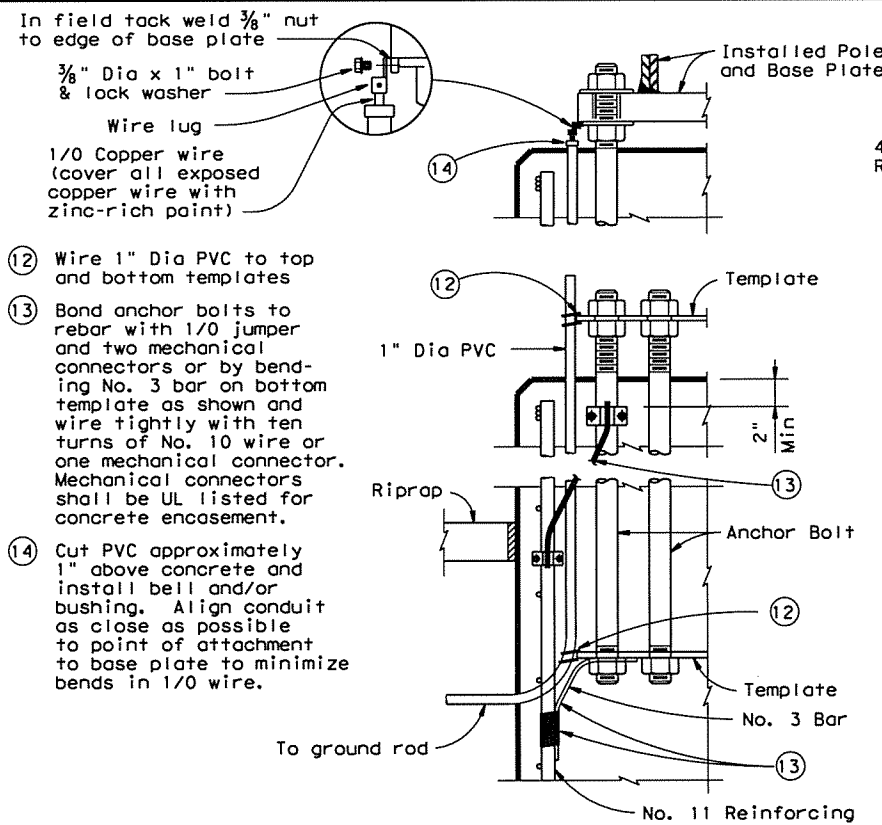
ANCHOR BOLT TEMPLATES



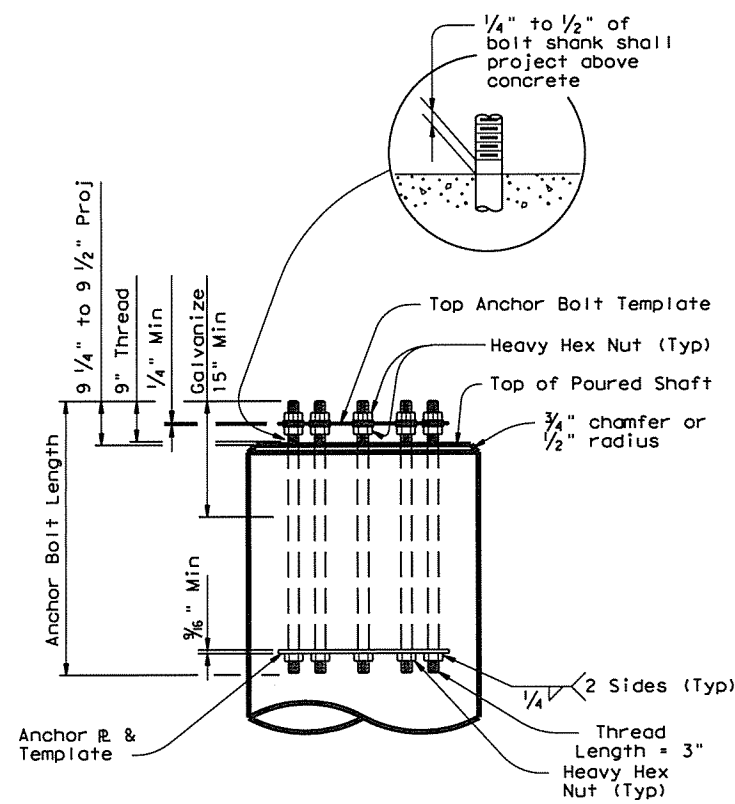
RIPRAP ON SLOPES



- ⑤ Match slope of finished ground if slope is less than approx 4 to 1. For steeper slopes, bench to provide work area with approx 2 1/2 slope around pole base. Other configurations may be shown elsewhere on the plans.
- ④ If rock is encountered, the Drilled Shaft shall extend a minimum of two diameters into solid rock.



LIGHTNING PROTECTION SYSTEM



ANCHOR BOLT ASSEMBLY

(See Anchor Bolt Table for number of bolts required)

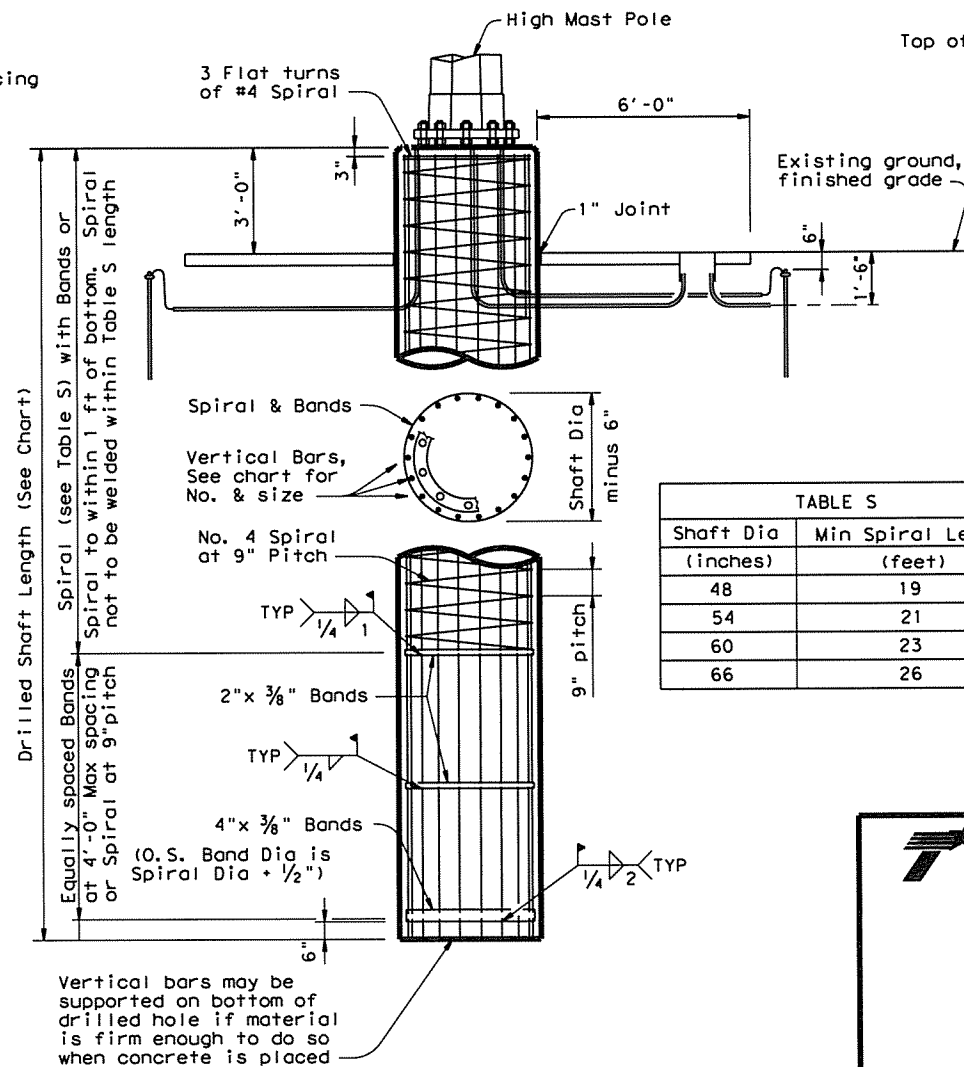


TABLE S

Shaft Dia (inches)	Min Spiral Length (feet)
48	19
54	21
60	23
66	26

DRILLED SHAFT FOUNDATION DETAIL

Texas Department of Transportation
Traffic Operations Division

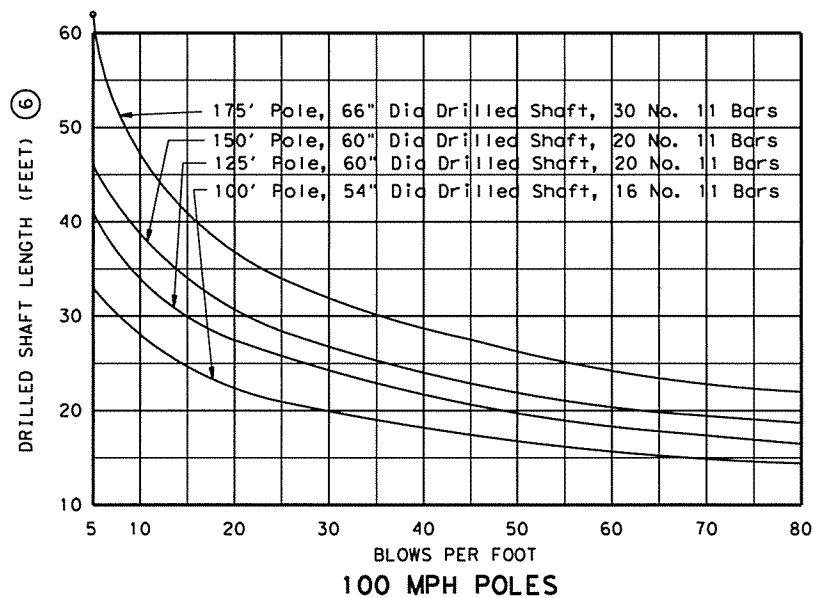
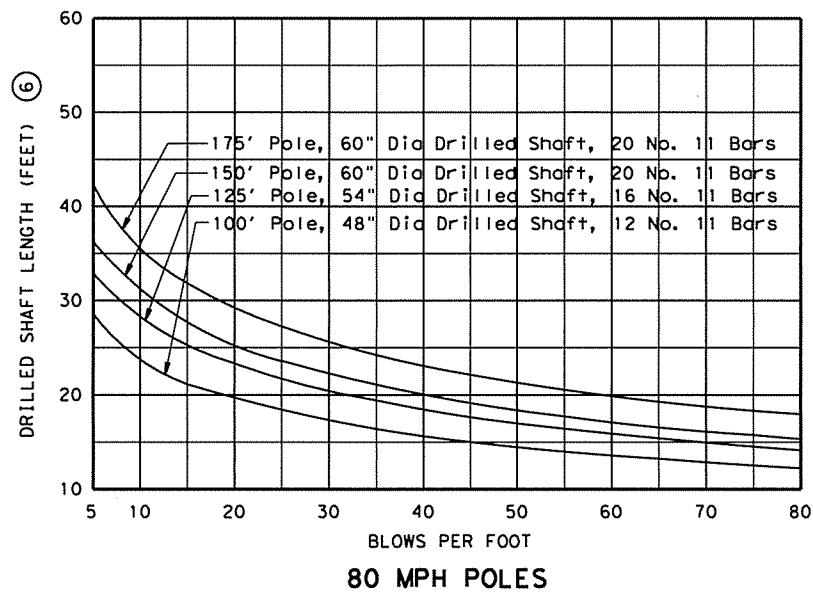
HIGH MAST ILLUMINATION POLE FOUNDATIONS

SHEET 1 OF 2 HMIF (1) -98

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11-97 REVISIONS	CONT	SECT	JOB	HIGHWAY
5-98 - Anchor Bolt Circle Dia	6459	93	001	I-610, etc.
	DIST	COUNTY	SHEET NO.	
	HOU	HARRIS, etc.	36	

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⑥ Includes normal 3 Ft exposure. Shafts with more than 3 Ft exposure must have additional length.



TEXAS CONE PENETROMETER TEST TABLES

NOTE: Use average "N" value over the top third of the embedded shaft. Ignore the top 2' of soil.

ANCHOR BOLT TABLE						
Pole Height (feet)	Bolt Diameter (inches)	Bolt Length (feet)	Bolt Templates		No. of Bolts	Bolt Cir Dia (inches)
			O D (inches)	I D (inches)		
8 SIDED POLE						
175	2.25	4.83	45.5	36.5	16	41
150	2.25	4.83	42.5	33.5	12	38
125	2.25	4.83	39.5	30.5	8	35
100	2.25	4.83	35.5	26.5	6	31
12 SIDED POLE						
175	2.25	4.83	48.5	39.5	12	44
150	2.25	4.83	45.5	36.5	10	41
125	2.25	4.83	40.5	31.5	8	36
100	2.25	4.83	36.5	27.5	6	32
8 SIDED POLE						
175	2.25	4.83	50.5	41.5	20	46
150	2.25	4.83	47.5	38.5	16	43
125	2.25	4.83	43.5	34.5	12	39
100	2.25	4.83	38.5	29.5	10	34
12 SIDED POLE						
175	2.25	4.83	50.5	41.5	16	46
150	2.25	4.83	48.5	39.5	12	44
125	2.25	4.83	44.5	35.5	10	40
100	2.25	4.83	40.5	31.5	6	36

MISCELLANEOUS QUANTITIES - ONE HMIF			
Shaft Diameter (in) ⑦	48	54	60
Concrete Riprap (CY)	2.33	2.44	2.56
Reinforcing (Lbs) ⑧	94	99	103
Ground Box (ea)	1	1	1
R O W Marker (ea) ⑨	1	1	1

- ⑦ See elsewhere on plans for length of Drilled Shaft required.
- ⑧ For Contractors information only.
- ⑨ Designated elsewhere on plans if required.

GENERAL NOTES:

Unless otherwise noted, the welded steel bands may be replaced with spiral as shown on the foundation details.

Anchor bolts shall be placed in foundation so there are always two bolts on reference line.

Drilled shaft lengths as determined from the foundation design chart or other acceptable methods are to be as shown elsewhere on the plans.

ODSR may not be used for HMIF drilled shafts.

Concrete for drilled shafts shall be Class C.

Repair welded areas with zinc-rich paint.

All Anchor Bolts, Nuts and Washers shall be galvanized in accordance with Item 445, "Galvanizing".



HIGH MAST ILLUMINATION POLE FOUNDATIONS

SHEET 2 OF 2 HMIF (2) -98

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5-98 - Anchor Bolt Circle Dia	CONT	SECT	JOB	HIGHWAY			
	6459	93	001	I-610, etc.			
	DIST	COUNTY		SHEET NO.			
	HOU	HARRIS, etc.		37			

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BARRICADE AND CONSTRUCTION (BC) STANDARD SHEETS GENERAL NOTES:

1. The Barricade and Construction Standard Sheets (BC sheets) are intended to show typical examples for placement of temporary traffic control devices, construction pavement markings, and typical work zone signs. The information contained in these sheets meet or exceed the requirements shown in the "Texas Manual on Uniform Traffic Control Devices" (TMUTCD).
2. The development and design of the Traffic Control Plan (TCP) is the responsibility of the Engineer.
3. The Contractor may propose changes to the TCP that are signed and sealed by a licensed professional engineer for approval. The Engineer may develop, sign and seal Contractor proposed changes.
4. The Contractor is responsible for installing and maintaining the traffic control devices as shown in the plans. The Contractor may not move or change the approximate location of any device without the approval of the Engineer.
5. Geometric design of lane shifts and detours should, when possible, meet the applicable design criteria contained in manuals such as the American Association of State Highway and Transportation Officials (AASHTO), "A Policy on Geometric Design of Highways and Streets," the TxDOT "Roadway Design Manual" or engineering judgment.
6. When projects abut, the Engineer(s) may omit the END ROAD WORK, TRAFFIC FINES DOUBLE, and other advance warning signs if the signing would be redundant and the work areas appear continuous to the motorists. If the adjacent project is completed first, the Contractor shall erect the necessary warning signs as shown on these sheets, the TCP sheets or as directed by the Engineer. The BEGIN ROAD WORK NEXT X MILES sign shall be revised to show appropriate work zone distance.
7. The Engineer may require duplicate warning signs on the median side of divided highways where median width will permit and traffic volumes justify the signing.
8. All signs shall be constructed in accordance with the details found in the "Standard Highway Sign Designs for Texas," latest edition. Sign details not shown in this manual shall be shown in the plans or the Engineer shall provide a detail to the Contractor before the sign is manufactured.
9. The temporary traffic control devices shown in the illustrations of the BC sheets are examples. As necessary, the Engineer will determine the most appropriate traffic control devices to be used.
10. Where highway construction or maintenance work is being undertaken, other than mobile operations as defined by the Texas Manual on Uniform Traffic Control Devices, CSJ limit signs are required. CSJ limit signs are shown on BC(2). The OBEY WARNING SIGNS STATE LAW sign, STAY ALERT TALK OR TEXT LATER and the WORK ZONE TRAFFIC FINES DOUBLE sign with plaque shall be erected in advance of the CSJ limits. The BEGIN ROAD WORK NEXT X MILES, CONTRACTOR and END ROAD WORK signs shall be erected at or near the CSJ limits. For mobile operations, CSJ limit signs are not required.
11. Traffic control devices should be in place only while work is actually in progress or a definite need exists.
12. The Engineer has the final decision on the location of all traffic control devices.
13. Inactive equipment and work vehicles, including workers' private vehicles must be parked away from travel lanes. They should be as close to the right-of-way line as possible, or located behind a barrier or guardrail, or as approved by the Engineer.

WORKER SAFETY NOTES:

1. Workers on foot who are exposed to traffic or to construction equipment within the right-of-way shall wear high-visibility safety apparel meeting the requirements of ISEA "American National Standard for High-Visibility Apparel," or equivalent revisions, and labeled as ANSI 107-2004 standard performance for Class 2 or 3 risk exposure. Class 3 garments should be considered for high traffic volume work areas or night time work.
2. Except in emergency situations, flagger stations shall be illuminated when flagging is used at night.


COMPLIANT WORKZONE TRAFFIC CONTROL DEVICES

1. Only pre-qualified products shall be used. The "Compliant Work Zone Traffic Control Devices List" (CWZTCD) describes pre-qualified products and their sources.
2. Work zone traffic control devices shall be compliant with the Manual for Assessing safety Hardware (MASH).

THE DOCUMENTS BELOW CAN BE FOUND ON-LINE AT http://www.txdot.gov
COMPLIANT WORK ZONE TRAFFIC CONTROL DEVICES LIST (CWZTCD)
DEPARTMENTAL MATERIAL SPECIFICATIONS (DMS)
MATERIAL PRODUCER LIST (MPL)
ROADWAY DESIGN MANUAL - SEE "MANUALS (ONLINE MANUALS)"
STANDARD HIGHWAY SIGN DESIGNS FOR TEXAS (SHSD)
TEXAS MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES (TMUTCD)
TRAFFIC ENGINEERING STANDARD SHEETS

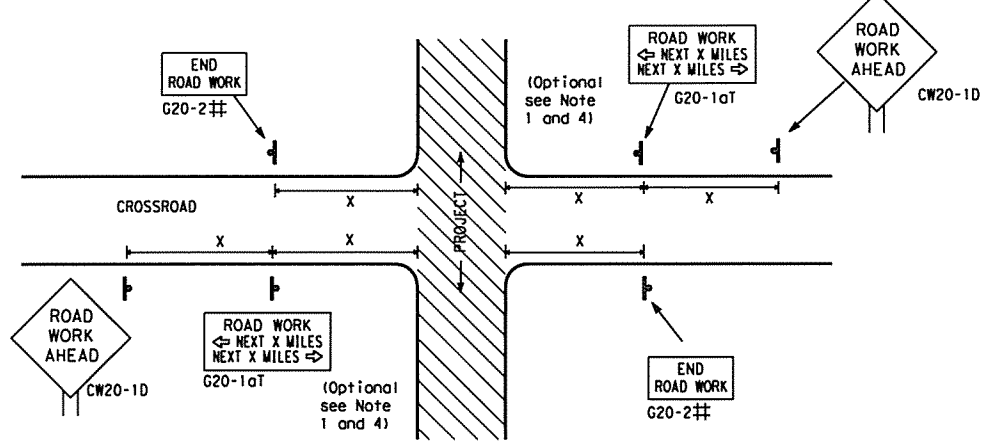
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SHEET 1 OF 12

 Texas Department of Transportation		Traffic Safety Division Standard
<h2 style="margin: 0;">BARRICADE AND CONSTRUCTION GENERAL NOTES AND REQUIREMENTS</h2> <h3 style="margin: 0;">BC (1) - 21</h3>		
FILE:	bc-21.dgn	DN: TxDOT CK: TxDOT DW: TxDOT CR: TxDOT
© TxDOT	November 2002	CONT SECT JOB HIGHWAY
4-03	7-13	6459 93 001 I-610, etc.
9-07	8-14	DIST COUNTY SHEET NO.
5-10	5-21	HOU HARRIS, etc. 38

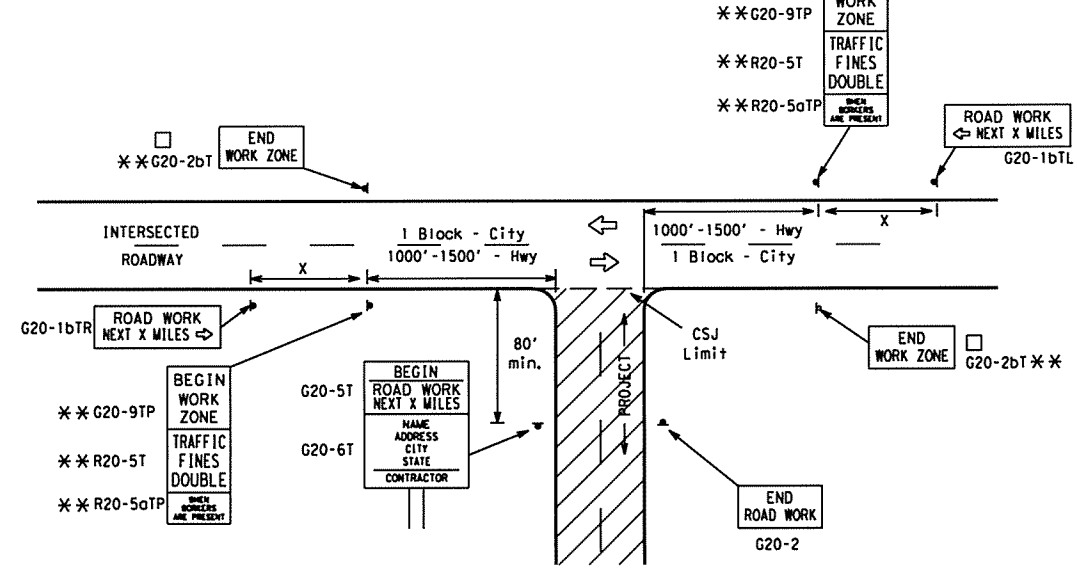
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TYPICAL LOCATION OF CROSSROAD SIGNS



- ## May be mounted on back of "ROAD WORK AHEAD" (CW20-1D) sign with approval of Engineer. (See note 2 below)
- The typical minimum signing on a crossroad approach should be a "ROAD WORK AHEAD" (CW20-1D) sign and a (G20-2) "END ROAD WORK" sign, unless noted otherwise in plans.
 - The Engineer may use the reduced size 36" x 36" ROAD WORK AHEAD (CW20-1D) sign mounted back to back with the reduced size 36" x 18" "END ROAD WORK" (G20-2) sign on low volume crossroads (see Note 4 under "Typical Construction Warning Sign Size and Spacing"). See the "Standard Highway Sign Designs for Texas" manual for sign details. The Engineer may omit the advance warning signs on low volume crossroads. The Engineer will determine whether a road is low volume as per TMUTCD Part 5. This information shall be shown in the plans.
 - Based on existing field conditions, the Engineer/Inspector may require additional signs such as FLAGGER AHEAD, LOOSE GRAVEL, or other appropriate signs. When additional signs are required, these signs will be considered part of the minimum requirements. The Engineer/Inspector will determine the proper location and spacing of any sign not shown on the BC sheets, Traffic Control Plan sheets or the Work Zone Standard Sheets.
 - The "ROAD WORK NEXT X MILES" (G20-1aT) sign shall be required at high volume crossroads to advise motorists of the length of construction in either direction from the intersection. The Engineer will determine whether a roadway is considered high volume.
 - Additional traffic control devices may be shown elsewhere in the plans for higher volume crossroads.
 - When work occurs in the intersection area, appropriate traffic control devices, as shown elsewhere in the plans or as determined by the Engineer/Inspector, shall be in place.

T-INTERSECTION



CSJ LIMITS AT T-INTERSECTION

- The Engineer will determine the types and location of any additional traffic control devices, such as a flagger and accompanying signs, or other signs, that should be used when work is being performed at or near an intersection.
- If construction closes the road at a T-intersection, the Contractor shall place the "CONTRACTOR NAME" (G20-6T) sign behind the Type 3 Barricades for the road closure (see BC(10) also). The "ROAD WORK NEXT X MILES" left arrow (G20-1bTL) and "ROAD WORK NEXT X MILES" right arrow (G20-1bTR) signs shall be replaced by the detour signing called for in the plans.

TYPICAL CONSTRUCTION WARNING SIGN SIZE AND SPACING^{1,5,6}

Sign Number or Series	SIZE		SPACING	
	Conventional Road	Expressway/Freeway	Posted Speed	Sign Δ Spacing "x"
CW20 ⁴	48" x 48"	48" x 48"	MPH	Feet (Apprx.)
CW21			30	120
CW22			35	160
CW23			40	240
CW25			45	320
CW1, CW2, CW7, CW8, CW9, CW11, CW14	36" x 36"	48" x 48"	50	400
			55	500 ²
			60	600 ²
			65	700 ²
CW3, CW4, CW5, CW6, CW8-3, CW10, CW12	48" x 48"	48" x 48"	70	800 ²
			75	900 ²
			80	1000 ²
			*	*

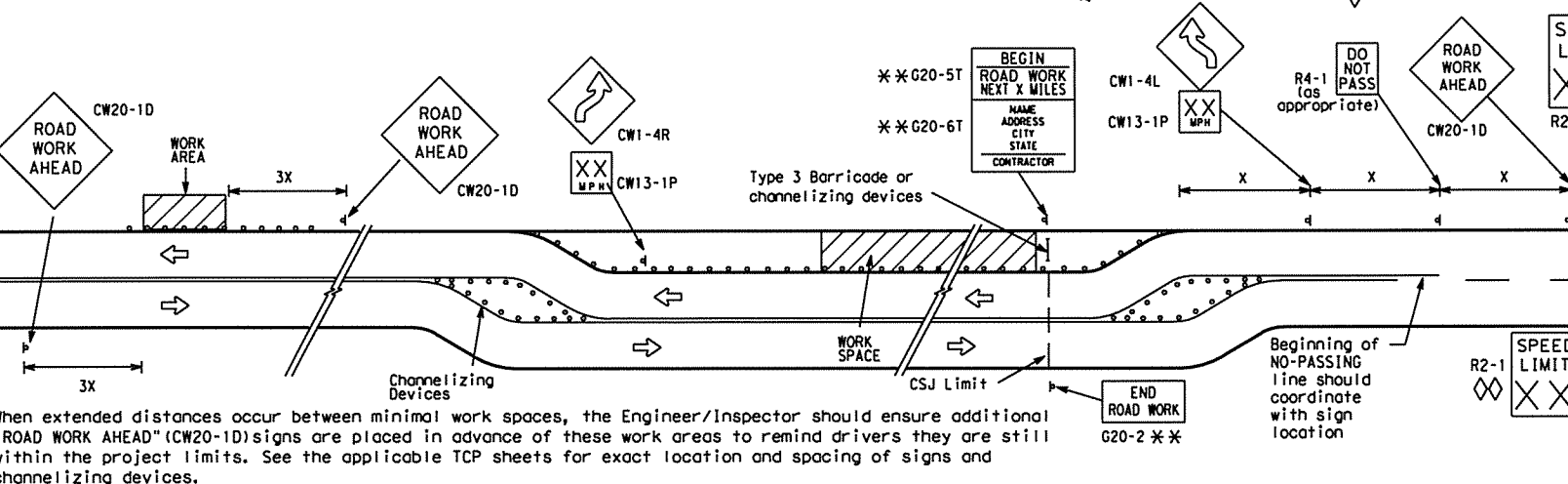
* For typical sign spacings on divided highways, expressways and freeways, see Part 6 of the "Texas Manual on Uniform Traffic Control Devices" (TMUTCD) typical application diagrams or TCP Standard Sheets.

Δ Minimum distance from work area to first Advance Warning sign nearest the work area and/or distance between each additional sign.

GENERAL NOTES

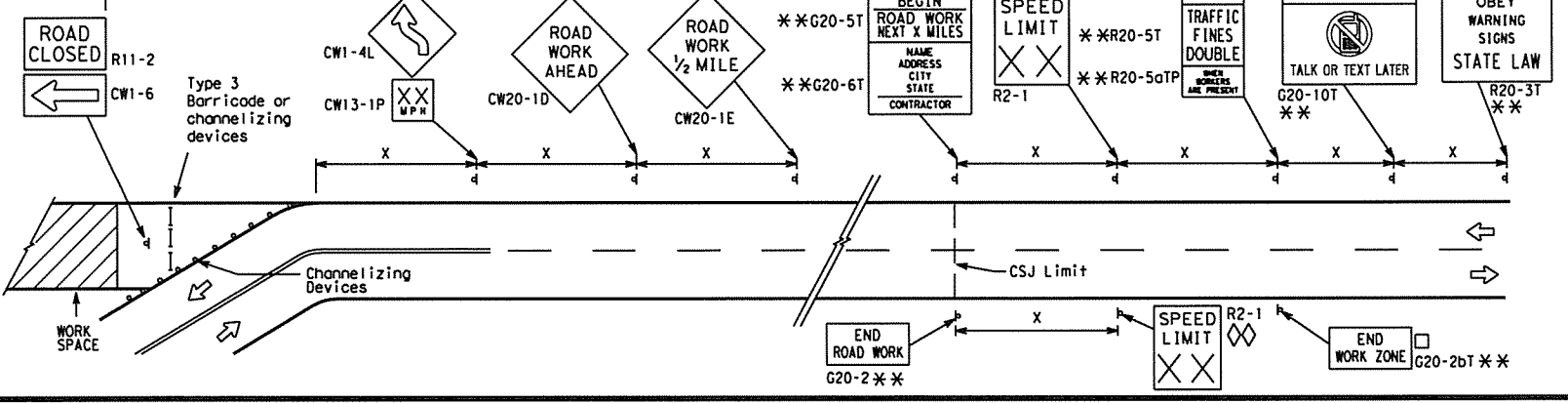
- Special or larger size signs may be used as necessary.
- Distance between signs should be increased as required to have 1500 feet advance warning.
- Distance between signs should be increased as required to have 1/2 mile or more advance warning.
- 36" x 36" "ROAD WORK AHEAD" (CW20-1D) signs may be used on low volume crossroads at the discretion of the Engineer as per TMUTCD Part 5. See Note 2 under "Typical Location of Crossroad Signs".
- Only diamond shaped warning sign sizes are indicated.
- See sign size listing in "TMUTCD", Sign Appendix or the "Standard Highway Sign Designs for Texas" manual for complete list of available sign design sizes.

WORK AREAS IN MULTIPLE LOCATIONS WITHIN CSJ LIMITS

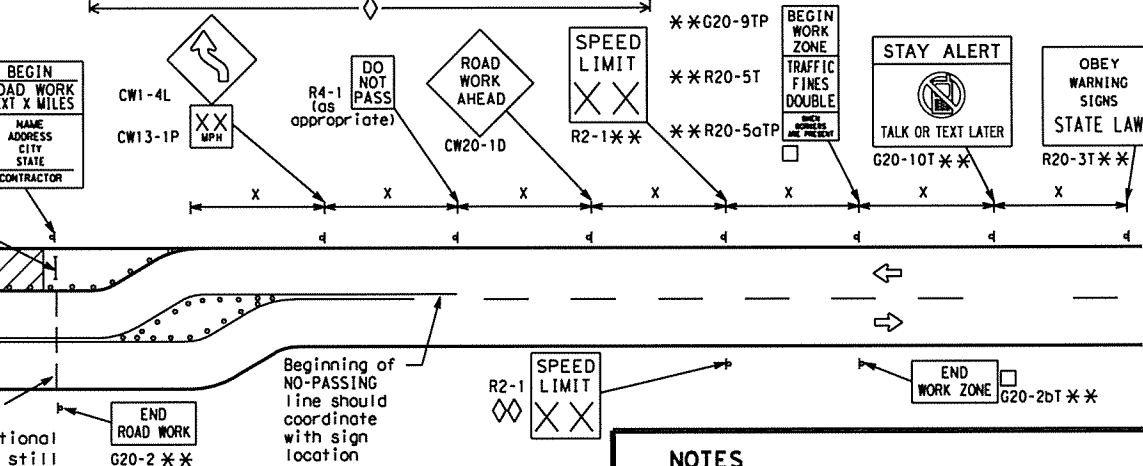


When extended distances occur between minimal work spaces, the Engineer/Inspector should ensure additional "ROAD WORK AHEAD" (CW20-1D) signs are placed in advance of these work areas to remind drivers they are still within the project limits. See the applicable TCP sheets for exact location and spacing of signs and channelizing devices.

SAMPLE LAYOUT OF SIGNING FOR WORK BEGINNING DOWNSTREAM OF THE CSJ LIMITS



SAMPLE LAYOUT OF SIGNING FOR WORK BEGINNING AT THE CSJ LIMITS



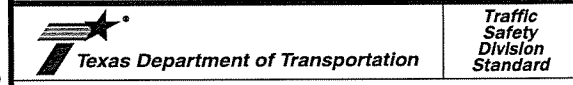
NOTES

- The Contractor shall determine the appropriate distance to be placed on the G20-1 series signs and "BEGIN ROAD WORK NEXT X MILES" (G20-5T) sign for each specific project. This distance shall replace the "X" and shall be rounded to the nearest whole mile with the approval of the Engineer. No decimals shall be used.
- The "BEGIN WORK ZONE" (G20-9TP) and "END WORK ZONE" (G20-2bT) shall be used as shown on the sample layout when advance signs are required outside the CSJ Limits. They inform the motorist of entering or leaving a part of the work zone lying outside the CSJ Limits where traffic fines may double if workers are present.
 - CSJ limit signing is required for highway construction and maintenance work, with the exception of mobile operations.
 - Area for placement of "ROAD WORK AHEAD" (CW20-1D) sign and other signs or devices as called for on the Traffic Control Plan.
 - Contractor will install a regulatory speed limit sign at the end of the work zone.

LEGEND

—	Type 3 Barricade
○ ○ ○	Channelizing Devices
□	Sign
X	See Typical Construction Warning Sign Size and Spacing chart or the TMUTCD for sign spacing requirements.

SHEET 2 OF 12



BARRICADE AND CONSTRUCTION PROJECT LIMIT

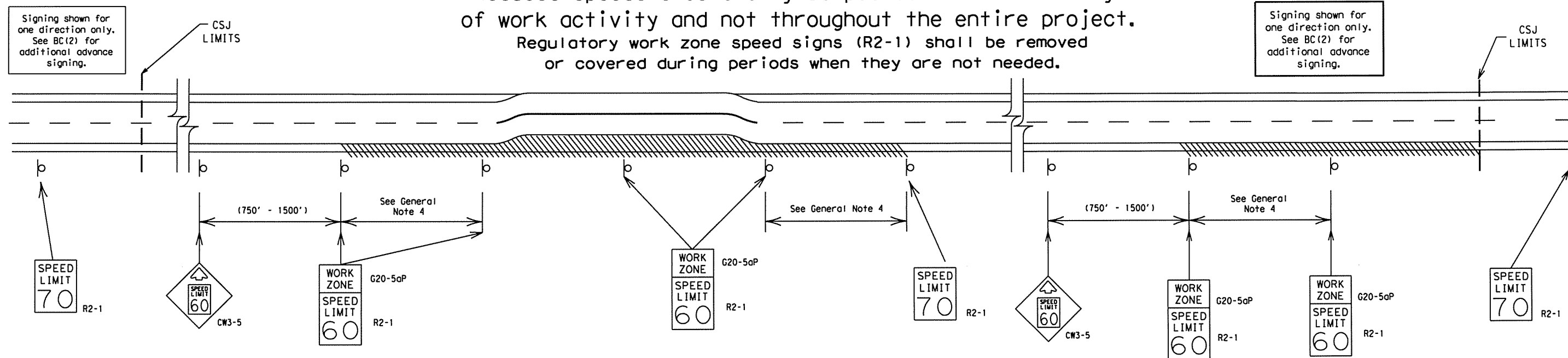
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REVISIONS	6459	SECT	93	JOB	HIGHWAY		
9-07	8-14			001	I-610, etc.		
7-13	5-21	DIST		COUNTY		SHEET NO.	
		HOU		HARRIS, etc.		39	

TYPICAL APPLICATION OF WORK ZONE SPEED LIMIT SIGNS

Work zone speed limits shall be regulatory, established in accordance with the "Procedures for Establishing Speed Zones," and approved by the Texas Transportation Commission, or by City Ordinance when within Incorporated City Limits.

Reduced speeds should only be posted in the vicinity of work activity and not throughout the entire project. Regulatory work zone speed signs (R2-1) shall be removed or covered during periods when they are not needed.



GUIDANCE FOR USE:

LONG/INTERMEDIATE TERM WORK ZONE SPEED LIMITS

This type of work zone speed limit should be included on the design of the traffic control plans when restricted geometrics with a lower design speed are present in the work zone and modification of the geometrics to a higher design speed is not feasible.

Long/Intermediate Term Work Zone Speed Limit signs, when approved as described above, should be posted and visible to the motorist when work activity is present. Work activity may also be defined as a change in the roadway that requires a reduced speed for motorists to safely negotiate the work area, including:

- a) rough road or damaged pavement surface
- b) substantial alteration of roadway geometrics (diversions)
- c) construction detours
- d) grade
- e) width
- f) other conditions readily apparent to the driver

As long as any of these conditions exist, the work zone speed limit signs should remain in place.

SHORT TERM WORK ZONE SPEED LIMITS

This type of work zone speed limit may be included on the design of the traffic control plans when workers or equipment are not behind concrete barrier, when work activity is within 10 feet of the traveled way or actually in the traveled way.

Short Term Work Zone Speed Limit signs should be posted and visible to the motorists only when work activity is present. When work activity is not present, signs shall be removed or covered. (See Removing or Covering on BC(4)).

GENERAL NOTES

1. Regulatory work zone speed limits should be used only for sections of construction projects where speed control is of major importance.
2. Regulatory work zone speed limit signs shall be placed on supports at a 7 foot minimum mounting height.
3. Speed zone signs are illustrated for one direction of travel and are normally posted for each direction of travel.
4. Frequency of work zone speed limit signs should be:
 - 40 mph and greater 0.2 to 2 miles
 - 35 mph and less 0.2 to 1 mile
5. Regulatory speed limit signs shall have black legend and border on a white reflective background (See "Reflective Sheeting" on BC(4)).
6. Fabrication, erection and maintenance of the "ADVANCE SPEED LIMIT" (CW3-5) sign, "WORK ZONE" (G20-5aP) plaque and the "SPEED LIMIT" (R2-1) signs shall not be paid for directly, but shall be considered subsidiary to Item 502.
7. Turning signs from view, laying signs over or down will not be allowed, unless as otherwise noted under "REMOVING OR COVERING" on BC(4).
8. Techniques that may help reduce traffic speeds include but are not limited to:
 - A. Law enforcement.
 - B. Flagger stationed next to sign.
 - C. Portable changeable message sign (PCMS).
 - D. Low-power (drone) radar transmitter.
 - E. Speed monitor trailers or signs.
9. Speeds shown on details above are for illustration only. Work Zone Speed Limits should only be posted as approved for each project.
10. For more specific guidance concerning the type of work, work zone conditions and factors impacting allowable regulatory construction speed zone reduction see TxDOT form #1204 in the TxDOT e-form system.

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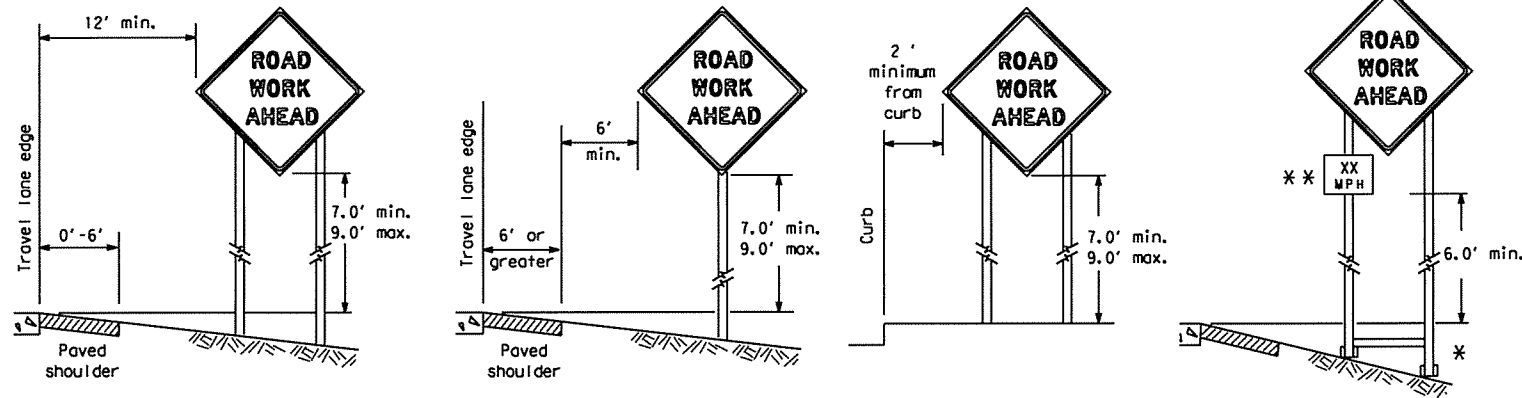
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SHEET 3 OF 12

		Traffic Safety Division Standard	
<h2>BARRICADE AND CONSTRUCTION WORK ZONE SPEED LIMIT</h2>			
<h3>BC (3) - 21</h3>			
FILE#	bc-21.dgn	DW# TxDOT	CK# TxDOT
© TxDOT	November 2002	CONT SECT	JOB HIGHWAY
REVISIONS		6459 93	001 I-610, etc.
9-07	8-14	DIST	COUNTY SHEET NO.
7-13	5-21	HOU	HARRIS, etc. 40

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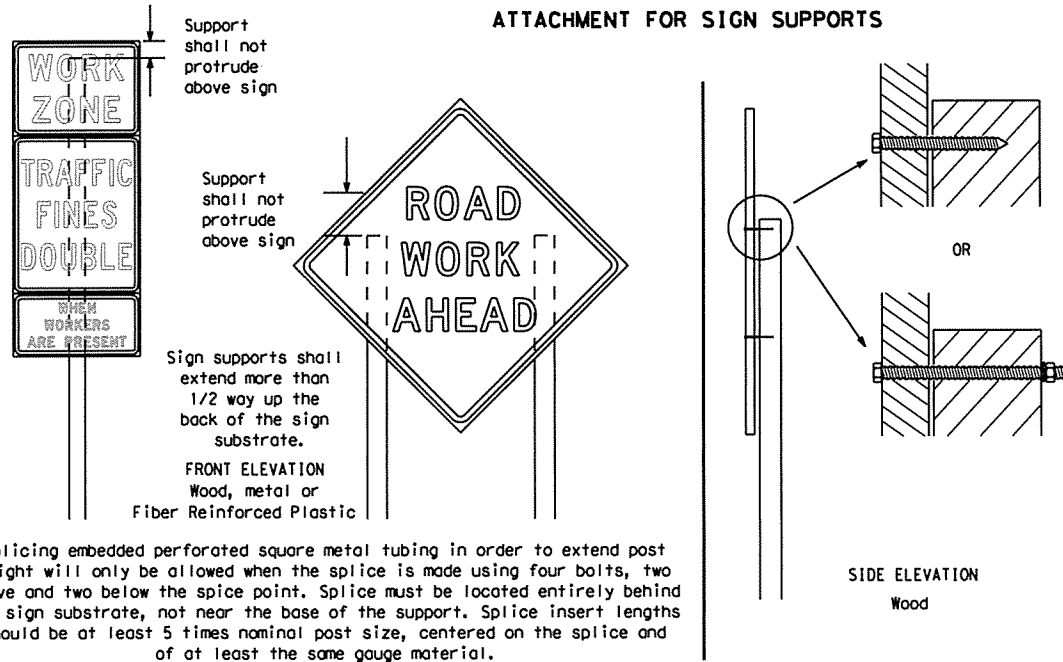
TYPICAL MINIMUM CLEARANCES FOR LONG TERM AND INTERMEDIATE TERM SIGNS



* When placing skid supports on unlevel ground, the leg post lengths must be adjusted so the sign appears straight and plumb. Objects shall NOT be placed under skids as a means of leveling.

** When plaques are placed on dual-leg supports, they should be attached to the upright nearest the travel lane. Supplemental plaques (advisory or distance) should not cover the surface of the parent sign.

ATTACHMENT FOR SIGN SUPPORTS



Splicing embedded perforated square metal tubing in order to extend post height will only be allowed when the splice is made using four bolts, two above and two below the splice point. Splice must be located entirely behind the sign substrate, not near the base of the support. Splice insert lengths should be at least 5 times nominal post size, centered on the splice and of at least the same gauge material.

GENERAL NOTES FOR WORK ZONE SIGNS

- Contractor shall install and maintain signs in a straight and plumb condition and/or as directed by the Engineer.
- Wooden sign posts shall be painted white.
- Barricades shall NOT be used as sign supports.
- All signs shall be installed in accordance with the plans or as directed by the Engineer. Signs shall be used to regulate, warn, and guide the traveling public safely through the work zone.
- The Contractor may furnish either the sign design shown in the plans or in the "Standard Highway Sign Designs for Texas" (SHSD). The Engineer/Inspector may require the Contractor to furnish other work zone signs that are shown in the TMUTCD but may have been omitted from the plans. Any variation in the plans shall be documented by written agreement between the Engineer and the Contractor's Responsible Person. All changes must be documented in writing before being implemented. This can include documenting the changes in the Inspector's TxDOT diary and having both the Inspector and Contractor initial and date the agreed upon changes.
- The Contractor shall furnish sign supports listed in the "Compliant Work Zone Traffic Control Device List" (CWZTCD) for small roadside signs. Supports for temporary large roadside signs shall meet the requirements detailed on the Temporary Large Roadside Signs (TLRS) standard sheets. The Contractor shall install the sign support in accordance with the manufacturer's recommendations. If there is a question regarding installation procedures, the Contractor shall furnish the Engineer a copy of the manufacturer's installation recommendations so the Engineer can verify the correct procedures are being followed.
- The Contractor is responsible for installing signs on approved supports and replacing signs with damaged or cracked substrates and/or damaged or marred reflective sheeting as directed by the Engineer/Inspector.
- 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 inch.
- The Contractor shall replace damaged wood posts. New or damaged wood sign posts shall not be spliced.

DURATION OF WORK (as defined by the "Texas Manual on Uniform Traffic Control Devices" Part 6)

- The types of sign supports, sign mounting height, the size of signs, and the type of sign substrates can vary based on the type of work being performed. The Engineer is responsible for selecting the appropriate size sign for the type of work being performed. The Contractor is responsible for ensuring the sign support, sign mounting height and substrate meets manufacturer's recommendations in regard to crashworthiness and duration of work requirements.
 - Long-term stationary - work that occupies a location more than 3 days.
 - Intermediate-term stationary - work that occupies a location more than one daylight period up to 3 days, or nighttime work lasting more than one hour.
 - Short-term stationary - daytime work that occupies a location for more than 1 hour in a single daylight period.
 - Short, duration - work that occupies a location up to 1 hour.
 - Mobile - work that moves continuously or intermittently (stopping for up to approximately 15 minutes.)

SIGN MOUNTING HEIGHT

- The bottom of Long-term/Intermediate-term signs shall be at least 7 feet, but not more than 9 feet, above the paved surface, except as shown for supplemental plaques mounted below other signs.
- The bottom of Short-term/Short Duration signs shall be a minimum of 1 foot above the pavement surface but no more than 2 feet above the ground.
- Long-term/Intermediate-term signs may be used in lieu of Short-term/Short Duration signing.
- Short-term/Short Duration signs shall be used only during daylight and shall be removed at the end of the workday or raised to appropriate Long-term/Intermediate sign height.
- Regulatory signs shall be mounted at least 7 feet, but not more than 9 feet, above the paved surface regardless of work duration.

SIZE OF SIGNS

- The Contractor shall furnish the sign sizes shown on BC (2) unless otherwise shown in the plans or as directed by the Engineer.

SIGN SUBSTRATES

- The Contractor shall ensure the sign substrate is installed in accordance with the manufacturer's recommendations for the type of sign support that is being used. The CWZTCD lists each substrate that can be used on the different types and models of sign supports.
- "Mesh" type materials are NOT an approved sign substrate, regardless of the tightness of the weave.
- All wooden individual sign panels fabricated from 2 or more pieces shall have one or more plywood cleat, 1/2" thick by 6" wide, fastened to the back of the sign and extending fully across the sign. The cleat shall be attached to the back of the sign using wood screws that do not penetrate the face of the sign panel. The screws shall be placed on both sides of the splice and spaced at 6" centers. The Engineer may approve other methods of splicing the sign face.

REFLECTIVE SHEETING

- All signs shall be retroreflective and constructed of sheeting meeting the color and retro-reflectivity requirements of DMS-8300 for rigid signs or DMS-8310 for roll-up signs. The web address for DMS specifications is shown on BC(1).
- White sheeting, meeting the requirements of DMS-8300 Type A, shall be used for signs with a white background.
- Orange sheeting, meeting the requirements of DMS-8300 Type B_{FL} or Type C_{FL}, shall be used for rigid signs with orange backgrounds.

SIGN LETTERS

- All sign letters and numbers shall be clear, and open rounded type uppercase alphabet letters as approved by the Federal Highway Administration (FHWA) and as published in the "Standard Highway Sign Design for Texas" manual. Signs, letters and numbers shall be of first class workmanship in accordance with Department Standards and Specifications.

REMOVING OR COVERING

- When sign messages may be confusing or do not apply, the signs shall be removed or completely covered.
- Long-term stationary or intermediate stationary signs installed on square metal tubing may be turned away from traffic 90 degrees when the sign message is not applicable. This technique may not be used for signs installed in the median of divided highways or near any intersections where the sign may be seen from approaching traffic.
- Signs installed on wooden skids shall not be turned at 90 degree angles to the roadway. These signs should be removed or completely covered when not required.
- 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 shall NOT be used to cover signs.
- Duct tape or other adhesive material shall NOT be affixed to a sign face.
- Signs and anchor stubs shall be removed and holes backfilled upon completion of work.

SIGN SUPPORT WEIGHTS

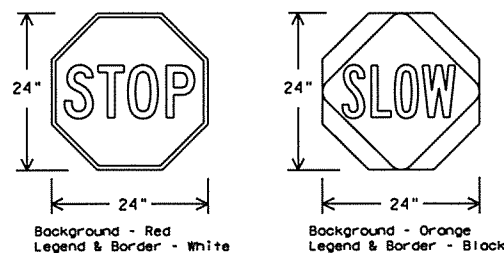
- Where sign supports require the use of weights to keep from turning over, the use of sandbags with dry, cohesionless sand should be used.
- The sandbags will be tied shut to keep the sand from spilling and to maintain a constant weight.
- Rock, concrete, iron, steel or other solid objects shall not be permitted for use as sign support weights.
- Sandbags should weigh a minimum of 35 lbs and a maximum of 50 lbs.
- Sandbags shall be made of a durable material that tears upon vehicular impact. Rubber (such as tire inner tubes) shall NOT be used.
- 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.
- 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 fasteners. Sandbags shall be placed along the length of the skids to weigh down the sign support.
- Sandbags shall NOT be placed under the skid and shall not be used to level sign supports placed on slopes.

FLAGS ON SIGNS

- Flags may be used to draw attention to warning signs. When used, the flag shall be 16 inches square or larger and shall be orange or fluorescent red-orange in color. Flags shall not be allowed to cover any portion of the sign face.

STOP/SLOW PADDLES

- STOP/SLOW paddles are the primary method to control traffic by flaggers. The STOP/SLOW paddle size should be 24" x 24".
- STOP/SLOW paddles shall be retroreflectORIZED when used at night.
- STOP/SLOW paddles may be attached to a staff with a minimum length of 6' to the bottom of the sign.
- Any lights incorporated into the STOP or SLOW paddle faces shall only be as specifically described in Section 6E.03 Hand Signaling Devices in the TMUTCD.



CONTRACTOR REQUIREMENTS FOR MAINTAINING PERMANENT SIGNS WITHIN THE PROJECT LIMITS

- Permanent signs are used to give notice of traffic laws or regulations, call attention to conditions that are potentially hazardous to traffic operations, show route designations, destinations, directions, distances, services, points of interest, and other geographical, recreational, specific service (LOGO), or cultural information. Drivers proceeding through a work zone need the same, if not better route guidance as normally installed on a roadway without construction.
- When permanent regulatory or warning signs conflict with work zone conditions, remove or cover the permanent signs until the permanent sign message matches the roadway condition. For details for covering large guide signs see the TS-CD standard.
- When existing permanent signs are moved and relocated due to construction purposes, they shall be visible to motorists at all times.
- If existing signs are to be relocated on their original supports, they shall be installed on crashworthy bases as shown on the SMD Standard sheets. The signs shall meet the required mounting heights shown on the BC Sheets or the SMD Standards. This work should be paid for under the appropriate pay item for relocating existing signs.
- If permanent signs are to be removed and relocated using temporary supports, the Contractor shall use crashworthy supports as shown on the BC standard sheets, TLRS standard sheets or the CWZTCD list. The signs shall meet the required mounting heights shown on the BC, or the SMD standard sheets during construction. This work should be paid for under the appropriate pay item for relocating existing signs.
- Any sign or traffic control device that is struck or damaged by the Contractor or his/her construction equipment shall be replaced as soon as possible by the Contractor to ensure proper guidance for the motorists. This will be subsidiary to Item 502.

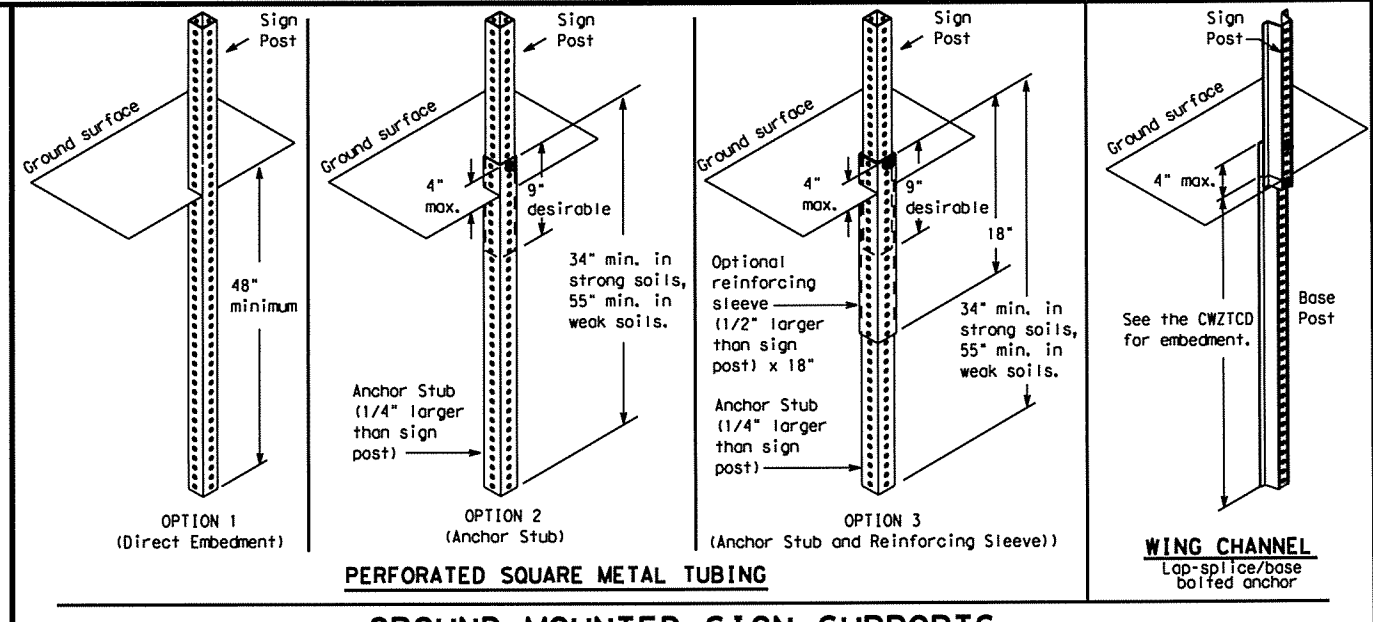
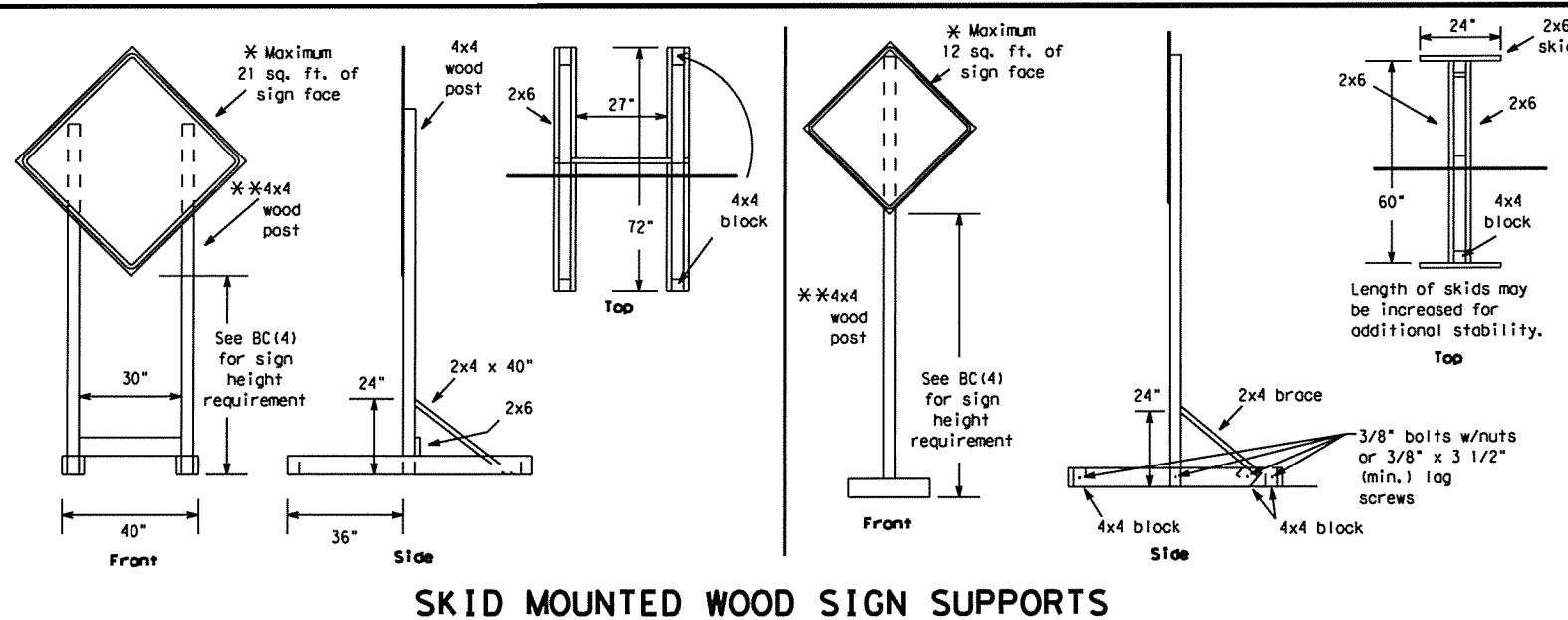


BARRICADE AND CONSTRUCTION TEMPORARY SIGN NOTES

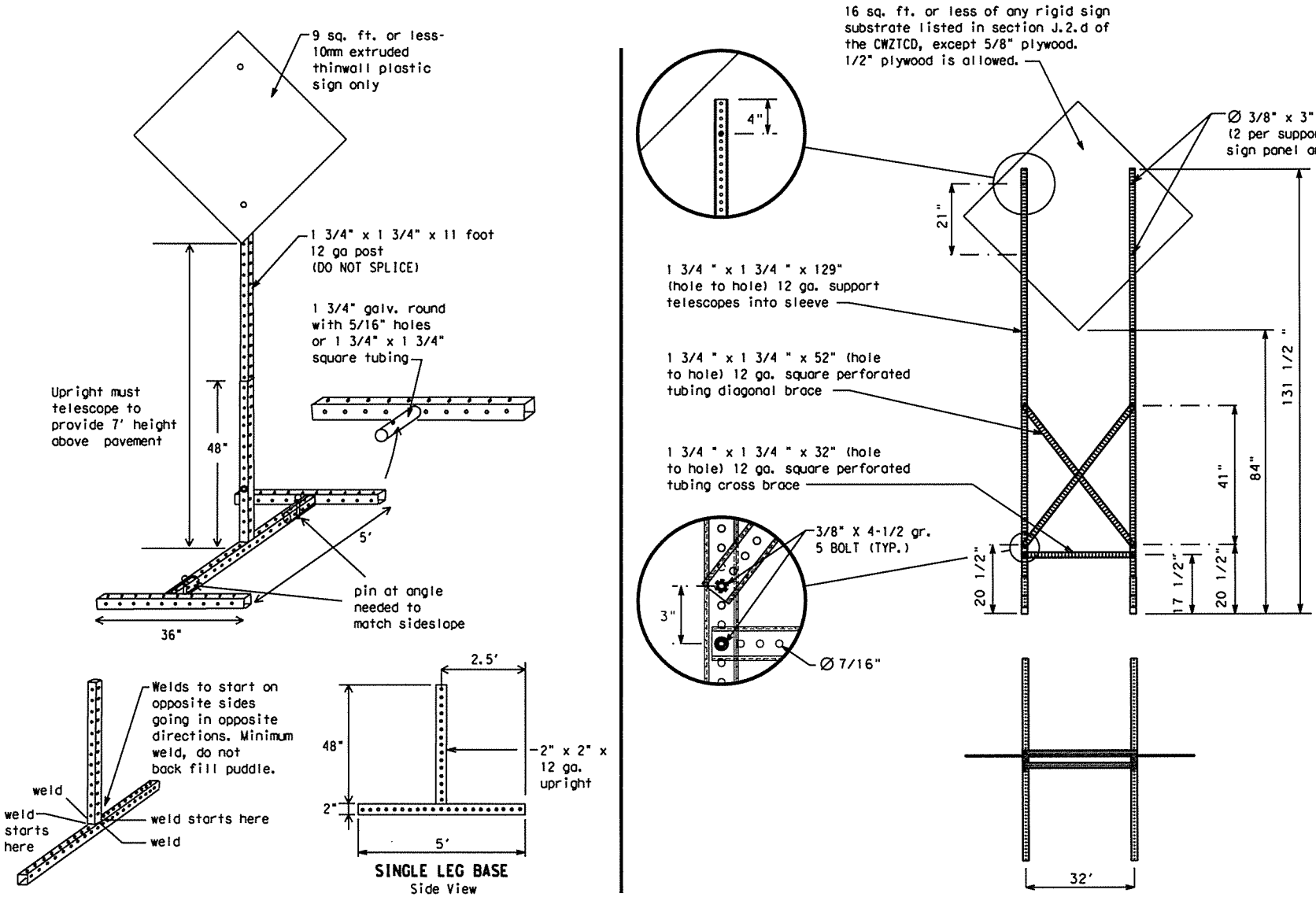
BC (4) - 21

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REVISIONS		6459	93	001	I-610, etc.				
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Refer to the CWZTCD and the manufacturer's installation procedure for each type sign support. The maximum sign square footage shall adhere to the manufacturer's recommendation. Two post installations can be used for larger signs.



WEDGE ANCHORS
 Both steel and plastic Wedge Anchor Systems as shown on the SMD Standard Sheets may be used as temporary sign supports for signs up to 10 square feet of sign face. They may be set in concrete or in sturdy soils if approved by the Engineer. (See web address for "Traffic Engineering Standard Sheets" on BC(1)).

OTHER DESIGNS
 MORE DETAILS OF APPROVED LONG/INTERMEDIATE AND SHORT TERM SUPPORTS CAN BE FOUND ON THE CWZTCD LIST. SEE BC(1) FOR WEBSITE LOCATION.

- GENERAL NOTES**
- Nails may be used in the assembly of wooden sign supports, but 3/8" bolts with nuts or 3/8" x 3 1/2" lag screws must be used on every joint for final connection.
 - No more than 2 sign posts shall be placed within a 7 ft. circle, except for specific materials noted on the CWZTCD List.
 - When project is completed, all sign supports and foundations shall be removed from the project site. This will be considered subsidiary to Item 502.

- * See BC(4) for definition of "Work Duration."
- ** Wood sign posts MUST be one piece. Splicing will NOT be allowed. Posts shall be painted white.
- See the CWZTCD for the type of sign substrate that can be used for each approved sign support.

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 Texas Department of Transportation
 Traffic Safety Division Standard

BARRICADE AND CONSTRUCTION TYPICAL SIGN SUPPORT

BC(5) - 21

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DATE: FILE:

WHEN NOT IN USE, REMOVE THE PCMS FROM THE RIGHT-OF-WAY OR PLACE THE PCMS BEHIND BARRIER OR GUARDRAIL WITH SIGN PANEL TURNED PARALLEL TO TRAFFIC

RECOMMENDED PHASES AND FORMATS FOR PCMS MESSAGES DURING ROADWORK ACTIVITIES

(The Engineer may approve other messages not specifically covered here.)

PORTABLE CHANGEABLE MESSAGE SIGNS

- The Engineer/Inspector shall approve all messages used on portable changeable message signs (PCMS).
- Messages on PCMS should contain no more than 8 words (about four to eight characters per word), not including simple words such as "TO," "FOR," "AT," etc.
- Messages should consist of a single phase, or two phases that alternate. Three-phase messages are not allowed. Each phase of the message should convey a single thought, and must be understood by itself.
- Use the word "EXIT" to refer to an exit ramp on a freeway; i.e., "EXIT CLOSED." Do not use the term "RAMP."
- Always use the route or interstate designation (IH, US, SH, FM) along with the number when referring to a roadway.
- When in use, the bottom of a stationary PCMS message panel should be a minimum 7 feet above the roadway, where possible.
- The message term "WEEKEND" should be used only if the work is to start on Saturday morning and end by Sunday evening at midnight. Actual days and hours of work should be displayed on the PCMS if work is to begin on Friday evening and/or continue into Monday morning.
- The Engineer/Inspector may select one of two options which are available for displaying a two-phase message on a PCMS. Each phase may be displayed for either four seconds each or for three seconds each. Do not "flash" messages or words included in a message. The message should be steady burn or continuous while displayed.
- Do not present redundant information on a two-phase message; i.e., keeping two lines of the message the same and changing the third line.
- Do not use the word "Danger" in message.
- Do not display the message "LANES SHIFT LEFT" or "LANES SHIFT RIGHT" on a PCMS. Drivers do not understand the message.
- Do not display messages that scroll horizontally or vertically across the face of the sign.
- The following table lists abbreviated words and two-word phrases that are acceptable for use on a PCMS. Both words in a phrase must be displayed together. Words or phrases not on this list should not be abbreviated, unless shown in the T MUTCD.
- PCMS character height should be at least 18 inches for trailer mounted units. They should be visible from at least 1/2 (.5) mile and the text should be legible from at least 600 feet at night and 800 feet in daylight. Truck mounted units must have a character height of 10 inches and must be legible from at least 400 feet.
- Each line of text should be centered on the message board rather than left or right justified.
- If disabled, the PCMS should default to an illegible display that will not alarm motorists and will only be used to alert workers that the PCMS has malfunctioned. A pattern such as a series of horizontal solid bars is appropriate.

Phase 1: Condition Lists

Road/Lane/Ramp Closure List

FREEWAY CLOSED X MILE	FRONTAGE ROAD CLOSED
ROAD CLOSED AT SH XXX	SHOULDER CLOSED XXX FT
ROAD CLSD AT FM XXXX	RIGHT LN CLOSED XXX FT
RIGHT X LANES CLOSED	RIGHT X LANES OPEN
CENTER LANE CLOSED	DAYTIME LANE CLOSURES
NIGHT LANE CLOSURES	I-XX SOUTH EXIT CLOSED
VARIOUS LANES CLOSED	EXIT XXX CLOSED X MILE
EXIT CLOSED	RIGHT LN TO BE CLOSED
MALL DRIVEWAY CLOSED	X LANES CLOSED TUE - FRI
XXXXXXXXX BLVD CLOSED	

Other Condition List

ROADWORK XXX FT	ROAD REPAIRS XXXX FT
FLAGGER XXXX FT	LANE NARROWS XXXX FT
RIGHT LN NARROWS XXXX FT	TWO-WAY TRAFFIC XX MILE
MERGING TRAFFIC XXXX FT	CONST TRAFFIC XXX FT
LOOSE GRAVEL XXXX FT	UNEVEN LANES XXXX FT
DETOUR X MILE	ROUGH ROAD XXXX FT
ROADWORK PAST SH XXXX	ROADWORK NEXT FRI-SUN
BUMP XXXX FT	US XXX EXIT X MILES
TRAFFIC SIGNAL XXXX FT	LANES SHIFT *

* LANES SHIFT in Phase 1 must be used with STAY IN LANE in Phase 2.

Phase 2: Possible Component Lists

Action to Take/Effect on Travel List

MERGE RIGHT	FORM X LINES RIGHT
DETOUR NEXT X EXITS	USE XXXXX RD EXIT
USE EXIT XXX	USE EXIT I-XX NORTH
STAY ON US XXX SOUTH	USE I-XX E TO I-XX N
TRUCKS USE US XXX N	WATCH FOR TRUCKS
WATCH FOR TRUCKS	EXPECT DELAYS
EXPECT DELAYS	PREPARE TO STOP
REDUCE SPEED XXX FT	END SHOULDER USE
USE OTHER ROUTES	WATCH FOR WORKERS
STAY IN LANE *	

Location List

AT FM XXXX
BEFORE RAILROAD CROSSING
NEXT X MILES
PAST US XXX EXIT
XXXXXXXXX TO XXXXXXXX
US XXX TO FM XXXX

Warning List

SPEED LIMIT XX MPH
MAXIMUM SPEED XX MPH
MINIMUM SPEED XX MPH
ADVISORY SPEED XX MPH
RIGHT LANE EXIT
USE CAUTION
DRIVE SAFELY
DRIVE WITH CARE

** Advance Notice List

TUE-FRI XX AM- X PM
APR XX- XX X PM-X AM
BEGINS MONDAY
BEGINS MAY XX
MAY X-X XX PM - XX AM
NEXT FRI-SUN
XX AM TO XX PM
NEXT TUE AUG XX
TONIGHT XX PM- XX AM

** See Application Guidelines Note 6.

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WORD OR PHRASE	ABBREVIATION	WORD OR PHRASE	ABBREVIATION
Access Road	ACCS RD	Major	MAJ
Alternate	ALT	Miles	MI
Avenue	AVE	Miles Per Hour	MPH
Best Route	BEST RTE	Minor	MNR
Boulevard	BLVD	Monday	MON
Bridge	BRDG	Normal	NORM
Canot	CANT	North	N
Center	CTR	Northbound	(route) N
Construction Ahead	CONST AHD	Parking	PKING
CROSSING	XING	Road	RD
Detour Route	DETOUR RTE	Right Lane	RT LN
Do Not	DONT	Saturday	SAT
East	E	Service Road	SERV RD
Eastbound	(route) E	Shoulder	SHLDR
Emergency	EMER	Slippery	SLIP
Emergency Vehicle	EMER VEH	South	S
Entrance, Enter	ENT	Southbound	(route) S
Express Lane	EXP LN	Speed	SPD
Expressway	EXPWY	Street	ST
XXXX Feet	XXXX FT	Sunday	SUN
Fog Ahead	FOG AHD	Telephone	PHONE
Freeway	FRWY, FWY	Temporary	TEMP
Freeway Blocked	FWY BLKD	Thursday	THURS
Friday	FRI	To Downtown	TO DWNTN
Hazardous Driving	HAZ DRIVING	Traffic	TRAF
Hazardous Material	HAZMAT	Travelers	TRVLS
High-Occupancy	HOV	Tuesday	TUES
Vehicle	VEH	Time Minutes	TIME MIN
Highway	HWY	Upper Level	UPR LEVEL
Hour(s)	HR, HRS	Vehicles (s)	VEH, VEHS
Information	INFO	Warning	WARN
It Is	ITS	Wednesday	WED
Junction	JCT	Weight Limit	WT LIMIT
Left	LFT	West	W
Left Lane	LFT LN	Westbound	(route) W
Lane Closed	LN CLOSED	Wet Pavement	WET PVMT
Lower Level	LWR LEVEL	Will Not	WONT
Maintenance	MAINT		

Roadway designation * IH-number, US-number, SH-number, FM-number

APPLICATION GUIDELINES

- Only 1 or 2 phases are to be used on a PCMS.
- The 1st phase (or both) should be selected from the "Road/Lane/Ramp Closure List" and the "Other Condition List".
- A 2nd phase can be selected from the "Action to Take/Effect on Travel, Location, General Warning, or Advance Notice Phase Lists".
- A Location Phase is necessary only if a distance or location is not included in the first phase selected.
- If two PCMS are used in sequence, they must be separated by a minimum of 1000 ft. Each PCMS shall be limited to two phases, and should be understandable by themselves.
- For advance notice, when the current date is within seven days of the actual work date, calendar days should be replaced with days of the week. Advance notification should typically be for no more than one week prior to the work.

WORDING ALTERNATIVES

- The words RIGHT, LEFT and ALL can be interchanged as appropriate.
- Roadway designations IH, US, SH, FM and LP can be interchanged as appropriate.
- EAST, WEST, NORTH and SOUTH (or abbreviations E, W, N and S) can be interchanged as appropriate.
- Highway names and numbers replaced as appropriate.
- ROAD, HIGHWAY and FREEWAY can be interchanged as needed.
- AHEAD may be used instead of distances if necessary.
- FT and MI, MILE and MILES interchanged as appropriate.
- AT, BEFORE and PAST interchanged as needed.
- Distances or AHEAD can be eliminated from the message if a location phase is used.

PCMS SIGNS WITHIN THE R.O.W. SHALL BE BEHIND GUARDRAIL OR CONCRETE BARRIER OR SHALL HAVE A MINIMUM OF FOUR (4) PLASTIC DRUMS PLACED PERPENDICULAR TO TRAFFIC ON THE UPSTREAM SIDE OF THE PCMS, WHEN EXPOSED TO ONE DIRECTION OF TRAFFIC. WHEN EXPOSED TO TWO WAY TRAFFIC, THE FOUR DRUMS SHOULD BE PLACED WITH ONE DRUM AT EACH OF THE FOUR CORNERS OF THE UNIT.

FULL MATRIX PCMS SIGNS

- When Full Matrix PCMS signs are used, the character height and legibility/visibility requirements shall be maintained as listed in Note 15 under "PORTABLE CHANGEABLE MESSAGE SIGNS" above.
- When symbol signs, such as the "Flagger Symbol" (CW20-7) are represented graphically on the Full Matrix PCMS sign and, with the approval of the Engineer, it shall maintain the legibility/visibility requirement listed above.
- When symbol signs are represented graphically on the Full Matrix PCMS, they shall only supplement the use of the static sign represented, and shall not substitute for, or replace that sign.
- A full matrix PCMS may be used to simulate a flashing arrow board provided it meets the visibility, flash rate and dimming requirements on BC(7), for the same size arrow.



Traffic Safety Division Standard

BARRICADE AND CONSTRUCTION PORTABLE CHANGEABLE MESSAGE SIGN (PCMS)

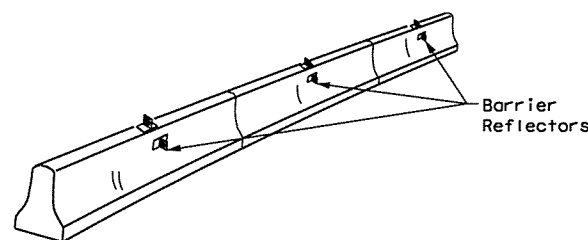
BC (6) - 21

FILE: bc-21.dgn	DW: TxDOT	CK: TxDOT	DW: TxDOT	CK: TxDOT
© TxDOT November 2002	CONT	SECT	JOB	HIGHWAY
REVISIONS	6459	93	001	I-610, etc.
9-07 8-14	DIST	COUNTY	SHEET NO.	
7-13 5-21	HOU	HARRIS, etc.	43	

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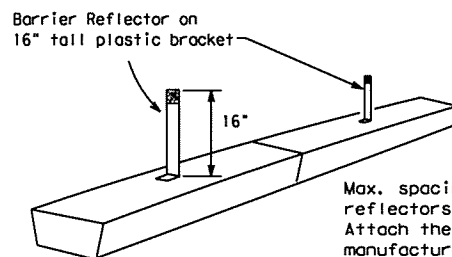
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- Barrier Reflectors shall be pre-qualified, and conform to the color and reflectivity requirements of DMS-8600. A list of prequalified Barrier Reflectors can be found at the Material Producer List web address shown on BC(1).
- Color of Barrier Reflectors shall be as specified in the TMUTCD. The cost of the reflectors shall be considered subsidiary to Item 512.



CONCRETE TRAFFIC BARRIER (CTB)

- Where traffic is on one side of the CTB, two (2) Barrier Reflectors shall be mounted in approximately the midsection of each section of CTB. An alternate mounting location is uniformly spaced at one end of each CTB. This will allow for attachment of a barrier grapple without damaging the reflector. The Barrier Reflector mounted on the side of the CTB shall be located directly below the reflector mounted on top of the barrier, as shown in the detail above.
- Where CTB separates two-way traffic, three barrier reflectors shall be mounted on each section of CTB. The reflector unit on top shall have two yellow reflective faces (Bi-Directional) while the reflectors on each side of the barrier shall have one yellow reflective face, as shown in the detail above.
- When CTB separates traffic traveling in the same direction, no barrier reflectors will be required on top of the CTB.
- Barrier Reflector units shall be yellow or white in color to match the edgeline being supplemented.
- Maximum spacing of Barrier Reflectors is forty (40) feet.
- Pavement markers or temporary flexible-reflective roadway marker tabs shall NOT be used as CTB delineation.
- Attachment of Barrier Reflectors to CTB shall be per manufacturer's recommendations.
- Missing or damaged Barrier Reflectors shall be replaced as directed by the Engineer.
- Single slope barriers shall be delineated as shown on the above detail.

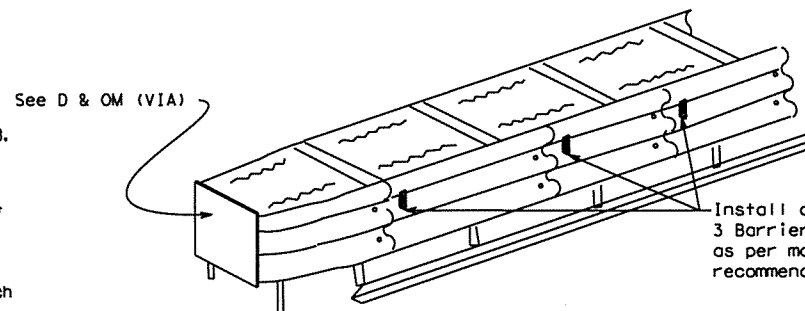


LOW PROFILE CONCRETE BARRIER (LPCB) USED IN WORK ZONES

LPCB is approved for use in work zone locations, where the posted speed is 45mph, or less. See Roadway Standard Sheet LPCB.

Max. spacing of barrier reflectors is 20 feet. Attach the delineators as per manufacturer's recommendations.

LOW PROFILE CONCRETE BARRIER (LPCB)



DELINEATION OF END TREATMENTS

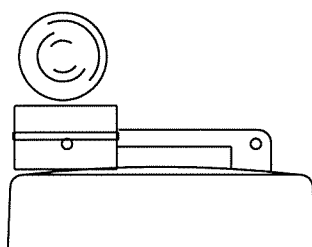
END TREATMENTS FOR CTB'S USED IN WORK ZONES

End treatments used on CTB's in work zones shall meet the appropriate crashworthy standards as defined in the Manual for Assessing Safety Hardware (MASH). Refer to the CWZTCD List for approved end treatments and manufacturers.

BARRIER REFLECTORS FOR CONCRETE TRAFFIC BARRIER AND ATTENUATORS

WARNING LIGHTS

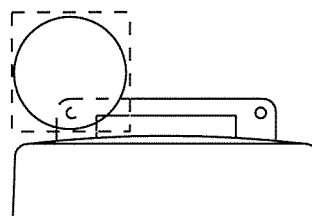
- Warning lights shall meet the requirements of the TMUTCD.
- Warning lights shall NOT be installed on barricades.
- Type A-Low Intensity Flashing Warning Lights are commonly used with drums. They are intended to warn of or mark a potentially hazardous area. Their use shall be as indicated on this sheet and/or other sheets of the plans by the designation "FL". The Type A Warning Lights shall not be used with signs manufactured with Type B_{FL} or C_{FL} Sheeting meeting the requirements of Departmental Material Specification DMS-8300.
- Type-C and Type D 360 degree Steady Burn Lights are intended to be used in a series for delineation to supplement other traffic control devices. Their use shall be as indicated on this sheet and/or other sheets of the plans by the designation "SB".
- The Engineer/Inspector or the plans shall specify the location and type of warning lights to be installed on the traffic control devices.
- When required by the Engineer, the Contractor shall furnish a copy of the warning lights certification. The warning light manufacturer will certify the warning lights meet the requirements of the latest ITE Purchase Specifications for Flashing and Steady-Burn Warning Lights.
- When used to delineate curves, Type-C and Type D Steady Burn Lights should only be placed on the outside of the curve, not the inside.
- The location of warning lights and warning reflectors on drums shall be as shown elsewhere in the plans.



Type C Warning Light or approved substitute mounted on a drum adjacent to the travel way.

WARNING LIGHTS MOUNTED ON PLASTIC DRUMS

- Type A flashing warning lights are intended to warn drivers that they are approaching or are in a potentially hazardous area.
- Type A random flashing warning lights are not intended for delineation and shall not be used in a series.
- A series of sequential flashing warning lights placed on channelizing devices to form a merging taper may be used for delineation. If used, the successive flashing of the sequential warning lights should occur from the beginning of the taper to the end of the merging taper in order to identify the desired vehicle path. The rate of flashing for each light shall be 65 flashes per minute, plus or minus 10 flashes.
- Type C and D steady-burn warning lights are intended to be used in a series to delineate the edge of the travel lane on detours, on lane changes, on lane closures, and on other similar conditions.
- Type A, Type C and Type D warning lights shall be installed at locations as detailed on other sheets in the plans.
- Warning lights shall not be installed on a drum that has a sign, chevron or vertical panel.
- The maximum spacing for warning lights on drums should be identical to the channelizing device spacing.



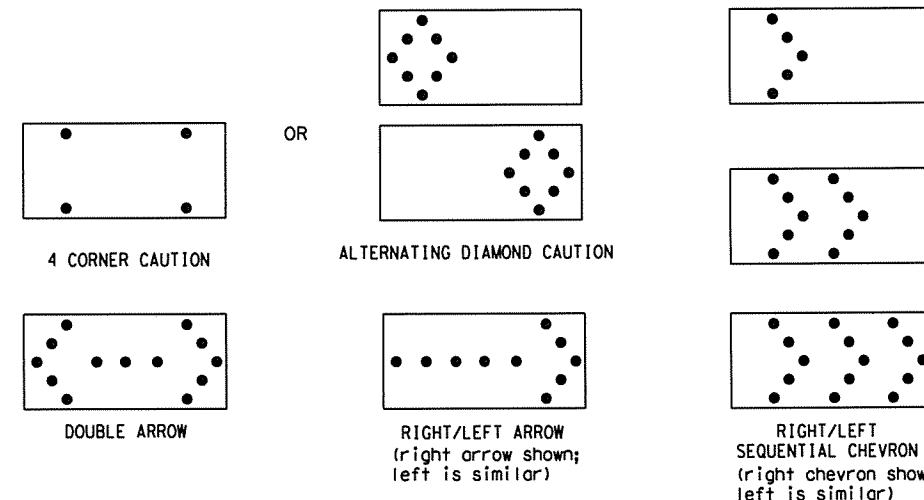
Warning reflector may be round or square. Must have a yellow reflective surface area of at least 30 square inches

WARNING REFLECTORS MOUNTED ON PLASTIC DRUMS AS A SUBSTITUTE FOR TYPE C (STEADY BURN) WARNING LIGHTS

- A warning reflector or approved substitute may be mounted on a plastic drum as a substitute for a Type C, steady burn warning light at the discretion of the Contractor unless otherwise noted in the plans.
- The warning reflector shall be yellow in color and shall be manufactured using a sign substrate approved for use with plastic drums listed on the CWZTCD.
- The warning reflector shall have a minimum retroreflective surface area (one-side) of 30 square inches.
- Round reflectors shall be fully reflectorized, including the area where attached to the drum.
- Square substrates must have a minimum of 30 square inches of reflectorized sheeting. They do not have to be reflectorized where it attaches to the drum.
- The side of the warning reflector facing approaching traffic shall have sheeting meeting the color and retroreflectivity requirements for DMS 8300-Type B or Type C.
- When used near two-way traffic, both sides of the warning reflector shall be reflectorized.
- The warning reflector should be mounted on the side of the handle nearest approaching traffic.
- The maximum spacing for warning reflectors should be identical to the channelizing device spacing requirements.

Arrow Boards may be located behind channelizing devices in place for a shoulder taper or merging taper, otherwise they shall be delineated with four (4) channelizing devices placed perpendicular to traffic on the upstream side of traffic.

- The Flashing Arrow Board should be used for all lane closures on multi-lane roadways, or slow moving maintenance or construction activities on the travel lanes.
- Flashing Arrow Boards should not be used on two-lane, two-way roadways, detours, diversions or work on shoulders unless the "CAUTION" display (see detail below) is used.
- The Engineer/Inspector shall choose all appropriate signs, barricades and/or other traffic control devices that should be used in conjunction with the Flashing Arrow Board.
- The Flashing Arrow Board should be able to display the following symbols:



- The "CAUTION" display consists of four corner lamps flashing simultaneously, or the Alternating Diamond Caution mode as shown.
- The straight line caution display is NOT ALLOWED.
- The Flashing Arrow Board shall be capable of minimum 50 percent dimming from rated lamp voltage. The flashing rate of the lamps shall not be less than 25 nor more than 40 flashes per minute.
- Minimum lamp "on time" shall be approximately 50 percent for the flashing arrow and equal intervals of 25 percent for each sequential phase of the flashing chevron.
- The sequential arrow display is NOT ALLOWED.
- The flashing arrow display is the TxDOT standard; however, the sequential chevron display may be used during daylight operations.
- The Flashing Arrow Board shall be mounted on a vehicle, trailer or other suitable support.
- A Flashing Arrow Board SHALL NOT BE USED to laterally shift traffic.
- A full matrix PCMS may be used to simulate a Flashing Arrow Board provided it meets visibility, flash rate and dimming requirements on this sheet for the same size arrow.
- Minimum mounting height of trailer mounted Arrow Boards should be 7 feet from roadway to bottom of panel.

REQUIREMENTS			
TYPE	MINIMUM SIZE	MINIMUM NUMBER OF PANEL LAMPS	MINIMUM VISIBILITY DISTANCE
B	30 x 60	13	3/4 mile
C	48 x 96	15	1 mile

ATTENTION
Flashing Arrow Boards shall be equipped with automatic dimming devices.

WHEN NOT IN USE, REMOVE THE ARROW BOARD FROM THE RIGHT-OF-WAY OR PLACE THE ARROW BOARD BEHIND CONCRETE TRAFFIC BARRIER OR GUARDRAIL.

FLASHING ARROW BOARDS

SHEET 7 OF 12

TRUCK-MOUNTED ATTENUATORS

- Truck-mounted attenuators (TMA) used on TxDOT facilities must meet the requirements outlined in the Manual for Assessing Safety Hardware (MASH).
- Refer to the CWZTCD for the requirements of Level 2 or Level 3 TMAs.
- Refer to the CWZTCD for a list of approved TMAs.
- TMAs are required on freeways unless otherwise noted in the plans.
- A TMA should be used anytime that it can be positioned 30 to 100 feet in advance of the area of crew exposure without adversely affecting the work performance.
- The only reason a TMA should not be required is when a work area is spread down the roadway and the work crew is an extended distance from the TMA.



BARRICADE AND CONSTRUCTION ARROW PANEL, REFLECTORS, WARNING LIGHTS & ATTENUATOR

BC (7) - 21

FILE#	bc-21.dgn	DW#	TxDOT	CK#	TxDOT	DR#	TxDOT	CK#	TxDOT
© TxDOT	November 2002	CONT	SECT	JOB	HIGHWAY				
REVISIONS		6459	93	001	I-610, etc.				
9-07	8-14	DIST	COUNTY		SHEET NO.				
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GENERAL NOTES

- For long term stationary work zones on freeways, drums shall be used as the primary channelizing device.
- For intermediate term stationary work zones on freeways, drums should be used as the primary channelizing device but may be replaced in tangent sections by vertical panels, or 42" two-piece cones. In tangent sections, one-piece cones may be used with the approval of the Engineer but only if personnel are present on the project at all times to maintain the cones in proper position and location.
- For short term stationary work zones on freeways, drums are the preferred channelizing device but may be replaced in tapers, transitions and tangent sections by vertical panels, two-piece cones or one-piece cones as approved by the Engineer.
- Drums and all related items shall comply with the requirements of the current version of the "Texas Manual on Uniform Traffic Control Devices" (TMUTCD) and the "Compliant Work Zone Traffic Control Devices List" (CWZTCD).
- Drums, bases, and related materials shall exhibit good workmanship and shall be free from objectionable marks or defects that would adversely affect their appearance or serviceability.
- The Contractor shall have a maximum of 24 hours to replace any plastic drums identified for replacement by the Engineer/Inspector. The replacement device must be an approved device.

GENERAL DESIGN REQUIREMENTS

Pre-qualified plastic drums shall meet the following requirements:

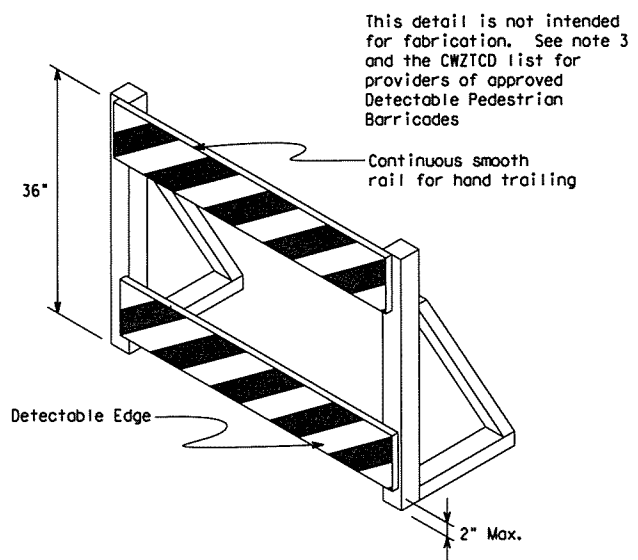
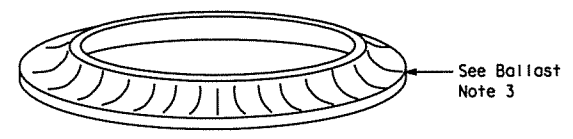
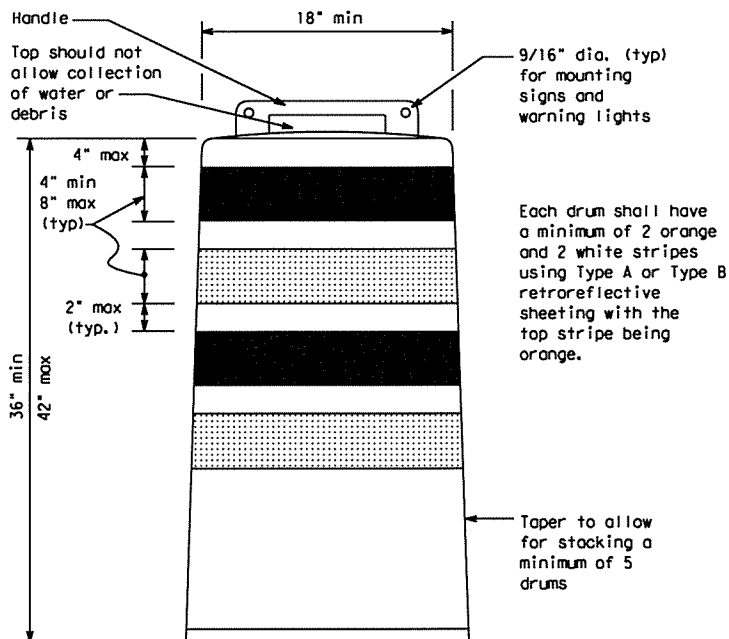
- Plastic drums shall be a two-piece design; the "body" of the drum shall be the top portion and the "base" shall be the bottom.
- The body and base shall lock together in such a manner that the body separates from the base when impacted by a vehicle traveling at a speed of 20 MPH or greater but prevents accidental separation due to normal handling and/or air turbulence created by passing vehicles.
- Plastic drums shall be constructed of lightweight flexible, and deformable materials. The Contractor shall NOT use metal drums or single piece plastic drums as channelization devices or sign supports.
- Drums shall present a profile that is a minimum of 18 inches in width at the 36 inch height when viewed from any direction. The height of drum unit (body installed on base) shall be a minimum of 36 inches and a maximum of 42 inches.
- The top of the drum shall have a built-in handle for easy pickup and shall be designed to drain water and not collect debris. The handle shall have a minimum of two widely spaced 9/16 inch diameter holes to allow attachment of a warning light, warning reflector unit or approved compliant sign.
- The exterior of the drum body shall have a minimum of four alternating orange and white retroreflective circumferential stripes not less than 4 inches nor greater than 8 inches in width. Any non-reflectorized space between any two adjacent stripes shall not exceed 2 inches in width.
- Bases shall have a maximum width of 36 inches, a maximum height of 4 inches, and a minimum of two footholds of sufficient size to allow base to be held down while separating the drum body from the base.
- Plastic drums shall be constructed of ultra-violet stabilized, orange, high-density polyethylene (HDPE) or other approved material.
- Drum body shall have a maximum unballasted weight of 11 lbs.
- Drum and base shall be marked with manufacturer's name and model number.

RETROREFLECTIVE SHEETING

- The stripes used on drums shall be constructed of sheeting meeting the color and retroreflectivity requirements of Departmental Materials Specification DMS-8300, "Sign Face Materials." Type A or Type B reflective sheeting shall be supplied unless otherwise specified in the plans.
- The sheeting shall be suitable for use on and shall adhere to the drum surface such that, upon vehicular impact, the sheeting shall remain adhered in-place and exhibit no delaminating, cracking, or loss of retroreflectivity other than that loss due to abrasion of the sheeting surface.

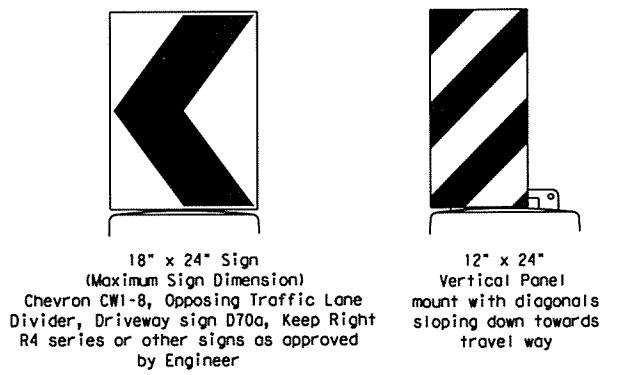
BALLAST

- Unballasted bases shall be large enough to hold up to 50 lbs. of sand. This base, when filled with the ballast material, should weigh between 35 lbs (minimum) and 50 lbs (maximum). The ballast may be sand in one to three sandbags separate from the base, sand in a sand-filled plastic base, or other ballasting devices as approved by the Engineer. Stacking of sandbags will be allowed, however height of sandbags above pavement surface may not exceed 12 inches.
- Bases with built-in ballast shall weigh between 40 lbs. and 50 lbs. Built-in ballast can be constructed of an integral crumb rubber base or a solid rubber base.
- Recycled truck tire sidewalls may be used for ballast on drums approved for this type of ballast on the CWZTCD list.
- The ballast shall not be heavy objects, water, or any material that would become hazardous to motorists, pedestrians, or workers when the drum is struck by a vehicle.
- When used in regions susceptible to freezing, drums shall have drainage holes in the bottoms so that water will not collect and freeze becoming a hazard when struck by a vehicle.
- Ballast shall not be placed on top of drums.
- Adhesives may be used to secure base of drums to pavement.



DETECTABLE PEDESTRIAN BARRICADES

- When existing pedestrian facilities are disrupted, closed, or relocated in a TTC zone, the temporary facilities shall be detectable and include accessibility features consistent with the features present in the existing pedestrian facility. Refer to WZ(BTS-2) for Pedestrian Control requirements for Sidewalk Diversions, Sidewalk Detours and Crosswalk Closures.
- Where pedestrians with visual disabilities normally use the closed sidewalk, a Detectable Pedestrian Barricade shall be placed across the full width of the closed sidewalk instead of a Type 3 Barricade.
- Detectable pedestrian barricades similar to the one pictured above, longitudinal channelizing devices, some concrete barriers, and wood or chain link fencing with a continuous detectable edging can satisfactorily delineate a pedestrian path.
- Tape, rope, or plastic chain strung between devices are not detectable, do not comply with the design standards in the "Americans with Disabilities Act Accessibility Guidelines (ADAAG)" and should not be used as a control for pedestrian movements.
- Warning lights shall not be attached to detectable pedestrian barricades.
- Detectable pedestrian barricades should use 8" nominal barricade rails as shown on BC(10) provided that the top rail provides a smooth continuous rail suitable for hand trailing with no splinters, burrs, or sharp edges.



Plywood, Aluminum or Metal sign substrates shall NOT be used on plastic drums

SIGNS, CHEVRONS, AND VERTICAL PANELS MOUNTED ON PLASTIC DRUMS

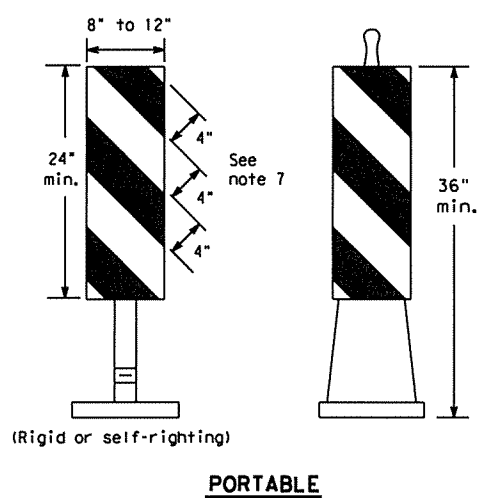
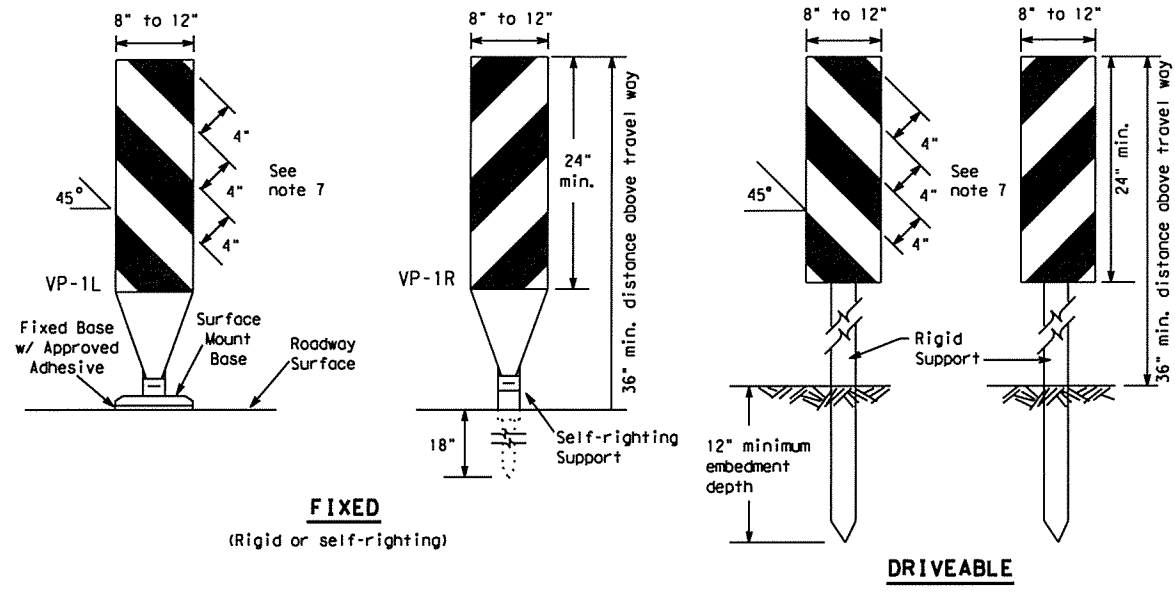
- Signs used on plastic drums shall be manufactured using substrates listed on the CWZTCD.
- Chevrons and other work zone signs with an orange background shall be manufactured with Type B_{FL} or Type C_{FL} Orange sheeting meeting the color and retroreflectivity requirements of DMS-8300, "Sign Face Material," unless otherwise specified in the plans.
- Vertical Panels shall be manufactured with orange and white sheeting meeting the requirements of DMS-8300 Type A or Type B. Diagonal stripes on Vertical Panels shall slope down toward the intended traveled lane.
- Other sign messages (text or symbolic) may be used as approved by the Engineer. Sign dimensions shall not exceed 18 inches in width or 24 inches in height, except for the R9 series signs discussed in note 8 below.
- Signs shall be installed using a 1/2 inch bolt (nominal) and nut, two washers, and one locking washer for each connection.
- Mounting bolts and nuts shall be fully engaged and adequately torqued. Bolts should not extend more than 1/2 inch beyond nuts.
- Chevrons may be placed on drums on the outside of curves, on merging tapers or on shifting tapers. When used in these locations, they may be placed on every drum or spaced not more than on every third drum. A minimum of three (3) should be used at each location called for in the plans.
- R9-9, R9-10, R9-11 and R9-11a Sidewalk Closed signs which are 24 inches wide may be mounted on plastic drums, with approval of the Engineer.

SHEET 8 OF 12

		Traffic Safety Division Standard	
<h2>BARRICADE AND CONSTRUCTION CHANNELIZING DEVICES</h2>			
<h3>BC (8) - 21</h3>			
FILE: bc-21.dgn	DW: TxDOT	CHK: TxDOT	CHK: TxDOT
© TxDOT November 2002	CONT: 6459	SECT: 93	JOB: 001
REVISIONS 4-03 8-14 9-07 5-21 7-13		DIST: HOU	COUNTY: HARRIS, etc.
		SHEET NO. 45	

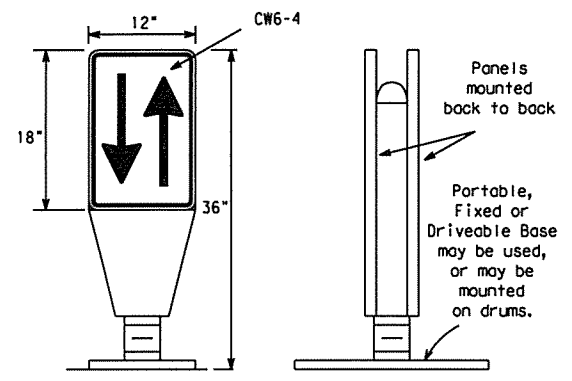
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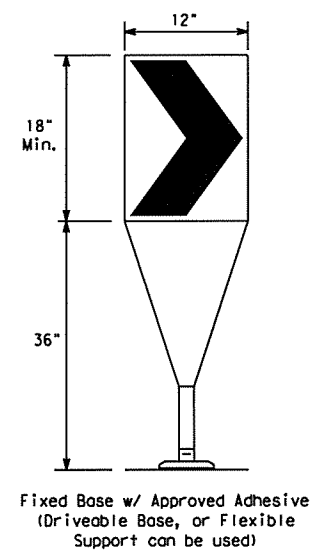
- Vertical Panels (VP's) are normally used to channelize traffic or divide opposing lanes of traffic.
- VP's may be used in daytime or nighttime situations. They may be used at the edge of shoulder drop-offs and other areas such as lane transitions where positive daytime and nighttime delineation is required. The Engineer/Inspector shall refer to the Roadway Design Manual for additional requirements on the use VP's for drop-offs.
- VP's should be mounted back to back if used at the edge of cuts adjacent to two-way two lane roadways. Stripes are to be reflective orange and reflective white and should always slope downward toward the travel lane.
- VP's used on expressways and freeways or other high speed roadways, may have more than 270 square inches of retroreflective area facing traffic.
- Self-righting supports are available with portable base. See "Compliant Work Zone Traffic Control Devices List" (CWZTCD).
- Sheeting for the VP's shall be retroreflective Type A or Type B conforming to Departmental Material Specification DMS-8300, unless noted otherwise.
- Where the height of reflective material on the vertical panel is 36 inches or greater, a panel stripe of 6 inches shall be used.

VERTICAL PANELS (VPs)



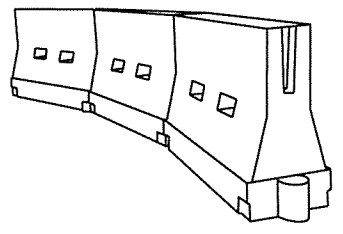
- Opposing Traffic Lane Dividers (OTLD) are delineation devices designed to convert a normal one-way roadway section to two-way operation. OTLD's are used on temporary centerlines. The upward and downward arrows on the sign's face indicate the direction of traffic on either side of the divider. The base is secured to the pavement with an adhesive or rubber weight to minimize movement caused by a vehicle impact or wind gust.
- The OTLD may be used in combination with 42" cones or VP's.
- Spacing between the OTLD shall not exceed 500 feet. 42" cones or VP's placed between the OTLD's should not exceed 100 foot spacing.
- The OTLD shall be orange with a black non-reflective legend. Sheeting for the OTLD shall be retroreflective Type B_{FL} or Type C_{FL} conforming to Departmental Material Specification DMS-8300, unless noted otherwise. The legend shall meet the requirements of DMS-8300.

OPPOSING TRAFFIC LANE DIVIDERS (OTLD)



- The chevron shall be a vertical rectangle with a minimum size of 12 by 18 inches.
- Chevrons are intended to give notice of a sharp change of alignment with the direction of travel and provide additional emphasis and guidance for vehicle operators with regard to changes in horizontal alignment of the roadway.
- Chevrons, when used, shall be erected on the outside of a sharp curve or turn, or on the far side of an intersection. They shall be in line with and at right angles to approaching traffic. Spacing should be such that the motorist always has three in view, until the change in alignment eliminates its need.
- To be effective, the chevron should be visible for at least 500 feet.
- Chevrons shall be orange with a black nonreflective legend. Sheeting for the chevron shall be retroreflective Type B_{FL} or Type C_{FL} conforming to Departmental Material Specification DMS-8300, unless noted otherwise. The legend shall meet the requirements of DMS-8300.
- For Long Term Stationary use on tapers or transitions on freeways and divided highways, self-righting chevrons may be used to supplement plastic drums but not to replace plastic drums.

CHEVRONS



LONGITUDINAL CHANNELIZING DEVICES (LCD)

- LCDs are crashworthy, lightweight, deformable devices that are highly visible, have good target value and can be connected together. They are not designed to contain or redirect a vehicle on impact.
- LCDs may be used instead of a line of cones or drums.
- LCDs shall be placed in accordance to application and installation requirements specific to the device, and used only when shown on the CWZTCD list.
- LCDs should not be used to provide positive protection for obstacles, pedestrians or workers.
- LCDs shall be supplemented with retroreflective delineation as required for temporary barriers on BC(7) when placed roughly parallel to the travel lanes.
- LCDs used as barricades placed perpendicular to traffic should have at least one row of reflective sheeting meeting the requirements for barricade rails as shown on BC(10). Place reflective sheeting near the top of the LCD along the full length of the device.

WATER BALLASTED SYSTEMS USED AS BARRIERS

- Water ballasted systems used as barriers shall not be used solely to channelize road users, but also to protect the work space per the appropriate Manual for Assessing Safety Hardware (MASH) crashworthiness requirements based on roadway speed and barrier application.
- Water ballasted systems used to channelize vehicular traffic shall be supplemented with retroreflective delineation or channelizing devices to improve daytime/nighttime visibility. They may also be supplemented with pavement markings.
- Water ballasted systems used as barriers shall be placed in accordance to application and installation requirements specific to the device, and used only when shown on the CWZTCD list.
- Water ballasted systems used as barriers should not be used for a merging taper except in low speed (less than 45 MPH) urban areas. When used on a taper in a low speed urban area, the taper shall be delineated and the taper length should be designed to optimize road user operations considering the available geometric conditions.
- When water ballasted systems used as barriers have blunt ends exposed to traffic, they should be attenuated as per manufacturer recommendations or flared to a point outside the clear zone.

If used to channelize pedestrians, longitudinal channelizing devices or water ballasted systems must have a continuous detectable bottom for users of long cones and the top of the unit shall not be less than 32 inches in height.

HOLLOW OR WATER BALLASTED SYSTEMS USED AS LONGITUDINAL CHANNELIZING DEVICES OR BARRIERS

GENERAL NOTES

- Work Zone channelizing devices illustrated on this sheet may be installed in close proximity to traffic and are suitable for use on high or low speed roadways. The Engineer/Inspector shall ensure that spacing and placement is uniform and in accordance with the "Texas Manual on Uniform Traffic Control Devices" (TMUTCD).
- Channelizing devices shown on this sheet may have a driveable, fixed or portable base. The requirement for self-righting channelizing devices must be specified in the General Notes or other plan sheets.
- Channelizing devices on self-righting supports should be used in work zone areas where channelizing devices are frequently impacted by errant vehicles or vehicle related wind gusts making alignment of the channelizing devices difficult to maintain. Locations of these devices shall be detailed elsewhere in the plans. These devices shall conform to the TMUTCD and the "Compliant Work Zone Traffic Control Devices List" (CWZTCD).
- The Contractor shall maintain devices in a clean condition and replace damaged, nonreflective, faded, or broken devices and bases as required by the Engineer/Inspector. The Contractor shall be required to maintain proper device spacing and alignment.
- Portable bases shall be fabricated from virgin and/or recycled rubber. The portable bases shall weigh a minimum of 30 lbs.
- Pavement surfaces shall be prepared in a manner that ensures proper bonding between the adhesives, the fixed mount bases and the pavement surface. Adhesives shall be prepared and applied according to the manufacturer's recommendations.
- The installation and removal of channelizing devices shall not cause detrimental effects to the final pavement surfaces, including pavement surface discoloration or surface integrity. Driveable bases shall not be permitted on final pavement surfaces. The Engineer/Inspector shall approve all application and removal procedures of fixed bases.

Posted Speed	Formula	Minimum Desirable Taper Lengths **			Suggested Maximum Spacing of Channelizing Devices	
		10' Offset	11' Offset	12' Offset	On a Taper	On a Tangent
30	L = WS ² / 60	150'	165'	180'	30'	60'
35		205'	225'	245'	35'	70'
40		265'	295'	320'	40'	80'
45	L = WS	450'	495'	540'	45'	90'
50		500'	550'	600'	50'	100'
55		550'	605'	660'	55'	110'
60		600'	660'	720'	60'	120'
65		650'	715'	780'	65'	130'
70		700'	770'	840'	70'	140'
75		750'	825'	900'	75'	150'
80	800'	880'	960'	80'	160'	

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

SUGGESTED MAXIMUM SPACING OF CHANNELIZING DEVICES AND MINIMUM DESIRABLE TAPER LENGTHS



BARRICADE AND CONSTRUCTION CHANNELIZING DEVICES

BC (9) - 21

FILE: bc-21.dgn	DN: TxDOT	CK: TxDOT	DW: TxDOT	CR: TxDOT
© TxDOT November 2002	CONT	SECT	JOB	HIGHWAY
REVISIONS				
9-07 8-14	6459	93	001	I-610, etc.
7-13 5-21	DIST	COUNTY	SHEET NO.	
	HOU	HARRIS, etc.	46	

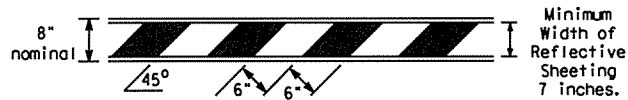
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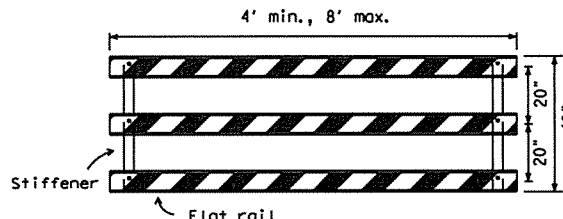
TYPE 3 BARRICADES

1. Refer to the Compliant Work Zone Traffic Control Devices List (CWZTCD) for details of the Type 3 Barricades and a list of all materials used in the construction of Type 3 Barricades.
2. Type 3 Barricades shall be used at each end of construction projects closed to all traffic.
3. Barricades extending across a roadway should have stripes that slope downward in the direction toward which traffic must turn in detouring. When both right and left turns are provided, the chevron striping may slope downward in both directions from the center of the barricade. Where no turns are provided at a closed road, striping should slope downward in both directions toward the center of roadway.
4. Striping of rails, for the right side of the roadway, should slope downward to the left. For the left side of the roadway, striping should slope downward to the right.
5. Identification markings may be shown only on the back of the barricade rails. The maximum height of letters and/or company logos used for identification shall be 1".
6. Barricades shall not be placed parallel to traffic unless an adequate clear zone is provided.
7. Warning lights shall NOT be installed on barricades.
8. Where barricades require the use of weights to keep from turning over, the use of sandbags with dry, cohesionless sand is recommended. The sandbags will be tied shut to keep the sand from spilling and to maintain a constant weight. Sand bags shall not be stacked in a manner that covers any portion of a barricade rails reflective sheeting. Rock, concrete, iron, steel or other solid objects will NOT be permitted. Sandbags should weigh a minimum of 35 lbs and a maximum of 50 lbs. Sandbags shall be made of a durable material that tears upon vehicular impact. Rubber (such as tire inner tubes) shall not be used for sandbags. Sandbags shall only be placed along or upon the base supports of the device and shall not be suspended above ground level or hung with rope, wire, chains or other fasteners.
9. Sheeting for barricades shall be retroreflective Type A or Type B conforming to Departmental Material Specification DMS-8300 unless otherwise noted.

Barricades shall NOT be used as a sign support.



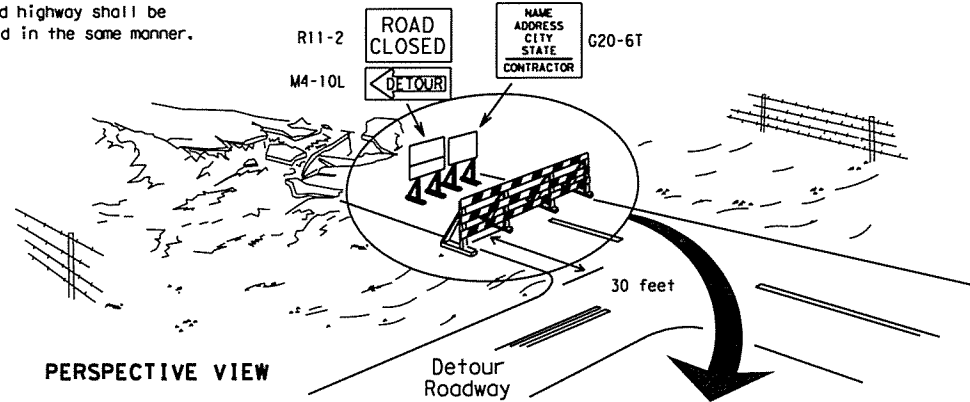
TYPICAL STRIPING DETAIL FOR BARRICADE RAIL



Stiffener may be inside or outside of support, but no more than 2 stiffeners shall be allowed on one barricade.

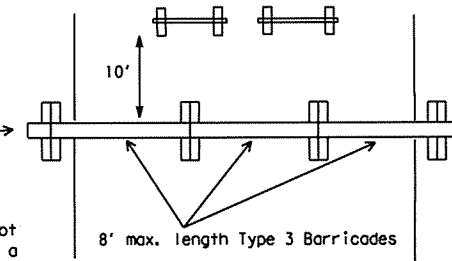
TYPICAL PANEL DETAIL FOR SKID OR POST TYPE BARRICADES

Each roadway of a divided highway shall be barricaded in the same manner.



PERSPECTIVE VIEW

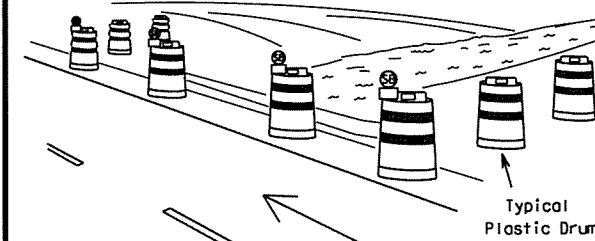
The three rails on Type 3 barricades shall be reflectorized orange and reflective white stripes on one side facing one-way traffic and both sides for two-way traffic. Barricade striping should slant downward in the direction of detour.



PLAN VIEW

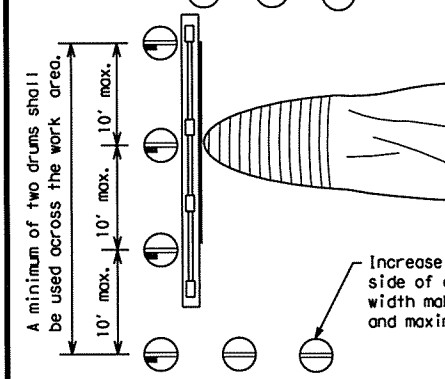
1. Signs should be mounted on independent supports at a 7 foot mounting height in center of roadway. The signs should be a minimum of 10 feet behind Type 3 Barricades.
2. Advance signing shall be as specified elsewhere in the plans.

TYPE 3 BARRICADE (POST AND SKID) TYPICAL APPLICATION



PERSPECTIVE VIEW

These drums are not required on one-way roadway

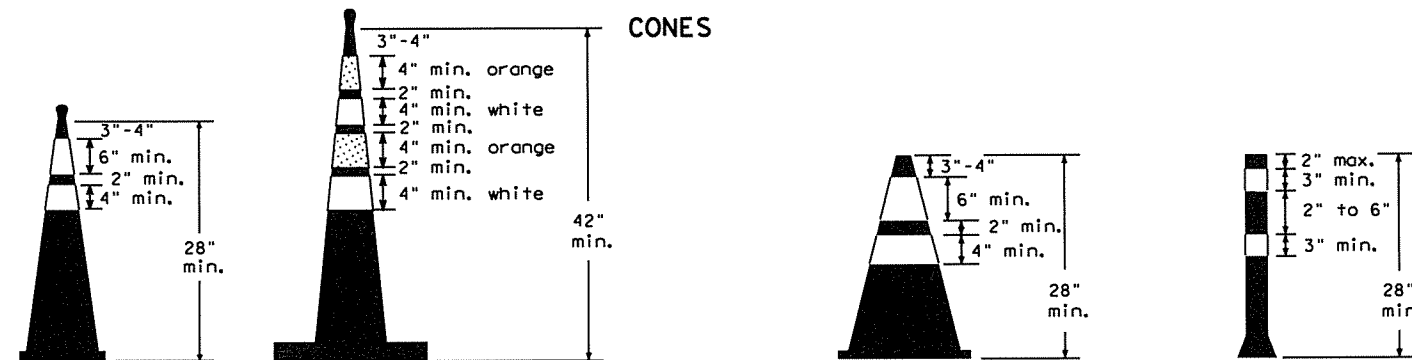


PLAN VIEW

Increase number of plastic drums on the side of approaching traffic if the crown width makes it necessary. (minimum of 2 and maximum of 4 drums)

LEGEND	
	Plastic drum
	Plastic drum with steady burn light or yellow warning reflector
	Steady burn warning light or yellow warning reflector

CULVERT WIDENING OR OTHER ISOLATED WORK WITHIN THE PROJECT LIMITS

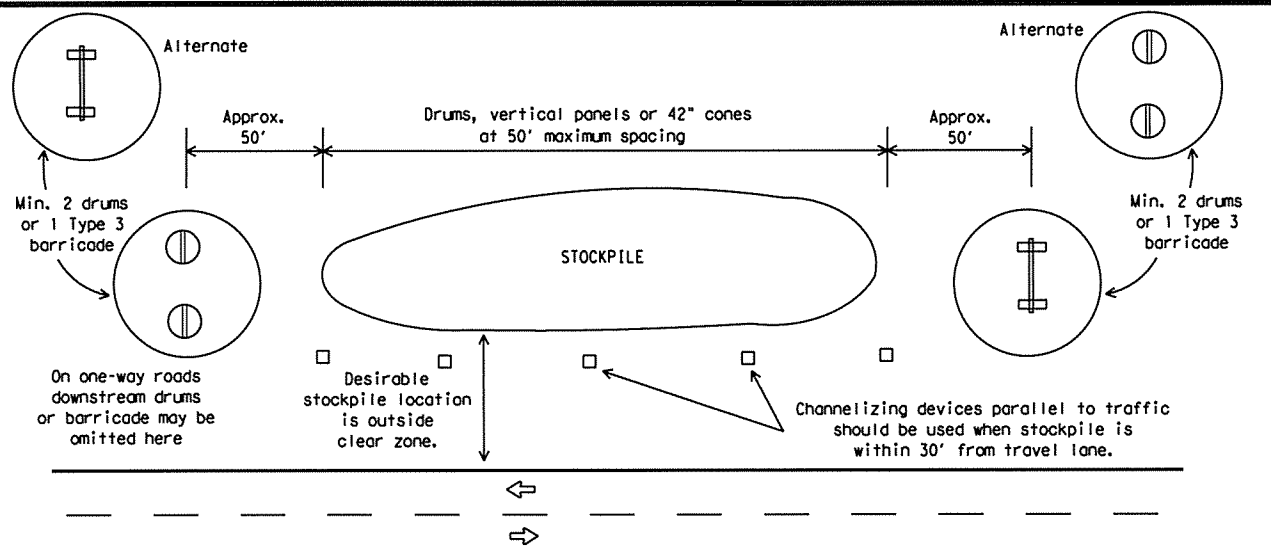


Two-Piece cones

One-Piece cones

Tubular Marker

28" Cones shall have a minimum weight of 9 1/2 lbs.
42" 2-piece cones shall have a minimum weight of 30 lbs. including base.



TRAFFIC CONTROL FOR MATERIAL STOCKPILES

1. Traffic cones and tubular markers shall be predominantly orange, and meet the height and weight requirements shown above.
2. One-piece cones have the body and base of the cone molded in one consolidated unit. Two-piece cones have a cone shaped body and a separate rubber base, or ballast, that is added to keep the device upright and in place.
3. Two-piece cones may have a handle or loop extending up to 8" above the minimum height shown, in order to aid in retrieving the device.
4. Cones or tubular markers shall have white or white and orange reflective bands as shown above. The reflective bands shall have a smooth, sealed outer surface and meet the requirements of Departmental Material Specification DMS-8300 Type A or Type B.
5. 28" cones and tubular markers are generally suitable for short duration and short-term stationary work as defined on BC(4). These should not be used for intermediate-term or long-term stationary work unless personnel is on-site to maintain them in their proper upright position.
6. 42" two-piece cones, vertical panels or drums are suitable for all work zone durations.
7. Cones or tubular markers used on each project should be of the same size and shape.

BARRICADE AND CONSTRUCTION CHANNELIZING DEVICES

BC(10)-21

FILE: bc-21.dgn	DN: TxDOT	CK: TxDOT	DW: TxDOT	CK: TxDOT
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REVISIONS	6459	93	001	1-610, etc.
9-07 8-14	DIST	COUNTY	SHEET NO.	
7-13 5-21	HOU	HARRIS, etc.	47	

WORK ZONE PAVEMENT MARKINGS

GENERAL

1. The Contractor shall be responsible for maintaining work zone and existing pavement markings, in accordance with the standard specifications and special provisions, on all roadways open to traffic within the CSJ limits unless otherwise stated in the plans.
2. Color, patterns and dimensions shall be in conformance with the "Texas Manual on Uniform Traffic Control Devices" (TMUTCD).
3. Additional supplemental pavement marking details may be found in the plans or specifications.
4. Pavement markings shall be installed in accordance with the TMUTCD and as shown on the plans.
5. When short term markings are required on the plans, short term markings shall conform with the TMUTCD, the plans and details as shown on the Standard Plan Sheet WZ (STPM).
6. When standard pavement markings are not in place and the roadway is opened to traffic, DO NOT PASS signs shall be erected to mark the beginning of the sections where passing is prohibited and PASS WITH CARE signs at the beginning of sections where passing is permitted.
7. All work zone pavement markings shall be installed in accordance with Item 662, "Work Zone Pavement Markings."

RAISED PAVEMENT MARKERS

1. Raised pavement markers are to be placed according to the patterns on BC(12).
2. All raised pavement markers used for work zone markings shall meet the requirements of Item 672, "RAISED PAVEMENT MARKERS" and Departmental Material Specification DMS-4200 or DMS-4300.

PREFABRICATED PAVEMENT MARKINGS

1. Removable prefabricated pavement markings shall meet the requirements of DMS-8241.
2. Non-removable prefabricated pavement markings (foil back) shall meet the requirements of DMS-8240.

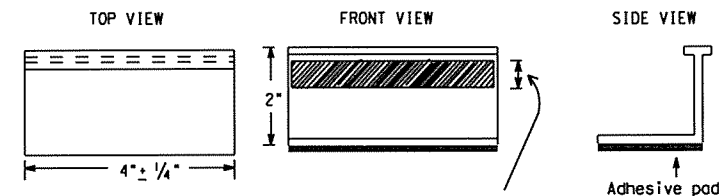
MAINTAINING WORK ZONE PAVEMENT MARKINGS

1. The Contractor will be responsible for maintaining work zone pavement markings within the work limits.
2. Work zone pavement markings shall be inspected in accordance with the frequency and reporting requirements of work zone traffic control device inspections as required by Form 599.
3. The markings should provide a visible reference for a minimum distance of 300 feet during normal daylight hours and 160 feet when illuminated by automobile low-beam headlights at night, unless sight distance is restricted by roadway geometrics.
4. Markings failing to meet this criteria within the first 30 days after placement shall be replaced at the expense of the Contractor as per Specification Item 662.

REMOVAL OF PAVEMENT MARKINGS

1. Pavement markings that are no longer applicable, could create confusion or direct a motorist toward or into the closed portion of the roadway shall be removed or obliterated before the roadway is opened to traffic.
2. The above shall not apply to detours in place for less than three days, where floggers and/or sufficient channelizing devices are used in lieu of markings to outline the detour route.
3. Pavement markings shall be removed to the fullest extent possible, so as not to leave a discernable marking. This shall be by any method approved by TxDOT Specification Item 677 for "Eliminating Existing Pavement Markings and Markers".
4. The removal of pavement markings may require resurfacing or seal coating portions of the roadway as described in Item 677.
5. Subject to the approval of the Engineer, any method that proves to be successful on a particular type pavement may be used.
6. Blast cleaning may be used but will not be required unless specifically shown in the plans.
7. Over-painting of the markings SHALL NOT BE permitted.
8. Removal of raised pavement markers shall be as directed by the Engineer.
9. Removal of existing pavement markings and markers will be paid for directly in accordance with Item 677, "ELIMINATING EXISTING PAVEMENT MARKINGS AND MARKERS," unless otherwise stated in the plans.
10. Black-out marking tape may be used to cover conflicting existing markings for periods less than two weeks when approved by the Engineer.

Temporary Flexible-Reflective Roadway Marker Tabs



Height of sheeting is usually more than 1/4" and less than 1".

STAPLES OR NAILS SHALL NOT BE USED TO SECURE TEMPORARY FLEXIBLE-REFLECTIVE ROADWAY MARKER TABS TO THE PAVEMENT SURFACE

1. Temporary flexible-reflective roadway marker tabs used as guidemarks shall meet the requirements of DMS-8242.
2. Tabs detailed on this sheet are to be inspected and accepted by the Engineer or designated representative. Sampling and testing is not normally required, however at the option of the Engineer, either "A" or "B" below may be imposed to assure quality before placement on the roadway.
 - A. Select five (5) or more tabs at random from each lot or shipment and submit to the Construction Division, Materials and Pavement Section to determine specification compliance.
 - B. Select five (5) tabs and perform the following test. Affix five (5) tabs at 24 inch intervals on an asphaltic pavement in a straight line. Using a medium size passenger vehicle or pickup, run over the markers with the front and rear tires at a speed of 35 to 40 miles per hour, four (4) times in each direction. No more than one (1) out of the five (5) reflective surfaces shall be lost or displaced as a result of this test.
3. Small design variances may be noted between tab manufacturers.
4. See Standard Sheet WZ (STPM) for tab placement on new pavements. See Standard Sheet TCP (7-1) for tab placement on seal coat work.

RAISED PAVEMENT MARKERS USED AS GUIDEMARKS

1. Raised pavement markers used as guidemarks shall be from the approved product list, and meet the requirements of DMS-4200.
2. All temporary construction raised pavement markers provided on a project shall be of the same manufacturer.
3. Adhesive for guidemarks shall be bituminous material hot applied or butyl rubber pad for all surfaces, or thermoplastic for concrete surfaces.

Guidemarks shall be designated as:
 YELLOW - (two amber reflective surfaces with yellow body).
 WHITE - (one silver reflective surface with white body).

DEPARTMENTAL MATERIAL SPECIFICATIONS	
PAVEMENT MARKERS (REFLECTORIZED)	DMS-4200
TRAFFIC BUTTONS	DMS-4300
EPOXY AND ADHESIVES	DMS-6100
BITUMINOUS ADHESIVE FOR PAVEMENT MARKERS	DMS-6130
PERMANENT PREFABRICATED PAVEMENT MARKINGS	DMS-8240
TEMPORARY REMOVABLE, PREFABRICATED PAVEMENT MARKINGS	DMS-8241
TEMPORARY FLEXIBLE, REFLECTIVE ROADWAY MARKER TABS	DMS-8242

A list of prequalified reflective raised pavement markers, non-reflective traffic buttons, roadway marker tabs and other pavement markings can be found at the Material Producer List web address shown on BC(1).

SHEET 11 OF 12

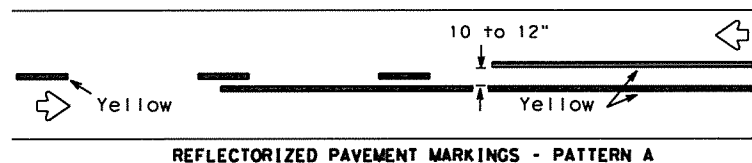
		Traffic Safety Division Standard	
BARRICADE AND CONSTRUCTION PAVEMENT MARKINGS			
BC (11) - 21			
FILE#	bc-21.dgn	DN#	TxDOT
©	TxDOT February 1998	CK#	TxDOT
REVISIONS		DN#	TxDOT
2-98	9-07 5-21	CONT	SECT
1-02	7-13	6459	93
11-02	8-14	JOB	HIGHWAY
		DIST	COUNTY
		HOU	HARRIS, etc.
		SHEET NO.	48

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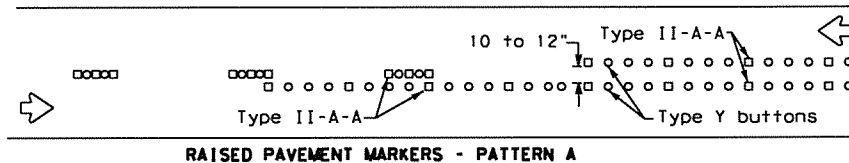
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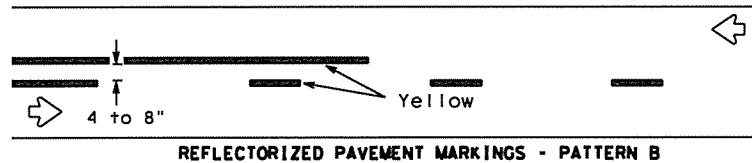
PAVEMENT MARKING PATTERNS



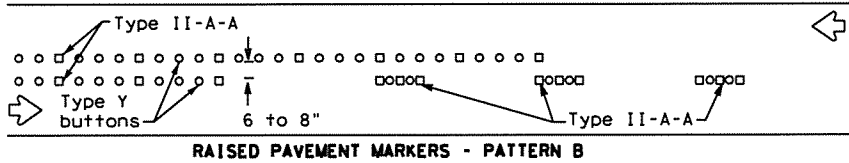
REFLECTORIZED PAVEMENT MARKINGS - PATTERN A



RAISED PAVEMENT MARKERS - PATTERN A



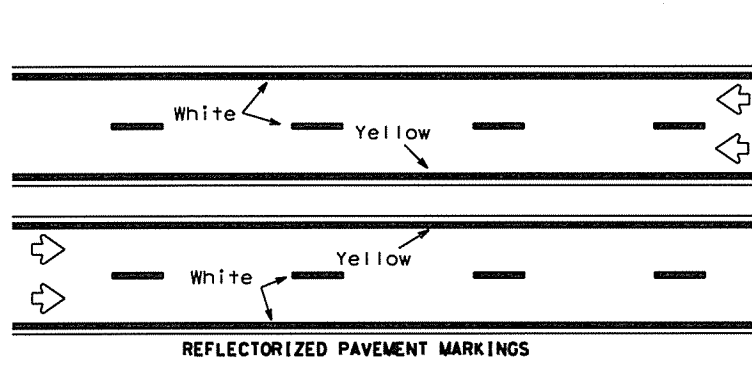
REFLECTORIZED PAVEMENT MARKINGS - PATTERN B



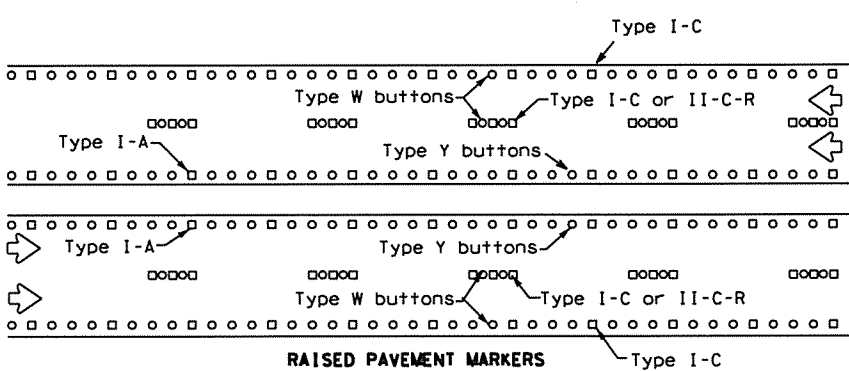
RAISED PAVEMENT MARKERS - PATTERN B

Pattern A is the TxDOT Standard, however Pattern B may be used if approved by the Engineer. Prefabricated markings may be substituted for reflectorized pavement markings.

CENTER LINE & NO-PASSING ZONE BARRIER LINES FOR TWO-LANE, TWO-WAY HIGHWAYS



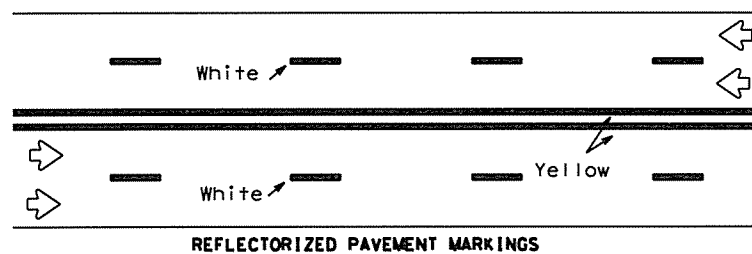
REFLECTORIZED PAVEMENT MARKINGS



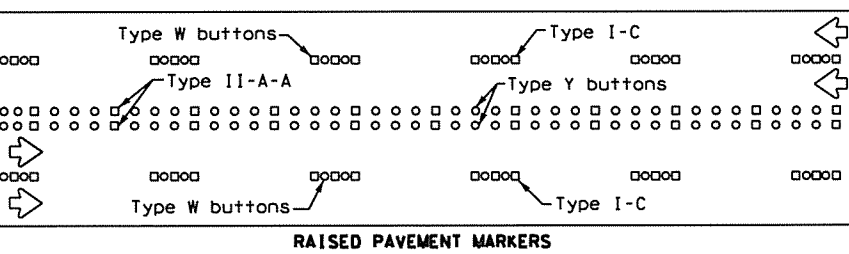
RAISED PAVEMENT MARKERS

Prefabricated markings may be substituted for reflectorized pavement markings.

EDGE & LANE LINES FOR DIVIDED HIGHWAY



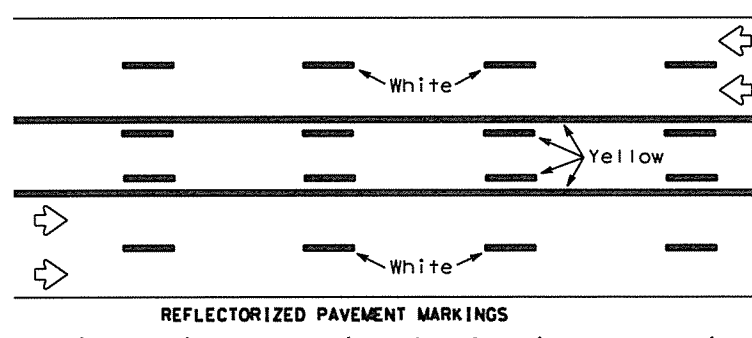
REFLECTORIZED PAVEMENT MARKINGS



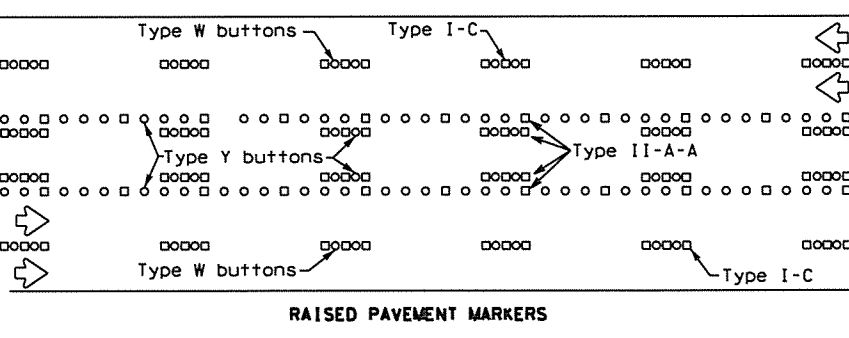
RAISED PAVEMENT MARKERS

Prefabricated markings may be substituted for reflectorized pavement markings.

LANE & CENTER LINES FOR MULTILANE UNDIVIDED HIGHWAYS



REFLECTORIZED PAVEMENT MARKINGS

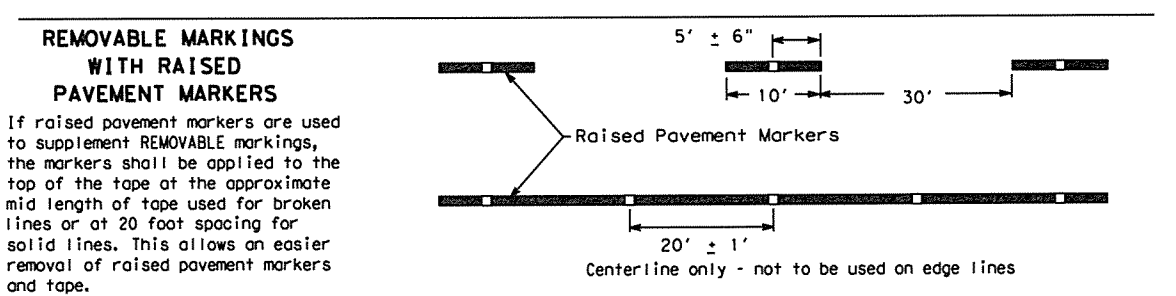
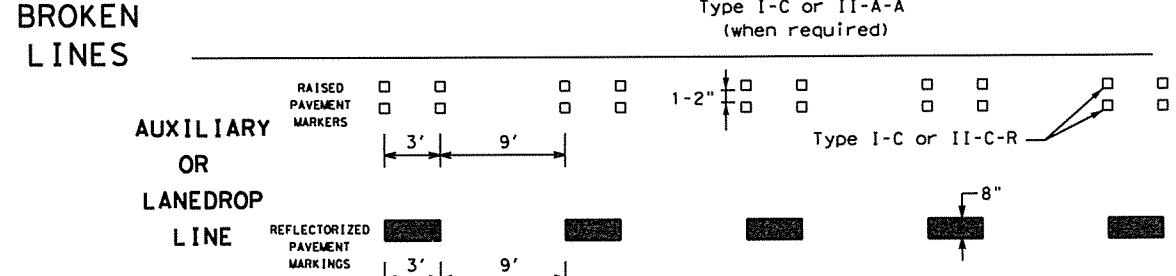
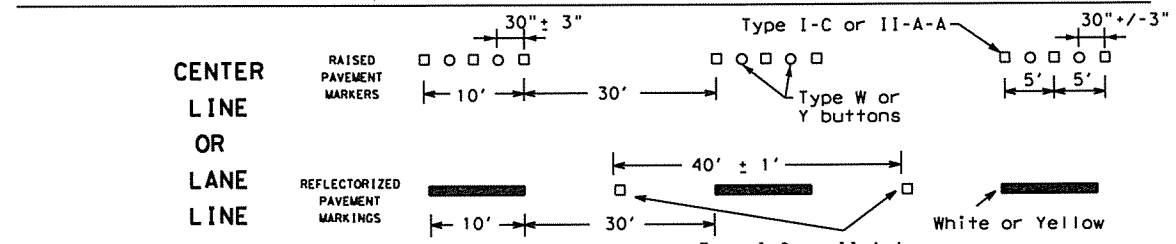
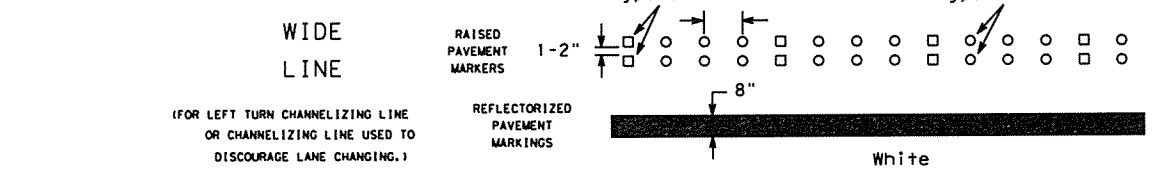
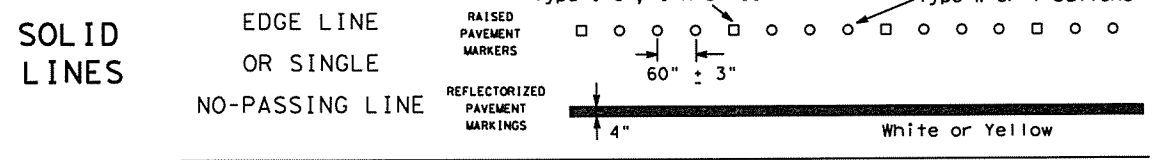
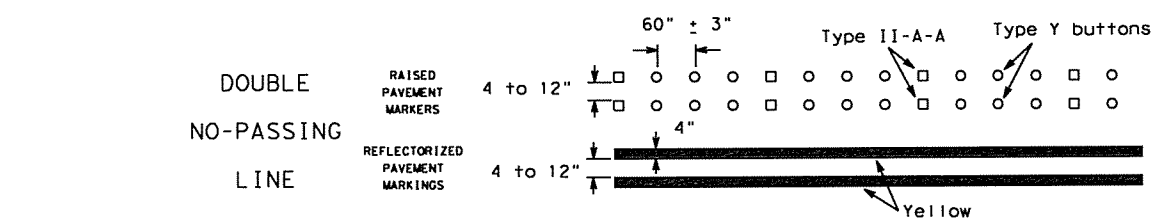


RAISED PAVEMENT MARKERS

Prefabricated markings may be substituted for reflectorized pavement markings.

TWO-WAY LEFT TURN LANE

STANDARD WORK ZONE PAVEMENT MARKINGS DETAILS



REMOVABLE MARKINGS WITH RAISED PAVEMENT MARKERS



Raised pavement markers used as standard pavement markings shall be from the approved products list and meet the requirements of Item 672 "RAISED PAVEMENT MARKERS."

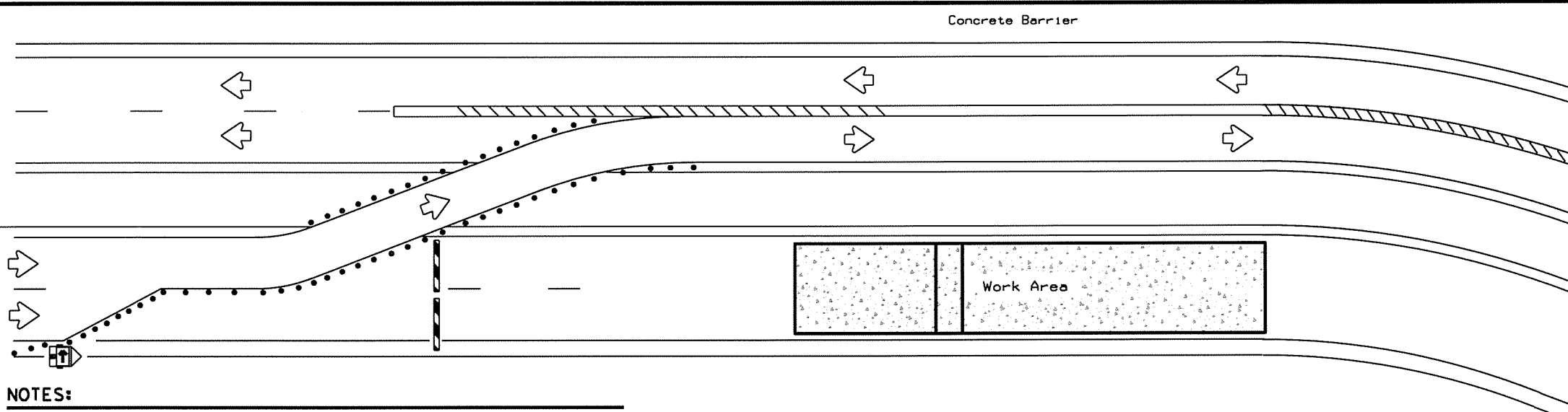
Texas Department of Transportation
Traffic Safety Division Standard

BARRICADE AND CONSTRUCTION PAVEMENT MARKING PATTERNS

BC(12)-21

FILE: bc-21.dgn	DN: TxDOT	CS: TxDOT	DN: TxDOT	CS: TxDOT
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REVISIONS	6459	93	001	1-610, etc.
1-97 9-07 5-21				
2-98 7-13	DIST	COUNTY		SHEET NO.
11-02 8-14	HOU	HARRIS, etc.		49

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NOTES:

1. Length of Safety Glare screen will be specified elsewhere in the plans.
2. The cumulative nominal length of the modular safety glare screen units shall equal the length of the individual sections of temporary concrete traffic barrier on which they are installed so the joint between barrier sections will not be spanned by any one safety glare screen unit.
3. Screen Panel/blades will be designed such that reflective sheeting conforming with Departmental Material Specification DMS-8300, Sign Face Materials, Type B or C Yellow, minimum size of 2 inches by 12 inches can be attached to the edge of the panel/blade. The sheeting shall be attached to one glare screen panel/blade per section of concrete barrier not to exceed a spacing of 30 feet. Barrier reflectors are not necessary when panel/blades are installed with reflective sheeting as described.
4. Payment for these devices will be under statewide Special Specification "Modular Glare Screens for Headlight Barrier."
5. This detail is only intended to show types of locations where Glare Screens would be appropriate. Required signing and other devices shall be as shown elsewhere in the plans.

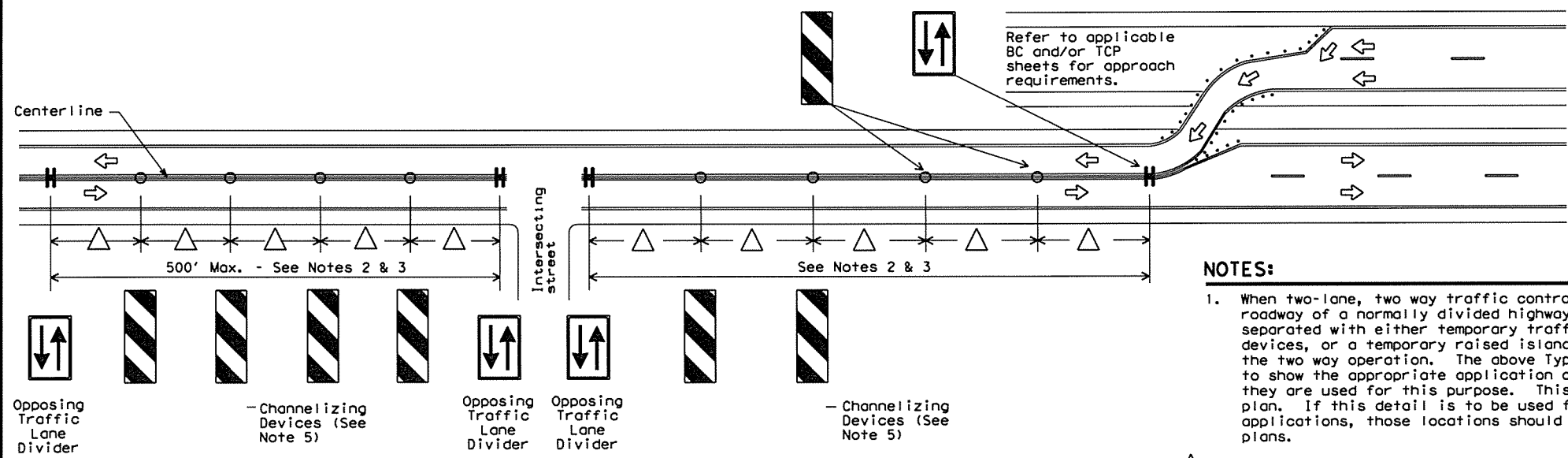
BARRIER DELINEATION WITH MODULAR GLARE SCREENS

LEGEND	
	Type 3 Barricade
	Channelizing Devices
	Trailer Mounted Flashing Arrow Board
	Sign
	Safety glare screen

DEPARTMENTAL MATERIAL SPECIFICATIONS	
SIGN FACE MATERIALS	DMS-8300
DELINEATORS AND OBJECT MARKERS	DMS-8600
MODULAR GLARE SCREENS FOR HEADLIGHT BARRIER	DMS-8610

Only pre-qualified products shall be used. A copy of the Compliant Work Zone Traffic Control Devices List" CWZTCDL describes pre-qualified products and their sources and may be found at the following web address:

<http://www.txdot.gov/business/resources/producer-list.html>



NOTES:

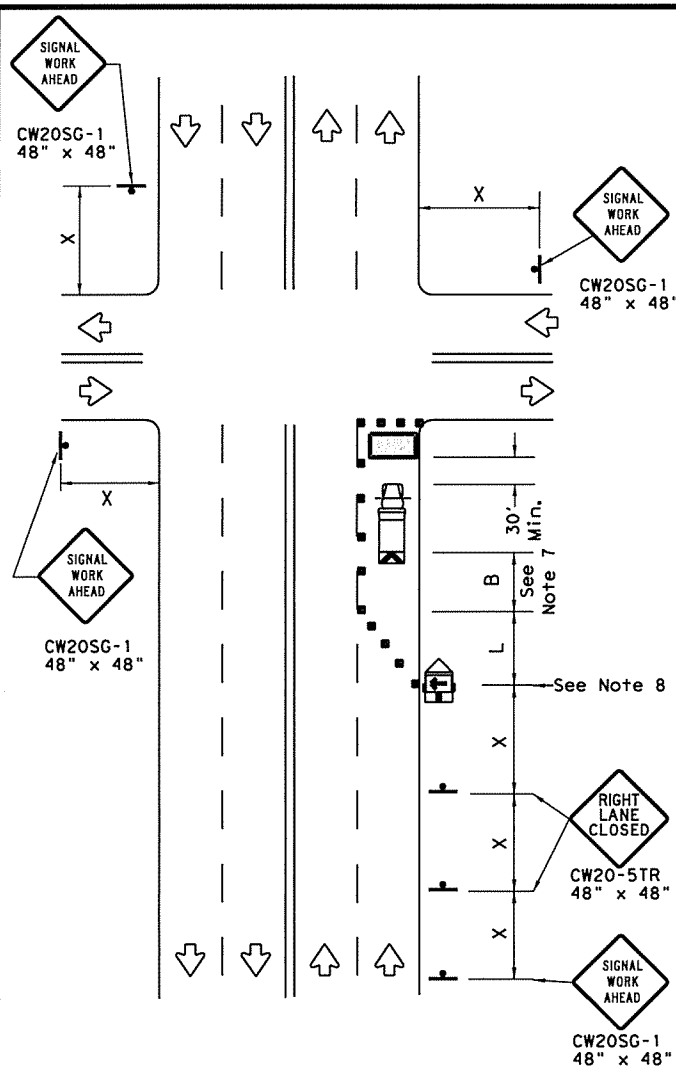
1. When two-lane, two way traffic control must be maintained on one roadway of a normally divided highway, opposing traffic shall be separated with either temporary traffic barriers, channelizing devices, or a temporary raised island throughout the length of the two way operation. The above Typical Application is intended to show the appropriate application of channelizing devices when they are used for this purpose. This is not a traffic control plan. If this detail is to be used for other types of roads or applications, those locations should be stated elsewhere in the plans.
2. Space devices according to the Tangent Spacing shown on the Device Spacing table on BC(9) but not exceeding 100'.
3. Every fifth device should be an OTLD except when spaced closer to accommodate an intersection. An OTLD should be the first device on each side of intersecting streets or roads.
4. Locations where surface mount bases with adhesives or self-righting devices will be required in order to maintain them in their proper position should be noted elsewhere in the plans.
5. Channelizing devices are to be vertical panels, 42" cones or tubular markers that are at least 36" tall. Tubular markers used to separate traffic should have a rubber base weighing at least 30 pounds. Tubular markers that are 42" tall or more shall have four bands of reflective material as detailed for 42" cones on BC(10). Tubular markers less than 42" but at least 36" tall shall have three bands of 3" wide white reflective material spaced 2" apart. Reflective material shall meet DMS-8300, Type A.

VERTICAL PANELS & OPPOSING TRAFFIC LANE DIVIDERS (OTLD) SEPARATING TWO-WAY TRAFFIC ON NORMALLY DIVIDED HIGHWAYS

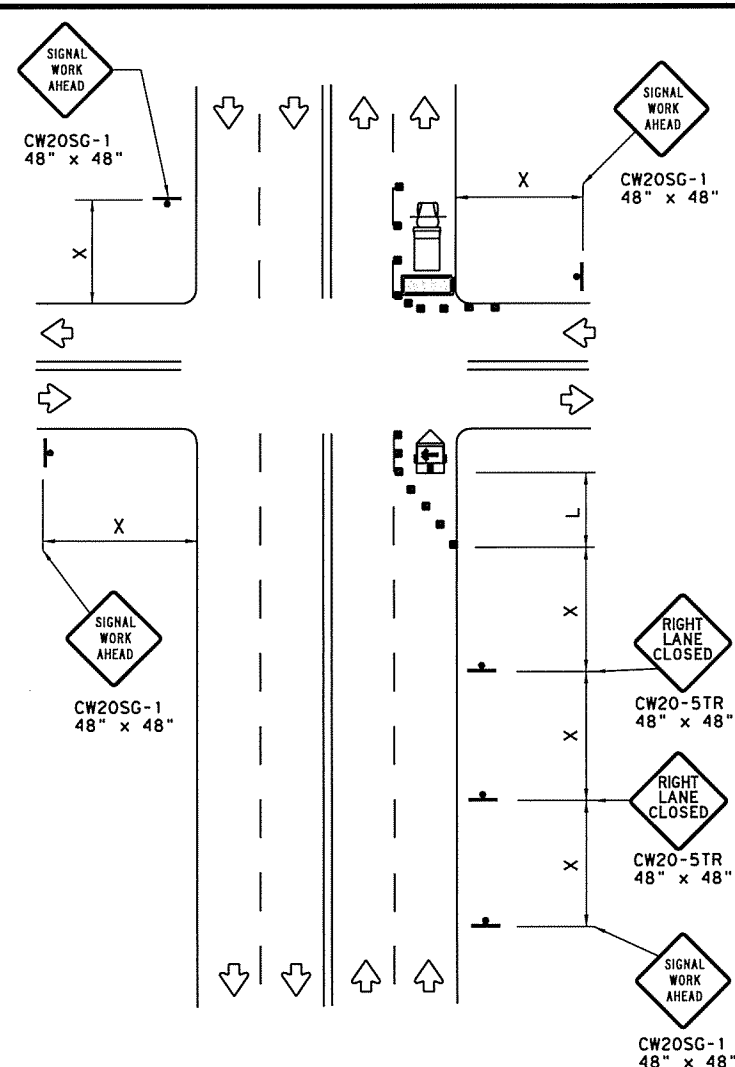
		Traffic Operations Division Standard	
TRAFFIC CONTROL PLAN TYPICAL DETAILS			
WZ(TD) - 17			
FILE: wzt-d-17.dgn	DN: TxDOT	CK: TxDOT	DW: TxDOT
© TxDOT February 1998	CONT	SECT	JOB
4-98	6459	93	001
3-03	DIST	COUNTY	SHEET NO.
7-13	HOU	HARRIS, etc.	50

DATE: FILE:

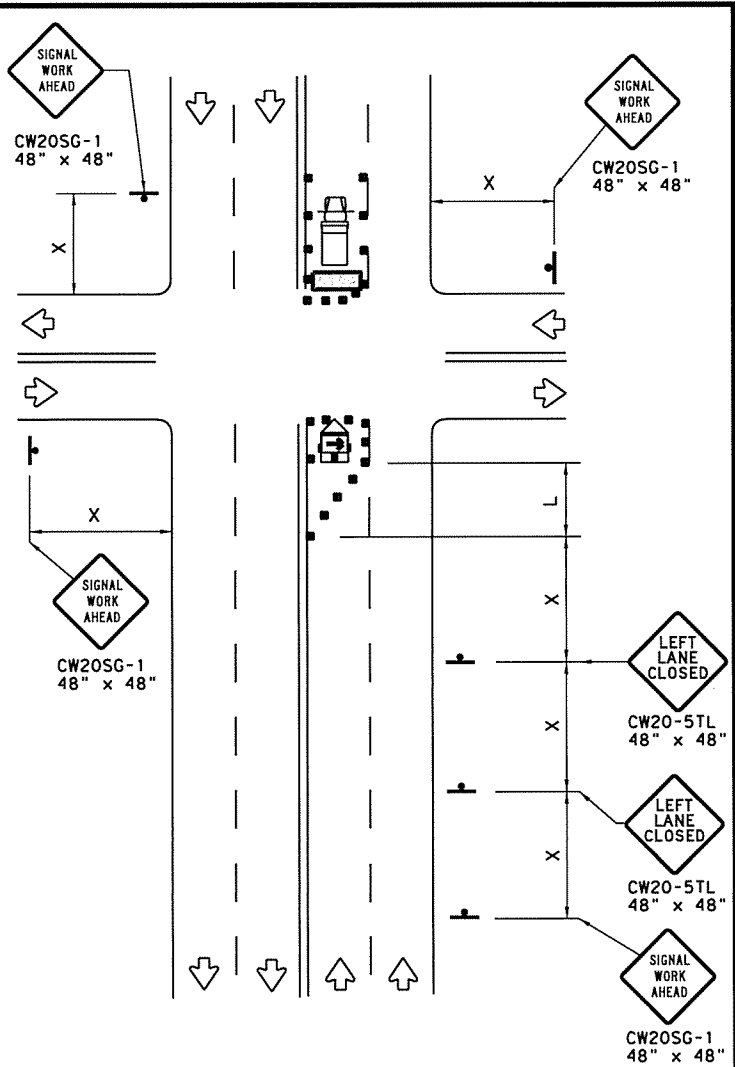
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NEAR SIDE LANE CLOSURE
SHORT DURATION OR SHORT TERM STATIONARY



FAR SIDE RIGHT LANE CLOSURE
SHORT DURATION OR SHORT TERM STATIONARY



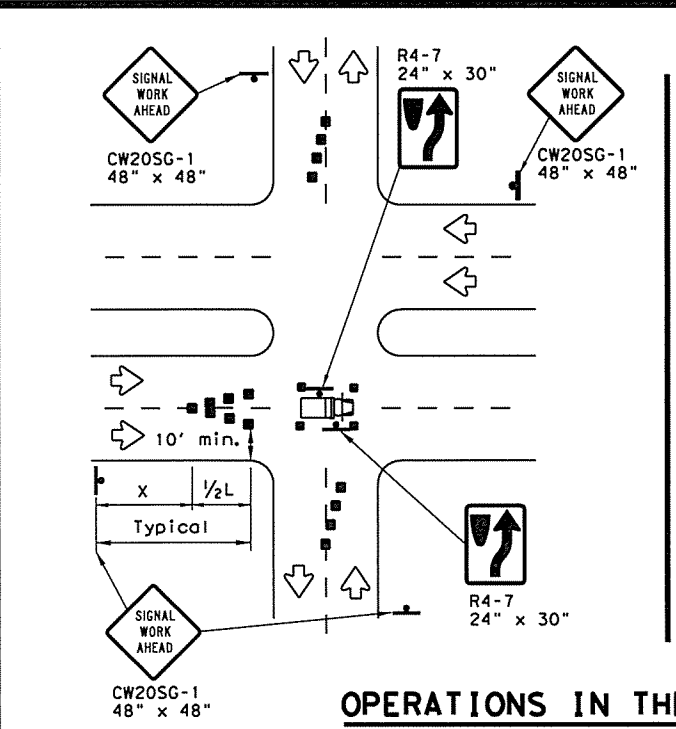
FAR SIDE LEFT LANE CLOSURE
SHORT DURATION OR SHORT TERM STATIONARY

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

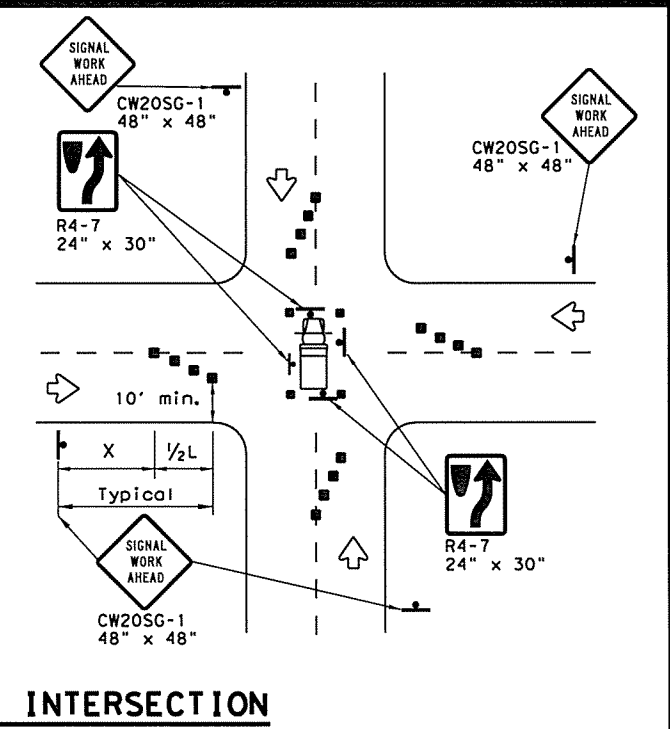
Posted Speed *	Formula	Minimum Desirable Taper Lengths **			Suggested Maximum Spacing of Channelizing Devices		Minimum Sign Spacing "X" Distance	Suggested Longitudinal Buffer Space "B"
		10' Offset	11' Offset	12' Offset	On a Taper	On a Tangent		
30	L = WS ² / 60	150'	165'	180'	30'	60'	120'	90'
35		205'	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

- 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.
- Obstructions or hazards at the work area shall be clearly marked and delineated at all times.
- Flaggers and Flagger Symbol (CW20-7) signs may be required according to field conditions.
- Vehicles parked in roadway shall be equipped with at least two high intensity rotating, flashing, oscillating or strobe type lights.
- High level warning devices (flag trees) may be used at corners of the vehicle.
- 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.
- 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.
- 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.
- 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.

Texas Department of Transportation
 Traffic Operations Division Standard

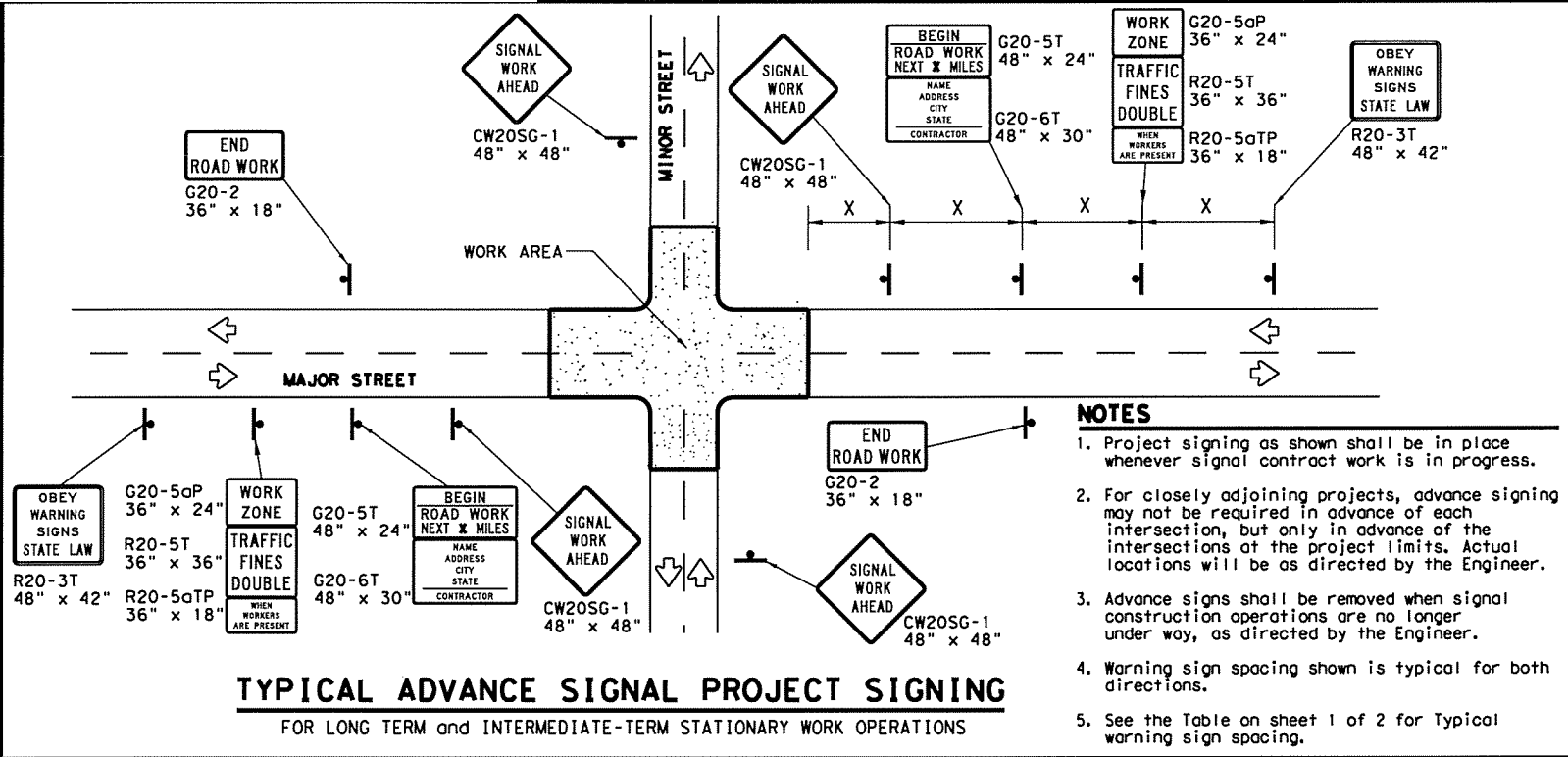
TRAFFIC SIGNAL WORK TYPICAL DETAILS

WZ (BTS-1) - 13

FILE: wzbts-13.dgn	DN: TxDOT	CK: TxDOT	DN: TxDOT	CK: TxDOT
© TxDOT April 1992	CONT	SECT	JOB	HIGHWAY
REVISIONS		6459	93	001
2-98	10-99	7-13	DIST	COUNTY
4-98	3-03		HOU	HARRIS, etc.
				SHEET NO. 51

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GENERAL NOTES FOR WORK ZONE SIGNS

- Signs shall be installed and maintained in a straight and plumb condition.
- Wooden sign posts shall be painted white.
- Barricades shall NOT be used as sign supports.
- Nails shall NOT be used to attach signs to any support.
- All signs shall be installed in accordance with the plans or as directed by the Engineer.
- The Contractor shall furnish the sign design shown in the plans or in the "Standard Highway Sign Designs for Texas" (SHSD).
- 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.
- Temporary signs that have damaged or cracked substrates and/or damaged or marred reflective sheeting shall be replaced as directed by the Engineer.
- 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".
- Damaged wood posts shall be replaced. Splicing wood posts will not be allowed.

DURATION OF WORK

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

SIGN MOUNTING HEIGHT

- Sign height of Long-term/Intermediate-term warning signs shall be as shown on Figure 6F-1 of the TMUTCD.
- Sign height of Short-term/Short Duration warning signs shall be as shown on Figure 6F-2 of the TMUTCD.
- 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

- When sign messages may be confusing or do not apply, the signs shall be removed or completely covered, unless otherwise approved by the Engineer.
- 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.
- Duct tape or other adhesive material shall NOT be affixed to a sign face.
- Signs and anchor stubs shall be removed and holes back filled upon completion of the work.

REFLECTIVE SHEETING

- 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

- Weights used to keep signs from turning over should be sandbags filled with dry, cohesionless material.
- The sandbags will be tied shut to keep the sand from spilling and to maintain a constant weight.
- Rock, concrete, iron, steel or other solid objects will not be permitted for use as sign support weights.
- Sandbags should weigh a minimum of 35 lbs and a maximum of 50 lbs.
- Sandbags shall be made of a durable material that tears upon vehicular impact. Rubber, such as tire inner tubes, shall not be used.
- 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.
- 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 fasteners. Sandbags shall be placed along the length of the skids to weigh down the sign support.
- Sandbags shall NOT be placed under the skid and shall not be used to level sign supports placed on slopes.

LEGEND

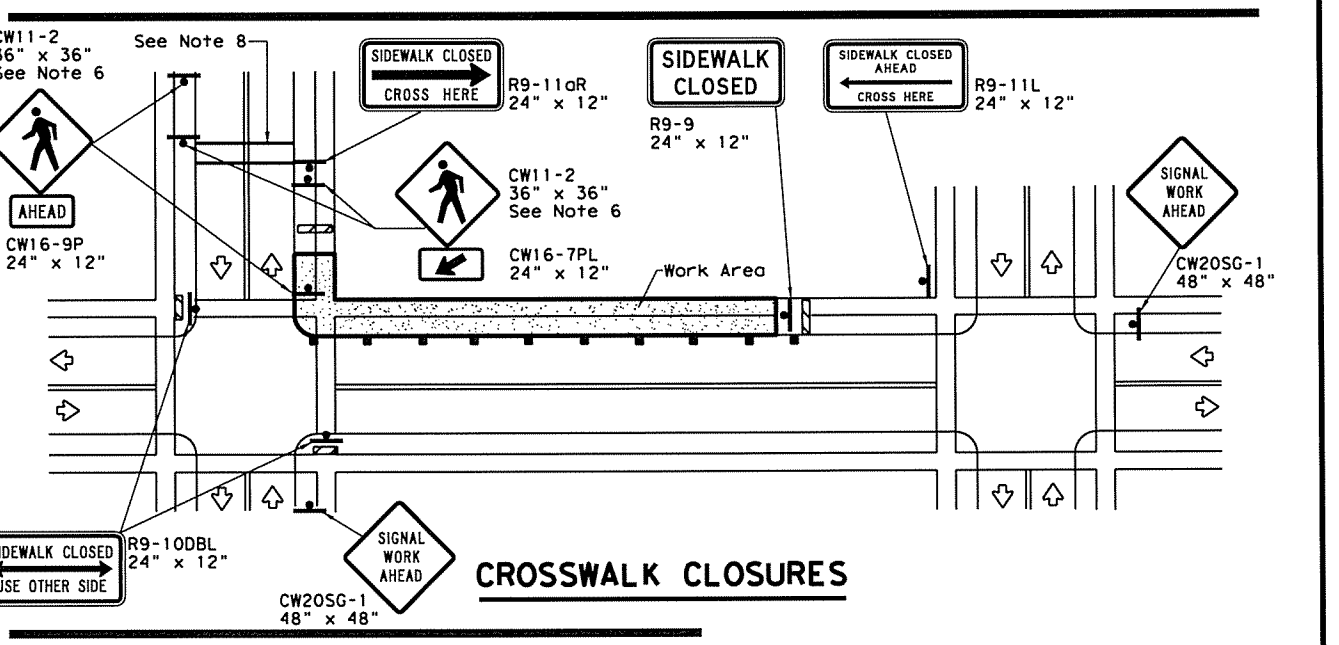
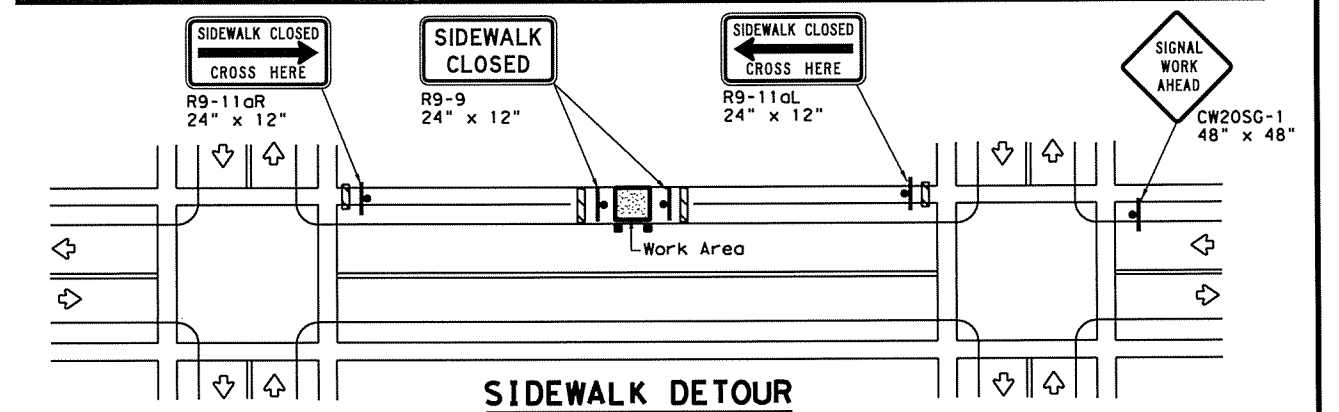
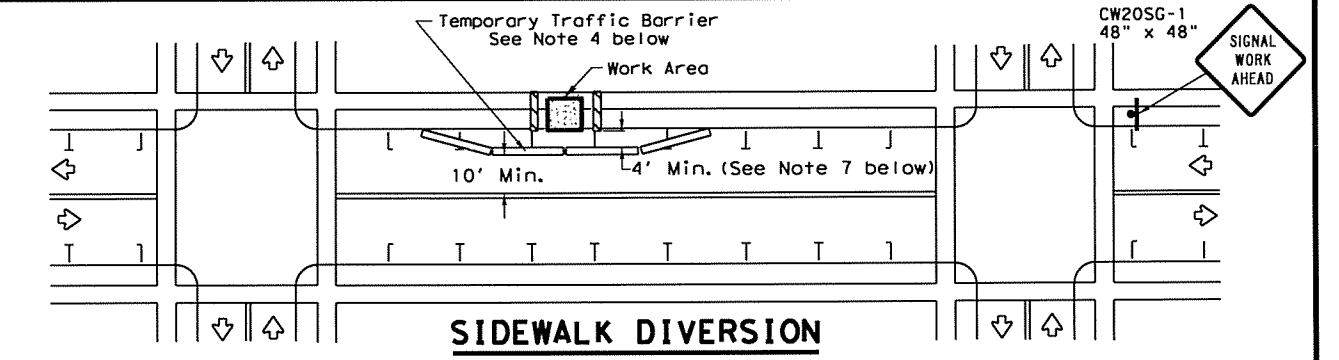
	Sign
	Channelizing Devices
	Type 3 Barricade

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



PEDESTRIAN CONTROL

- 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.
- "CROSSWALK CLOSURES" as detailed above will require the Engineer's approval prior to installation.
- 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.
- 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.
- Location of devices are for general guidance. Actual device spacing and location must be field adjusted to meet actual conditions.
- Where pedestrians with visual disabilities normally use the closed sidewalk Detectable Pedestrian Barricades should be used instead of the Type 3 Barricades shown.
- The width of existing sidewalk should be maintained if practical.
- Pavement markings for mid-block crosswalks shall be paid for under the appropriate bid items.
- 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

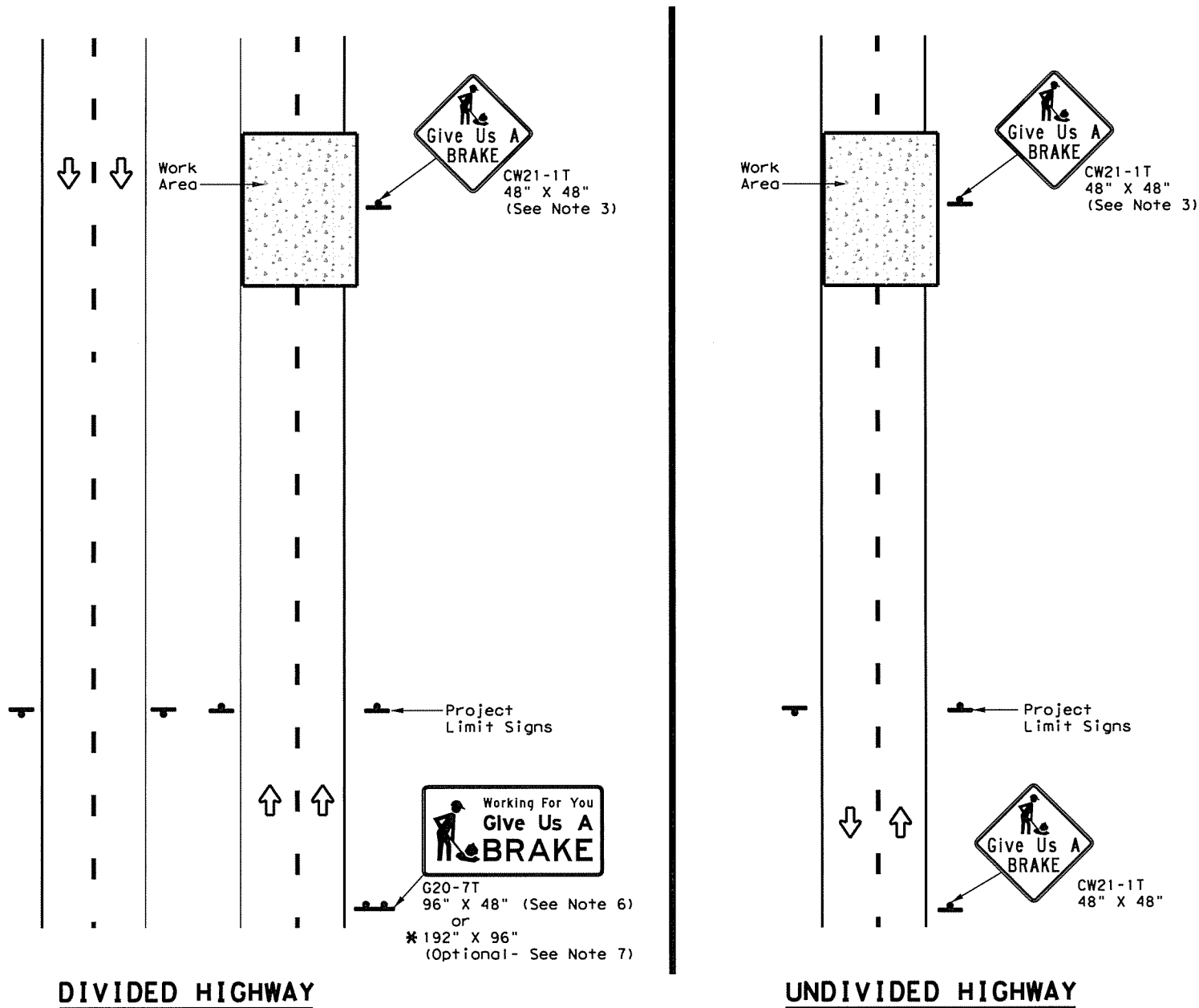
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REVISIONS	6459	93	001	I-610, etc.
2-98 10-99 7-13	DIST	COUNTY	COUNTY	SHEET NO.
4-98 3-03	HOU	HARRIS, etc.		52

115

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DIVIDED HIGHWAY

UNDIVIDED HIGHWAY

SIGNS ARE SHOWN FOR ONE DIRECTION OF TRAVEL

* When the optional larger WORKING FOR YOU GIVE US A BRAKE (G20-7T) 192" x 96" sign is required, the locations shall be noted elsewhere in the plans.

SUMMARY OF LARGE SIGNS

BACKGROUND COLOR	SIGN DESIGNATION	SIGN	SIGN DIMENSIONS	REFLECTIVE SHEETING	SQ FT	GALVANIZED STRUCTURAL STEEL		DRILLED SHAFT
						Size	(LF)	
							① ②	24" DIA. (LF)
Orange	G20-7T		96" X 48"	Type B _{FL} or C _{FL}	32	▲	▲ ▲	▲
Orange	G20-7T		192" X 96"	Type B _{FL} or C _{FL}	128	W8x18	16 17	12

▲ See Note 6 Below

LEGEND	
	Sign
	Large Sign
	Traffic Flow

DEPARTMENTAL MATERIAL SPECIFICATIONS	
PLYWOOD SIGN BLANKS	DMS-7100
ALUMINUM SIGN BLANKS	DMS-7110
SIGN FACE MATERIALS	DMS-8300

COLOR	USAGE	SHEETING MATERIAL
ORANGE	BACKGROUND	TYPE B _{FL} OR TYPE C _{FL}
BLACK	LEGEND & BORDERS	NON-REFLECTIVE ACRYLIC FILM

GENERAL NOTES

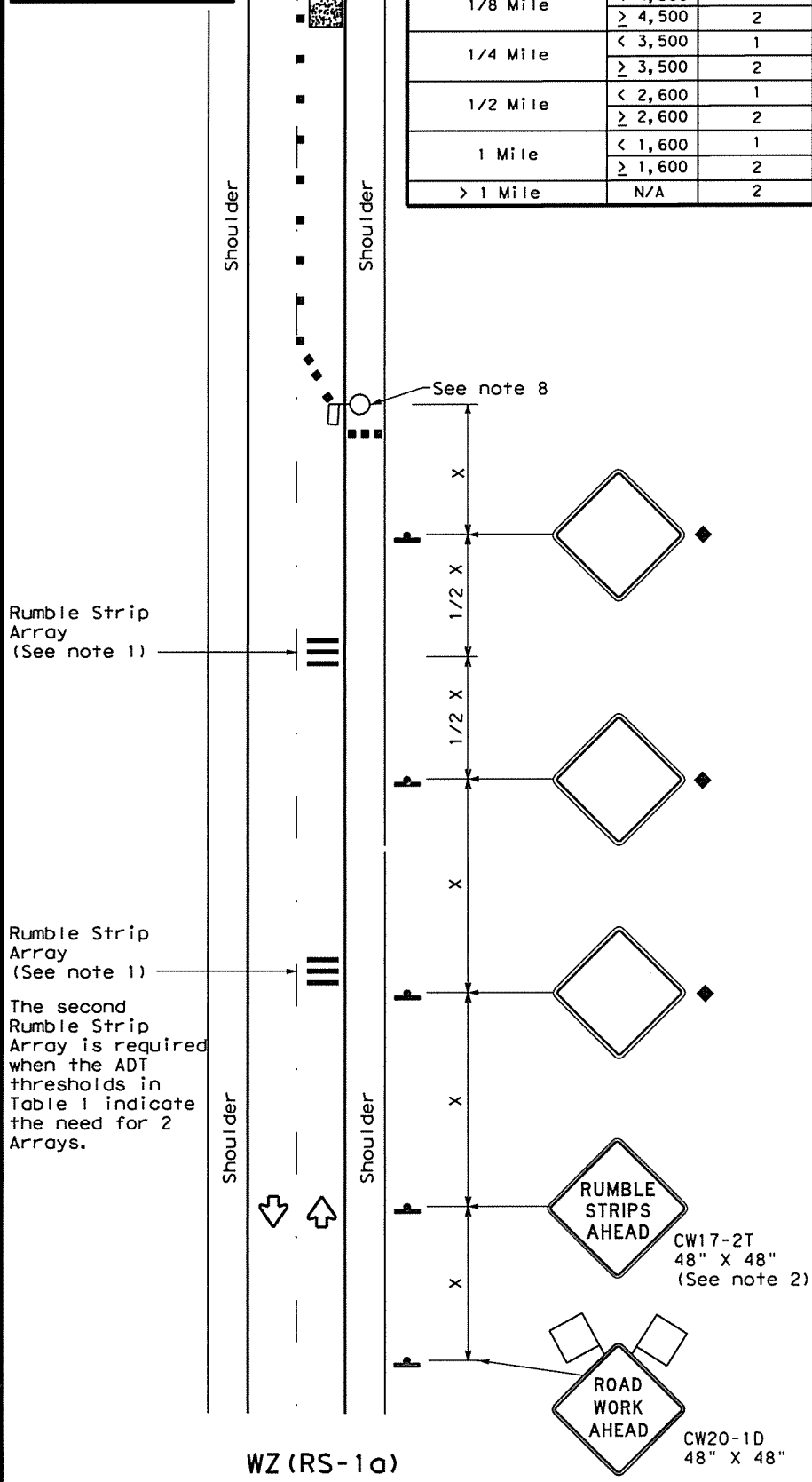
- See BC and SMD sheets for additional sign support details.
- Sign locations shall be approved by the Engineer.
- For projects more than two miles in length, Give Us a BRAKE signs should be repeated halfway through the project. The Give Us a Brake (CW21-1T) may be used for this purpose.
- Work zone speed limits are sometimes used in conjunction with GIVE US A BRAKE signing. See BC(3) for location and spacing of construction speed zone signing when required.
- Give Us a Brake (CW21-1T) signs and supports shall be considered subsidiary to Item 502, "Barricades, Signs and Traffic Handling."
- The 96" X 48" Working For You Give Us A BRAKE (G20-7T) may use a 1/2" or 5/8" plywood substrate or 0.125" aluminum sheeting substrate and may be supported by two 4" x 6" wood posts with drilled holes for breakaway as per BC(5) and will be subsidiary to Item 502.
- The Working For You Give Us A BRAKE (G20-7T) 192" X 96" sign shall be paid for under the following specification items:
 Item 636 - Aluminum Signs
 Item 647 - Large Roadside Sign Supports and Assemblies.
 Item 416 - Drilled Shaft Foundations
- All signs shall be constructed in accordance with the details found in the "Standard Highway Sign Designs for Texas," latest edition. Sign details not shown in this manual shall be shown in the plans or the Engineer shall provide a detail to the Contractor before the sign is manufactured.

		Traffic Operations Division Standard	
WORK ZONE "GIVE US A BRAKE" SIGNS			
WZ (BRK) - 13			
FILE:	wzbrk-13.dgn	DN:	TxDOT
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REVISIONS		SECT:	93
		JOB:	001
		HIGHWAY:	I-610, etc.
6-96	5-98	DIST:	7-13
8-96	3-03	COUNTY:	
		SHEET NO.:	53
		HOU:	HARRIS, etc.

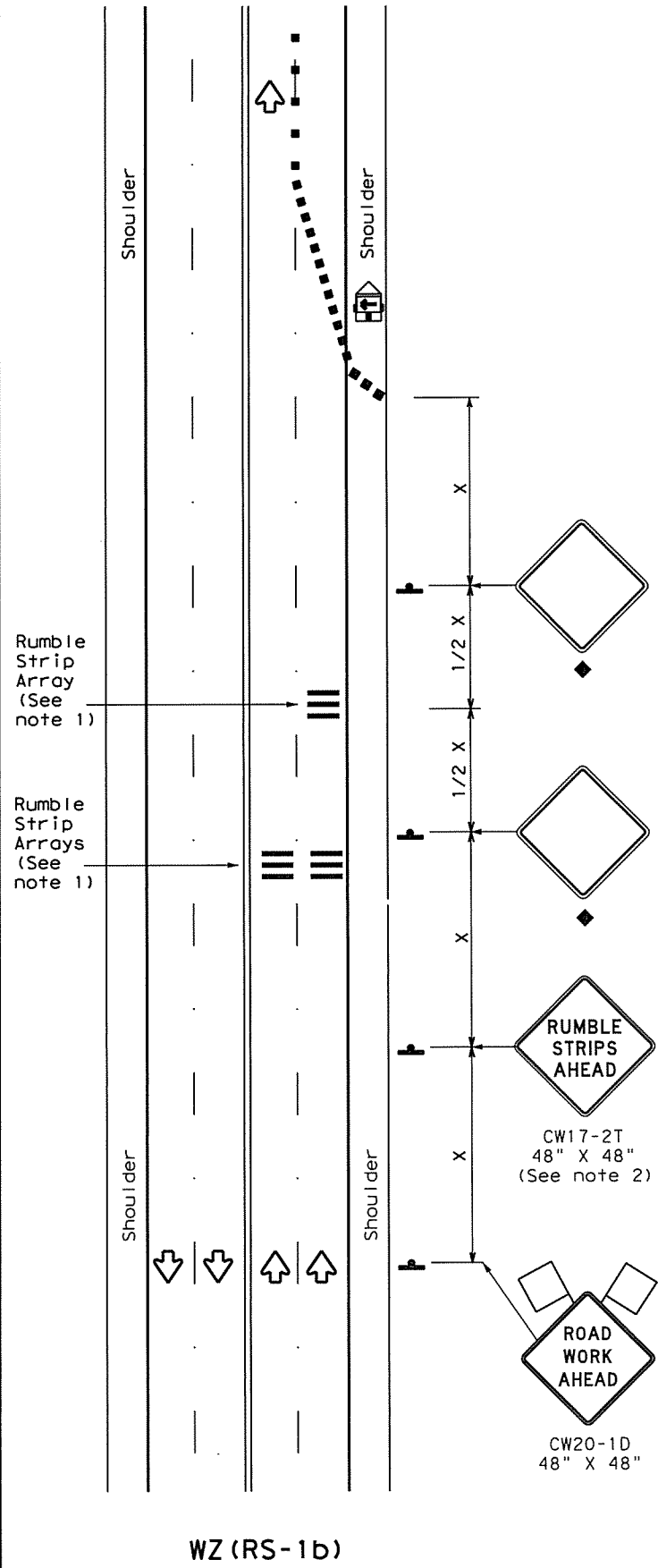
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Warning sign and rumble strip sequence in opposite direction is same as below.

Flagger to Flagger (Length of Work Area)	ADT	# of Rumble Strip Arrays
1/8 Mile	< 4,500	1
	≥ 4,500	2
1/4 Mile	< 3,500	1
	≥ 3,500	2
1/2 Mile	< 2,600	1
	≥ 2,600	2
1 Mile	< 1,600	1
	≥ 1,600	2
> 1 Mile	N/A	2



RUMBLE STRIPS ON ONE-LANE TWO-WAY APPLICATION



RUMBLE STRIPS FOR LANE CLOSURE ON CONVENTIONAL ROADWAY

GENERAL NOTES

- Each Rumble Strip Array should consist of three rumble strips spaced center to center at the spacing shown in Table 2, placed transverse across the lane at locations shown.
- The CW17-2T "RUMBLE STRIPS AHEAD" sign should be located after the CW20-1D "ROAD WORK AHEAD" sign and spaced as shown. If traffic is observed to be queuing, or is expected to queue beyond the Rumble Strips, the CW17-2T sign and the first Rumble Strip Array may be located upstream of the CW20-1D sign as necessary to provide needed warning.
- Temporary Rumble Strips will be considered subsidiary to Item 502, and shall be a product listed on the Compliant Work Zone Traffic Control Devices.
- Remove Temporary Rumble Strips before removing the advanced warning signs.
- Temporary Rumble Strips should not be used on horizontal curves, loose gravel, soft or bleeding asphalt, heavily rutted pavements or unpaved surfaces.
- Temporary Rumble Strips shall be installed and maintained as per manufacturer's recommendations.
- This standard sheet shall be used in conjunction with other appropriate TCP standard, TMUTCD typical application or project specific detail for the project.
- The one-lane two-way application may utilize a flagger, an Automated Flagger Assistance Device (AFAD) or a Portable Traffic Signal (PTS).
- Replace defective Temporary Rumble Strips as directed by the Engineer.
- Temporary Rumble Strips may be used on freeways or expressways based on engineering judgment and written direction from the Engineer.

Speed	Approximate distance between strips in an array
≤ 40 MPH	10'
> 40 MPH & ≤ 55 MPH	15'
= 60 MPH	20'
≥ 65 MPH	* 35' +

	Type 3 Barricade		Channelizing Devices
	Heavy Work Vehicle		Truck Mounted Attenuator (TMA)
	Trailer Mounted Flashing Arrow Panel		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)

MOBILE	SHORT DURATION	SHORT TERM STATIONARY	INTERMEDIATE TERM STATIONARY	LONG TERM STATIONARY
	✓	✓		

◆ Signs are for illustrative purposes only. Signs required may vary depending on the TCP, TMUTCD Typical Application, or project specific details for the project.

* For posted speeds in excess of 65 MPH, it is recommended that spacing is increased as speed limits increase. Increasing space between rumble strips will improve effectiveness.

Texas Department of Transportation
 Traffic Safety Division Standard

TEMPORARY RUMBLE STRIPS

WZ (RS) -22

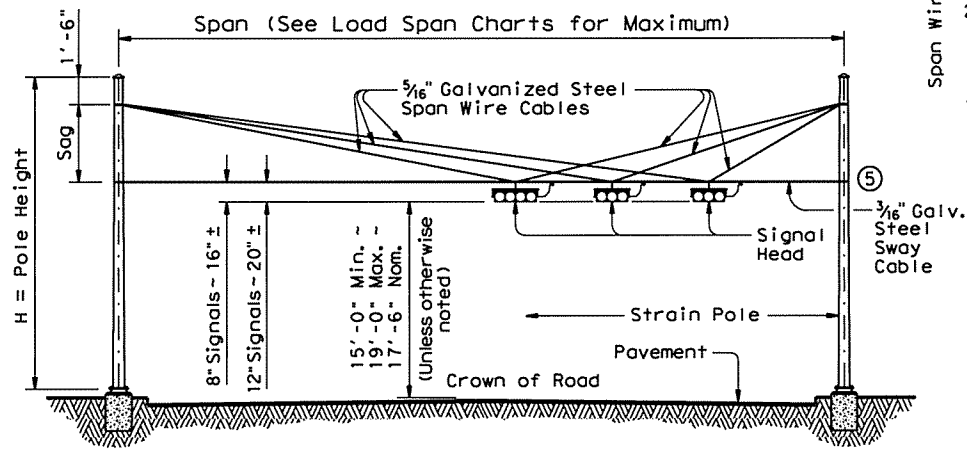
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2-14 1-22	DIST	COUNTY	SHEET NO.	
4-16	HOU	HARRIS, etc.	54	

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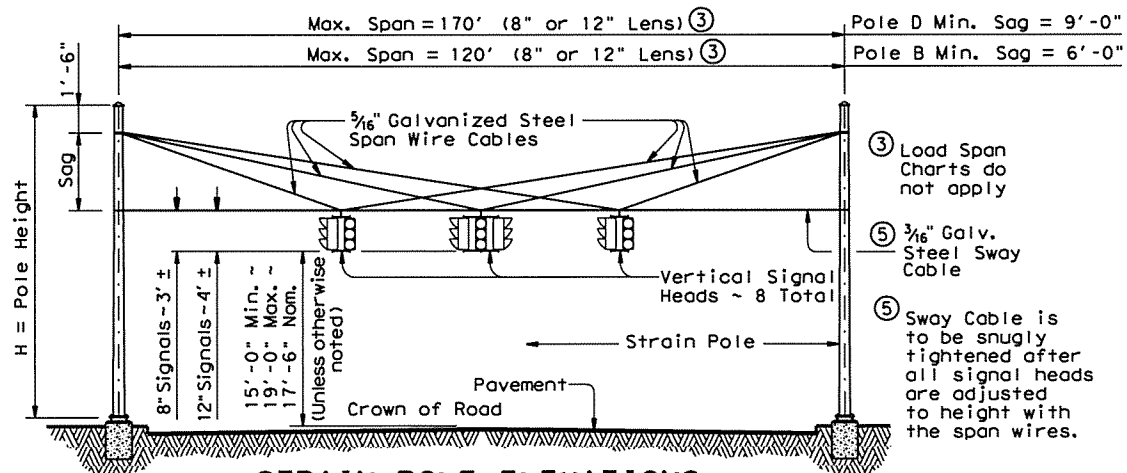
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STRAIN POLE DESCRIPTION			
Pole Type	Foundation Type	Maximum Permissible Span Wire Load (lbs.)	
26' Pole	A	36-A	5200
30' Pole	B	36-A	4600
30' Pole with Lum.	B	36-A	4400
30' Pole with 20' Mast Arm	C	36-B	5600
30' Pole with 24' Mast Arm	C	36-B	5500
30' Pole with 28' Mast Arm	C	36-B	5300
30' Pole with 32' Mast Arm	C	36-B	5100
30' Pole with 36' Mast Arm	C	36-B	4900
30' Pole with 20' Mast Arm & Lum.	C	36-B	5300
30' Pole with 24' Mast Arm & Lum.	C	36-B	5200
30' Pole with 28' Mast Arm & Lum.	C	36-B	5000
30' Pole with 32' Mast Arm & Lum.	C	36-B	4800
30' Pole with 36' Mast Arm & Lum.	C	36-B	4500
34' Pole	D	36-B	5600
34' Pole with Lum.	D	36-B	5400

② Numbers on Load Span Charts indicate the number of signal heads on the span. The total span wire design load is based on one 5-section head and one or more additional 3-section head(s). Design wind pressures on cables are assumed as 1.0 lb/ft. Weight of span wire cables (one per signal head) is assumed as 0.65 lb/ft which includes an allowance for conductor cables and miscellaneous hardware. The effect of the sway cable on load distribution is ignored as it is assumed to break at design wind conditions. When a pole supports 2 spans, the span wire design loads for both spans should be added vectorially to determine the design load for that pole.

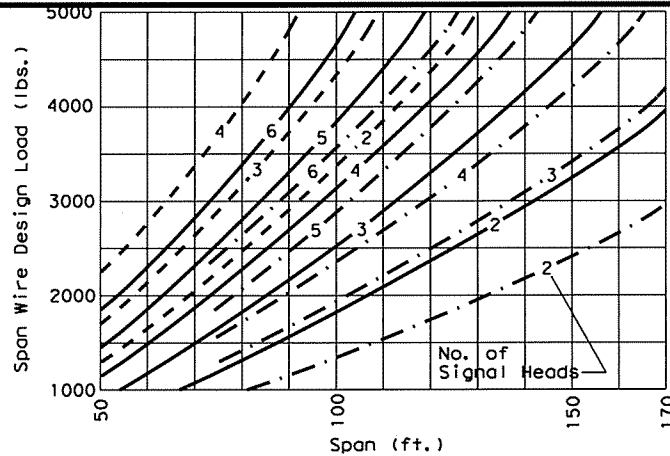


**STRAIN POLE ELEVATIONS
HORIZONTAL SIGNALS**

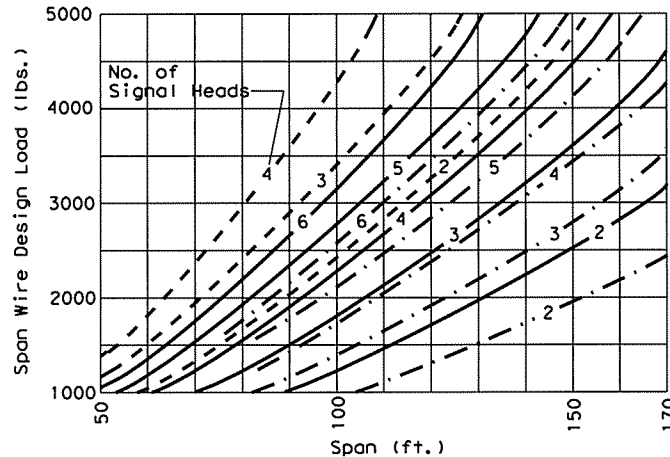


**STRAIN POLE ELEVATIONS
VERTICAL SIGNALS**

(Mast arms are not used with vertical signals)



② SIGNALS WITH 12-INCH LENS



② SIGNALS WITH 8-INCH LENS

Signal Head Type	Wt. Per Head	Wind Area
5-Section, 12" Lens	125 lbs	9.6 sq. ft.
5-Section, 8" Lens	70 lbs	4.8 sq. ft.
3-Section, 12" Lens	75 lbs	5.64 sq. ft.
3-Section, 8" Lens	45 lbs	3.0 sq. ft.

◆ Effective projected design wind area (actual area times drag coefficient)

- Sag = 4'-6" (26' or 30' Pole)
- Sag = 8'-0" (30' or 34' Pole)
- · - · - Sag = 11'-6" (34' Pole)

Pole Type	ROUND POLES				POLYGONAL POLES			
	D _B in.	D _T in.	(4)thk in.	H ft.	D _B in.	D _T in.	(4)thk in.	H ft.
A	12.5	8.9	.239	26	13.0	9.0	.239	26
B	13.5	9.3	.239	30	14.0	9.0	.239	30
C	15.5	11.3	.239	30	16.0	11.0	.239	30
D	15.5	10.7	.239	34	16.0	11.0	.239	34

D_B = Pole Base O.D. D_T = Pole Top O.D. H = Pole Height

④ Thickness shown are minimum, thicker materials may be used.

SHIPPING PARTS LIST

Poles (Without Traffic Signal Arm)						
Pole Type	Strain poles with Luminaire			Strain poles without Luminaire		
	Description	Designation	Quantity	Description	Designation	Quantity
A				26' Strain Pole	SP 26 A-80	
B	30' Strain Pole	SPL 30 B-80		30' Strain Pole	SP 30 B-80	
D	34' Strain Pole	SPL 34 D-80		34' Strain Pole	SP 34 D-80	
Poles (With Traffic Signal Arm)						
Pole Type	Strain poles with Luminaire			Strain poles without Luminaire		
	Description	Designation	Quantity	Description	Designation	Quantity
C	30' SPw/TS Arm	SPL 30 C-80		30' SPw/TS Arm	SP 30 C-80	
Traffic Signal Arms (For Type C poles)						
Nominal Arm Length	Type I Arm (1 Signal)		Type II Arm (2 Signals)		Type III Arm (3 Signals)	
	Designation	Quantity	Designation	Quantity	Designation	Quantity
ft.						
20	20I-80					
24	24I-80		24 II-80			
28	28I-80		28 II-80			
32			32 II-80		32 III-80	
36			36 II-80		36 III-80	
Anchor Bolt Assemblies (1 per pole)						
Anchor Bolt Diameter	Anchor Bolt Length	Templates may be removed for shipment.				
1 3/4"	3'-10"	Quantity				
2"	4'-3"					
Luminaire Arms						
Nominal Arm Length	Quantity					
8' Arm						

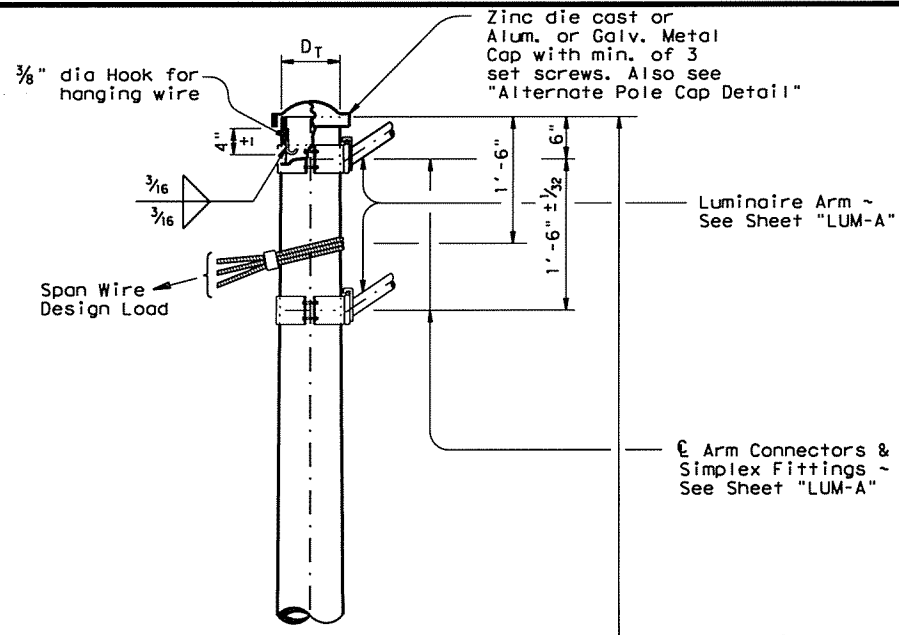
Each Anchor Bolt Assembly consists of the following: Top and Bottom templates, 4 anchor bolts, 8 nuts, 8 flat washers, and 4 nut anchor devices (Type 2) per Standard Drawing "TS-FD".

① See Sheet "DMA-80"

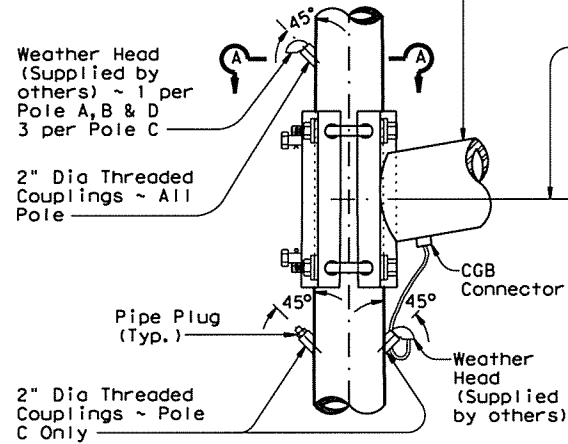
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 Traffic Operations Division
TRAFFIC SIGNAL SUPPORT STRUCTURES STRAIN POLE ASSEMBLIES
 (80 MPH WIND ZONE)
SP-80(1)-12

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6-96		6459	93	001	1-610, etc.
1-12		DIST	COUNTY	SHEET NO.	
		HOU	HARRIS, etc.	55	

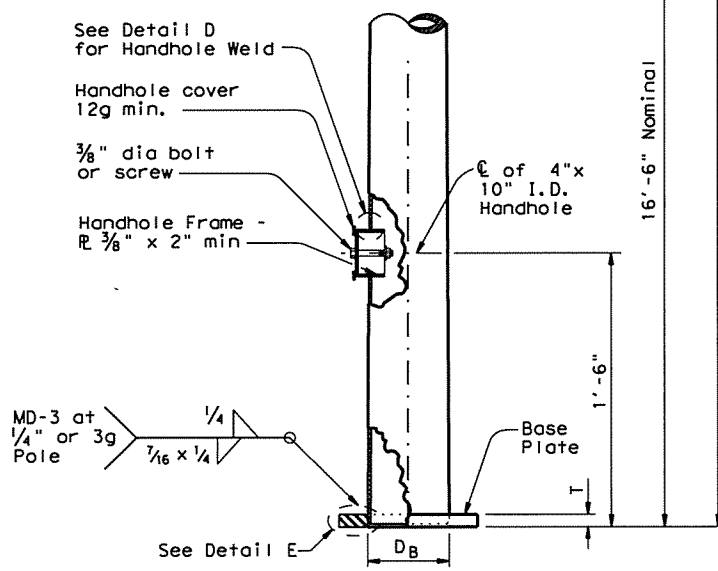
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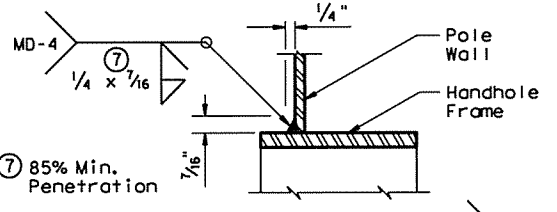
DETAIL A



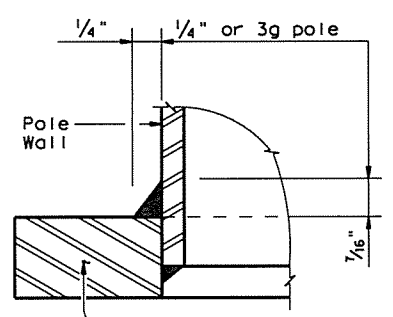
DETAIL B



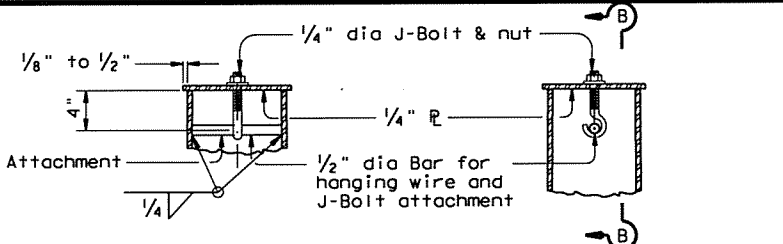
DETAIL C
POLE ELEVATION



DETAIL D

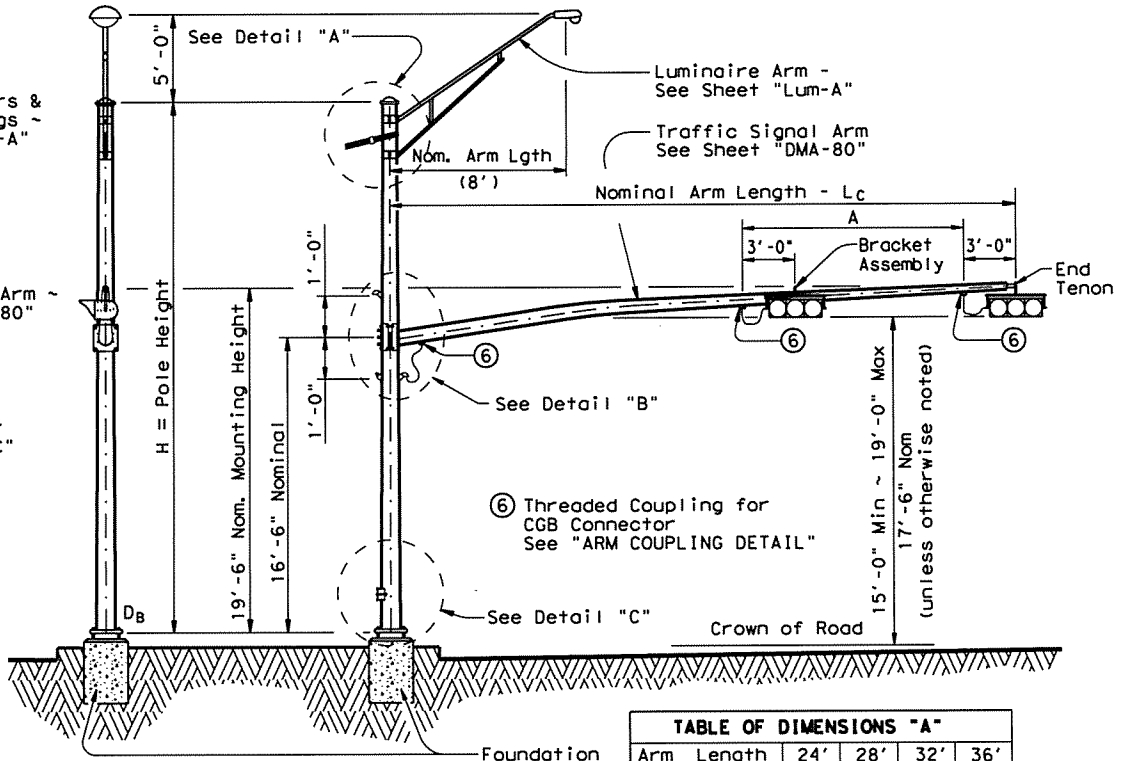


DETAIL E



SECTION B-B

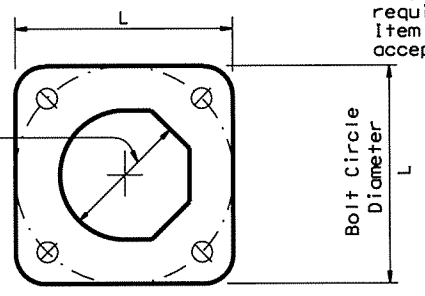
ALTERNATE POLE CAP DETAIL



STRUCTURE ASSEMBLY

TABLE OF DIMENSIONS "A"

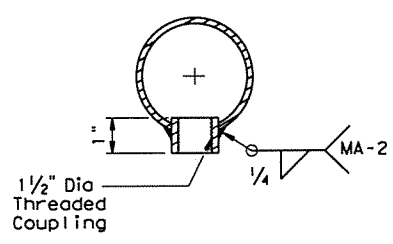
Arm Length	24'	28'	32'	36'
Arm Type II	10'	11'	12'	13'
Arm Type III			10'	11'



BASE PLATE PLAN

SECTION A-A
(Pole Coupling and Seam Weld Details)

⑧ 60% Min. penetration, except 100% penetration within 6" of circumferential base welds.



ARM COUPLING DETAIL

MATERIALS

Round Shafts or Polygonal Shafts ⑨	ASTM A595 Gr. A, A588, A1008 HSLAS Gr. 50 Class 2, A1011 HSLAS Gr. 50 Class 2, A572 Gr. 50 or A1011 SS Gr. 50 ⑩
Plates ⑨	ASTM A36, A588, or A572 Gr. 50
Connection Bolts	ASTM A325 except where noted
Pin Bolts	ASTM A325
Pipe ⑨	ASTM A53 Gr. B, A501, A1008 HSLAS-F Gr. 50, A1011 HSLAS-F Gr. 50
Steel Cable	ASTM A475, 7 Wire Utilities Grade
Misc. Hardware	Galvanized steel or stainless steel or as noted

⑨ ASTM A572, A1008 HSLAS, A1011 HSLAS, A1008 HSLAS-F, A1011 HSLAS-F, or A1011 SS may have higher yield strengths but shall not have less elongation than the grade indicated.

⑩ ASTM A1011 SS Gr. 50 shall also have a minimum elongation of 18 percent in 8 inches or 23 percent in 2 inches. Material thickness in excess of those stipulated under A1011 SS will be acceptable providing the material meets all other A1011 SS requirements and the requirements of this item.

GENERAL NOTES

Design conforms to 1994 AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals and Interim Specifications thereto. Design Wind Speed equals 80 mph plus a 1.3 gust factor. The maximum permissible span wire design loads tabulated are calculated at a stress load of 1.4 times the basic allowable stress. A simultaneous wind on the pole, mast arm, and luminaire is also included.

See standard sheet "DMA-80" for details of clamp-on traffic signal arms, sheet "MA-C" for traffic signal arm connection details, sheet "LUM-A" for luminaire arm and connection details, and sheet "TS-FD" for anchor bolt and foundation details.

Fabrication shall be in accordance with Item 686, "Traffic Signal Pole Assemblies (Steel)" and with the details, dimensions, and weld procedures shown herein. Weld references call for preapproved weld procedures which the Fabricator must obtain prior to fabrication. Materials, fabrication tolerances, and shipping practices shall meet the requirements of this sheet and Item 686, "Traffic Signal Pole Assemblies (Steel)".

Unless otherwise noted, all parts shall be galvanized in accordance with Item 445, "Galvanizing", after fabrication.

Deviation from the details and dimensions shown herein require submission of shop drawings in accordance with Item 441, "Steel Structures". Alternate designs are not acceptable.

Foundation Type	Anchor Bolt Diameter	Bolt Hole Diameter	Bolt Circle Diameter	Base R. Dim. L x T
36-A	1 3/4"	2"	19"	19" x 1 3/4"
36-B	2"	2 1/4"	21"	21" x 2"

Texas Department of Transportation
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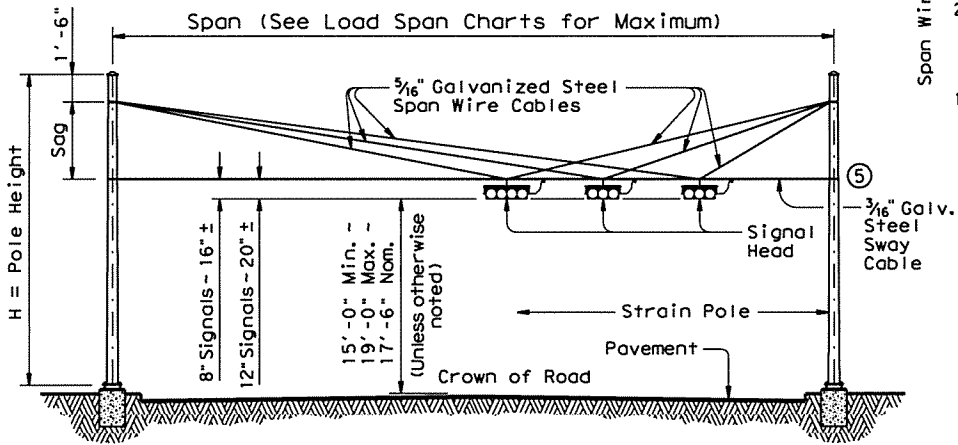
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(80 MPH WIND ZONE)
SP-80(2)-12

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	HOU	HARRIS, etc.	56	

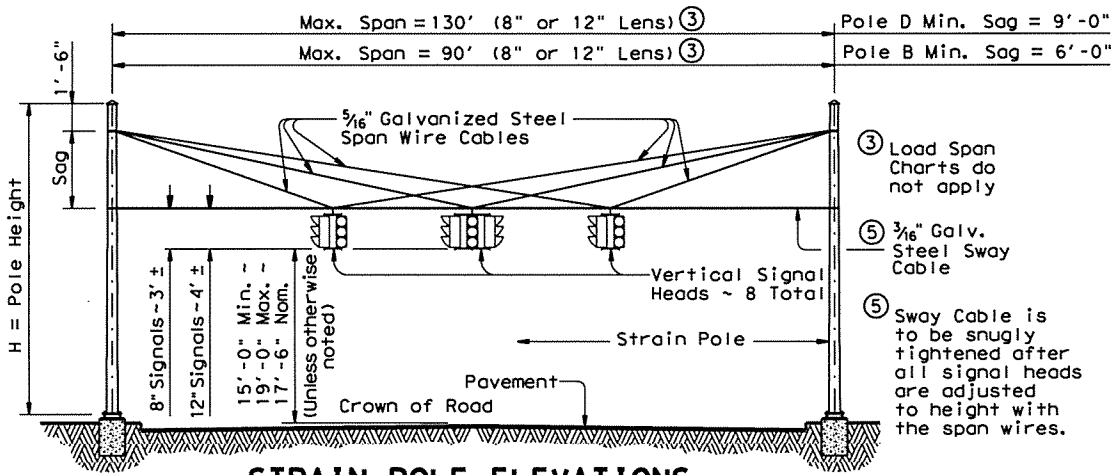
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STRAIN POLE DESCRIPTION	Pole Type	Foundation Type	Maximum Permissible Span Wire Load (lbs.)
26' Pole	A	36-A	4900
30' Pole	B	36-A	4300
30' Pole with Lum.	B	36-A	4000
30' Pole with 20' Mast Arm	C	36-B	4400
30' Pole with 24' Mast Arm	C	36-B	4000
30' Pole with 28' Mast Arm	C	36-B	3600
30' Pole with 32' Mast Arm	C	36-B	3300
30' Pole with 36' Mast Arm	C	36-B	2900
30' Pole with 20' Mast Arm & Lum.	C	36-B	4100
30' Pole with 24' Mast Arm & Lum.	C	36-B	3800
30' Pole with 28' Mast Arm & Lum.	C	36-B	3400
30' Pole with 32' Mast Arm & Lum.	C	36-B	3000
30' Pole with 36' Mast Arm & Lum.	C	36-B	2500
34' Pole	D	36-B	5200
34' Pole with Lum.	D	36-B	4900

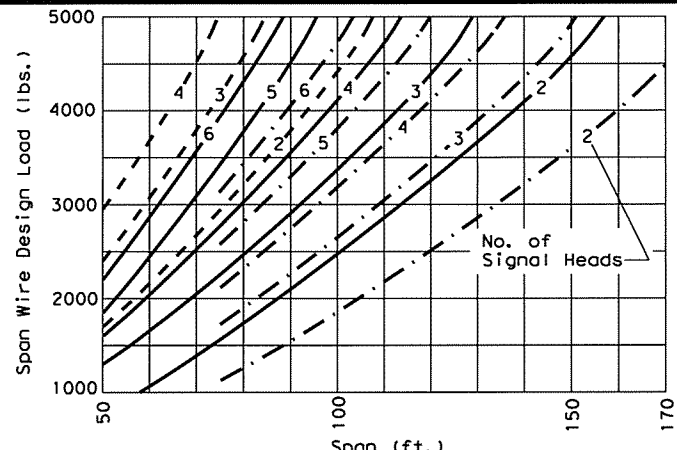
② Numbers on Load Span Charts indicate the number of signal heads on the span. The total span wire design load is based on one 5-section head and one or more additional 3-section head(s). Design wind pressures on cables are assumed as 1.6 lb/ft. Weight of span wire cables (one per signal head) is assumed as 0.65 lb/ft which includes an allowance for conductor cables and miscellaneous hardware. The effect of the sway cable on load distribution is ignored as it is assumed to break at design wind conditions. When a pole supports 2 spans, the span wire design loads for both spans should be added vectorially to determine the design load for that pole.



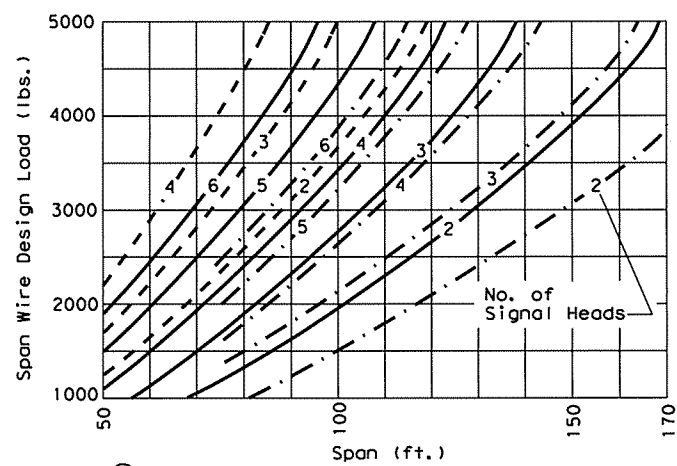
STRAIN POLE ELEVATIONS HORIZONTAL SIGNALS



STRAIN POLE ELEVATIONS VERTICAL SIGNALS
(Mast arms are not used with vertical signals)



② **SIGNALS WITH 12-INCH LENS**



② **SIGNALS WITH 8-INCH LENS**

Signal Head Type	Wt. Per Head	Wind Area
5-Section, 12" Lens	125 lbs	9.6 sq. ft.
5-Section, 8" Lens	70 lbs	4.8 sq. ft.
3-Section, 12" Lens	75 lbs	5.64 sq. ft.
3-Section, 8" Lens	45 lbs	3.0 sq. ft.

◆ Effective projected design wind area (actual area times drag coefficient)

--- Sag = 4'-6" (26' or 30' Pole)
 - - - Sag = 8'-0" (30' or 34' Pole)
 - · - · Sag = 11'-6" (34' Pole)

Pole Type	ROUND POLES				POLYGONAL POLES			
	D _B in.	D _T in.	(4)thk in.	H ft.	D _B in.	D _T in.	(4)thk in.	H ft.
A	12.5	8.9	.239	26	13.0	9.0	.239	26
B	13.5	9.3	.239	30	14.0	9.0	.239	30
C	15.5	11.3	.239	30	16.0	11.0	.239	30
D	15.5	10.7	.239	34	16.0	11.0	.239	34

D_B = Pole Base O.D. D_T = Pole Top O.D. H = Pole Height

④ Thickness shown are minimum, thicker materials may be used.

SHIPPING PARTS LIST

Poles (Without Traffic Signal Arm)						
Pole Type	Strain poles with Luminaire			Strain poles without Luminaire		
	Description	Designation	Quantity	Description	Designation	Quantity
A				26' Strain Pole	SP 26 A-100	
B	30' Strain Pole	SPL 30 B-100		30' Strain Pole	SP 30 B-100	
D	34' Strain Pole	SPL 34 D-100		34' Strain Pole	SP 34 D-100	

Poles (With Traffic Signal Arm)						
Pole Type	Strain poles with Luminaire			Strain poles without Luminaire		
	Description	Designation	Quantity	Description	Designation	Quantity
C	30' SPw/TS Arm	SPL 30 C-100		30' SPw/TS Arm	SP 30 C-100	

Traffic Signal Arms (For Type C poles)						
Nominal Arm Length	Type I Arm (1 Signal)		Type II Arm (2 Signals)		Type III Arm (3 Signals)	
	ft.	Designation	Designation	Quantity	Designation	Quantity
20	20I-100					
24	24I-100		24 II-100			
28	28I-100		28 II-100			
32			32 II-100		32 III-100	
36			36 II-100		36 III-100	

Anchor Bolt Assemblies (1 per pole)

Anchor Bolt Diameter	Anchor Bolt Length	Quantity
1 3/4"	3'-10"	
2"	4'-3"	

Luminaire Arms

Nominal Arm Length	Quantity
8' Arm	

Each Anchor Bolt Assembly consists of the following: Top and Bottom templates, 4 anchor bolts, 8 nuts, 8 flat washers, and 4 nut anchor devices (Type 2) per Standard Drawing "TS-FD".

① See Sheet "DMA-100"

TRAFFIC SIGNAL SUPPORT STRUCTURES STRAIN POLE ASSEMBLIES
 (100 MPH WIND ZONE)
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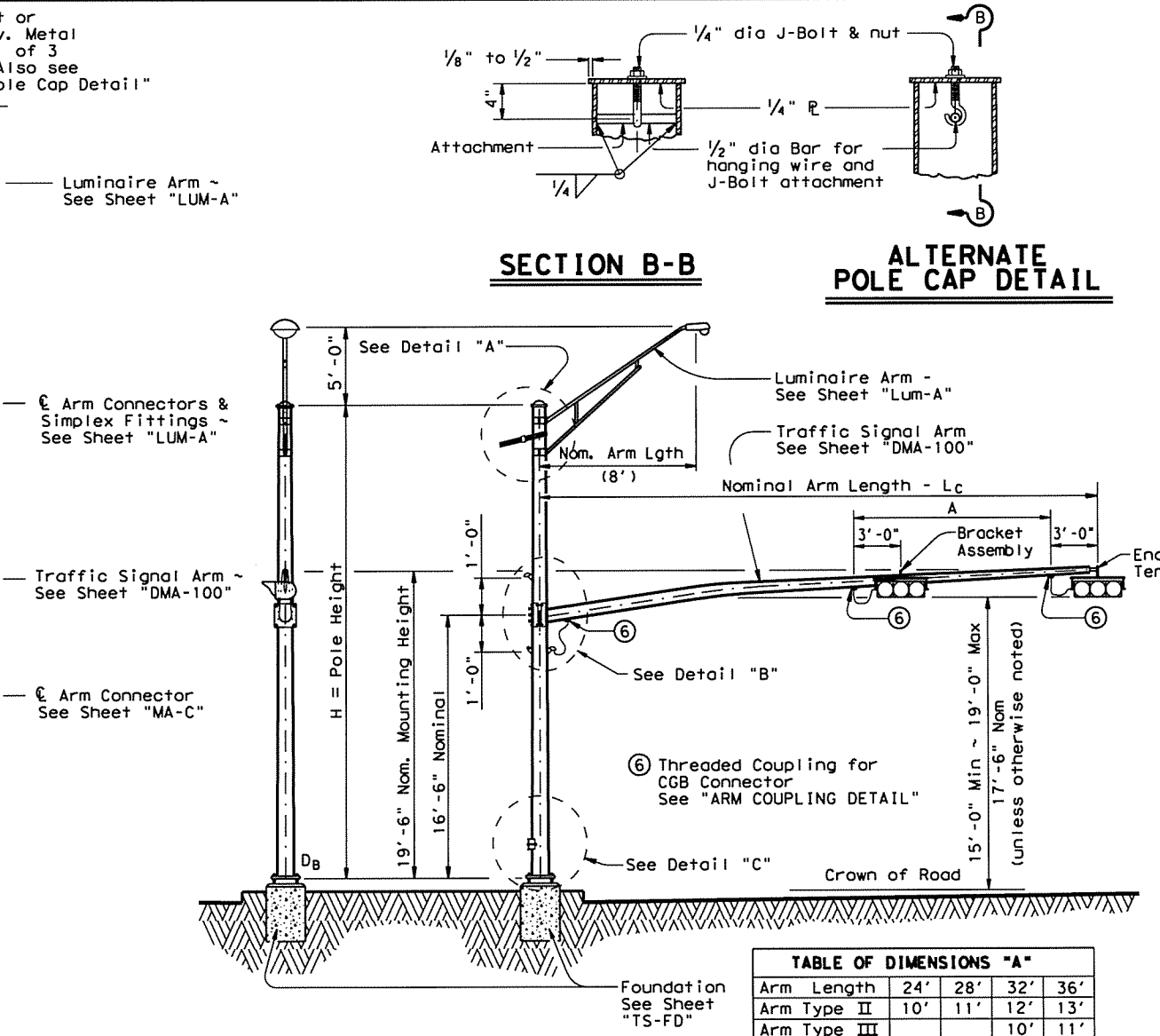
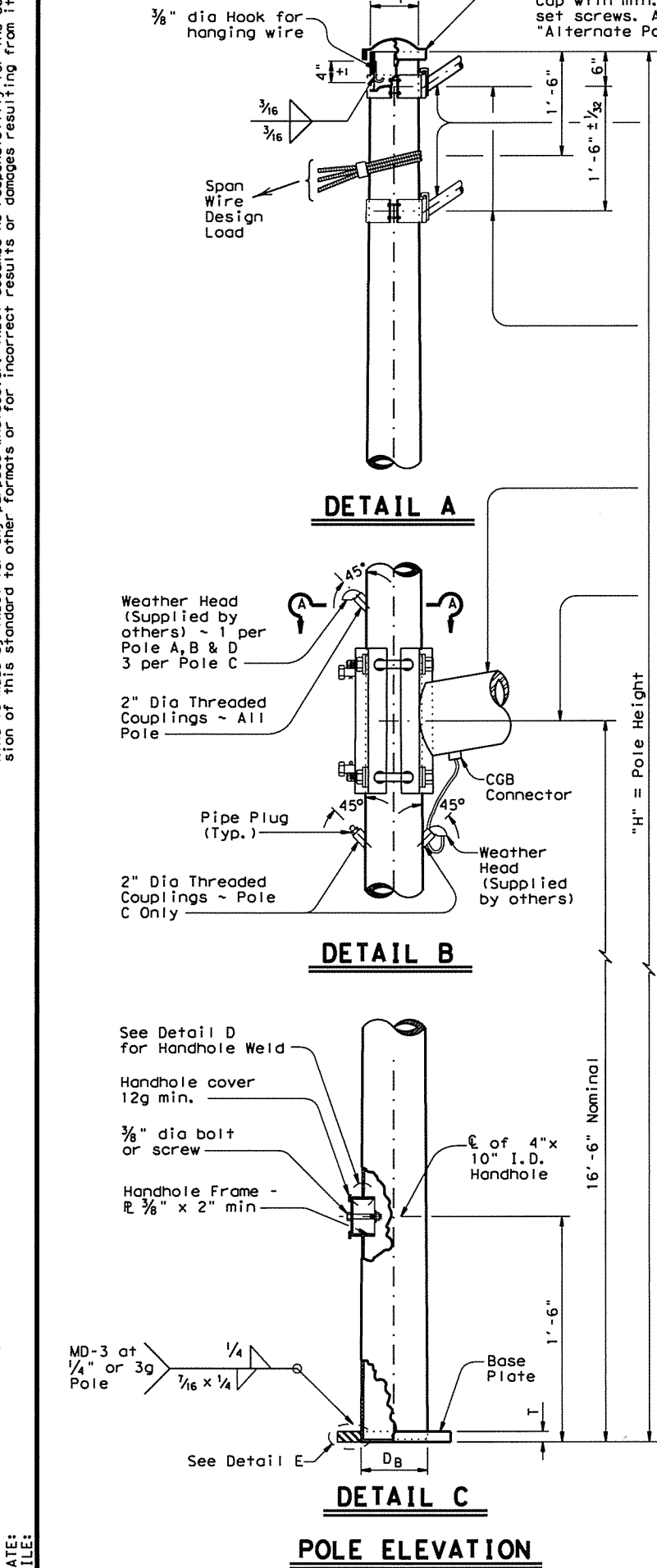


TABLE OF DIMENSIONS "A"

Arm Length	24'	28'	32'	36'
Arm Type II	10'	11'	12'	13'
Arm Type III			10'	11'

MATERIALS

Round Shafts or Polygonal Shafts ⁹	ASTM A595 Gr. A, A588, A1008 HSLAS Gr.50 Class 2, A1011 HSLAS Gr.50 Class 2, A572 Gr.50 or A1011 SS Gr.50 ¹⁰
Plates ⁹	ASTM A36, A588, or A572 Gr.50
Connection Bolts	ASTM A325 except where noted
Pin Bolts	ASTM A325
Pipe ⁹	ASTM A53 Gr. B, A501, A1008 HSLAS-F Gr.50, A1011 HSLAS-F Gr.50
Steel Cable	ASTM A475, 7 Wire Utilities Grade
Misc. Hardware	Galvanized steel or stainless steel or as noted

⁹ ASTM A572, A1008 HSLAS, A1011 HSLAS, A1008 HSLAS-F, A1011 HSLAS-F, or A1011 SS may have higher yield strengths but shall not have less elongation than the grade indicated.

¹⁰ ASTM A1011 SS Gr.50 shall also have a minimum elongation of 18 percent in 8 inches or 23 percent in 2 inches. Material thickness in excess of those stipulated under A1011 SS will be acceptable providing the material meets all other A1011 SS requirements and the requirements of this item.

GENERAL NOTES

Design conforms to 1994 AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals and Interim Specifications thereto. Design Wind Speed equals 100 mph plus a 1.3 gust factor. The maximum permissible span wire design loads tabulated are calculated at a stress load of 1.4 times the basic allowable stress. A simultaneous wind on the pole, mast arm, and luminaire is also included.

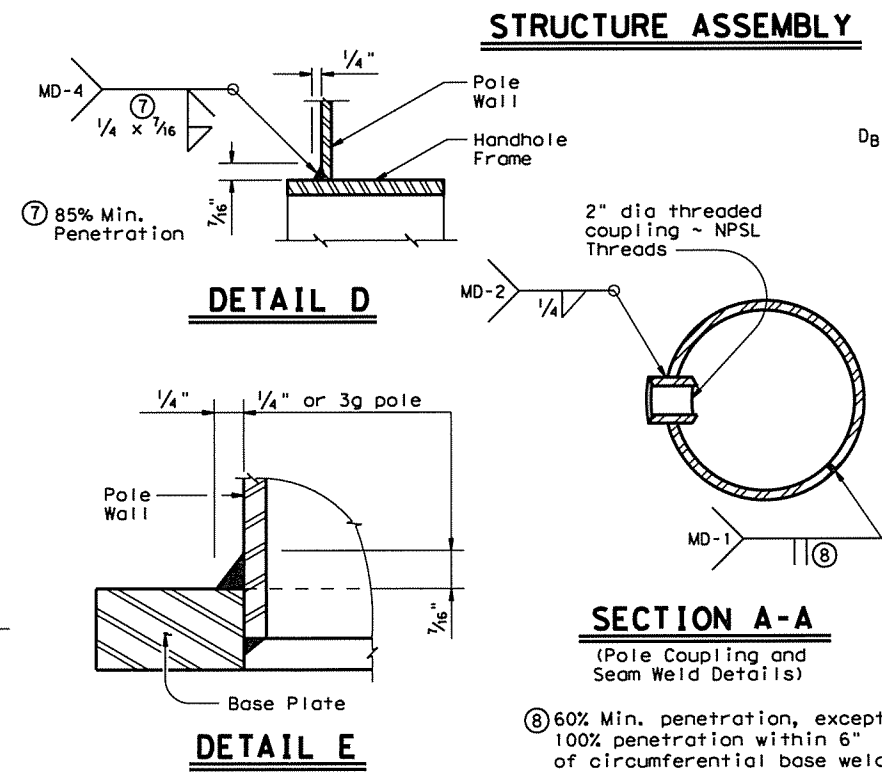
See standard sheet "DMA-100" for details of clamp-on traffic signal arms, sheet "MA-C" for traffic signal arm connection details, sheet "LUM-A" for luminaire arm and connection details, and sheet "TS-FD" for anchor bolt and foundation details.

Fabrication shall be in accordance with Item 686, "Traffic Signal Pole Assemblies (Steel)" and with the details, dimensions, and weld procedures shown herein. Weld references call for preapproved weld procedures which the Fabricator must obtain prior to fabrication. Materials, fabrication tolerances, and shipping practices shall meet the requirements of this sheet and Item 686, "Traffic Signal Pole Assemblies (Steel)".

Unless otherwise noted, all parts shall be galvanized in accordance with Item 445, "Galvanizing", after fabrication.

Deviation from the details and dimensions shown herein require submission of shop drawings in accordance with Item 441, "Steel Structures". Alternate designs are not acceptable.

Foundation Type	Anchor Bolt Diameter	Bolt Hole Diameter	Bolt Circle Diameter	Base R. Dim. L x T
36-A	1 3/4"	2"	19"	19" x 1 3/4"
36-B	2"	2 1/4"	21"	21" x 2"



⁸ 60% Min. penetration, except 100% penetration within 6" of circumferential base welds.

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TRAFFIC SIGNAL SUPPORT STRUCTURES STRAIN POLE ASSEMBLIES
 (100 MPH WIND ZONE)
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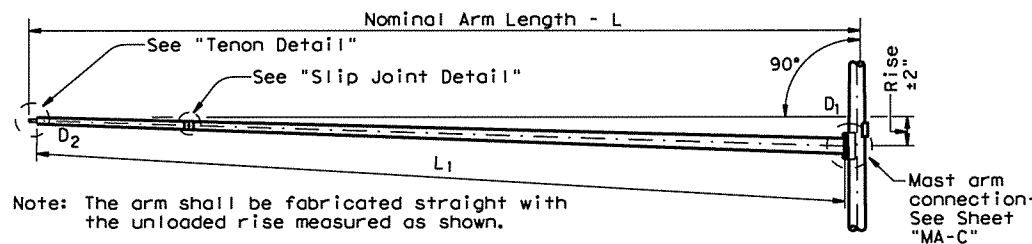
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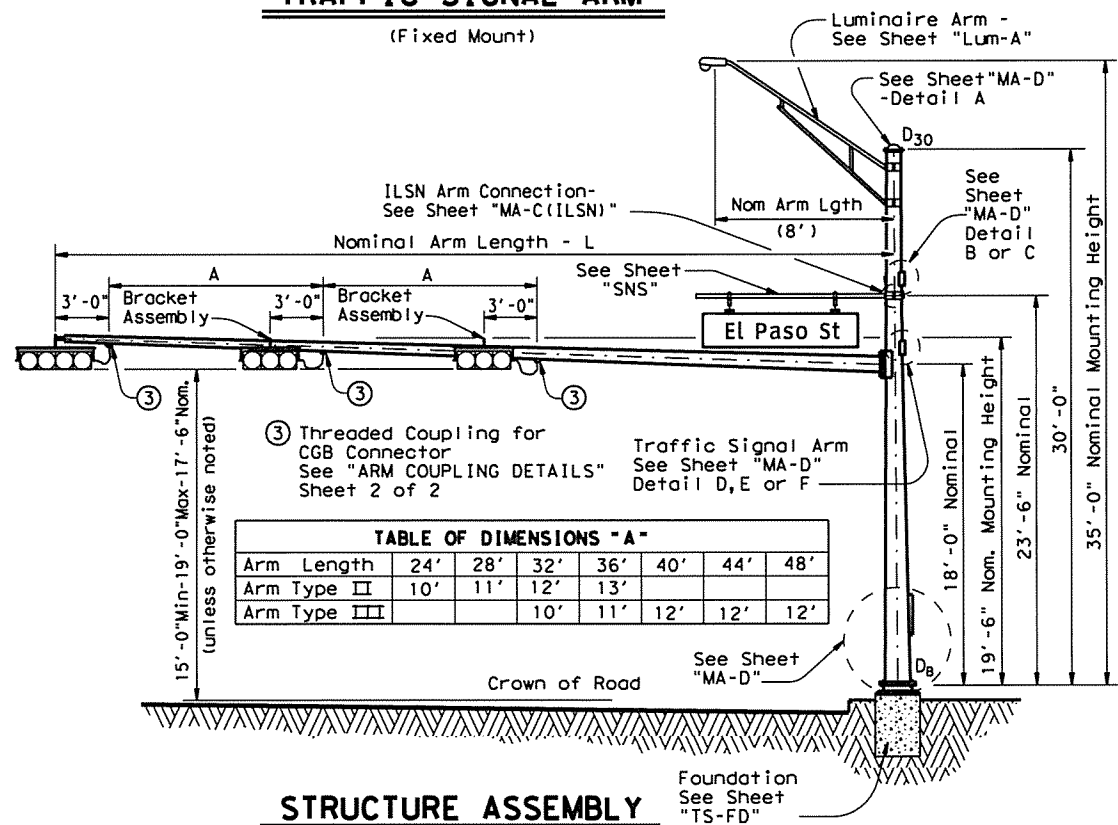
Arm Length	ROUND POLES					POLYGONAL POLES					Foundation Type
	D _B	D ₁₉	D ₂₄	D ₃₀	① thk	D _B	D ₁₉	D ₂₄	D ₃₀	① thk	
ft.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	
20	10.5	7.8	7.1	6.3	.179	11.5	8.5	7.7	6.8	.179	30-A
24	11.0	8.3	7.6	6.8	.179	12.0	9.0	8.2	7.3	.179	30-A
28	11.5	8.8	8.1	7.3	.179	12.5	9.5	8.7	7.8	.179	30-A
32	12.5	9.8	9.1	8.3	.179	12.0	9.0	8.2	7.3	.239	30-A
36	12.0	9.3	8.6	7.8	.239	12.5	9.5	8.7	7.8	.239	36-A
40	12.0	9.3	8.6	7.8	.239	13.5	10.5	9.7	8.8	.239	36-A
44	12.5	9.8	9.1	8.3	.239	14.0	11.0	10.2	9.3	.239	36-A
48	13.0	10.3	9.6	8.8	.239	15.0	12.0	11.2	10.3	.239	36-A

Arm Length	ROUND ARMS					POLYGONAL ARMS				
	L ₁	D ₁	D ₂	① thk	Rise	L ₁	D ₁	② D ₂	① thk	Rise
ft.	ft.	in.	in.	in.		ft.	in.	in.	in.	
20	19.1	6.5	3.8	.179	1'-9"	19.1	7.0	3.5	.179	1'-8"
24	23.1	7.5	4.3	.179	1'-10"	23.1	7.5	3.5	.179	1'-9"
28	27.1	8.0	4.2	.179	1'-11"	27.1	8.0	3.5	.179	1'-10"
32	31.0	9.0	4.7	.179	2'-1"	31.0	9.0	3.5	.179	2'-0"
36	35.0	9.5	4.6	.179	2'-4"	35.0	10.0	3.5	.179	2'-1"
40	39.0	9.5	4.1	.239	2'-8"	39.0	9.5	3.5	.239	2'-3"
44	43.0	10.0	4.1	.239	2'-11"	43.0	10.0	3.5	.239	2'-6"
48	47.0	10.5	4.1	.239	3'-4"	47.0	11.0	3.5	.239	2'-9"

D_B = Pole Base O.D.
 D₁₉ = Pole Top O.D. with no Luminaire and no ILSN
 D₂₄ = Pole Top O.D. with ILSN w/out Luminaire
 D₃₀ = Pole Top O.D. with Luminaire
 D₁ = Arm Base O.D.
 D₂ = Arm End O.D.
 L₁ = Shaft Length
 L = Nominal Arm Length
 ① Thickness shown are minimums, thicker materials may be used.
 ② D₂ may be increased by up to 1" for polygonal arms.



TRAFFIC SIGNAL ARM
(Fixed Mount)



Arm Length	24'	28'	32'	36'	40'	44'	48'
Arm Type II	10'	11'	12'	13'			
Arm Type III			10'	11'	12'	12'	12'

SHIPPING PARTS LIST

Ship each pole with the following attached: enlarged hand hole, pole cap, fixed-arm connection bolts and washers and any additional hardware listed in the table.

Nominal Arm Length	30' Poles With Luminaire		24' Poles With ILSN		19' Poles With No Luminaire and No ILSN	
	Designation	Quantity	Designation	Quantity	Designation	Quantity
ft	Above hardware plus: One (or two if ILSN attached) small hand hole, clamp-on simplex		Above hardware plus one small hand hole		See note above	
20	20L-80		20S-80		20-80	
24	24L-80		24S-80		24-80	
28	28L-80		28S-80		28-80	
32	32L-80		32S-80		32-80	
36	36L-80		36S-80		36-80	
40	40L-80		40S-80		40-80	
44	44L-80		44S-80		44-80	
48	48L-80		48S-80		48-80	

Traffic Signal Arms (1 per Pole) Ship each arm with the listed equipment attached

Nominal Arm Length	Type I Arm (1 Signal)		Type II Arm (2 Signals)		Type III Arm (3 Signals)	
	Designation	Quantity	Designation	Quantity	Designation	Quantity
ft	1 CGB connector		1 Bracket Assembly and 2 CGB Connectors		2 Bracket Assemblies and 3 CGB Connectors	
20	20I-80					
24	24I-80		24II-80			
28	28I-80		28II-80		32III-80	
32			32II-80		36III-80	
36			36II-80		40III-80	
40					44III-80	
44					48III-80	
48						

Luminaire Arms (1 per 30' pole)

Nominal Arm Length	Quantity
8' Arm	

ILSN Arm (Max. 2 per pole) Ship with clamps, bolts and washers


Nominal Arm Length	Quantity
7' Arm	
9' Arm	

Anchor Bolt Assemblies (1 per pole)

Anchor Bolt Diameter	Anchor Bolt Length	Quantity
1 1/2"	3'-4"	
1 3/4"	3'-10"	

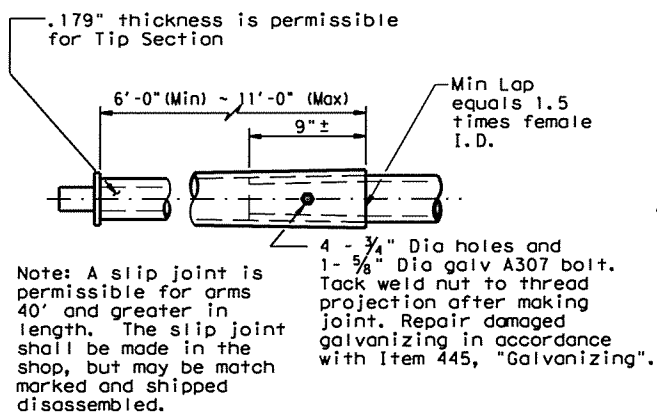
Each anchor bolt assembly consists of the following: Top and Bottom templates, 4 anchor bolts, 8 nuts, 8 flat washers, and 4 nut anchor devices (Type 2) per Standard Drawing "TS-FD".

Templates may be removed for shipment.

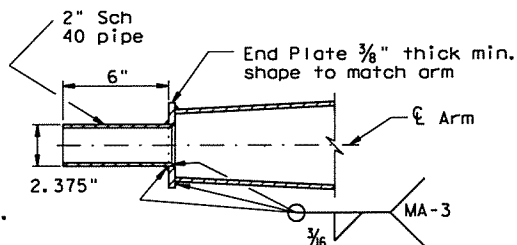

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 Traffic Operations Division
TRAFFIC SIGNAL SUPPORT STRUCTURES
SINGLE MAST ARM ASSEMBLY
(80 MPH WIND ZONE)
SMA-80(1)-12

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11-99	DIST	COUNTY	SHEET NO.	
1-12	HOU	HARRIS, etc.	59	

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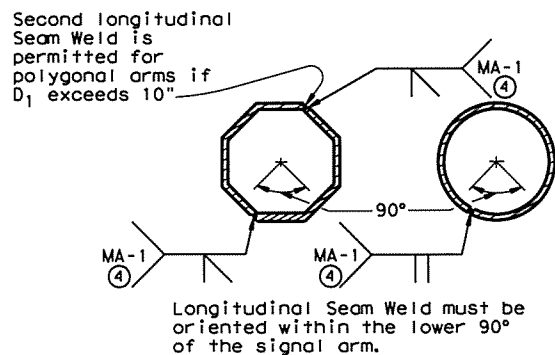
SLIP JOINT DETAIL



TENON DETAIL

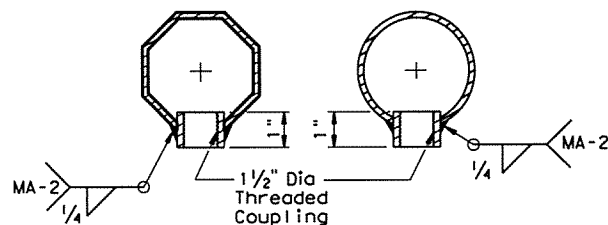
Stainless steel bands (or Cables) and cast bracket as in "Astro-Brac", "Sky Bracket" or "Easy Bracket" with 1 1/2" Dia Threaded Coupling.

BRACKET ASSEMBLY



ARM WELD DETAIL

④ 60% Min. penetration
100% penetration within 6" of circumferential base welds.



ARM COUPLING DETAILS

VIBRATION WARNING

Most Arms of SMA and DMA structures and clamp-on Arms of LMA structures of approximately 40 ft or longer are subject to harmonic vertical vibrations in light wind conditions due to the aeroelastic characteristics of a few of the myriads of possible combinations of the following: signal numbers, weights and positions; existence/solidity of backplates; presence of additional attachments to the arm, such as signs and cameras; arm-wind orientation; and arm-pole stiffness.

Such vibrations may cause fatigue damage to the structure and may lead to galloping in moderate wind conditions which may further damage the structure and alarm the public. Tests have indicated that when wind is blowing toward the back side of signal heads having un-vented backplates attached the probability of unacceptable harmonic vibration and/or galloping is rather high.

If backplates are not required for improved visibility they should not be applied to the signal heads or, if they must be applied, they should be vented as a first and inexpensive measure to mitigate vibrations.

The traffic signal mast arms shall be visually inspected in 5 to 20 mph wind conditions after installation of signal heads and any attachments, including any required backplates. If vertical movements with a total excursion (maximum upward excursion to maximum downward excursion) of more than approximately 8" are observed at the arm tip, a damping plate shall be fitted to the arm. See "Damping Plate Mounting Details" on standard sheet, MA-DP-10.

This visual inspection shall be repeated after each modification of the structure that could affect its aeroelastic response. Excessive vibrations shall not be allowed to continue for more than two days.

GENERAL NOTES:

Design conforms to 1994 AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals and Interim Specifications thereto. Design Wind Speed equals 80 mph plus a 1.3 gust factor.

Poles are designed to support one 8'-0" luminaire arm, one 9'-0" internally lighted street name sign and one traffic signal arm with a length as tabulated. The specified luminaire load applied at the end of the luminaire arm equals 60 lbs vertical dead load plus the horizontal wind load on an effective projected area of 1.6 sq ft. The specified internally lighted street name sign load applied 4.5 ft from the centerline of the pole equals 85 lbs vertical dead load plus horizontal wind load on an effective projected area of 11.5 sq ft. The specified signal load applied at the end of the traffic signal arm equals 180 lbs vertical dead load plus the horizontal wind load on an effective projected area of 32.4 sq ft (actual area times drag coefficient).

See Standard Sheet "MA-D" for pole details, "MA-C" for traffic signal arm connection details, "MA-C (ILSN)" for internally lighted street name sign arm connection details, "LUM-A" for luminaire arm and connection details, "SNS" for internally lighted street name sign details, and "TS-FD" for anchor bolt and foundation details. See "MA-C" for material specifications.

Fabrication shall be in accordance with Item 686, "Traffic Signal Pole Assemblies (Steel)" and with the details, dimensions, and weld procedures shown herein. Weld references call for preapproved weld procedures which the Fabricator must obtain prior to fabrication. Materials, fabrication tolerances, and shipping practices shall meet the requirements of this sheet and Item 686, "Traffic Signal Pole Assemblies (Steel)".

Unless otherwise noted, all parts shall be galvanized in accordance with Item 445, "Galvanizing", after fabrication.

Deviation from the details and dimensions shown herein require submission of shop drawings in accordance with Item 441, "Steel Structures". Alternate designs are not acceptable.

Texas Department of Transportation
Traffic Operations Division

**TRAFFIC SIGNAL
SUPPORT STRUCTURES
SINGLE MAST ARM ASSEMBLY
(80 MPH WIND ZONE)
SMA-80(2)-12**

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5-96 1-12	REVISIONS	CONT	SECT	JOB	HIGHWAY
		6459	93	001	1-610, etc.
		DIST	COUNTY	SHEET NO.	
		HOU	HARRIS, etc.	60	

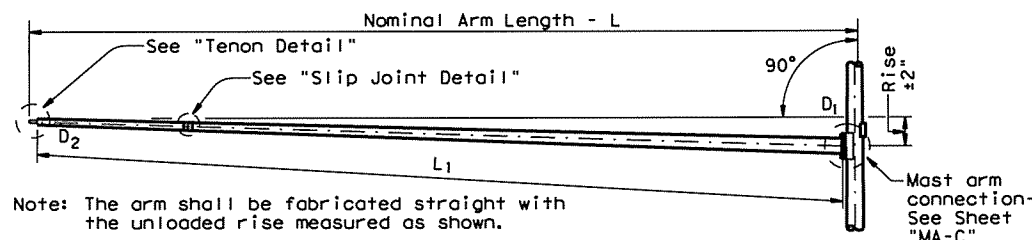
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Arm Length	ROUND POLES					POLYGONAL POLES					Foundation Type
	D _B	D ₁₉	D ₂₄	D ₃₀	① thk	D _B	D ₁₉	D ₂₄	D ₃₀	① thk	
ft.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	
20	12.0	9.3	8.6	7.8	.239	12.5	9.5	8.7	7.8	.239	36-A
24	12.0	9.3	8.6	7.8	.239	13.0	10.0	9.2	8.3	.239	36-A
28	12.0	9.3	8.6	7.8	.239	13.5	10.5	9.7	8.8	.239	36-A
32	13.0	10.3	9.6	8.8	.239	14.0	11.0	10.2	9.3	.239	36-A
36	13.5	10.8	10.1	9.3	.239	15.0	12.0	11.2	10.3	.239	36-A
40	14.0	11.3	10.6	9.8	.239	16.0	13.0	12.2	11.3	.239	36-B
44	14.5	11.8	11.1	10.3	.239	16.5	13.5	12.7	11.8	.239	36-B

Arm Length	ROUND ARMS					POLYGONAL ARMS				
	L ₁	D ₁	D ₂	① thk	Rise	L ₁	D ₁	② D ₂	① thk	Rise
ft.	ft.	in.	in.	in.		ft.	in.	in.	in.	
20	19.1	8.0	5.3	.179	1'-8"	19.1	8.0	3.5	.179	1'-7"
24	23.1	9.0	5.8	.179	1'-9"	23.1	9.0	3.5	.179	1'-8"
28	27.1	9.5	5.7	.179	1'-10"	27.1	10.0	3.5	.179	1'-9"
32	31.0	9.5	5.2	.239	1'-11"	31.0	9.5	3.5	.239	1'-10"
36	35.0	10.0	5.1	.239	2'-0"	35.0	10.0	3.5	.239	1'-11"
40	39.0	10.5	5.1	.239	2'-3"	39.0	11.0	3.5	.239	2'-1"
44	43.0	11.0	5.1	.239	2'-8"	43.0	11.5	4.0	.239	2'-3"

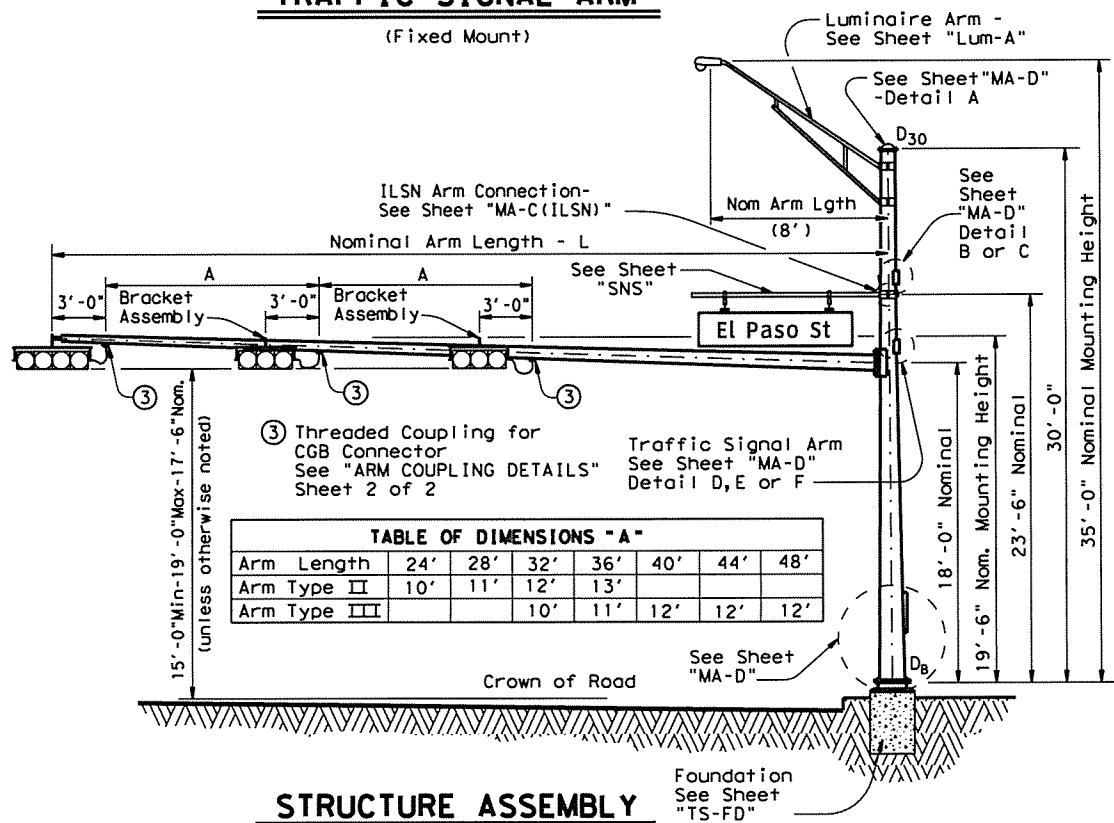
D_B = Pole Base O.D.
 D₁₉ = Pole Top O.D. with no Luminaire and no ILSN
 D₂₄ = Pole Top O.D. with ILSN w/out Luminaire
 D₃₀ = Pole Top O.D. with Luminaire
 D₁ = Arm Base O.D.
 D₂ = Arm End O.D.
 L₁ = Shaft Length
 L = Nominal Arm Length

- ① Thickness shown are minimums, thicker materials may be used.
 ② D₂ may be increased by up to 1" for polygonal arms.



Note: The arm shall be fabricated straight with the unloaded rise measured as shown.

TRAFFIC SIGNAL ARM
(Fixed Mount)



Arm Length	24'	28'	32'	36'	40'	44'	48'
Arm Type II	10'	11'	12'	13'			
Arm Type III			10'	11'	12'	12'	12'

SHIPPING PARTS LIST

Ship each pole with the following attached: enlarged hand hole, pole cap, fixed-arm connection bolts and washers and any additional hardware listed in the table.

Nominal Arm Length	30' Poles With Luminaire		24' Poles With ILSN		19' Poles With No Luminaire and No ILSN	
	Above hardware plus: One (or two if ILSN attached) small hand hole, clamp-on simplex		Above hardware plus one small hand hole		See note above	
ft	Designation	Quantity	Designation	Quantity	Designation	Quantity
20	20L-100		20S-100		20-100	
24	24L-100		24S-100		24-100	
28	28L-100		28S-100		28-100	
32	32L-100		32S-100		32-100	
36	36L-100		36S-100		36-100	
40	40L-100		40S-100		40-100	
44	44L-100		44S-100		44-100	

Traffic Signal Arms (1 per pole) Ship each arm with the listed equipment attached

Nominal Arm Length	Type I Arm (1 Signal)		Type II Arm (2 Signals)		Type III Arm (3 Signals)	
	1 CGB connector		1 Bracket Assembly and 2 CGB Connectors		2 Bracket Assemblies and 3 CGB Connectors	
ft	Designation	Quantity	Designation	Quantity	Designation	Quantity
20	20I-100					
24	24I-100		24II-100			
28	28I-100		28II-100			
32			32II-100		32III-100	
36			36II-100		36III-100	
40					40III-100	
44					44III-100	

Luminaire Arms (1 per 30' pole)

Nominal Arm Length	Quantity
8' Arm	

ILSN Arm (Max. 2 per pole) Ship with clamps, bolts and washers


Nominal Arm Length	Quantity
7' Arm	
9' Arm	

Anchor Bolt Assemblies (1 per pole)

Anchor Bolt Diameter	Anchor Bolt Length	Quantity
1 1/2"	3'-4"	
1 3/4"	3'-10"	
2"	4'-3"	

Each anchor bolt assembly consists of the following: Top and Bottom templates, 4 anchor bolts, 8 nuts, 8 flat washers, and 4 nut anchor devices (Type 2) per Standard Drawing "TS-FD".

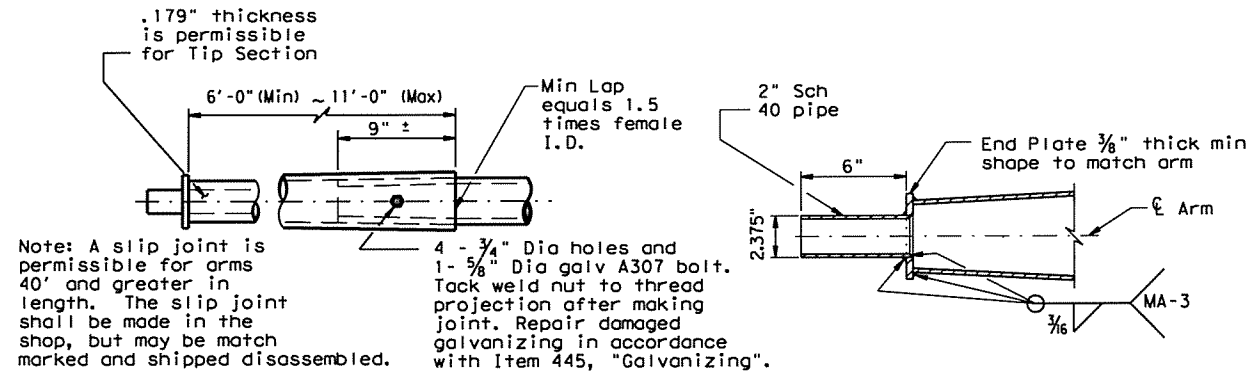
Templates may be removed for shipment.


Texas Department of Transportation
 Traffic Operations Division
TRAFFIC SIGNAL
SUPPORT STRUCTURES
 SINGLE MAST ARM ASSEMBLY
 (100 MPH WIND ZONE)
SMA-100(1)-12

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11-99		DIST COUNTY		SHEET NO.	
1-12		HOU		HARRIS, etc.	

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DISCLAIMER:



SLIP JOINT DETAIL

TENON DETAIL

Note: A slip joint is permissible for arms 40' and greater in length. The slip joint shall be made in the shop, but may be match marked and shipped disassembled.

4 - 3/4" Dia holes and 1-5/8" Dia galv A307 bolt. Tack weld nut to thread projection after making joint. Repair damaged galvanizing in accordance with Item 445, "Galvanizing".

VIBRATION WARNING

Mast Arms of SMA and DMA structures and clamp-on Arms of LMA structures of approximately 40 ft or longer are subject to harmonic vertical vibrations in light wind conditions due to the aeroelastic characteristics of a few of the myriads of possible combinations of the following: signal numbers, weights and positions; existence/solidity of backplates; presence of additional attachments to the arm, such as signs and cameras; arm-wind orientation; and arm-pole stiffness.

Such vibrations may cause fatigue damage to the structure and may lead to galloping in moderate wind conditions which may further damage the structure and alarm the public. Tests have indicated that when wind is blowing toward the back side of signal heads having un-vented backplates attached the probability of unacceptable harmonic vibration and/or galloping is rather high.

If backplates are not required for improved visibility they should not be applied to the signal heads or, if they must be applied, they should be vented as a first and inexpensive measure to mitigate vibrations.

The traffic signal mast arms shall be visually inspected in 5 to 20 mph wind conditions after installation of signal heads and any attachments, including any required backplates. If vertical movements with a total excursion (maximum upward excursion to maximum downward excursion) of more than approximately 8" are observed at the arm tip, a damping plate shall be fitted to the arm. See "Damping Plate Mounting Details" on standard sheet, MA-DPD-10.

This visual inspection shall be repeated after each modification of the structure that could affect its aeroelastic response. Excessive vibrations shall not be allowed to continue for more than two days.

Stainless steel bands (or Cables) and cast bracket as in "Astro-Brac", "Sky Bracket" or "Easy Bracket" with 1 1/2" Dia Threaded Coupling.

BRACKET ASSEMBLY

GENERAL NOTES:

Design conforms to 1994 AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals and Interim Specifications thereto. Design Wind Speed equals 100 mph plus a 1.3 gust factor.

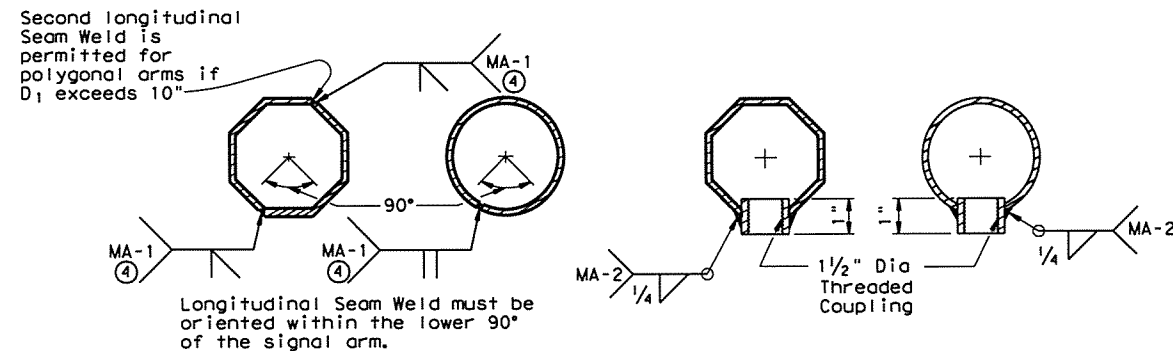
Poles are designed to support one 8'-0" luminaire arm, one 9'-0" internally lighted street name sign and one traffic signal arm with a length as tabulated. The specified luminaire load applied at the end of the luminaire arm equals 60 lbs vertical dead load plus the horizontal wind load on an effective projected area of 1.6 sq ft. The specified internally lighted street name sign load applied 4.5 ft from the centerline of the pole equals 85 lbs vertical dead load plus horizontal wind load on an effective projected area of 11.5 sq ft. The specified signal load applied at the end of the traffic signal arm equals 180 lbs vertical dead load plus the horizontal wind load on an effective projected area of 32.4 sq ft (actual area times drag coefficient).

See Standard Sheet "MA-D" for pole details, "MA-C" for traffic signal arm connection details, "MA-C (ILSN)" for internally lighted street name sign arm connection details, "LUM-A" for luminaire arm and connection details, "SNS" for internally lighted street name sign details, and "TS-FD" for anchor bolt and foundation details. See "MA-C" for material specifications.

Fabrication shall be in accordance with Item 686, "Traffic Signal Pole Assemblies (Steel)" and with the details, dimensions, and weld procedures shown herein. Weld references call for preapproved weld procedures which the Fabricator must obtain prior to fabrication. Materials, fabrication tolerances, and shipping practices shall meet the requirements of this sheet and Item 686, "Traffic Signal Pole Assemblies (Steel)".

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ARM WELD DETAIL

ARM COUPLING DETAILS

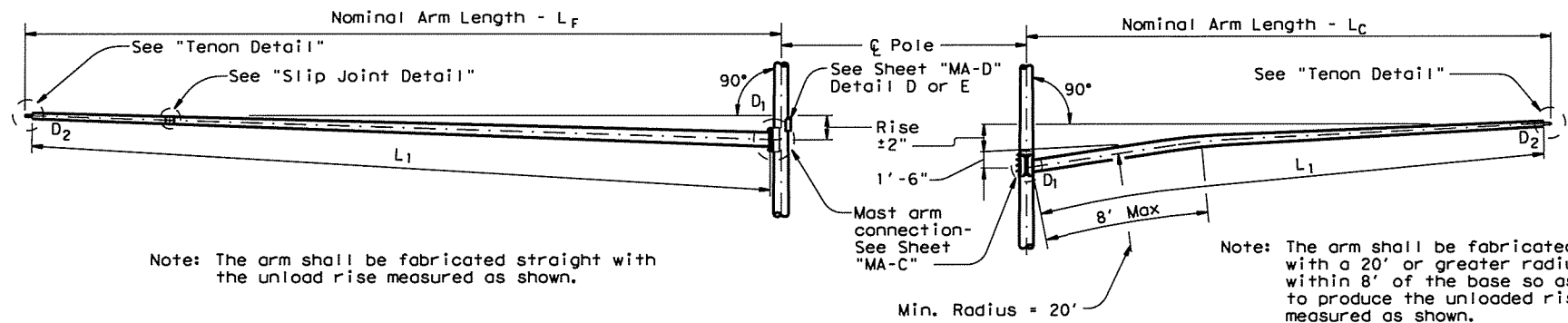
④ 60% Min. penetration
100% penetration within 6" of circumferential base welds.

Texas Department of Transportation
 Traffic Operations Division

TRAFFIC SIGNAL
 SUPPORT STRUCTURES
 SINGLE MAST ARM ASSEMBLY
 (100 MPH WIND ZONE)
 SMA-100(2)-12

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1-12	DIST	COUNTY	SHEET NO.	
	HOU	HARRIS, etc.	62	

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FIXED MOUNT TRAFFIC SIGNAL ARM

CLAMP-ON TRAFFIC SIGNAL ARM

GENERAL NOTES:

Design conforms to 1994 AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals and Interim Specifications thereto. Design Wind Speed equals 80 mph plus a 1.3 gust factor. Designs are based on an arm included angle of 90 degrees or more. Angles of less than approximately 75 degrees will require a special design.

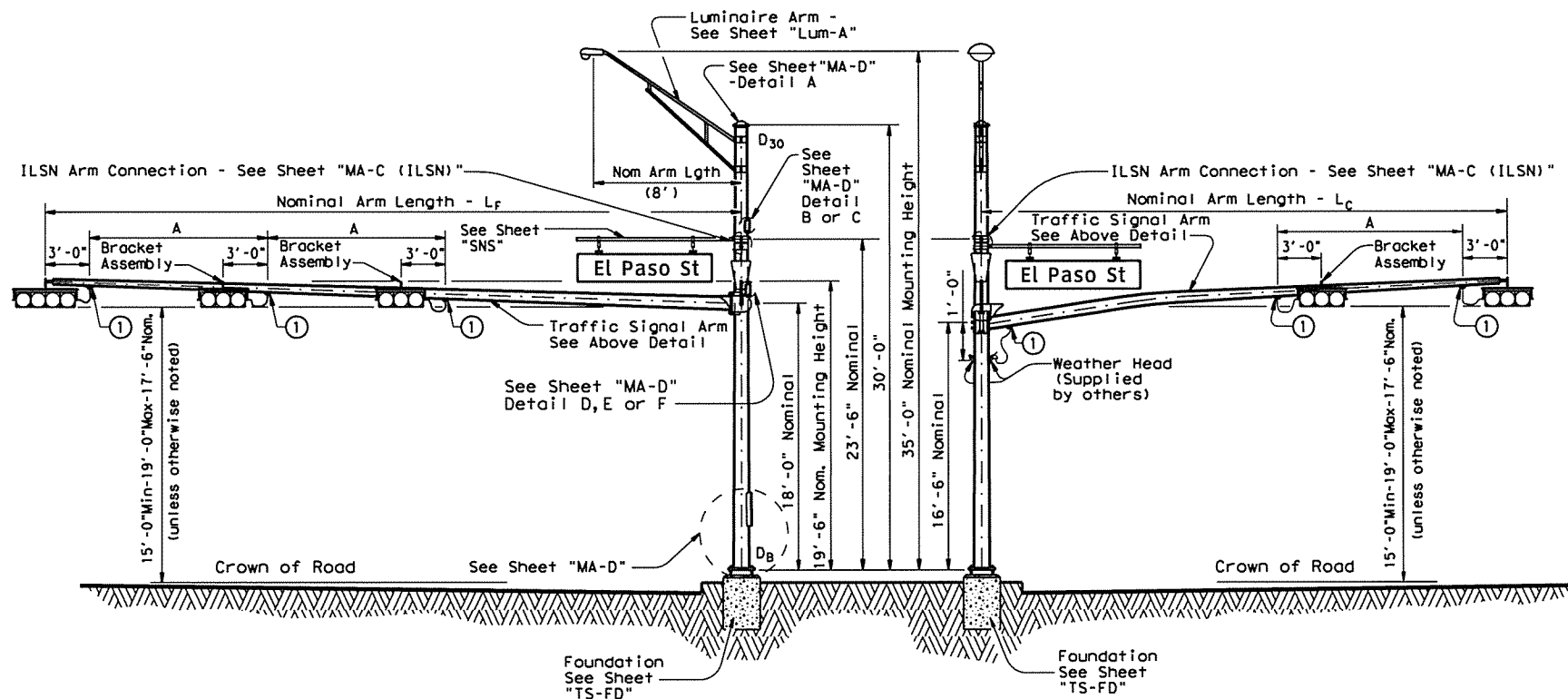
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See Standard Sheet "MA-D" for pole details, "MA-C" for traffic signal arm connection details, "MA-C (ILSN)" for internally lighted street name sign arm connection details, "LUM-A" for luminaire arm and connection details, "SNS" for internally lighted street name sign details, and "TS-FD" for anchor bolt and foundation details. See "MA-C" for material specifications.

Fabrication shall be in accordance with Item 686, "Traffic Signal Pole Assemblies (Steel)" and with the details, dimensions, and weld procedures shown herein. Weld references call for preapproved weld procedures which the fabricator must obtain prior to fabrication. Materials, fabrication tolerances, and shipping practices shall meet the requirements of this sheet and Item 686, "Traffic Signal Pole Assemblies (Steel)".

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Deviation from the details and dimensions shown herein require submission of shop drawings in accordance with Item 441, "Steel Structures". Alternate designs are not acceptable.



ELEVATION

(Showing fixed mount arm)

STRUCTURE ASSEMBLY

ELEVATION

(Showing clamp mount arm)

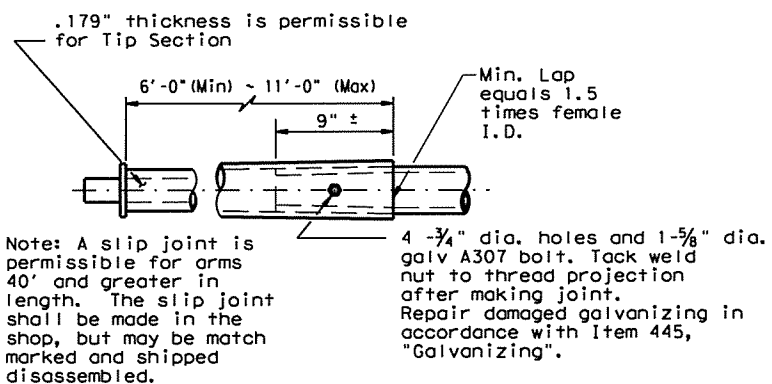
TABLE OF DIMENSIONS "A"						
Arm Length	24'	28'	32'	36'	40'	44'
Arm Type II	10'	11'	12'	13'		
Arm Type III			10'	11'	12'	12'

① Threaded Coupling for CGB Connector See "ARM COUPLING DETAILS" Sheet 2 of 3

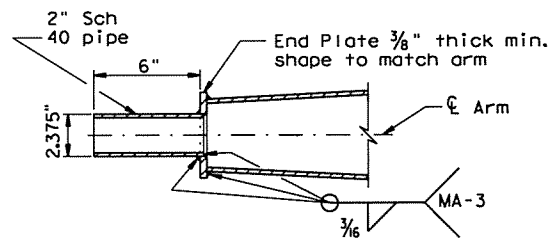
Texas Department of Transportation
 Traffic Operations Division
TRAFFIC SIGNAL SUPPORT STRUCTURES
DUAL MAST ARM ASSEMBLY
 (80 MPH WIND ZONE)
DMA-80 (1)-12

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		DIST		COUNTY	SHEET NO.
		HOU		HARRIS, etc.	63

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SLIP JOINT DETAIL



TENON DETAIL

Stainless steel bands (or Cables) and cast bracket as in "Astro-Brac", "Sky Bracket" or "Easy Bracket" with 1 1/2" Dia Threaded Coupling.

BRACKET ASSEMBLY

VIBRATION WARNING

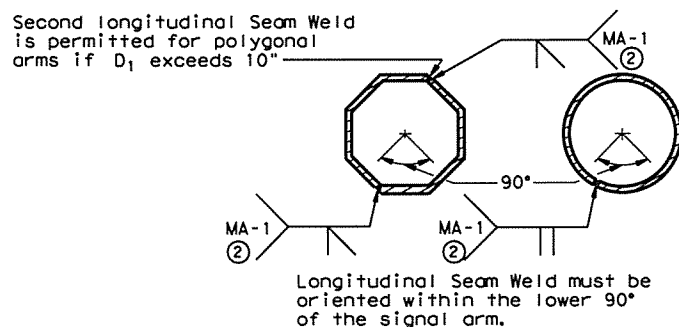
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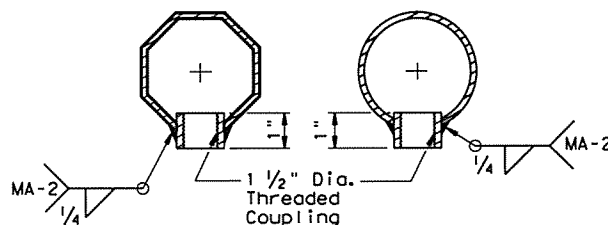
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ARM WELD DETAIL

② 60% Min. penetration
100% penetration within 6" of circumferential base welds.



ARM COUPLING DETAILS

Texas Department of Transportation
Traffic Operations Division

**TRAFFIC SIGNAL
SUPPORT STRUCTURES**

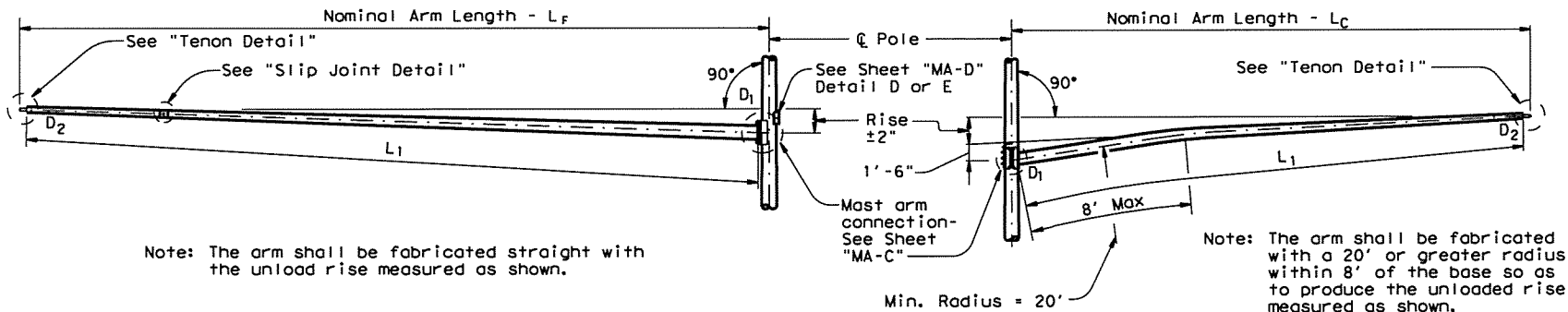
DUAL MAST ARM ASSEMBLY

(80 MPH WIND ZONE)

DMA-80 (2)-12

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5-96 1-12	REVISIONS	CONT	SECT	JOB	HIGHWAY
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		DIST	COUNTY	SHEET NO.	
		HOU	HARRIS, etc.	64	

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FIXED MOUNT TRAFFIC SIGNAL ARM

CLAMP-ON TRAFFIC SIGNAL ARM

GENERAL NOTES:

Design conforms to 1994 AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals and Interim Specifications thereto. Design Wind Speed equals 100 mph plus a 1.3 gust factor. Designs are based on an arm included angle of 90 degrees or more. Angles of less than approximately 75 degrees will require a special design.

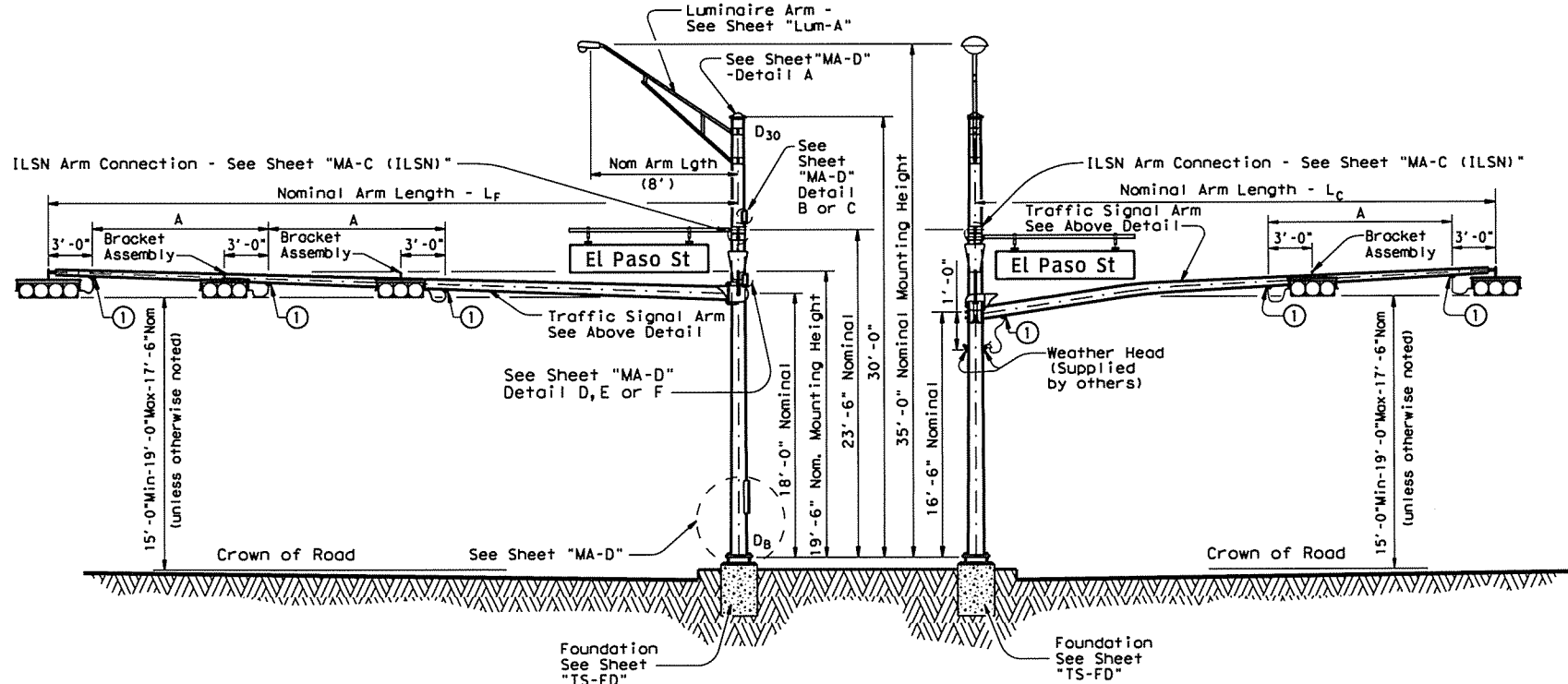
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See Standard Sheet "MA-D" for pole details, "MA-C" for traffic signal arm connection details, "MA-C (ILSN)" for internally lighted street name sign arm connection details, "LUM-A" for luminaire arm and connection details, "SNS" for internally lighted street name sign details, and "TS-FD" for anchor bolt and foundation details. See "MA-C" for material specifications.

Fabrication shall be in accordance with Item 686, "Traffic Signal Pole Assemblies (Steel)" and with the details, dimensions, and weld procedures shown herein. Weld references call for preapproved weld procedures which the Fabricator must obtain prior to fabrication. Materials, fabrication tolerances, and shipping practices shall meet the requirements of this sheet and Item 686, "Traffic Signal Pole Assemblies (Steel)".

Unless otherwise noted, all parts shall be galvanized in accordance with Item 445, "Galvanizing", after fabrication.

Deviation from the details and dimensions shown herein require submission of shop drawings in accordance with Item 441, "Steel Structures". Alternate designs are not acceptable.



① Threaded Coupling for CGB Connector See "ARM COUPLING DETAILS" Sheet 2 of 3

TABLE OF DIMENSIONS "A"

Arm Length	24'	28'	32'	36'	40'	44'
Arm Type II	10'	11'	12'	13'		
Arm Type III			10'	11'	12'	12'

Texas Department of Transportation

 Traffic Operations Division

TRAFFIC SIGNAL SUPPORT STRUCTURES

DUAL MAST ARM ASSEMBLY

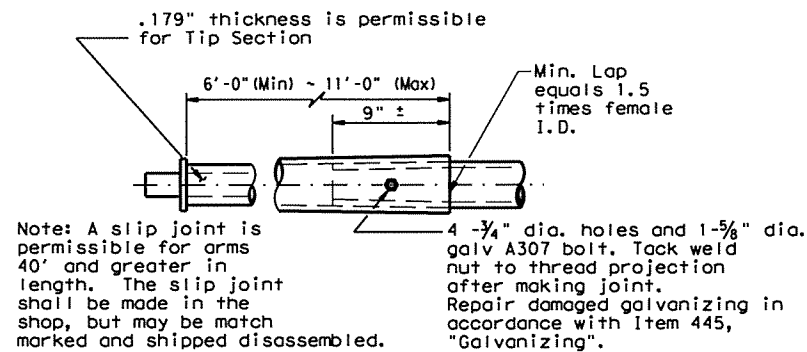
 (100 MPH WIND ZONE)

DMA-100 (1)-12

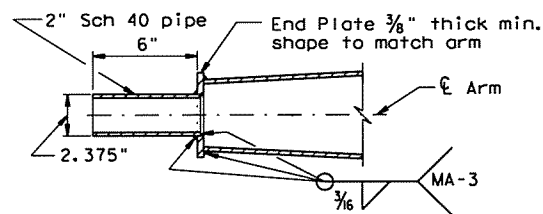
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REVISIONS					
CONT	SECT	JOB		HIGHWAY	
6459	93	001		I-610, etc.	
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DATE:
FILE:

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SLIP JOINT DETAIL



TENON DETAIL

Stainless steel bands (or Cables) and cast bracket as in "Astro-Brac", "Sky Bracket" or "Easy Bracket" with 1 1/2" Dia Threaded Coupling.

BRACKET ASSEMBLY

VIBRATION WARNING

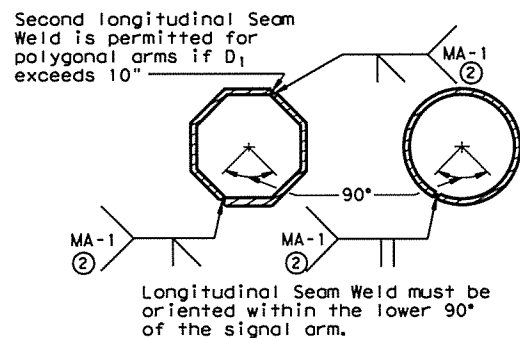
Most Arms of SMA and DMA structures and clamp-on Arms of LMA structures of approximately 40 ft or longer are subject to harmonic vertical vibrations in light wind conditions due to the aeroelastic characteristics of a few of the myriads of possible combinations of the following: signal numbers, weights and positions; existence/solidity of backplates; presence of additional attachments to the arm, such as signs and cameras; arm-wind orientation; and arm-pole stiffness.

Such vibrations may cause fatigue damage to the structure and may lead to galloping in moderate wind conditions which may further damage the structure and alarm the public. Tests have indicated that when wind is blowing toward the back side of signal heads having un-vented backplates attached the probability of unacceptable harmonic vibration and/or galloping is rather high.

If backplates are not required for improved visibility they should not be applied to the signal heads or, if they must be applied, they should be vented as a first and inexpensive measure to mitigate vibrations.

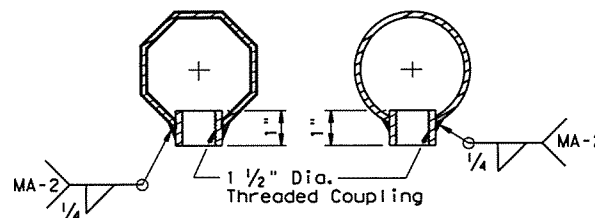
The traffic signal mast arms shall be visually inspected in 5 to 20 mph wind conditions after installation of signal heads and any attachments, including any required backplates. If vertical movements with a total excursion (maximum upward excursion to maximum downward excursion) of more than approximately 8" are observed at the arm tip, a damping plate shall be fitted to the arm. See "Damping Plate Mounting Details" on standard sheet, MA-DPD-10.

This visual inspection shall be repeated after each modification of the structure that could affect its aeroelastic response. Excessive vibrations shall not be allowed to continue for more than two days.




ARM WELD DETAIL

② 60% Min. penetration
100% penetration within 6" of circumferential base welds.



ARM COUPLING DETAILS


Texas Department of Transportation
 Traffic Operations Division
TRAFFIC SIGNAL SUPPORT STRUCTURES
DUAL MAST ARM ASSEMBLY
 (100 MPH WIND ZONE)
DMA-100 (2)-12

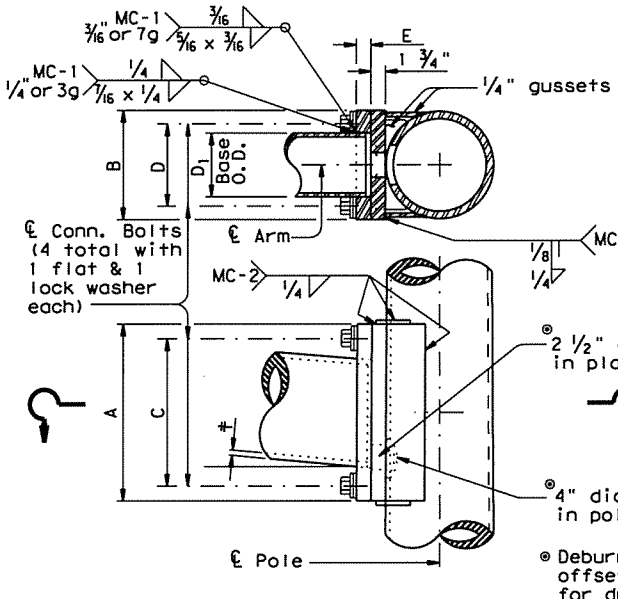
© TxDOT August 1995		DN: MS	CK1: JSY	DW: MMF	CK1: JSY
05-96 1-12	REVISIONS		CONT	SECT	JOB
			6459	93	001
			DIST	COUNTY	HIGHWAY
			HOU	HARRIS, etc.	67

DATE: FILE:

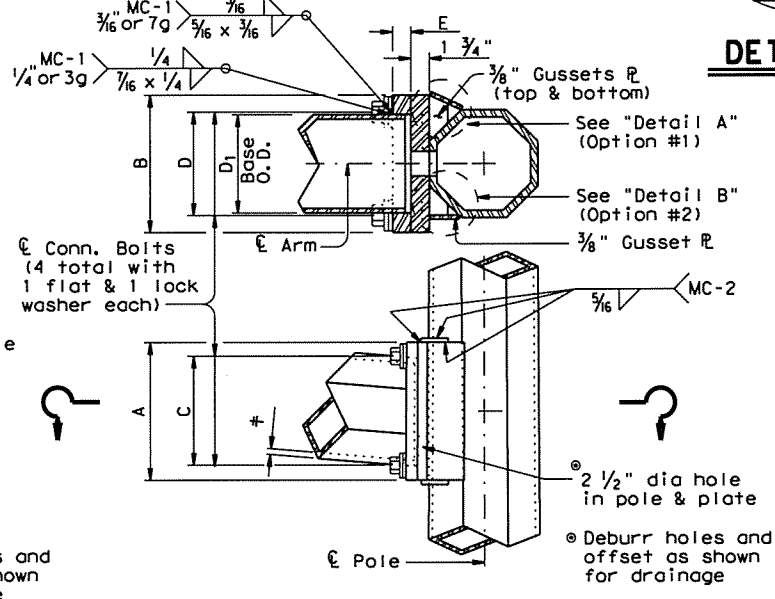
DISCLAIMER: The use of this standard is governed by the "Texas Engineering Practice Act". No warranty of any kind is made by TxDOT for any purpose whatsoever. TxDOT assumes no responsibility for the conversion of this standard to other formats or for incorrect results or damages resulting from its use.

ARM SIZE D ₁	#	ARM SIZE					CONN. BOLT DIA.
		A	B	C	D	E	
6.5	.179	12	9	9	6	1 3/4	1
7.5	.179	13	9	10	6	1 3/4	1
8.0	.179	14	10	11	7	2	1 1/4
9.0	.179	16	11	13	8	2	1 1/4
9.5	.179	17	12	14	9	2	1 1/4
9.5	.239	18	12	15	9	2	1 1/4
10.0	.239	18	12	15	9	2	1 1/4
10.5	.239	18	13	15	10	3	1 1/2
11.0	.239	18	13	15	10	3	1 1/2

ARM SIZE D ₁	#	ARM SIZE					CONN. BOLT DIA.
		A	B	C	D	E	
7.0	.179	11	11	8	8	1 3/4	1 1/4
7.5	.179	11	11	8	8	1 3/4	1 1/4
8.0	.179	11	11	8	8	2	1 1/4
9.0	.179	13	13	10	10	2	1 1/4
10.0	.179	13	13	10	10	2	1 1/4
9.5	.239	13	13	10	10	2	1 1/4
10.0	.239	14	14	11	11	2	1 1/2
11.0	.239	14	14	11	11	3	1 1/2
11.5	.239	14	14	11	11	3	1 1/2



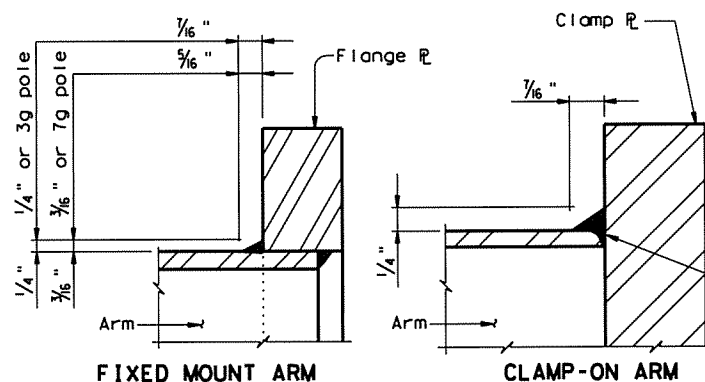
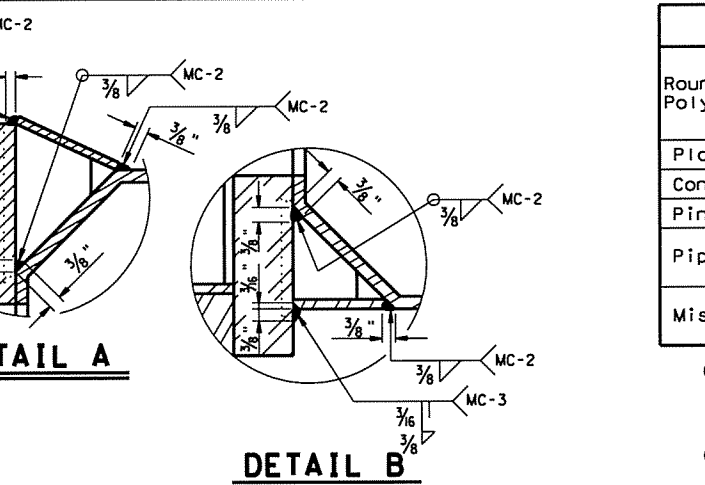
FIXED MOUNT DETAIL 1



FIXED MOUNT DETAIL 2

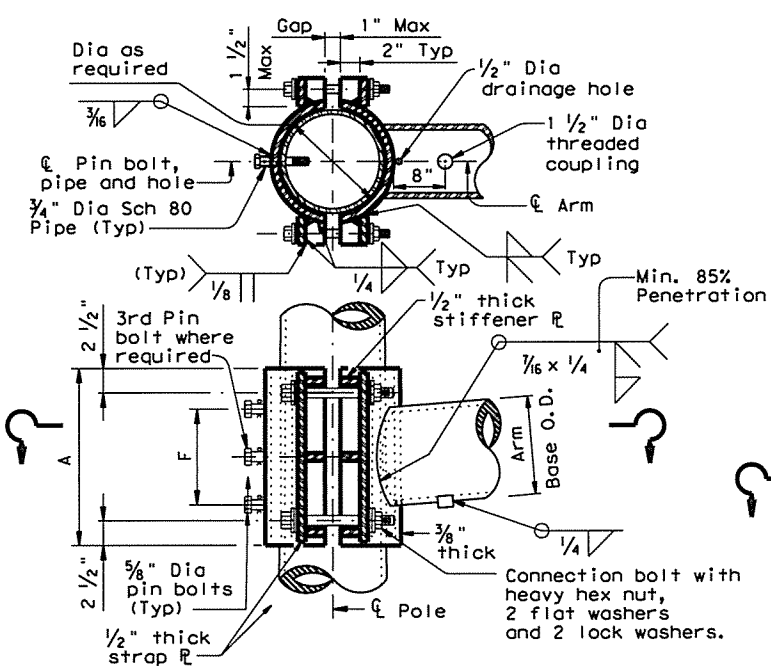
ARM SIZE D ₁	#	A	F	CONN. BOLTS		PIN BOLTS	
				No.	Dia	No.	Dia
6.5	.179	12	6	4	1	2	5/8
7.5	.179	14	8	4	1	2	5/8
8.0	.179	14	8	4	1	2	5/8
9.0	.179	16	10	4	1	2	5/8
9.5	.179	18	12	4	1 1/4	3	5/8
9.5	.239	18	12	4	1 1/4	3	5/8
10.0	.239	18	12	4	1 1/4	3	5/8

ARM SIZE D ₁	#	A	F	T	CONN. BOLTS		PIN BOLTS	
					No.	Dia	No.	Dia
7.0	.179	12	6	3/4	4	3/4	2	5/8
7.5	.179	14	8	3/4	4	3/4	2	5/8
8.0	.179	14	8	3/4	4	3/4	2	5/8
9.0	.179	16	10	7/8	4	1	2	5/8
10.0	.179	18	10	7/8	4	1	2	5/8
9.5	.239	18	10	1	6	1	3	5/8
10.0	.239	18	10	1	6	1	3	5/8

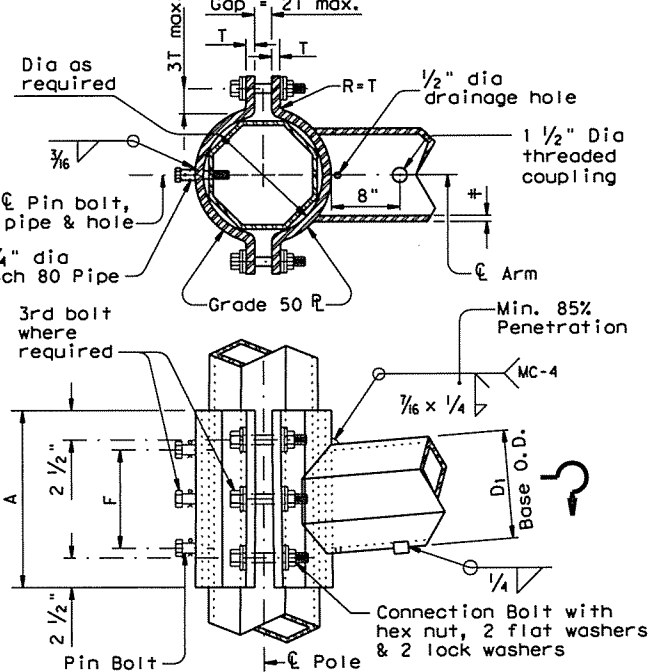


ARM BASE WELD DETAILS

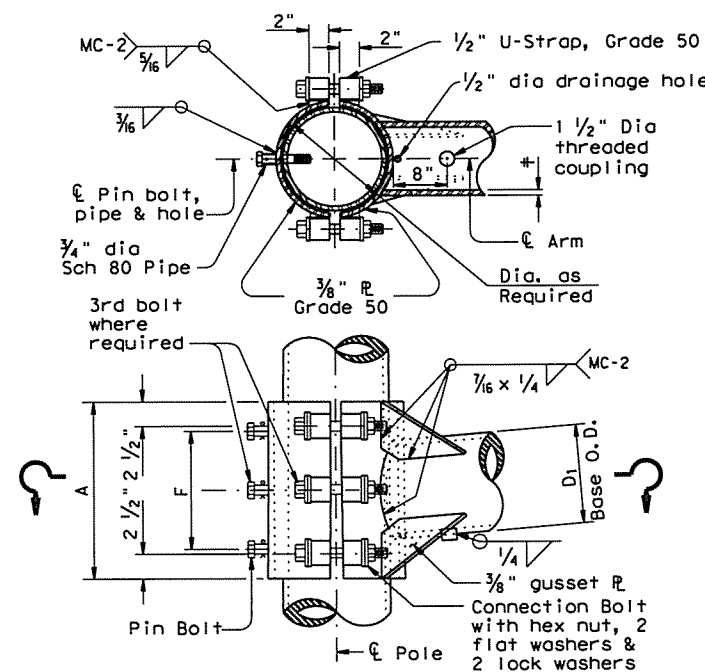
ARM SIZE D ₁	#	A	F	CONN. BOLTS		PIN BOLTS	
				No.	Dia	No.	Dia
6.5	.179	12	6	4	1	2	5/8
7.5	.179	14	8	4	1	2	5/8
8.0	.179	14	8	4	1	2	5/8
9.0	.179	16	10	4	1	2	5/8
9.5	.179	18	12	6	1	3	5/8
9.5	.239	18	12	6	1	3	5/8
10.0	.239	18	12	6	1	3	5/8



CLAMP-ON DETAIL 1



CLAMP-ON DETAIL 2



CLAMP-ON DETAIL 3

MATERIALS	
Round Shafts or Polygonal Shafts ①	ASTM A595 Gr. A, A588, A1008 HSLAS Gr. 50 Class 2, A1011 HSLAS Gr. 50 Class 2, A572 Gr. 50 or A1011 SS Gr. 50 ②
Plates ①	ASTM A36, A588, or A572 Gr. 50
Connection Bolts	ASTM A325 or A449, except where noted
Pin Bolts	ASTM A325
Pipe ①	ASTM A53 Gr. B, A501, A1008 HSLAS-F Gr. 50, A1011 HSLAS-F Gr. 50
Misc. Hardware	Galvanized steel or stainless steel or as noted

- ① ASTM A572, A1008 HSLAS, A1011 HSLAS, A1008 HSLAS-F, A1011 HSLAS-F or A1011 SS may have higher yield strengths but shall not have less elongation than the grade indicated.
- ② ASTM A1011 SS Gr. 50 material shall also have a minimum elongation of 18 percent in 8 inches or 23 percent in 2 inches. Material thickness in excess of those stipulated under A1011 SS will be acceptable providing the material meets all other A1011 SS requirements and the requirements of this item.

GENERAL NOTES:
Clamp-on details are used for the second arm on dual mast arm assemblies. A Maximum 1 1/2" wide vertical slotted hole shall be cut in the front clamp plate to facilitate drainage during galvanizing. The slot shall be centered behind the arm and shall be no longer than the arm diameter minus 1"

Fixed mount details are used for single mast arm assemblies and for the first arm on dual mast arm assemblies.

Where duplicate parts occur on a detail, welds shown for one part shall apply to all similar parts on the detail.

Pin bolts are required to prevent rotation of clamp-on arms under design wind forces.

NOTE:
Pin bolts shall be A325 with threads excluded from the shear plane. Pin bolt and 3/4" dia pipe shall have 3/8" dia holes for a 1/8" dia galvanized cotter pin. Back clamp plate shall be furnished with a 3/4" dia hole for each pin bolt. An 1/8" dia hole for each pin bolt shall be field drilled through the pole after arm orientations have been approved by the Engineer.

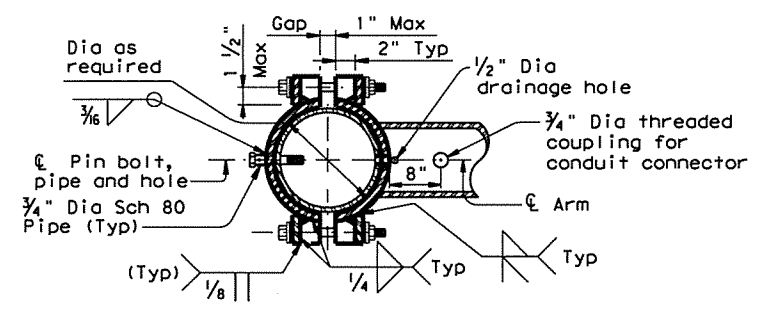
Texas Department of Transportation
Traffic Operations Division

STANDARD ASSEMBLY FOR TRAFFIC SIGNAL SUPPORT STRUCTURES MAST ARM CONNECTIONS MA-C-12

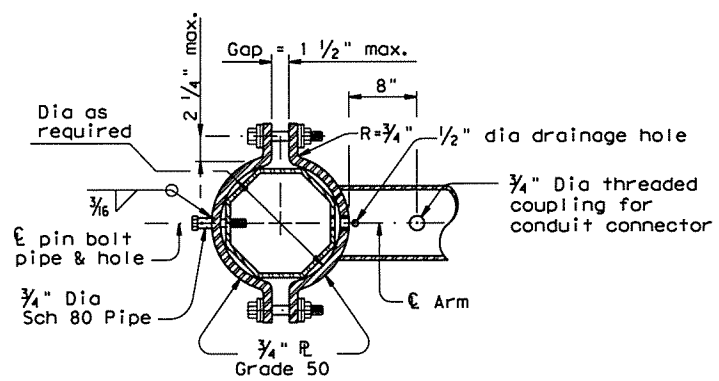
© TxDOT August 1995	DN: MS	CK: JSY	DN: JMF	CK: JSY
REVISIONS 3-96 5-99 1-12	CONT	SECT	JOB	HIGHWAY
	6459	93	001	I-610, etc.
	DIST	COUNTY	SHEET NO.	
	HOU	HARRIS, etc.	69	

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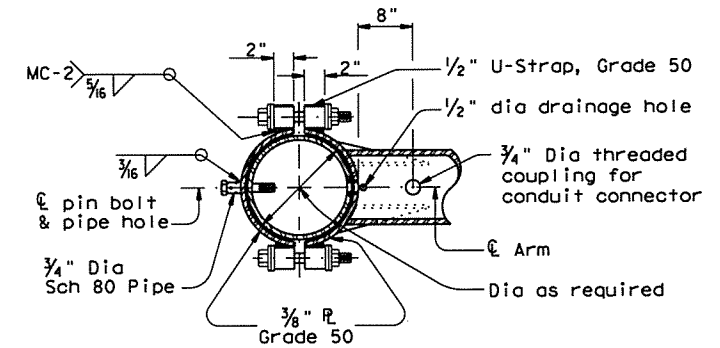
TABLE OF DIMENSIONS					
for ILSN Support Arm Clamp-on Details 1, 2 and 3					
ILSN ARM SIZE	A	F	CONN. BOLTS	PIN BOLTS	
	No.	No.	No.	Di.	Di.
3 in. dia Schedule 40 Pipe	in.	in.	ea.	in.	ea.
	10	4	4	3/4	2
				3/8	5/8



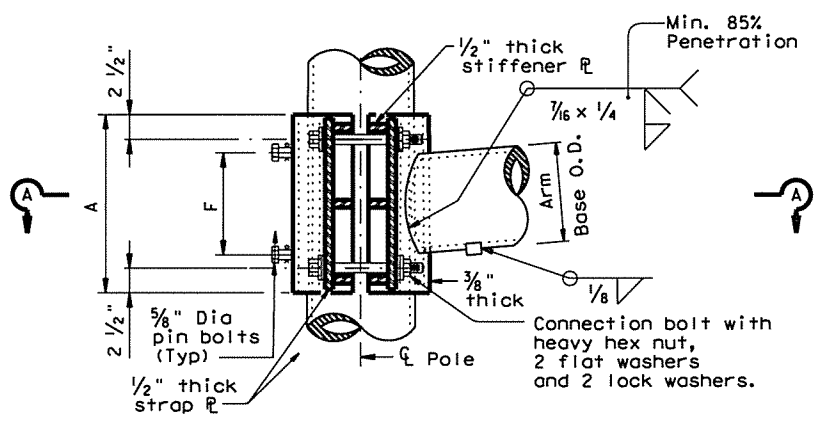
SECTION A-A



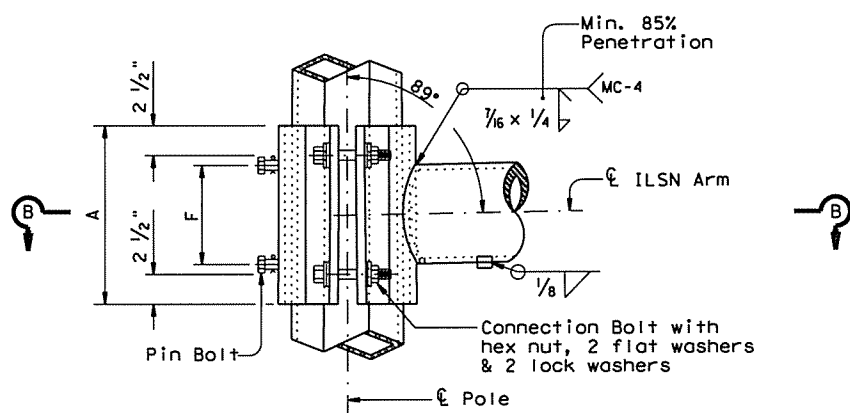
SECTION B-B



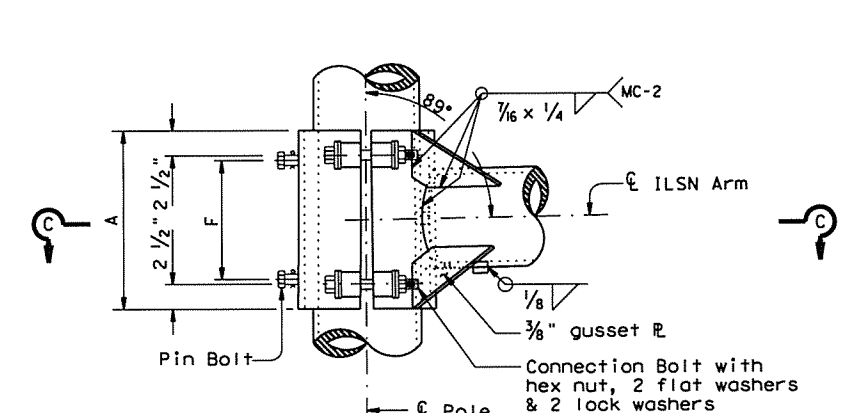
SECTION C-C



ILSN CLAMP-ON DETAIL 1



ILSN CLAMP-ON DETAIL 2



ILSN CLAMP-ON DETAIL 3

GENERAL NOTES:

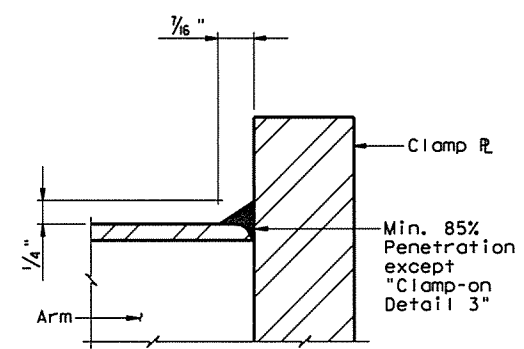
Clamp-on details shall be used for ILSN support arm assemblies. A 1 1/2 inch diameter hole shall be cut in the front clamp plate for wiring access. A matched hole shall be field drilled through the pole to provide wire access after arm is oriented. Deburr both holes.

Where duplicate parts occur on a detail, welds shown for one part shall apply to all similar parts on the details.

Pin bolts are required to prevent rotation of clamp-on arms under design wind forces.

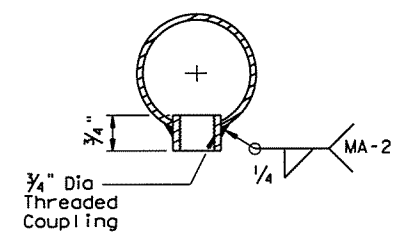
NOTE:

Pin bolts shall be A325 with threads excluded from the shear plane. Pin bolt and 3/4 inch diameter pipe shall have 3/16 inch diameter holes for a 1/8 inch diameter galvanized cotter pin. Back clamp plate shall be furnished with a 3/4 inch diameter hole for each pin bolt. An 1/16 inch diameter hole for each pin bolt shall be field drilled through the pole after arm orientations have been approved by the Engineer.



CLAMP-ON ARM

ARM BASE WELD DETAILS



ILSN ARM COUPLING DETAIL

Texas Department of Transportation
Traffic Operations Division

STANDARD ASSEMBLY FOR TRAFFIC SIGNAL SUPPORT STRUCTURES

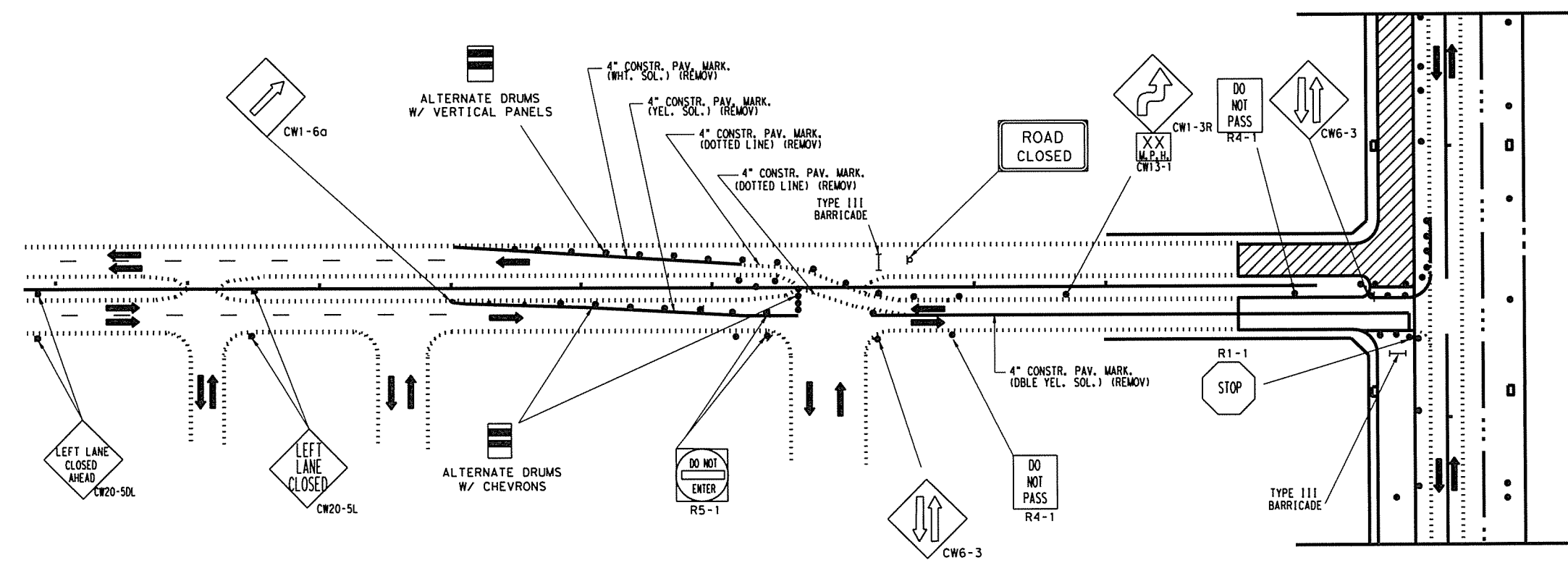
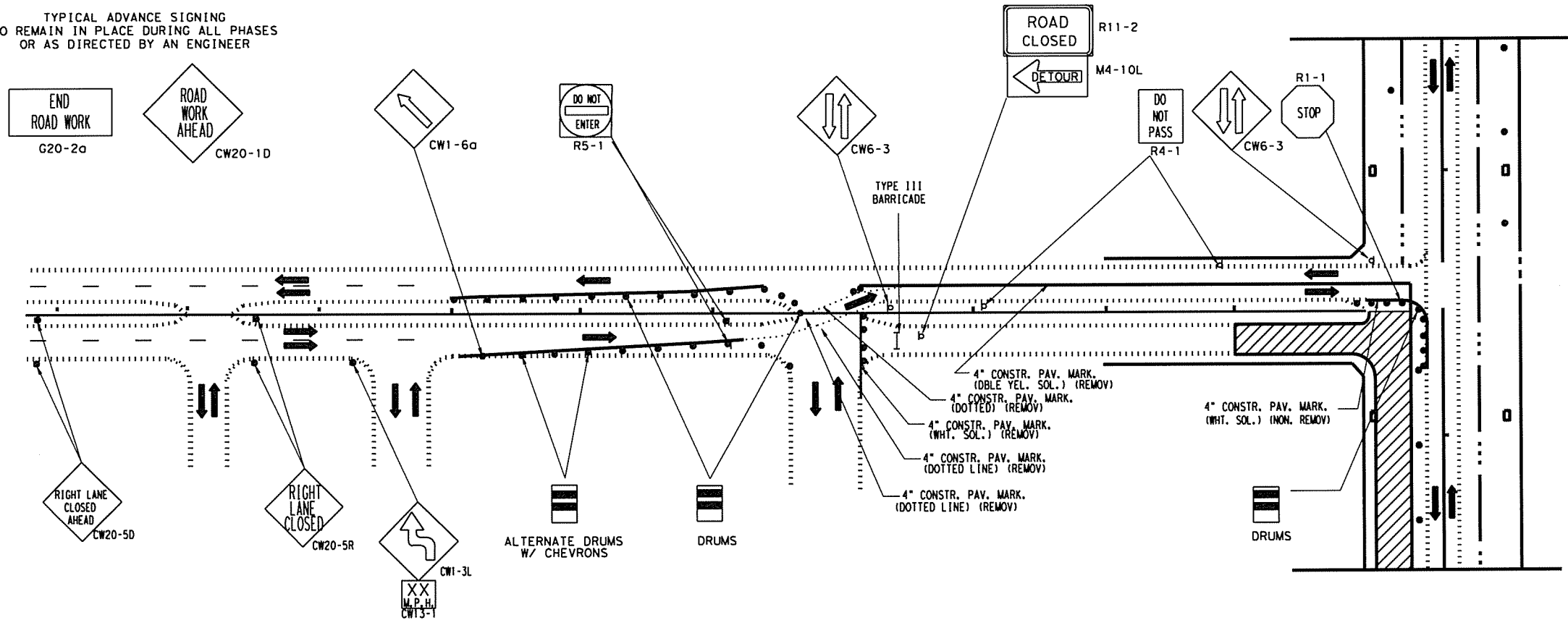
MAST-ARM CONNECTIONS

MA-C (ILSN) - 12

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REVISIONS					
5-96	1-12	CONT	SECT	JOB	HIGHWAY
		6459	93	001	I-610, etc.
		DIST		COUNTY	SHEET NO.
		HOU		HARRIS, etc.	70

DATE:
FILE:

TYPICAL ADVANCE SIGNING
TO REMAIN IN PLACE DURING ALL PHASES
OR AS DIRECTED BY AN ENGINEER



TYPICAL TRANSITION LENGTHS
AND
SUGGESTED MAXIMUM SPACING OF DEVICES

POSTED SPEED	FORMULA	MINIMUM DESIRABLE TAPER LENGTHS			SUGGESTED MAX. SPAC. OF DEVICE		MINIMUM SIGN SPACING X DISTANCE
		10' OFFSET	11' OFFSET	12' OFFSET	ON A TAPER	ON A TANGENT	
30	$L = \frac{WS^2}{60}$	150'	165'	180'	30'	60' - 75'	120'
35		205'	225'	245'	35'	70' - 90'	160'
40		265'	295'	320'	40'	80' - 100'	240'
45	$L = WS$	450'	495'	540'	45'	90' - 110'	320'
50		500'	550'	600'	50'	100' - 125'	400'
55		550'	605'	660'	55'	110' - 140'	500'
60		600'	660'	720'	60'	120' - 150'	Ⓞ 600'
65		650'	715'	780'	65'	130' - 165'	Ⓞ 700'
70	700'	770'	840'	70'	140' - 175'	Ⓞ 800'	

Ⓞ CONVENTIONAL ROADS ONLY
Ⓞ TAPER LENGTHS HAVE BEEN ROUNDED OFF.

CONSTRUCTION WARNING SIGN SPACING

POSTED SPEED (MPH)	"X" SIGN SPACINGS (FEET)
30 OR LESS	120
35	120
40	240
45	320
50	400
55	500
60	600
65	700
70	800

LEGEND

- CONSTRUCTION AREA
- OPEN TO TRAFFIC

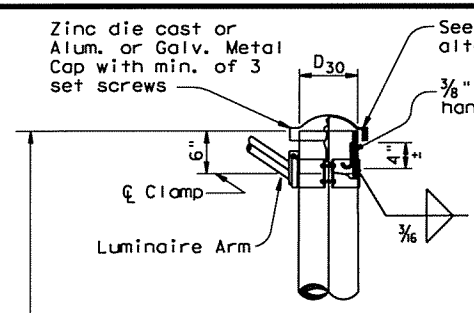
Texas Department of Transportation
Houston District

BOULEVARD CLOSURES

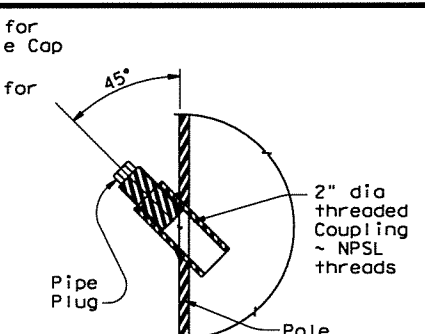
TCPTC 3050-96

FILE:	DN:	CK:	DW:	CK:
© TxDOT	DIST	FED REG	PROJECT NO.	
REVISIONS REV. 5/2006	HOU	6	RMC 6459-93-001	71
	COUNTY	CONTROL	SECT	JOB
	HARRIS, etc.	6459	93	001
				1-610, etc.

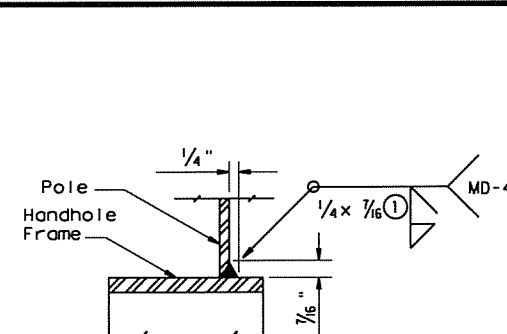
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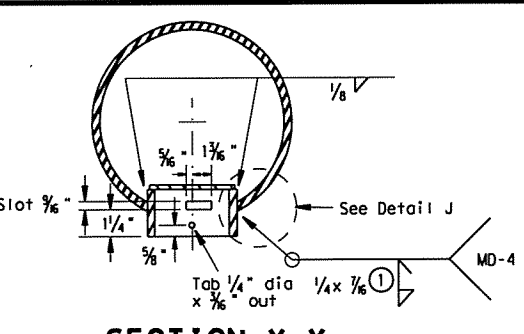
DETAIL A
(for pole with luminaire)



POLE COUPLING DETAIL

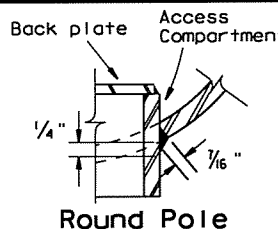


DETAIL G

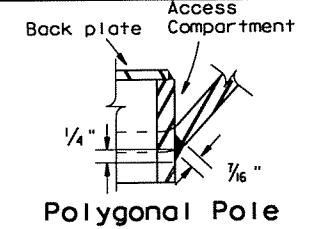


SECTION X-X

Opening for access compartment shall be no more than 1/16 inch wider than the access compartment itself.

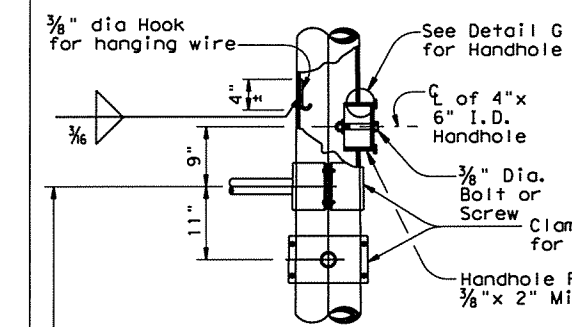


Round Pole

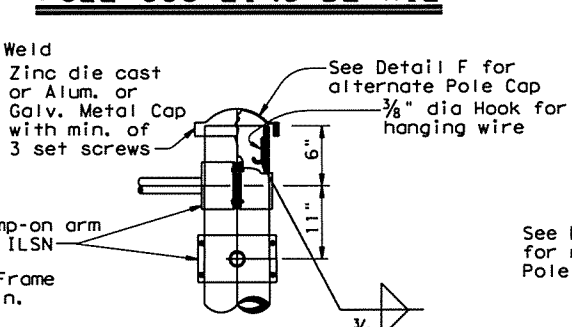


Polygonal Pole

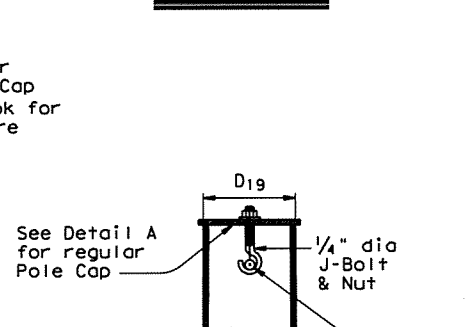
DETAIL J



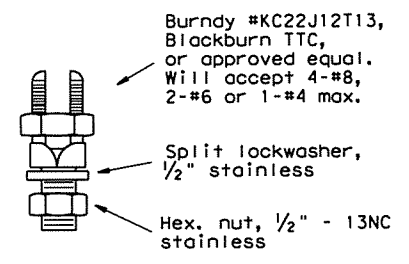
DETAIL B
(if ILSN applied)



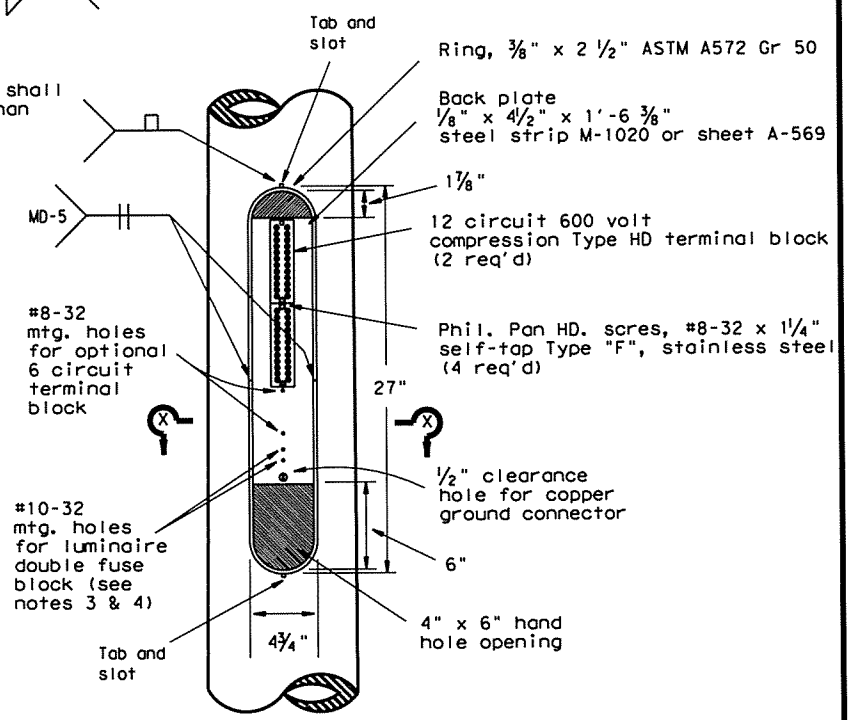
DETAIL C



SECTION Y-Y



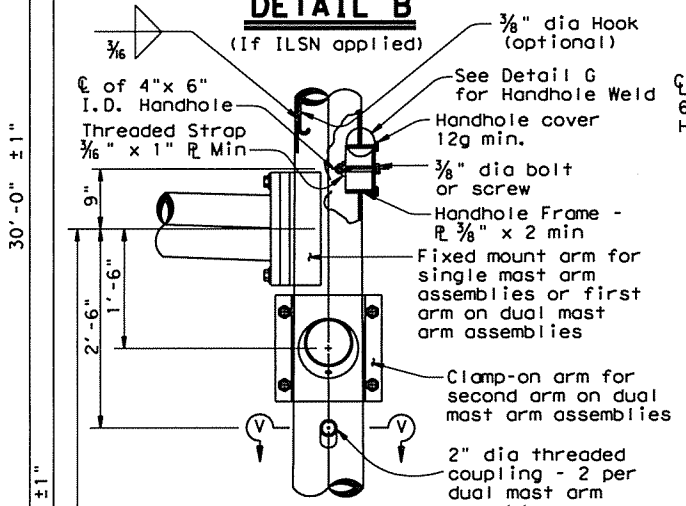
COPPER GROUND CONNECTOR



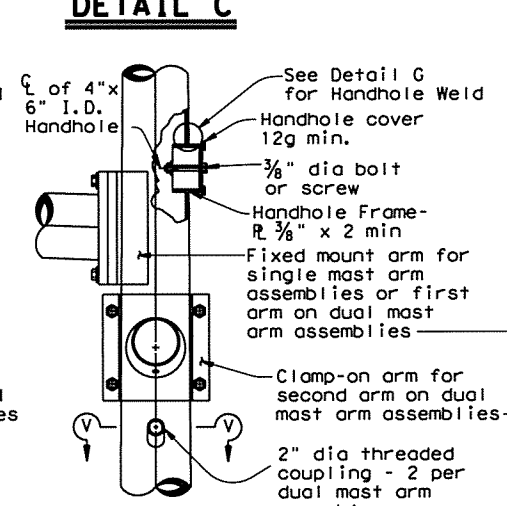
ACCESS COMPARTMENT

NOTES:

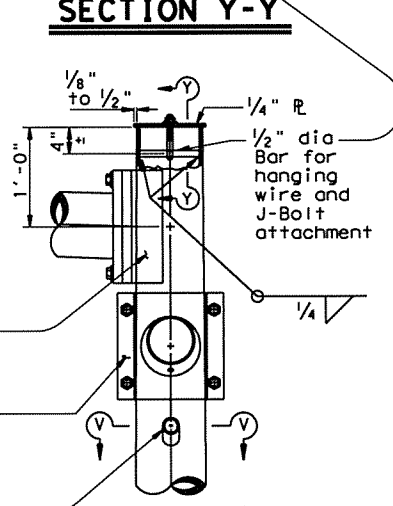
- The cover shall be one piece formed from ABS plastic, shall be a pearl gray color, and shall be suitable for exposure to harsh sunlight and extreme weather. Cover shall latch with two screw latches and shall fit tightly to the enclosure ring to create a rainproof seal. Latch screws shall be 1/4-20 stainless flat socket head screws with tamper proof feature.
- The pole manufacturer shall provide with each pole a separate kit consisting of: one cover with two latching assemblies, two terminal strips (Marathon #985GP12CU or approved equal), four #8-32 x 1 1/4 self tapping type "F" stainless steel pan head screws, and one ground connector (Blackburn TTC, Burndy KC22J12T13, or Ilco SSS-5). The traffic signal contractor shall install the kit items in the field.
- The screw hole spacing on the enclosure back plate shall be for two Marathon #985GP12 terminal strips, one Marathon #985GP06CU terminal strip, and one Bussmann #BM6032B fuse block.
- Install one Bussmann #BM6032B, Littelfuse #L60030M-2C, or Ferraz-Shawmut #30352 fuse block for poles where luminaires are to be installed.



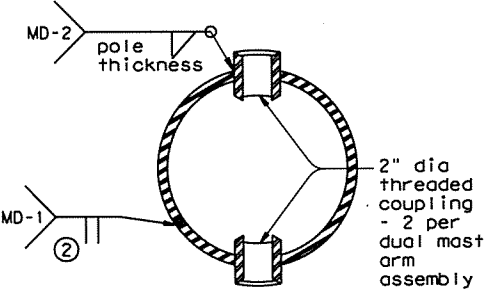
DETAIL D
(for 30' pole with luminaire and ILSN sign)



DETAIL E
(for 24' pole with ILSN sign and no luminaire)

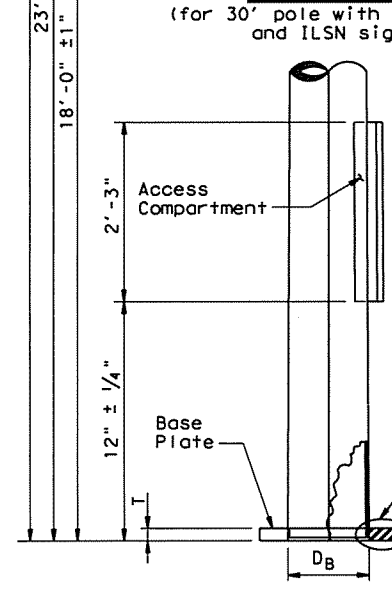


DETAIL F
(for 19' pole with no ILSN sign and no luminaire)

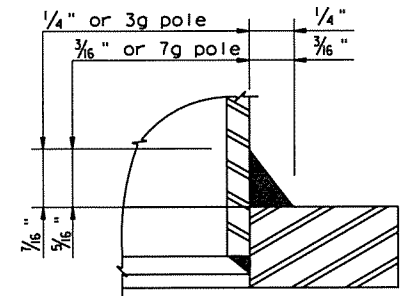


SECTION V-V

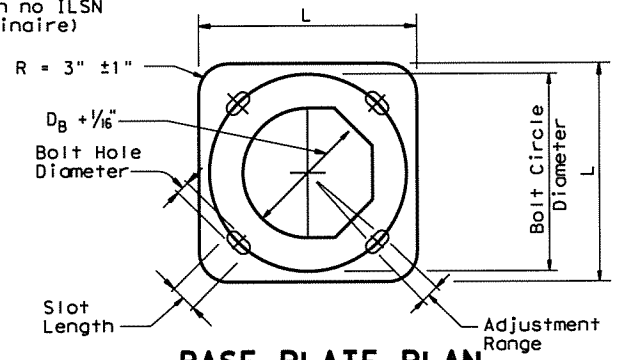
Anchor Bolt Diameter	Bolt Hole Diameter	Slot Length	Bolt Circle Diameter	Base R Dim. L x T	Adjust. Range
1 1/2"	1 3/4"	3 1/2"	17"	18" x 1 1/2"	13.4°
1 3/4"	2"	4"	19"	20" x 1 3/4"	13.5°
2"	2 1/4"	4 1/2"	21"	22" x 2"	13.6°
2 1/4"	2 1/2"	5"	23"	24" x 2 1/4"	13.7°



POLE ELEVATION



DETAIL H



BASE PLATE PLAN

- ① 85% Min. penetration
- ② 60% Min. penetration 100% penetration within 6" of circumferential base welds.

Texas Department of Transportation
 Traffic Operations Division

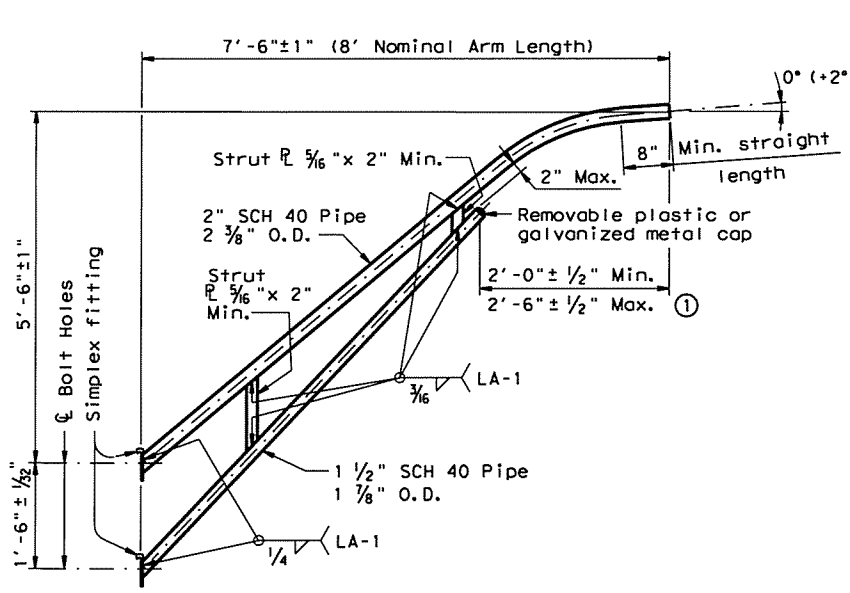
TRAFFIC SIGNAL
 SUPPORT STRUCTURES
 MAST ARM POLE DETAILS

MA-D-12

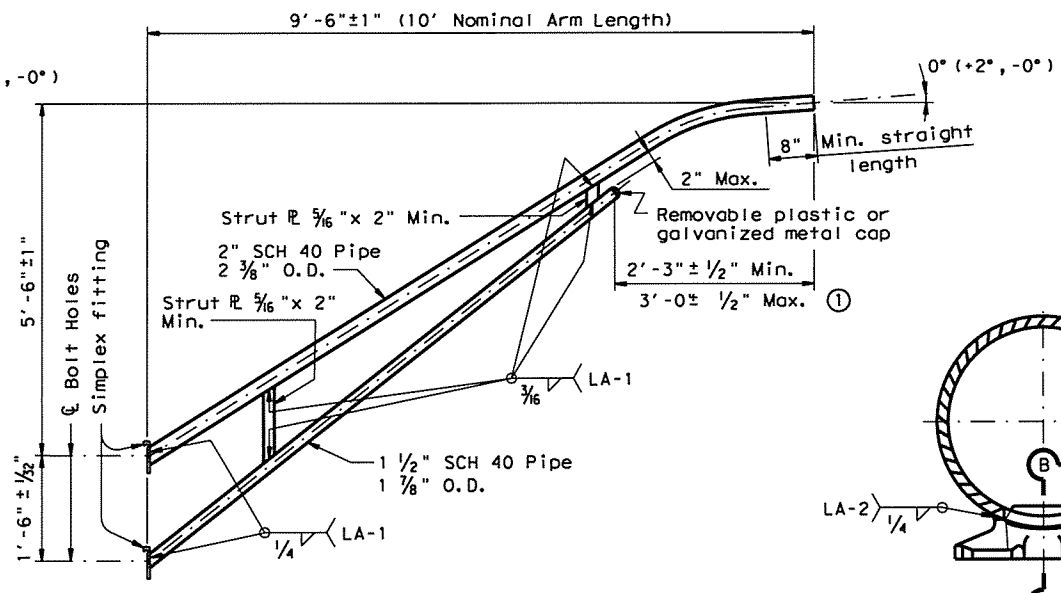
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REVISIONS		CONT	SECT	JOB	HIGHWAY
1-12		6459	93	001	1-610, etc.
		DIST	COUNTY	SHEET NO.	
		HOU	HARRIS, etc.	72	

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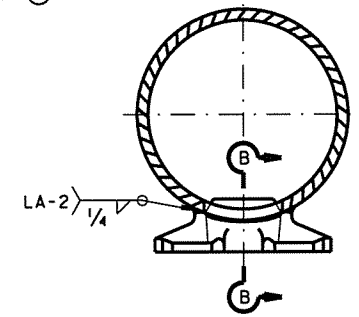
8-FOOT LUMINAIRE ARM



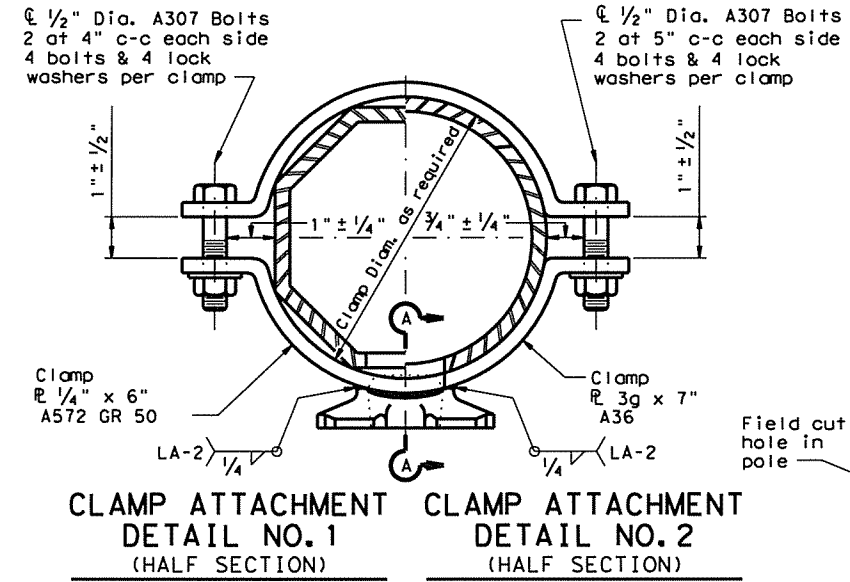
10-FOOT LUMINAIRE ARM

MATERIALS	
Pole or Arm Simplex	ASTM A27 Gr. 65-35 or A148 Gr. 80-50, A576 Gr. 1021 (3), or A36 (Arm only)
Arm Pipes	ASTM A53 Gr. B, A501, A1008 HSLAS-F Gr. 50 (4), or A1011 HSLAS-F Gr. 50 (4)
Arm Strut Plates (2)	ASTM A36, A572 Gr. 50 (4), or A588
Misc.	ASTM designations as noted

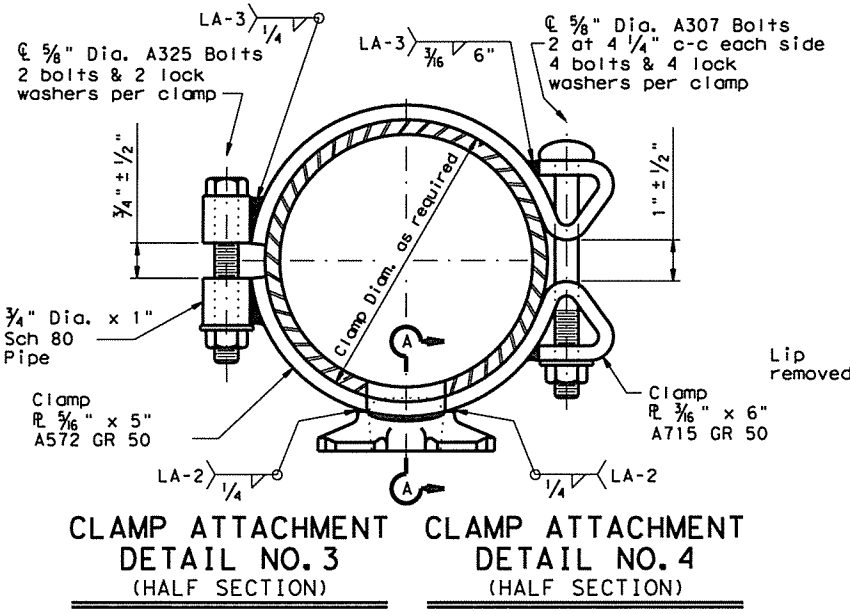
- ① Dimensional limits are given to show acceptable variation in design. All of a Fabricator's production of a particular arm length shall have the same dimensions within specified tolerances.
- ② Any of the materials listed for plates may be used where the drawings do not specify a particular ASTM designation.
- ③ A576 must be suitable for forging and also meet minimum tensile strength of 65 ksi, minimum yield of 35 ksi, and elongation in 2 inches of 22 percent.
- ④ ASTM A572, A1008 HSLAS-F, and A1011 HSLAS-F may have higher yield strengths but shall not have less elongation than the grade indicated.



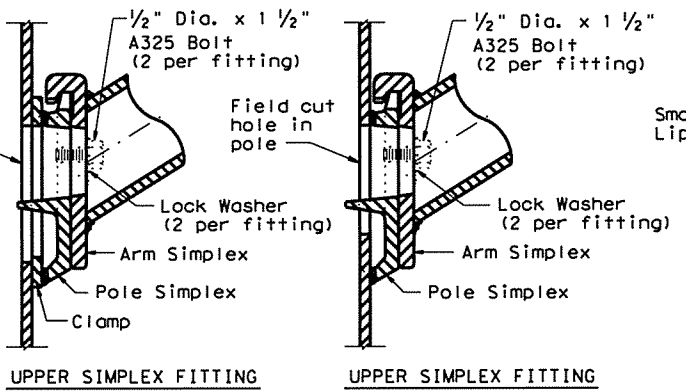
DIRECT ATTACHMENT DETAIL



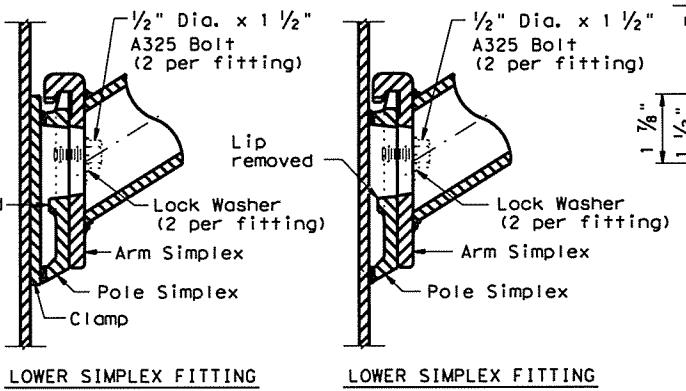
CLAMP ATTACHMENT DETAIL NO. 1 (HALF SECTION) CLAMP ATTACHMENT DETAIL NO. 2 (HALF SECTION)



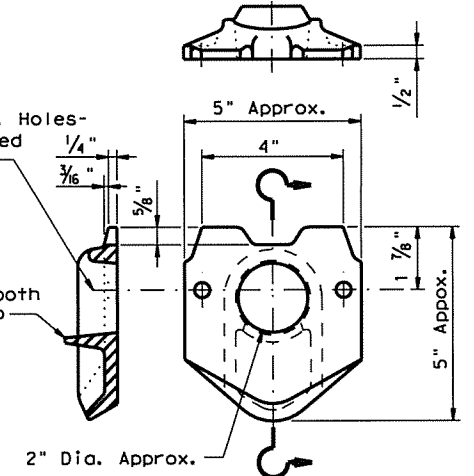
CLAMP ATTACHMENT DETAIL NO. 3 (HALF SECTION) CLAMP ATTACHMENT DETAIL NO. 4 (HALF SECTION)



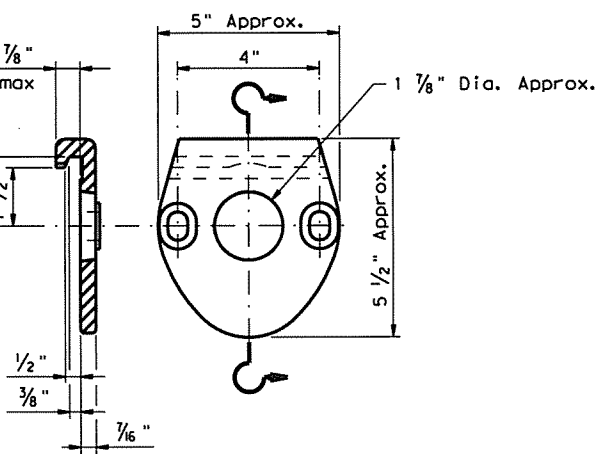
UPPER SIMPLEX FITTING



LOWER SIMPLEX FITTING



POLE SIMPLEX DETAIL



ARM SIMPLEX DETAIL

GENERAL NOTES:

Design conforms to 1994 AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals and Interim Revisions thereto. Design Wind Speed equals 90 mph plus a 1.3 gust factor. Arms are designed to support a 60 lb. luminaire having an effective projected area (actual area times drag coefficient) of 1.6 sq. ft.

Materials and fabrication shall be in accordance with Item 686, "Traffic Signal Pole Assemblies (Steel)" and with the details, dimensions, and weld procedures shown herein. Weld references call for preapproved weld procedures which the Fabricator must obtain prior to fabrication. In the absence of specified Fabricator tolerances, dimensions shall be within the tolerances generally obtainable in normal fabrication practice.

Unless otherwise noted, all parts shall be galvanized after fabrication in accordance with Item 445, "Galvanizing".

Deviation from the details and dimensions shown herein require submission of shop drawings in accordance with Item 441, "Steel Structures". Alternate designs are not acceptable.

Each pole simplex fitting shall be supplied with 2 ASTM A325 bolts and 2 lock washers of the size specified. The bolts and lock washers shall be secured to the pole with the other hardware items called for in the plans. When clamp attachment is specified, the Fabricator shall ship the clamp assembly securely attached to the pole at the location shown on the plans.

If clamp assemblies are ordered without poles, the Fabricator shall ship one upper and one lower clamp assembly together in a single package, including all nuts and washers required for the clamps and simplex fittings.

STANDARD ASSEMBLY DRAWINGS FOR LUMINAIRE SUPPORT STRUCTURES

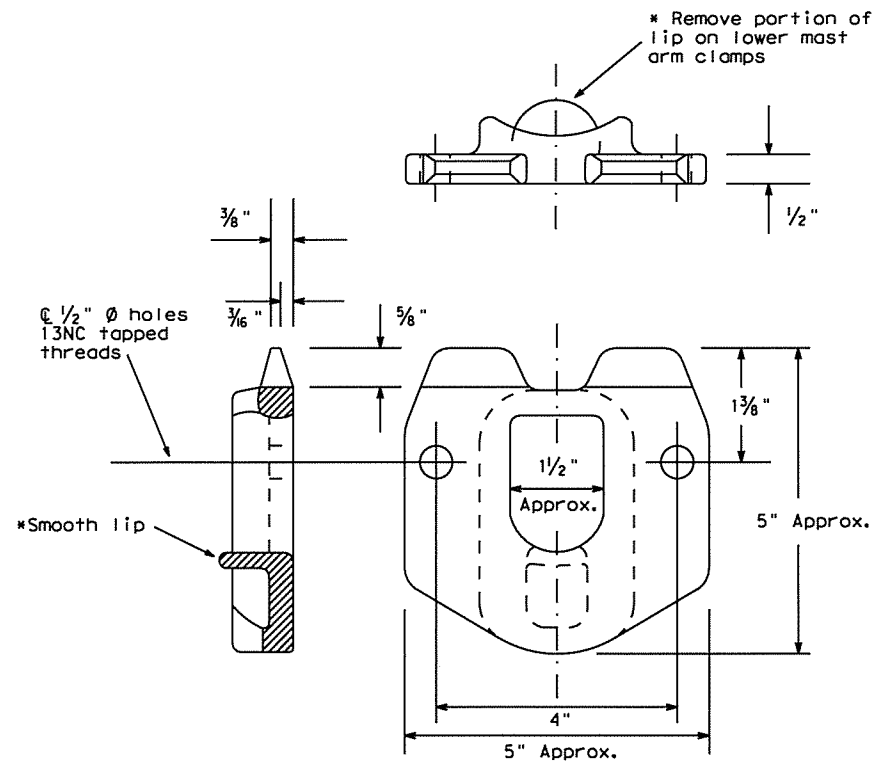
ARM DETAILS

LUM-A-12

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REVISIONS		CONT	SECT	JOB	HIGHWAY
5-96		6459	93	001	I-610, etc.
1-99		DIST	COUNTY		SHEET NO.
1-12		HOU	HARRIS, etc.		74

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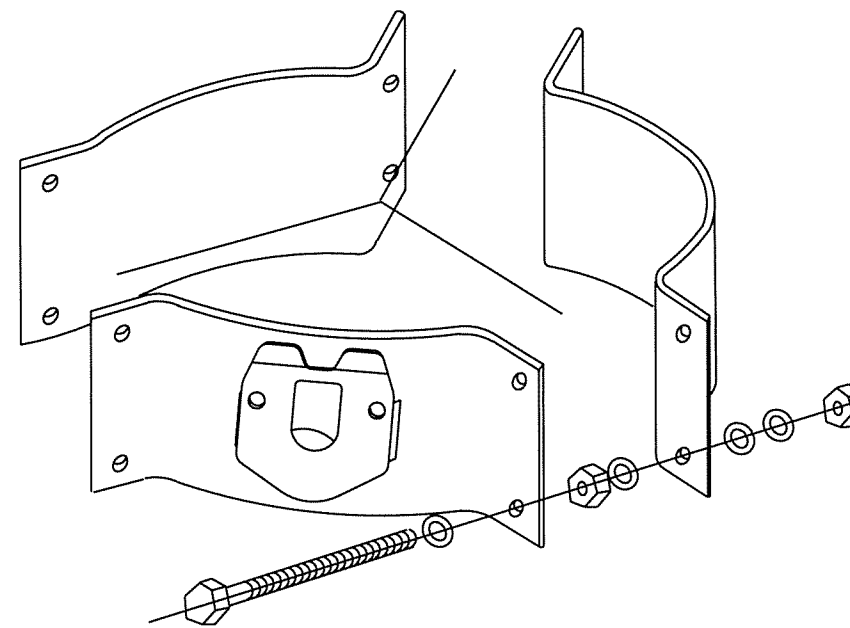
POLE SIMPLEX DETAILS

OTHER MATERIALS:

1. Pole simplex shall be ASTM A27 GR65-35 or A148 GR80-50 or A576 GR1021. ASTM A576 must be suitable for forging and also meet minimum tensile of 65ksi, minimum yield of 35ksi, and a minimum elongation of 22 percent in 2 inches.
2. Welded tabs and backplates shall be ASTM A-36 steel or better.
3. Nylon insert locknuts shall conform to ASTM A563.

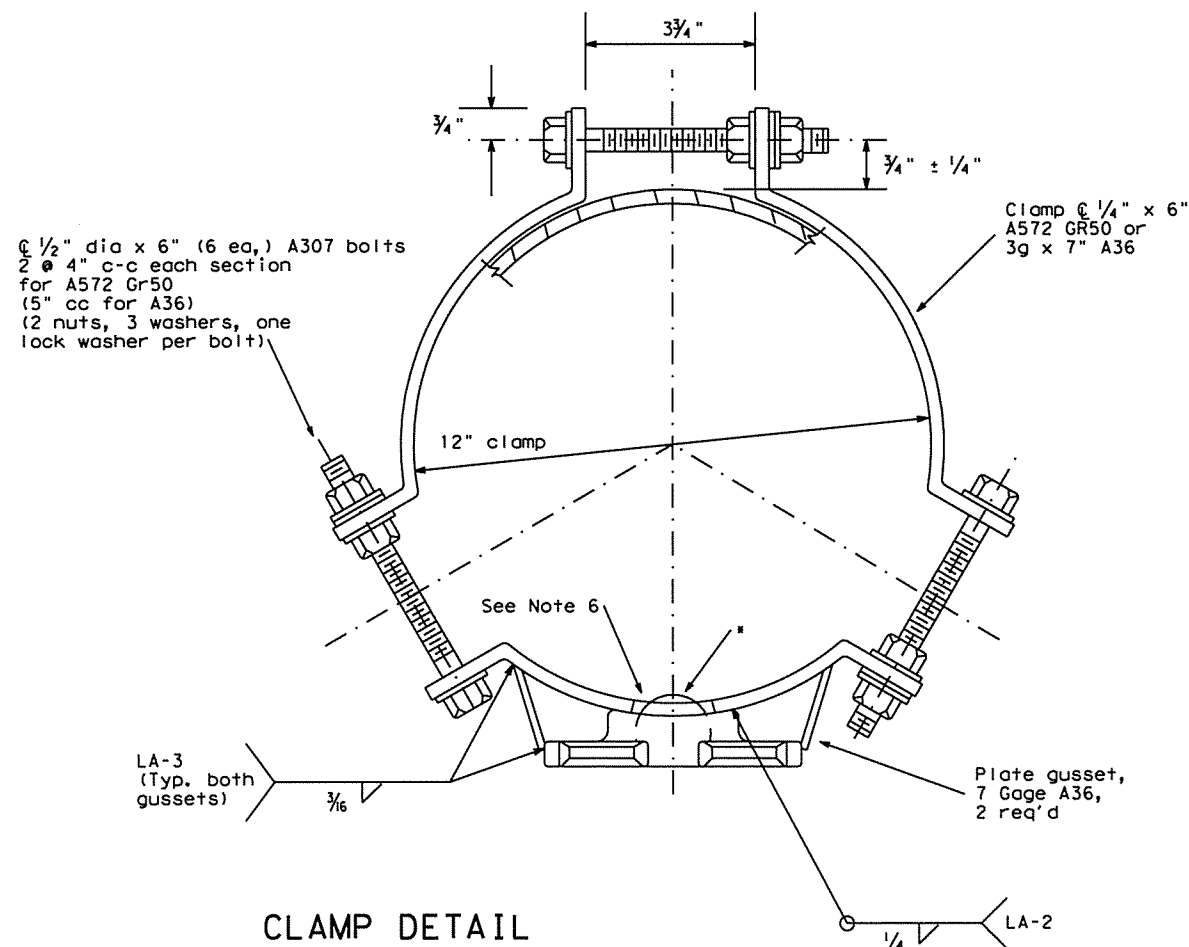
GENERAL NOTES:

1. Materials and fabrication shall be in accordance with Standard Sheet "MA-C" and with the details, dimensions, and weld procedures shown herein. Weld references call for preapproved weld procedures which the Fabricator must obtain prior to fabrication. In the absence of specified fabrication tolerances, dimensions shall be within the tolerances generally obtainable in normal fabrication practice.
2. All parts shall be galvanized after fabrication in accordance with Item 445, "Galvanizing". The throat of the Simplex shall be made free of all rough or sharp edges resulting from the galvanizing process.
3. Each simplex fitting shall be supplied with 2 ASTM A325 bolts, 1/2 in. X 1 1/2 in. and 2 lock washers. The bolts and lock washers shall be secured to the clamp with the other hardware items. The Fabricator shall ship clamp assembly together in a single package, including all bolts, nuts, and washers required for the clamp and simplex fitting.
4. Design conforms to 1994 AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals" and interim revisions thereto. Design Wind Speed equals 80 mph plus a 1.3 gust factor. Clamps are designed to support a 60 lb. luminaire having an effective projected area (actual area times drag coefficient) of 1.6 sq. ft., 12 ft. maximum arm length.
5. Each assembly shall consist of one upper piece simplex fitting having a smooth lip and one lower piece simplex fitting with the lip removed.
6. Approximately 2 in. diameter hole in upper mast arm clamp.



PROJECTION

For 8.9 - 12 inch diameter Signal Poles
(Two req'd for each mast arm)



CLAMP DETAIL

Texas Department of Transportation
Traffic Operations Division

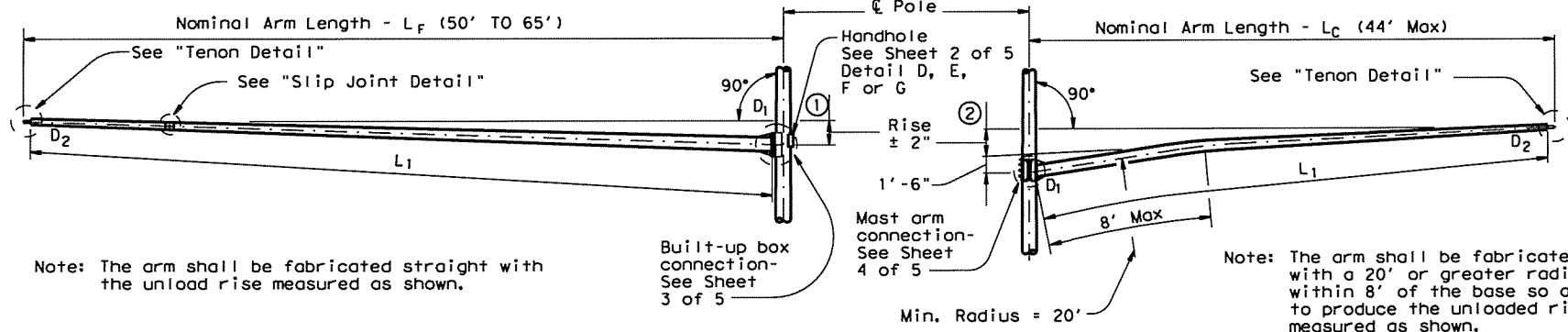
CLAMP ON FITTING ASSEMBLY FOR LUMINAIRE MAST ARM

CFA-12

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11-99	CONT	SECT	JOB	HIGHWAY
1-12	6459	93	001	I-610, etc.
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	HOU	HARRIS, etc.	75	

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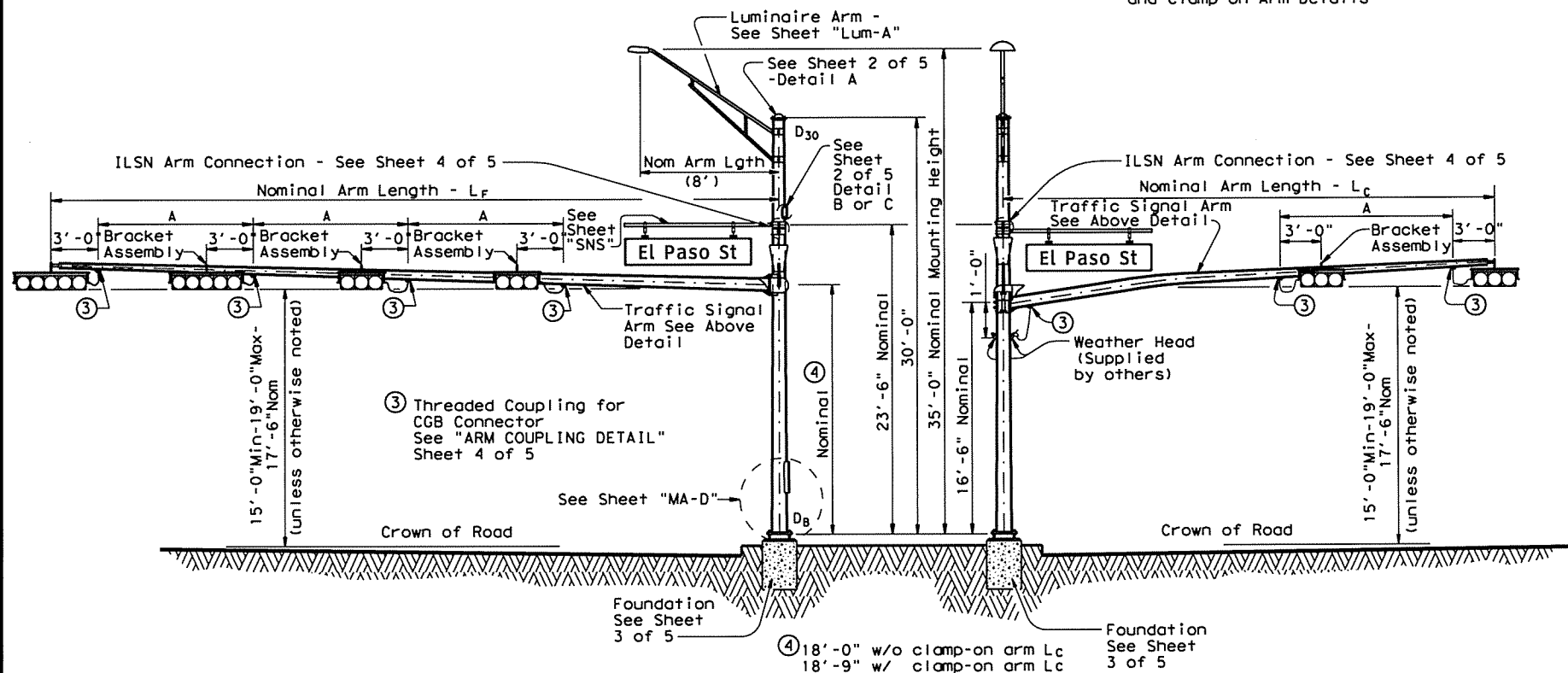


FIXED MOUNT TRAFFIC SIGNAL ARM

① See Sheet 3 of 5 for Arm Rise

CLAMP-ON TRAFFIC SIGNAL ARM (IF REQUIRED)

② See Sheet 4 of 5 for Arm Rise and Clamp-on Arm Details



ELEVATION

(Showing fixed mount arm)

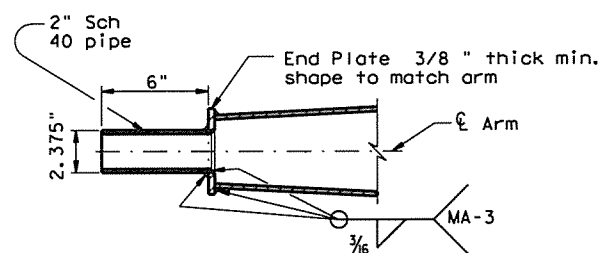
STRUCTURE ASSEMBLY

ELEVATION

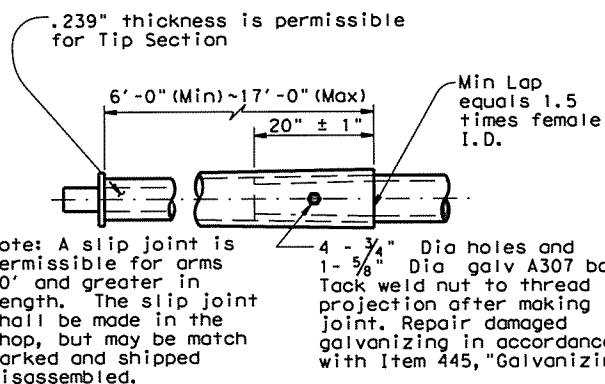
(Showing clamp-on arm)

TABLE OF DIMENSIONS "A"

Arm Length	24'	28'	32'	36'	40'	44'	50'	55'	60'	65'
Arm Type II	10'	11'	12'	13'						
Arm Type III			10'	11'	12'	12'				
Arm Type IV							12'	12'	12'	12'



TENON DETAIL



SLIP JOINT DETAIL (FIXED MOUNT ARM)

GENERAL NOTES:

Design conforms to 1994 AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals and Interim Specifications thereto. Design Wind Speed can be either 100 mph or 80 mph plus a 1.3 gust factor. If clamp-on traffic signal is required, designs are based on an arm included angle of 90 degrees or more. Angles of less than approximately 75 degrees will require a special design.

Poles are designed to support one 8'-0" luminaire arm, two 9'-0" internally lighted street name (ILSN) signs and two traffic signal arms with limited length combinations.

Each arm with its related attachment is shown below

Arm	Equivalent DL ⑤	WL EPA ⑤⑥
8' Luminaire Arm	Luminaire 60 lbs	1.6 sq ft
9' ILSN Arm	Sign 85 lbs	11.5 sq ft
50' to 65' Fixed Mount Arm	Signal Loads 310 lbs	52 sq ft
Up to 44' Clamp-on Arm	Signal Loads 180 lbs	32.4 sq ft

⑤ Equivalent dead load plus horizontal wind load applied at the end of arm except ILSN arm, which applied 4.5' from the centerline of the pole.

⑥ Effective projected area (actual area times drag coefficient) for the application of horizontal wind load.

Except as noted in Sheet 1 thru 5 of 5, other details not covered shall refer to Standard Sheet "MA-D" for pole details, "LUM-A" for luminaire arm and connection details, "SNS" for internally lighted street name sign details, and "TS-FD" for anchor bolt and foundation details.

Fabrication shall be in accordance with Item 686, "Traffic Signal Pole Assemblies (Steel)" and with the details, dimensions, and weld procedures shown herein. Weld references call for preapproved weld procedures which the Fabricator must obtain prior to fabrication. Material, fabrication tolerances, and shipping practices shall also meet the requirements of this sheet and Item 686, "Traffic Signal Pole Assemblies (Steel)".

Unless otherwise noted, all parts shall be galvanized in accordance with Item 445, "Galvanizing" after fabrication.

Deviations from the details and dimensions shown herein require submission of shop drawings in accordance with the Item 441, "Steel Structures". Alternate designs are not acceptable.

Installation of damping plate for the long mast arm is not recommended.

Provision of the bracket assembly used to support the traffic signal heads shall be under the direction of the Engineer for approval.

Design also conforms to NCHRP Report 412 for fatigue resistance except that there are no stiffeners at the base plate. TxDOT is conducting tests to determine if stiffeners at the base plate will or will not result in optimal performance; depending upon the results of the tests, poles may need a retrofit to ensure optimal fatigue performance.

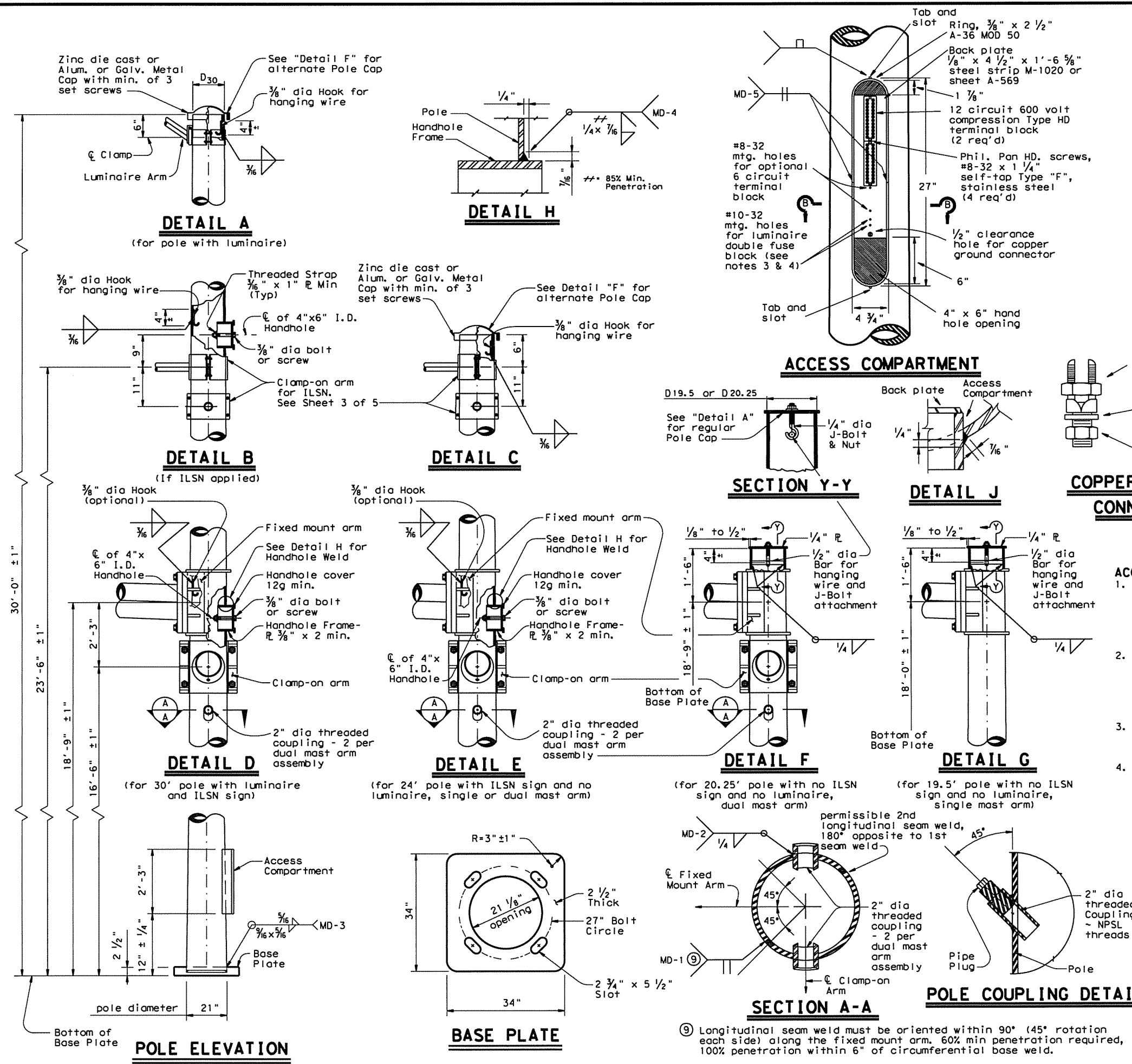
Texas Department of Transportation
Traffic Operations Division

TRAFFIC SIGNAL SUPPORT STRUCTURES
LONG MAST ARM ASSEMBLY
 (50 TO 65 FT)
 (80 AND 100 MPH WIND ZONE)
LMA(1)-12

Sheet 1 of 5

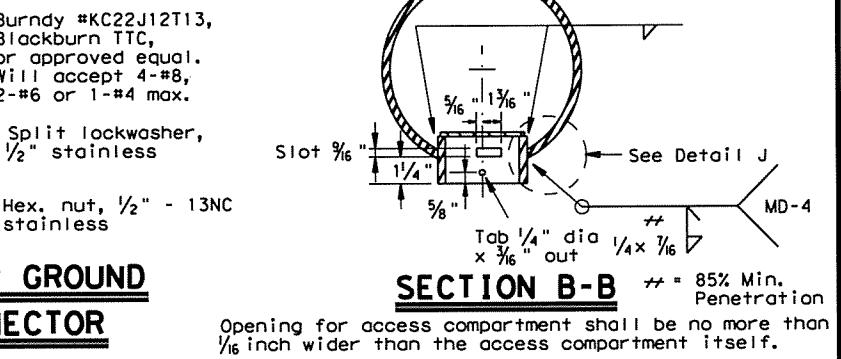
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REVISIONS					
4-20-01	1-12	CONT	SECT	JOB	HIGHWAY
		6459	93	001	I-610, etc.
		DIST		COUNTY	SHEET NO.
		HOU		HARRIS, etc.	76

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MATERIALS	
Round Shafts or Polygonal Shafts (7)	ASTM A595 Gr. A, A588, A1008 HSLAS Gr. 50 Class 2, A1011 HSLAS Gr. 50 Class 2, A572 Gr. 50 or A1011 SS Gr. 50 (8)
Plates (7)	ASTM A36, A588, or A572 Gr. 50
Connection Bolts	ASTM A325, or A449 except where noted
Pin Bolts	ASTM A325
Pipe (7)	ASTM A53 Gr. B, A501, A1008 HSLAS-F Gr. 50, A1011 HSLAS-F Gr. 50
Misc. Hardware	Galvanized steel or stainless steel or as noted

- (7) ASTM A572, A1008 HSLAS, A1011 HSLAS, A1008 HSLAS-F, A1011 HSLAS-F, or A1011 SS may have higher yield strengths but shall not have less elongation than the grade indicated.
- (8) ASTM A1011 SS Gr. 50 shall also have a minimum elongation of 18 percent in 8 inches or 23 percent in 2 inches. Material thickness in excess of those stipulated under A1011 SS will be acceptable providing the material meets all other A1011 SS requirements and the requirements of this item.



- ACCESS COMPARTMENT NOTES:**
- The cover shall be one piece formed from ABS plastic, shall be a pearl gray color, and shall be suitable for exposure to harsh sunlight and extreme weather. Cover shall latch with two screw latches and shall fit tightly to the enclosure ring to create a rainproof seal. Latch screws shall be 1/4-20 stainless flat socket head screws with tamper proof feature.
 - The pole manufacturer shall provide with each pole a separate kit consisting of: one cover with two latching assemblies, two terminal strips (Marathon #985GP12CU or approved equal), four #8-32 x 1 1/4" self tapping type "F" stainless steel pan head screws, and one ground connector (Blackburn TTC, Burndy KC22J12T13, or Ilco SSS-5). The traffic signal contractor shall install the kit items in the field.
 - The screw hole spacing on the enclosure back plate shall be for two Marathon #985GP12 terminal strips, one Marathon #985GP06CU terminal strip, and one Bussmann #BM6032B fuse block.
 - Install one Bussmann #BM6032B, Littelfuse #L60030M-2C, or Ferraz-Shawmut #30352 fuse block for poles where luminaires are to be installed.

(9) Longitudinal seam weld must be oriented within 90° (45° rotation each side) along the fixed mount arm. 60% min penetration required, 100% penetration within 6" of circumferential base weld.

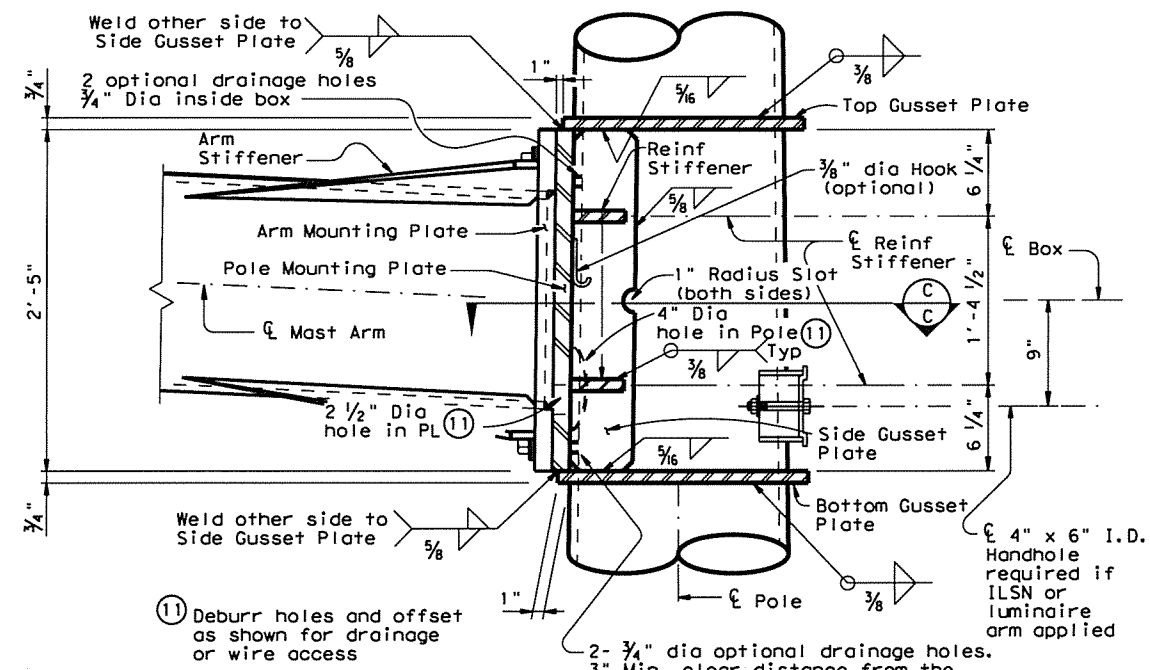
Texas Department of Transportation
 Traffic Operations Division
TRAFFIC SIGNAL SUPPORT STRUCTURES
LONG MAST ARM ASSEMBLY
 (50 TO 65 FT)
 (80 AND 100 MPH WIND ZONE)
LMA(2)-12

Sheet 2 of 5

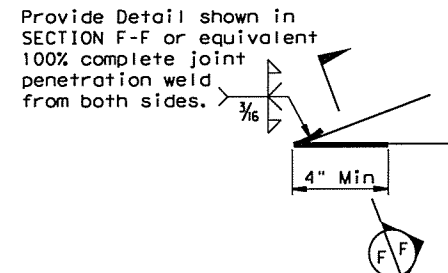
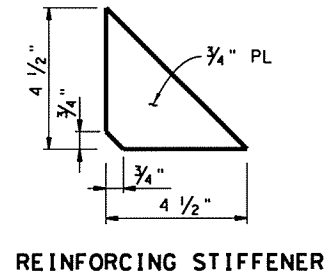
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REVISIONS				
6459	93	001	1-610, etc.	
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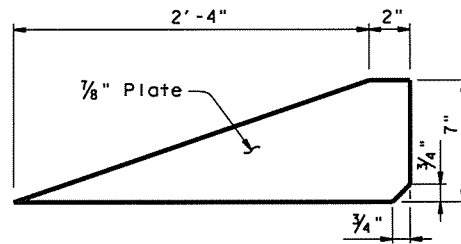
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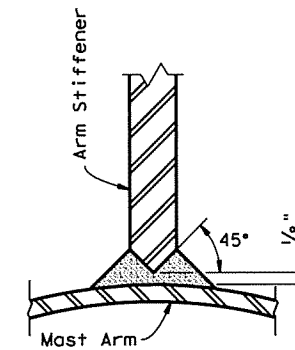
BUILT-UP BOX CONNECTION



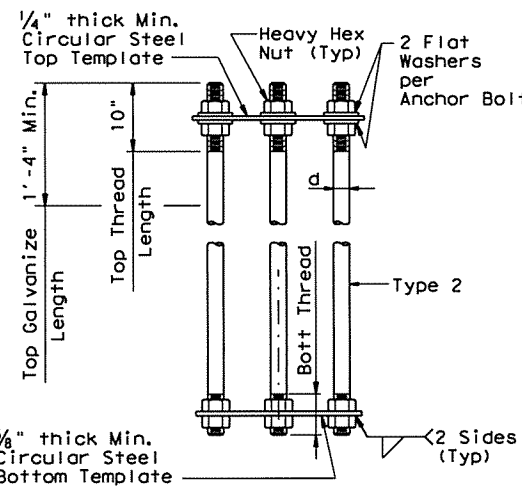
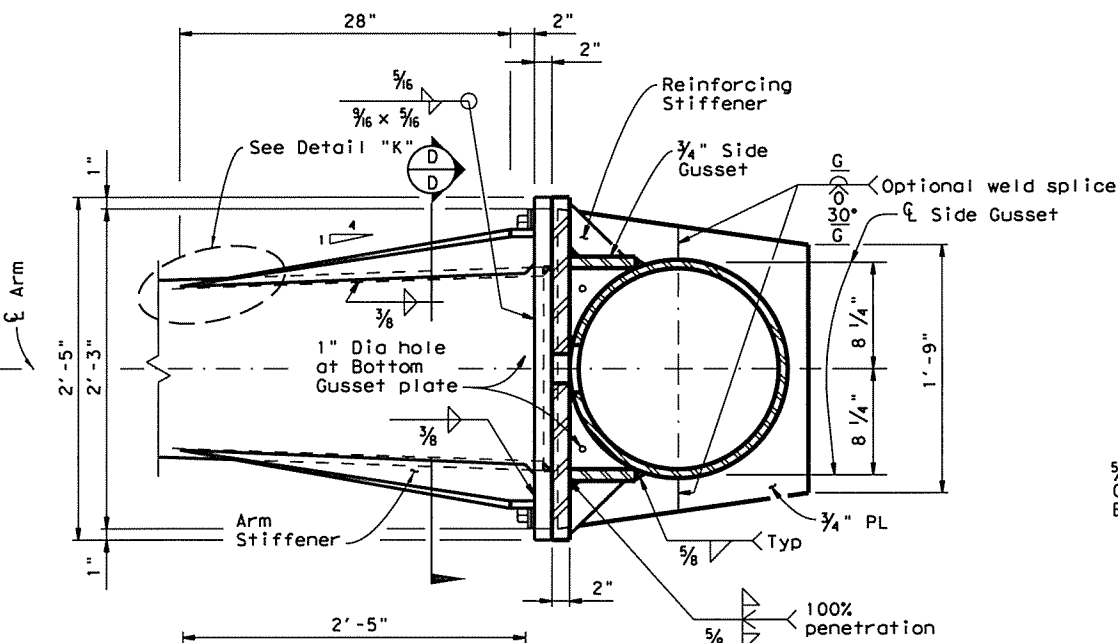
Only 4" length at tip of Arm Stiffener requires a complete joint penetration weld. Smooth weld radius to connect Stiffener. Only a fillet weld is required for the remaining weld length.



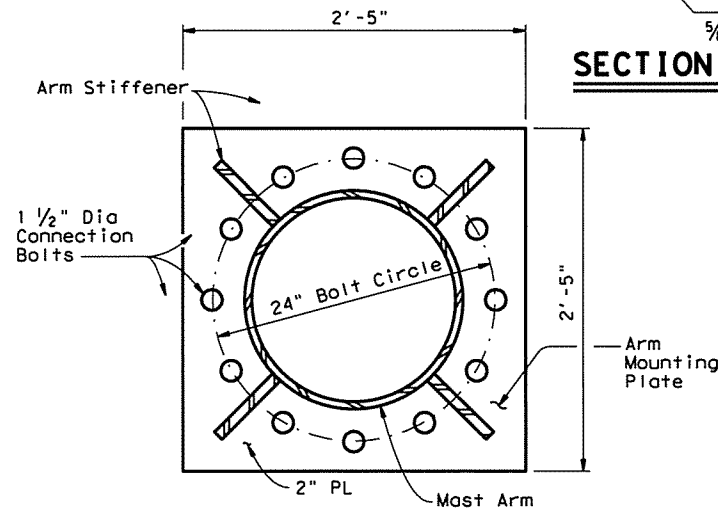
DETAIL "K"



SECTION F-F



TEMPLATE DETAIL



FDN TYPE	DRILLED SHAFT DIA	REINFORCING STEEL		DRILLED SHAFT LENGTH-ft (16), (17), (18)			ANCHOR BOLT DESIGN (14)			FOUNDATION DESIGN LOAD (15)		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			
48-A	48"	20 #9	#4 at 6"	21.9	19.5	14.7	2 1/2"	55	27"	2	490	10	50' to 65' Mast arm assembly.

SEE SHEET "TS-FD" FOR ADDITIONAL DETAILS.

- (14) Anchor bolt design develops the foundation capacity given under Foundation Design Loads.
- (15) Foundation Design Loads are the allowable moments and shears at the base of the structure.
- (16) Field Penetrometer readings at a depth of approximately 3 to 5 feet may be used to adjust shaft lengths.
- (17) If rock is encountered, the Drilled Shaft shall extend a minimum of two diameters into solid rock.
- (18) Decimal lengths in Design Table are to allow interpolation for other penetrometer values. Round to nearest foot for entry into Summary Table.

Fixed Mount Arm L F	ROUND POLES (13)					Foundation Type
	D _B	D _{19.5}	D _{20.25}	D ₂₄	D ₃₀	
ft.	in.	in.	in.	in.	(12)thk in.	
50', 55', 60', 65'	21.0	18.2	17.6	16.8	.3125	48-A

Fixed Mount Arm L F	ROUND ARMS (13)				
	L ₁	D ₁	D ₂	(12)thk	Rise
ft.	ft.	in.	in.	in.	
50	49	18.5	11.7	.3125	3'-3"
55	54	18.5	11.0	.3125	3'-7"
60	59	18.5	10.3	.3125	3'-11"
65	64	18.5	9.6	.3125	4'-4"

- D_B = Pole Base O.D.
- D_{19.5} = Pole Top O.D. with no Luminaire and no ILSN (single mast arm)
- D_{20.25} = Pole Top O.D. with no Luminaire and no ILSN (dual mast arm)
- D₂₄ = Pole Top O.D. with ILSN w/out Luminaire
- D₃₀ = Pole Top O.D. with Luminaire
- D₁ = Arm Base O.D.
- D₂ = Arm End O.D.
- L₁ = Shaft Length
- L F = Fixed Arm Length

- (12) Thickness shown is minimum, thicker materials may be used.
- (13) Shaft profile 16-sided or 18-sided is considered to be equivalent to round section.

GENERAL NOTES:

Built-up Box Connection: For the welded arm-to-pole connection as a built-up box configuration illustrated here is an example only, fabricators are required to submit a shop drawing of box connection for approval. The drawing shall specify the details of each box element, welds of arm-to-pole connection, arm-to-plate socket connection, and arm rise creation. Specify the proper location of drain holes along the pole. 2 1/2" dia hole in the pole mounting plate and 4" dia hole in the pole need to be aligned for wiring access or drainage. Arm stiffeners cut to match arm inclination and taper shall also be included.

The deviation from flat for either arm or pole mounting plate shall not exceed 1/32 in., which is measured along the center of mounting plate to a radial distance of 13.5 in. The deformed-from-flat connection between arm and pole mounting plates shall not be allowed if the center of both mounting plates cannot contact directly.

Fixed mount details are used for single mast arm assemblies and for the first arm on dual mast arm assemblies.

ANCHOR BOLT & TEMPLATE SIZE						
Bolt Dia in.	Length †	Top Thread	Bottom Thread	Bolt Circle	R ₂	R ₁
2 1/2"	5'-2"	10"	6 1/2"	27"	16"	11"

†Min dimension given, longer bolts are acceptable.

Texas Department of Transportation

 Traffic Operations Division

TRAFFIC SIGNAL SUPPORT STRUCTURES

LONG MAST ARM ASSEMBLY

(50 TO 65 FT)

(80 AND 100 MPH WIND ZONE)

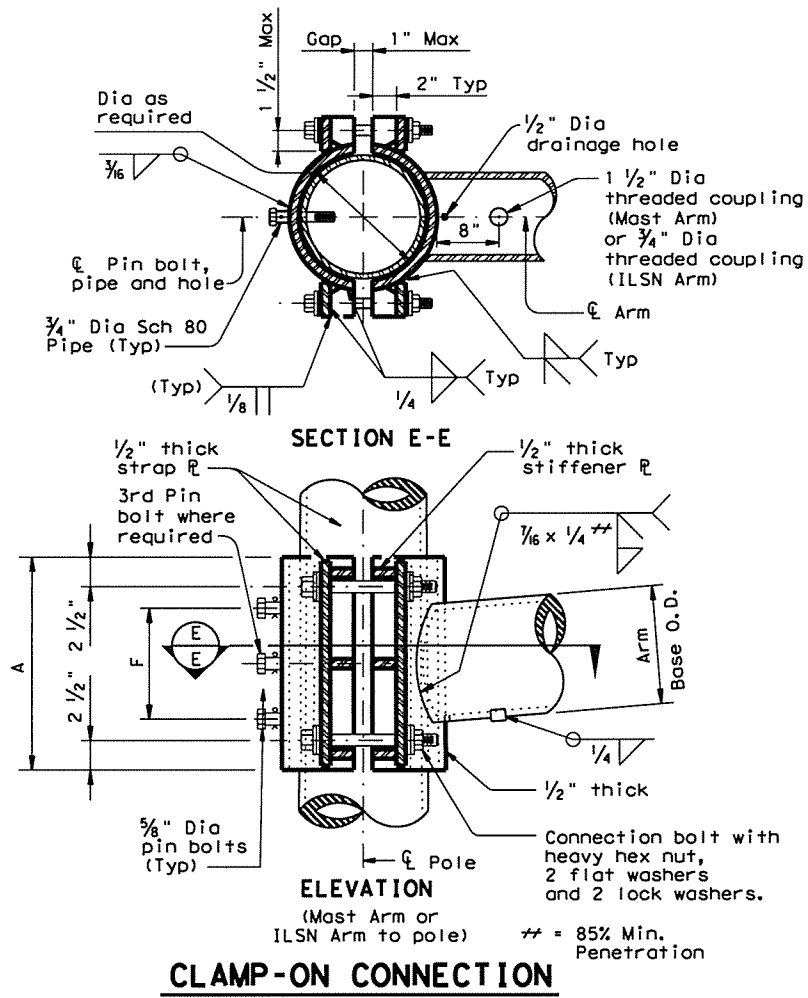
LMA (3) - 12

Sheet 3 of 5

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CLAMP-ON CONNECTION

80 MPH WIND										
Clamp-on Arm Lc	ROUND ARMS					POLYGONAL ARMS				
	L ₁	D ₁	D ₂	thk (12)	Rise	L ₁	D ₁	D ₂	thk (12)	Rise
20	19.1	6.5	3.8	.179	1'-9"	19.1	7.0	3.5	.179	1'-8"
24	23.1	7.5	4.3	.179	1'-10"	23.1	7.5	3.5	.179	1'-9"
28	27.1	8.0	4.2	.179	1'-11"	27.1	8.0	3.5	.179	1'-10"
32	31.0	9.0	4.7	.179	2'-1"	31.0	9.0	3.5	.179	2'-0"
36	35.0	9.5	4.6	.179	2'-4"	35.0	10.0	3.5	.179	2'-1"
40	39.0	9.5	4.1	.239	2'-8"	39.0	9.5	3.5	.239	2'-3"
44	43.0	10.0	4.1	.239	2'-11"	43.0	10.0	3.5	.239	2'-6"

100 MPH WIND										
Clamp-on Arm Lc	ROUND ARMS					POLYGONAL ARMS				
	L ₁	D ₁	D ₂	thk (12)	Rise	L ₁	D ₁	D ₂	thk (12)	Rise
20	19.1	8.0	5.3	.179	1'-8"	19.1	8.0	3.5	.179	1'-7"
24	23.1	9.0	5.8	.179	1'-9"	23.1	9.0	3.5	.179	1'-8"
28	27.1	9.5	5.7	.179	1'-10"	27.1	10.0	3.5	.179	1'-9"
32	31.0	9.5	5.2	.239	1'-11"	31.0	9.5	3.5	.239	1'-10"
36	35.0	10.0	5.1	.239	2'-0"	35.0	10.0	3.5	.239	1'-11"
40	39.0	10.5	5.1	.239	2'-3"	39.0	11.0	3.5	.239	2'-1"
44	43.0	11.0	5.1	.239	2'-8"	43.0	11.5	4.0	.239	2'-3"

D₁ = Arm Base O.D.
 D₂ = Arm End O.D.
 L₁ = Shaft Length
 Lc = Clamp-on Arm Length

(12) Thickness shown is minimum, thicker materials may be used.

CLAMP-ON ARM CONNECTION					
ILSN Arm Size		A	F	4 Conn. Bolts	5/8" Dia. Pin Bolts
Sch 40 pipe Dia	Thick				
in.	in.	in.	in.	in.	ea
3	.216	10	4	3/4	2

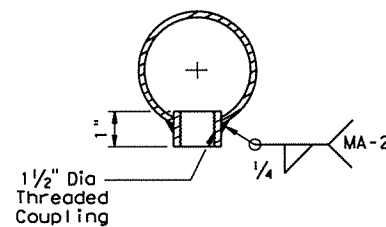
Mast Arm Size					
Base Dia	Thick	A	F	4 Conn. Bolts	5/8" Dia. Pin Bolts
in.	in.	in.	in.	in.	ea
6.5	.179	12	6	1	2
7.5	.179	14	8	1	2
8.0	.179	14	8	1	2
9.0	.179	16	10	1	2
9.5	.179	18	12	1 1/4	3
9.5	.239	18	12	1 1/4	3
10.0	.239	18	12	1 1/4	3
10.5	.239	18	12	1 1/4	3
11.0	.239	18	12	1 1/4	3
11.5	.239	18	12	1 1/4	3

GENERAL NOTES:

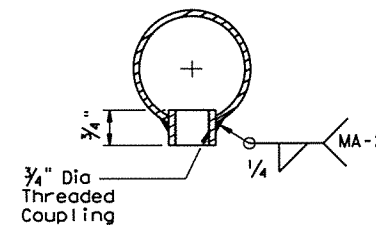
Clamp-on details are used for the second arm on dual mast arm assemblies or ILSN arm support. For a clamp-on mast arm, a maximum 1 1/2" wide vertical slotted hole may be cut in the front clamp plate to facilitate drainage during galvanizing. The slot shall be centered behind the arm and shall be no longer than the arm diameter minus 1". For an ILSN arm, a 1 1/2" diameter hole shall be cut in the front clamp plate for wire access. A matched hole shall be field drilled through the pole to provide wire access after arm is oriented. Deburr both holes.

Where duplicate parts occur on a detail, welds shown for part shall apply to all similar parts on the detail.

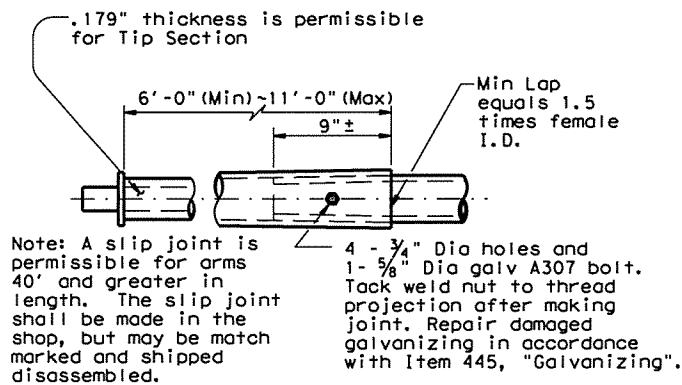
Pin bolts are required to prevent rotation of clamp-on arms under design wind forces. Pin bolts shall be ASTM A325 with threads excluded from the shear plane. Pin bolt and 3/4" diameter pipe shall have 3/16" diameter holes for a 1/8" diameter galvanized cotter pin. Back clamp plate shall be furnished with a 3/4" diameter hole for each pin bolt. An 1/16" diameter hole for each pin bolt shall be field drilled through the pole after arm orientations have been approved by the Engineer.



ARM COUPLING DETAIL



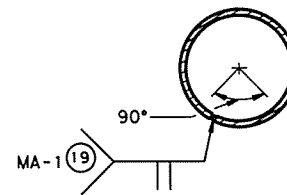
ILSN ARM COUPLING DETAIL



SLIP JOINT DETAIL (CLAMP-ON ARM)


Stainless steel bands (or Cables) and cast bracket as in "Astro-Brac", "Sky Bracket" or "Easy Bracket" with 1 1/2" Dia Threaded Coupling.

BRACKET ASSEMBLY



ARM WELD DETAIL

(19) Longitudinal Seam Weld must be oriented within the lower 90° of the signal arm. 60% Min penetration 100% penetration within 6" of circumferential base welds.


Texas Department of Transportation
 Traffic Operations Division
TRAFFIC SIGNAL SUPPORT STRUCTURES
LONG MAST ARM ASSEMBLY (50 TO 65 FT)
(80 AND 100 MPH WIND ZONE)
LMA(4)-12

Sheet 4 of 5

© TxDOT November 2000		DN: JK	CK: GRB	DF: FDN	CK: CAL
REVISIONS					
4-20-01	1-12	CONT	SECT	JOB	HIGHWAY
		6459	93	001	I-610, etc.
		DIST	COUNTY	SHEET NO.	
		HOU	HARRIS, etc.	79	

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Shipping Parts List							
Ship each pole with the following attached: enlarged hand hole, pole cap, fixed arm connection bolts and washers, and any additional hardware listed in the table.							
Nominal Arm Length	30' Poles with Luminaire	24' Poles with ILSN	19.50' (Single Mast Arm) 20.25' (Dual Mast Arm) Poles with no Luminaire and no ILSN See note above				
	See note above plus: one (or two if ILSN attached) small hand hole, clamp-on simplex	See note above plus one small hand hole					
Single Mast Arm							
Lf ft.	Designation	Quantity	Designation	Quantity	Designation	Quantity	
50	50L		50S		50		
55	55L		55S		55		
60	60L		60S		60		
65	65L		65S		65		
Dual Mast Arm							
Lf ft.	Lc ft.	Designation	Quantity	Designation	Quantity	Designation	Quantity
50	20	5020L		5020S		5020	
	24	5024L		5024S		5024	
	28	5028L		5028S		5028	
	32	5032L		5032S		5032	
	36	5036L		5036S		5036	
	40	5040L		5040S		5040	
55	20	5520L		5520S		5520	
	24	5524L		5524S		5524	
	28	5528L		5528S		5528	
	32	5532L		5532S		5532	
	36	5536L		5536S		5536	
	40	5540L		5540S		5540	
60	20	6020L		6020S		6020	
	24	6024L		6024S		6024	
	28	6028L		6028S		6028	
	32	6032L		6032S		6032	
	36	6036L		6036S		6036	
	40	6040L		6040S		6040	
65	20	6520L		6520S		6520	
	24	6524L		6524S		6524	
	28	6528L		6528S		6528	
	32	6532L		6532S		6532	
	36	6536L		6536S		6536	
	40	6540L		6540S		6540	
	44	6544L		6544S		6544	

Foundation Summary Table **

Location Ident.	Avg. N Blow/ft.	No. Each	Drill Shaft *** Length (feet)
			48-A
Total Drill Shaft Length			

Notes

- ** Foundations may be listed separately or grouped according to similarity of location and type. Quantities are for the Contractor's information only.
- *** Decimal lengths in Design Table are to allow interpolation for other penetrometer values. Round to nearest foot for entry into Summary Table.

Abbreviations

- Lf= Fixed Arm Length
- Lc= Clamp-on Arm Length (44' Max.)

Shipping Parts List						
Traffic Signal Arms (Fixed Mount) (1 per pole) Ship each arm with listed equipment attached						
Nominal Arm Length	Type IV Arm (4 Signals) 3 Bracket Assembly and 4 CGB Connectors	Luminaire Arms (1 per 30' pole)				
ft.	Designation	Quantity	Nominal Arm Length	Quantity		
50	50IV		8' Arm			
55	55IV		ILSN Arm (Max. 2 per pole) Ship with clamps, bolts and washers			
60	60IV		Nominal Arm Length	Quantity		
65	65IV		7' Arm			
			9' Arm			
Traffic Signal Arms (80 MPH Clamp-On Mount) (1 per pole) Ship each arm with listed equipment attached						
Nominal Arm Length	Type I Arm (1 Signal) 2 CGB connector and 1 clamp w/bolts and washers	Type II Arm (2 Signals) 1 Bracket Assembly and 3 CGB connectors, and 1 clamp w/bolts and washers		Type III Arm (3 Signals) 2 Bracket Assembly and 4 CGB connectors, and 1 clamp w/bolts and washers		
ft.	Designation	Quantity	Designation	Quantity	Designation	Quantity
20	20I-80					
24	24I-80		24II-80			
28	28I-80		28II-80			
32			32II-80		32III-80	
36			36II-80		36III-80	
40					40III-80	
44					44III-80	
Traffic Signal Arms (100 MPH Clamp-On Mount) (1 per pole) Ship each arm with listed equipment attached						
Nominal Arm Length	Type I Arm (1 Signal) 2 CGB connector and 1 clamp w/bolts and washers	Type II Arm (2 Signals) 1 Bracket Assembly and 3 CGB connectors, and 1 clamp		Type III Arm (3 Signals) 2 Bracket Assembly and 4 CGB connectors, and 1 clamp		
ft.	Designation	Quantity	Designation	Quantity	Designation	Quantity
20	20I-100					
24	24I-100		24II-100			
28	28I-100		28II-100			
32			32II-100		32III-100	
36			36II-100		36III-100	
40					40III-100	
44					44III-100	
Anchor Bolt Assemblies (1 per pole)						
Anchor Bolt Diameter	Anchor Bolt Length	Quantity		Each anchor bolt assembly consists of the following: Top and bottom templates, 4 anchor bolts, 8 nuts, 8 flat washers and 4 nut anchor devices (type 2) per Standard Drawing "TS-FD". Templates may be removed for shipment.		
2 1/2 "	5' - 3"					



**LONG MAST
ARM ASSEMBLY
PARTS LIST**

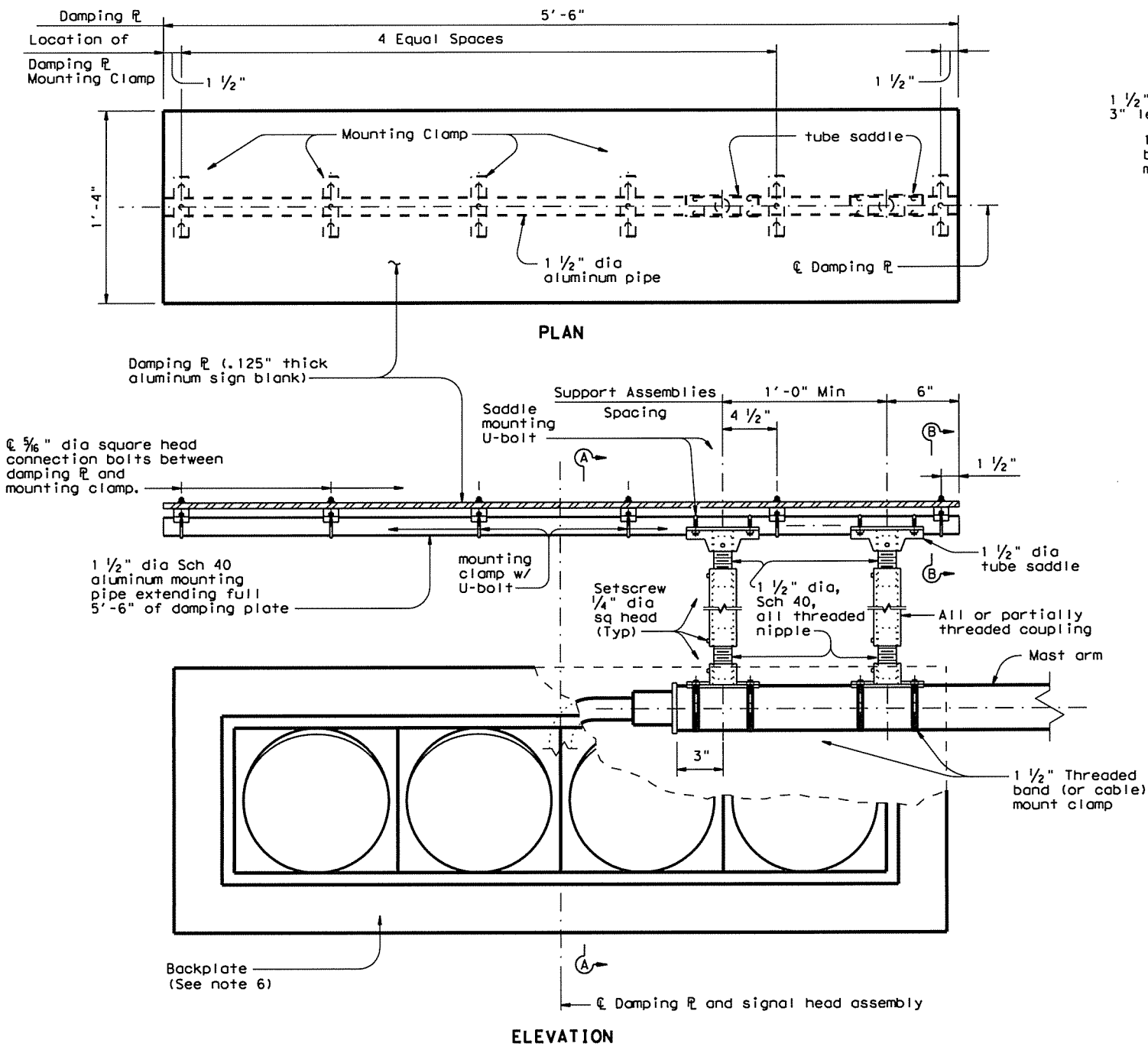
LMA (5) - 12

Sheet 5 of 5

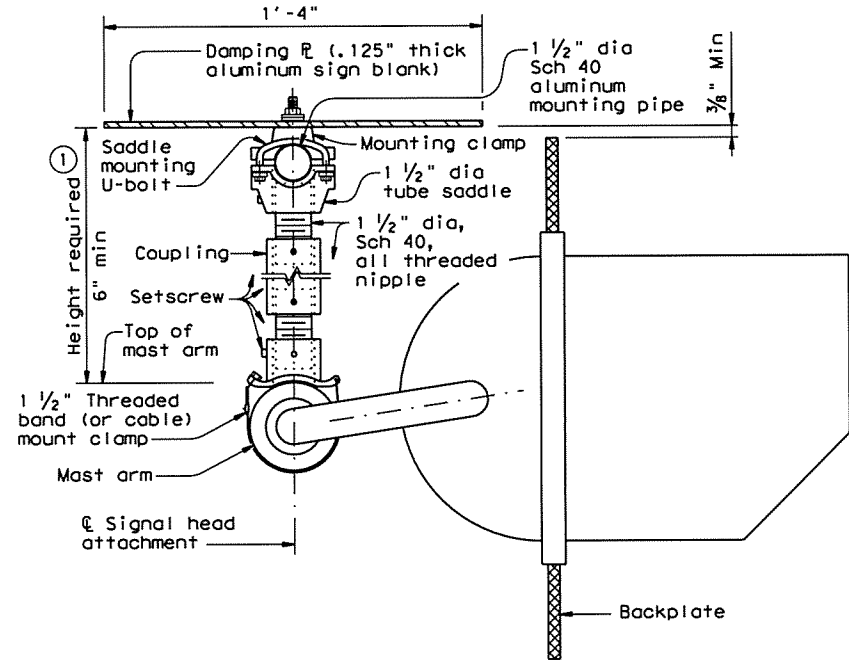
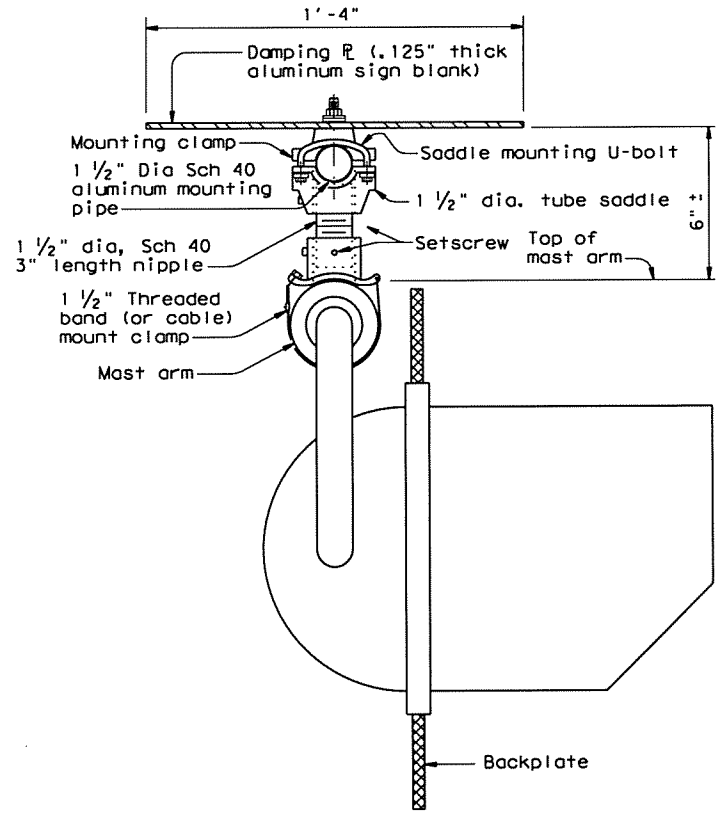
© TxDOT November 2000	DN: JK	CK: GRB	DN: FDN	CK: CAL	
4-20-01 1-12	REVISIONS	CONT	SECT	JOB	HIGHWAY
		6459	93	001	1-610, etc
		DIST	COUNTY	SHEET NO.	
		HOU	HARRIS, etc.	80	

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DATE: FILE:



DAMPING PLATE MOUNTING DETAILS
(Showing alternate placement of signal head)

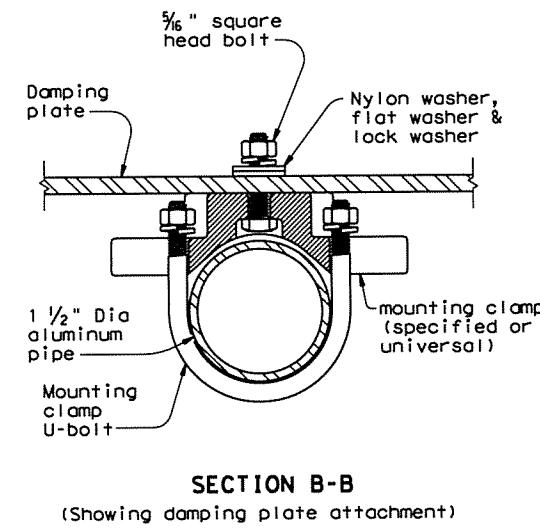


① Recommended supporting assemblies to achieve required height for horizontal section heads

Height required	One nipple each length	Two nipples each length plus one coupling each length	One coupling each length
6"-6 3/4"	3"	-	-
7"-8 1/2"	4"	-	-
9"-10 1/2"	6"	-	-
11"-15 1/2"	-	4"	5"
16"-24"	-	6"	10"

GENERAL NOTES:

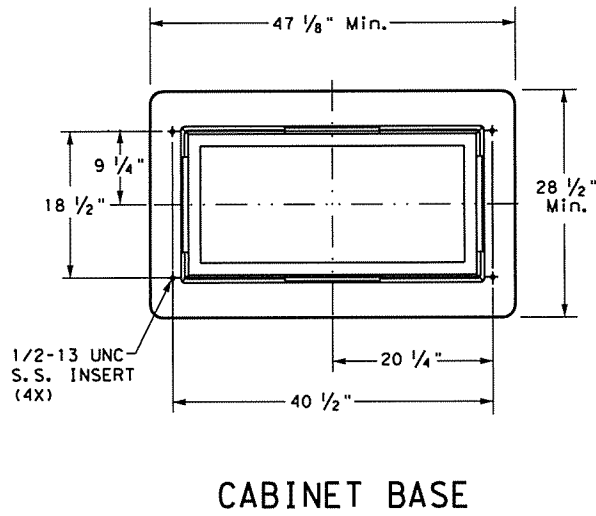
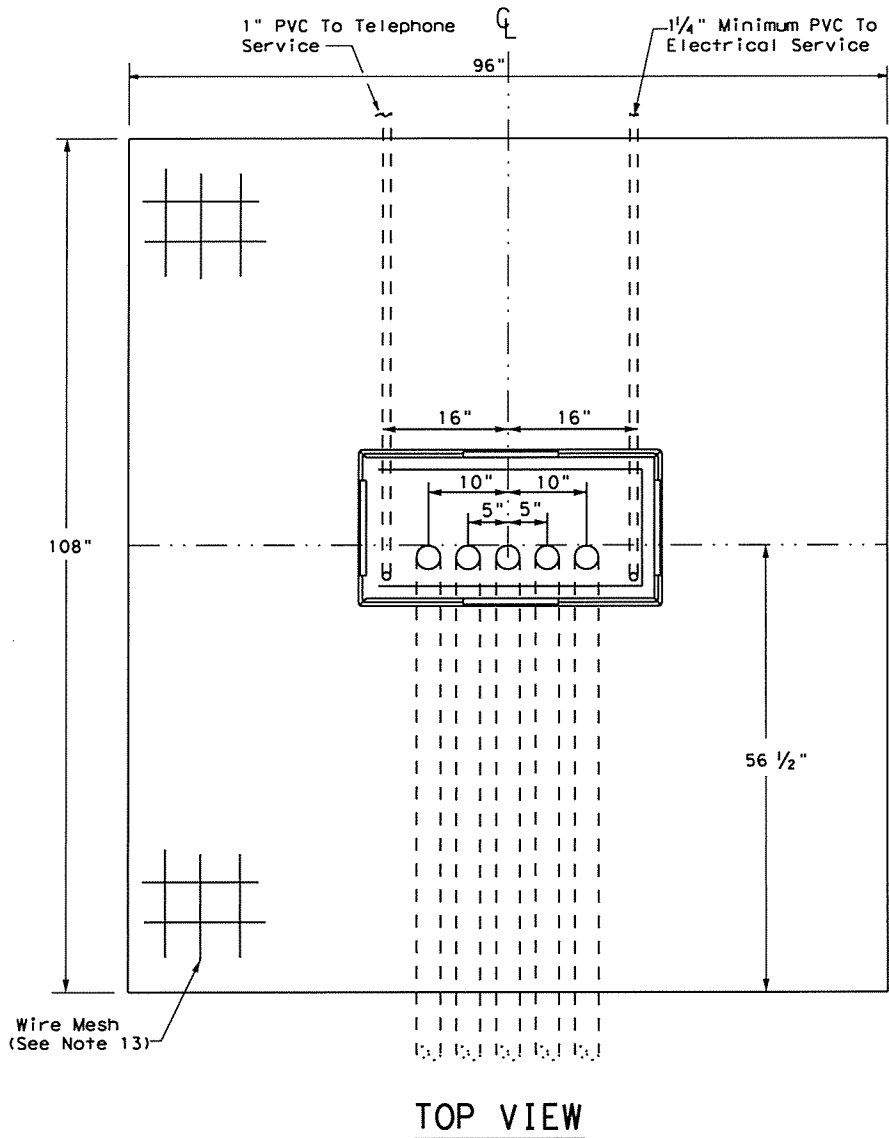
- In accordance with the findings of TxDOT sponsored research, the installation of a damping plate in accordance with the details shown here at the end of signal mast arms of SMA and DMA standard structures reduces excessive harmonic vertical vibration, and thus fatigue damage. Any deviation from these details may reduce the effectiveness of this damping device.
- Aluminum sign blank for damping plate will conform to Departmental Material Specifications DMS-7110. Materials for mast arm mounting clamp and tube saddle will be aluminum castings or aluminum alloys as in accordance with manufacturers' stipulations. Mounting pipe, pipe nipple and coupling will be aluminum alloy 6061-T6 or 6063-T6. Damping plate mounting clamp and U-bolt assemblies will conform to Standard sheet SMD(GEN). U-bolts for saddle mounting will have a minimum yield strength of 36 ksi.
- Damping plate will be mounted horizontally. Position centerline of damping plate to align with centerline of mast arm or horizontal signal head assembly. Vertical clearance between signal head (with or without backing plate) and bottom of damping plate will be maintained as shown. The attachments shown here are examples only, other supporting details which meet both alignment and vertical clearance requirements are also acceptable.
- Unless stipulated by the manufacturers, all steel parts will be galvanized finish in accordance with Standard Specification Item 445, "Galvanizing".
- Contractor will verify applicable field dimensions before the installation.
- Backplates are optional for traffic signals. When backplates are used, Backplates will have a 2-inch fluorescent yellow AASHTO Type B_{FL} or C_{FL} retroreflective border conforming to TxDOT DMS-8300 "Sign Face Materials." See Sheet TS-BP-20 for backplate details.



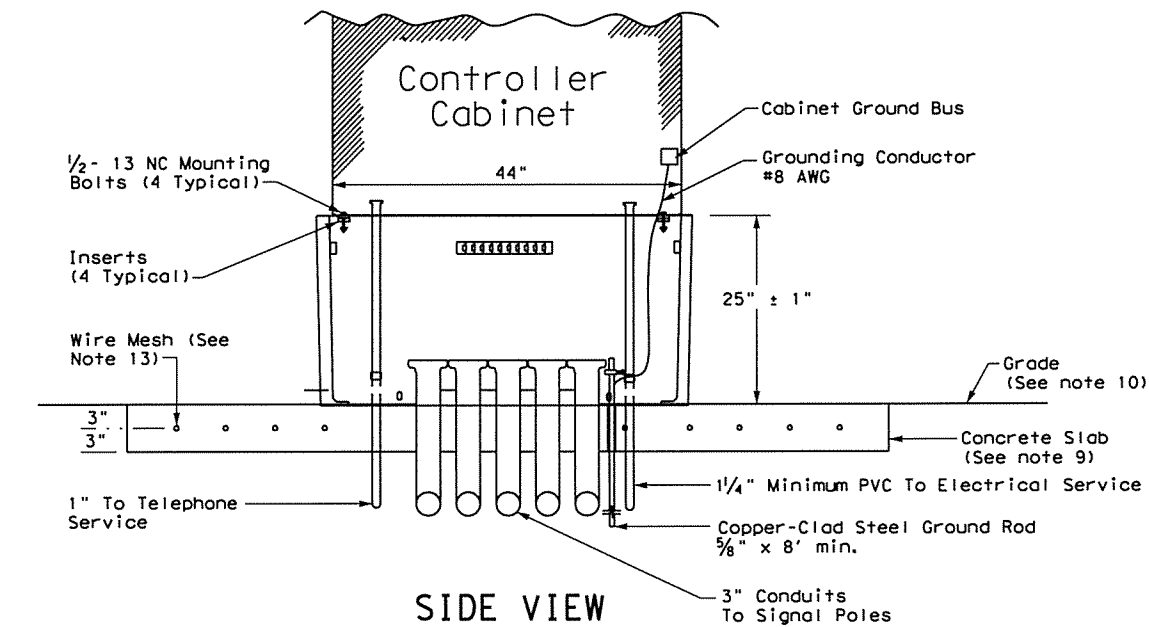
MAST ARM DAMPING PLATE DETAILS
MA-DPD-20

FILE: ma-dpd-20.dgn	DW: TxDOT	CHK: TxDOT	DW: TxDOT	CHK: TxDOT
© TxDOT January 2012	CONT	SECT	JOB	HIGHWAY
6-20	6459	93	001	I-610, etc.
	DIST	COUNTY	SHEET NO.	
	HOU	HARRIS, etc.		81

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CABINET BASE



SIDE VIEW

TRAFFIC SIGNAL CONTROLLER BASE:

1. Provide a traffic signal controller base (cabinet base) manufactured of polymer concrete material consisting of calcareous and siliceous stone; glass fibers and thermoset polyester resin. The polymer concrete cabinet base must be reinforced on the inside of the cabinet base with fiberglass matting. Provide one of the following bases: Armocast Part # A6001848X24, Quozite Model # PG3048Z709, or other as approved by TxDOT Traffic Safety Division.
2. The polymer concrete material must have a minimum compressive strength of 10,300 pounds per square inch (psi), minimum flexural strength of 3600 psi, and minimum shear strength of 3600 psi.
3. The polymer concrete cabinet base must conform to the dimensions shown and must accommodate a standard TxDOT basemount cabinet.
4. Supply the cabinet base with four 1#2"-13 UNC stainless steel inserts for attachment of the cabinet to the base. Inserts must withstand a minimum torque of 50 ft-lb and a minimum straight pull out strength of 750 lbs.
5. Provide the cabinet base with 4 cable racks mounted one on each side of the base 2" to 7" from the top edge of the base. Unless approved otherwise, cable racks must be 1-1/2 x 9#16x 3#16inch steel channel with eight T-slots spaced at 1-1/2 inches. The cable racks must easily accommodate the insertion of tie wraps to attach field wiring to the racks to serve as strain relief. Secure cable racks to the base using 1#2"-13 UNC stainless steel screws and inserts.
6. The cabinet base, when secured to the concrete slab with controller cabinet attached, must withstand a minimum wind load of 125 mph or a 850 lb force applied at 49" above the bottom of the base without causing the base or cabinet to come out of their anchored position or cause any permanent deformation. The manufacturer must supply certification by an independent testing laboratory or sealed by a Texas Licensed Professional Engineer. Provide the cabinet base with hardware for attachment to a concrete slab.
7. The traffic signal base must be permanently marked either by impress or by permanent ink with the manufacturer's model number and name or logo.
8. Seal the base to the concrete with a silicone caulk bead and fastened to the slab per manufacturer's instructions.

CONCRETE SLAB:

9. Traffic signal controller pad must be a portland cement concrete slab poured in place, must conform to the dimensions shown, and must be level.
10. Grade earthwork such that it is flush with the concrete pad on all four sides, unless otherwise shown on the plans. Subsidiary to ITEM 680, four inch rip rap may be used in lieu of earthwork. Slopes shall gradually contour to match plans.
11. Bond a #8 AWC copper ground wire and an 8 ft ground rod bonded to the reinforcing mesh by a suitable UL Listed clamp and terminated to the cabinet grounding bus for the purpose of providing a local ground for the electrical grounding conductor. The electrical grounding conductor specified in Item 680-3.A.4 is required and must be terminated to the cabinet ground bus.
12. Install a PVC sleeve to prevent the ground rod from direct embedment in the slab.
13. Provide welded wire mesh 6X6-W2.9 X W2.9 for reinforcement. Provide joints and splices in the mesh with a minimum 6-inch overlap. Center the mesh between top and bottom and provide a minimum 3 inch cover on the edges.
14. Provide Class B concrete minimum for the slab in accordance with Item 421. Construct the slab in accordance with Item 531.

CONDUITS:

15. Stub up and run 3-inch conduits through the slab to the various traffic signal poles and ground boxes as shown on the layouts. Install the number of conduits as shown on layouts plus two additional 3 inch conduits for future use. Terminate the conduits with a bushing between 2 and 4-inches above the slab.
16. Extend conduits for future use at least 18-inches from the edge of the slab, terminate underground with a coupling, and cap and seal so that the seal can be removed without damaging the coupling. This must also apply to unused telephone conduit.
17. Stub up two separate conduits through the slab from the electrical and telephone services. Run the conduit for the electrical feed directly to the electrical service enclosure. Run the conduit for the telephone line directly to the telephone service, usually located on the same pole as the electrical service. Telephone must not under any circumstance share a conduit with any other function.
18. Terminate electric and telephone conduits above the slab with a coupling. After the base is installed, extend the conduits above the top of the base and secure to the base using a steel one-hole strap or similar suitable substitute.

CONTROLLER CABINET:

19. Anchor the controller cabinet to the base using four stainless steel 1/2-13 NC bolts.
20. The silicone caulk bead specified in Item 680.3.B must be RTV 133.

PAYMENT:

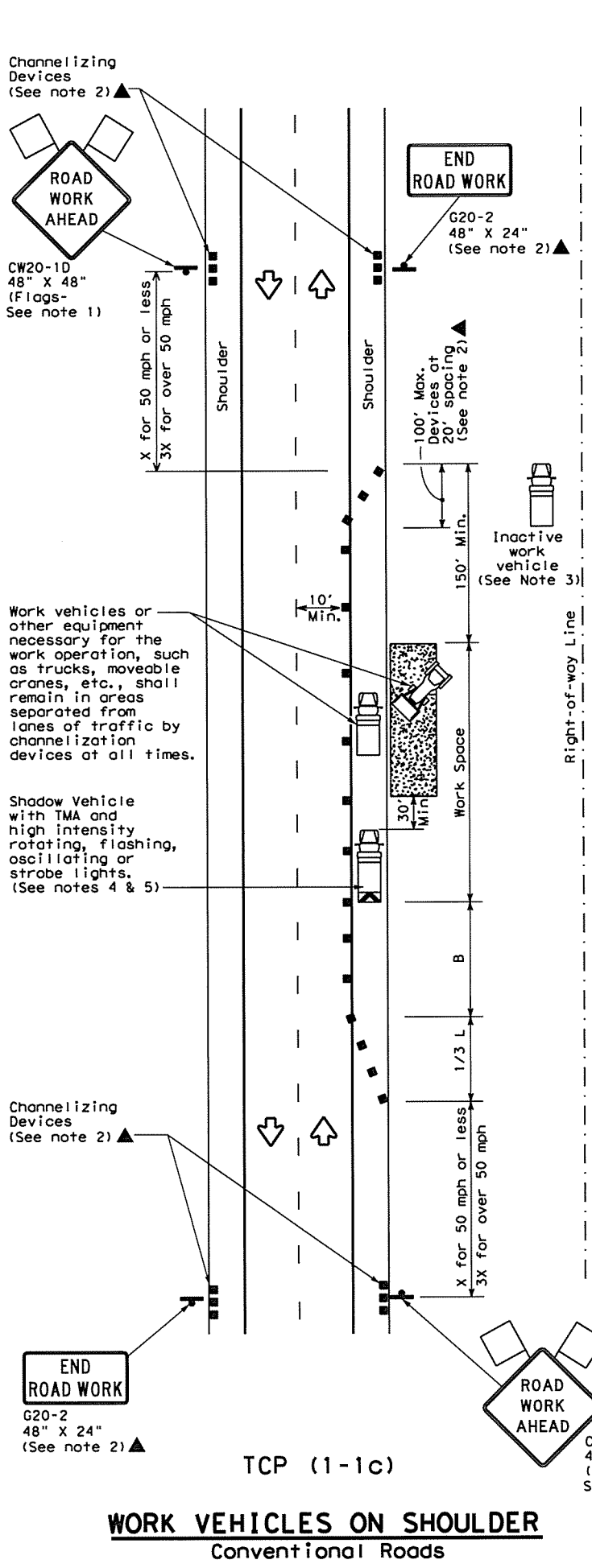
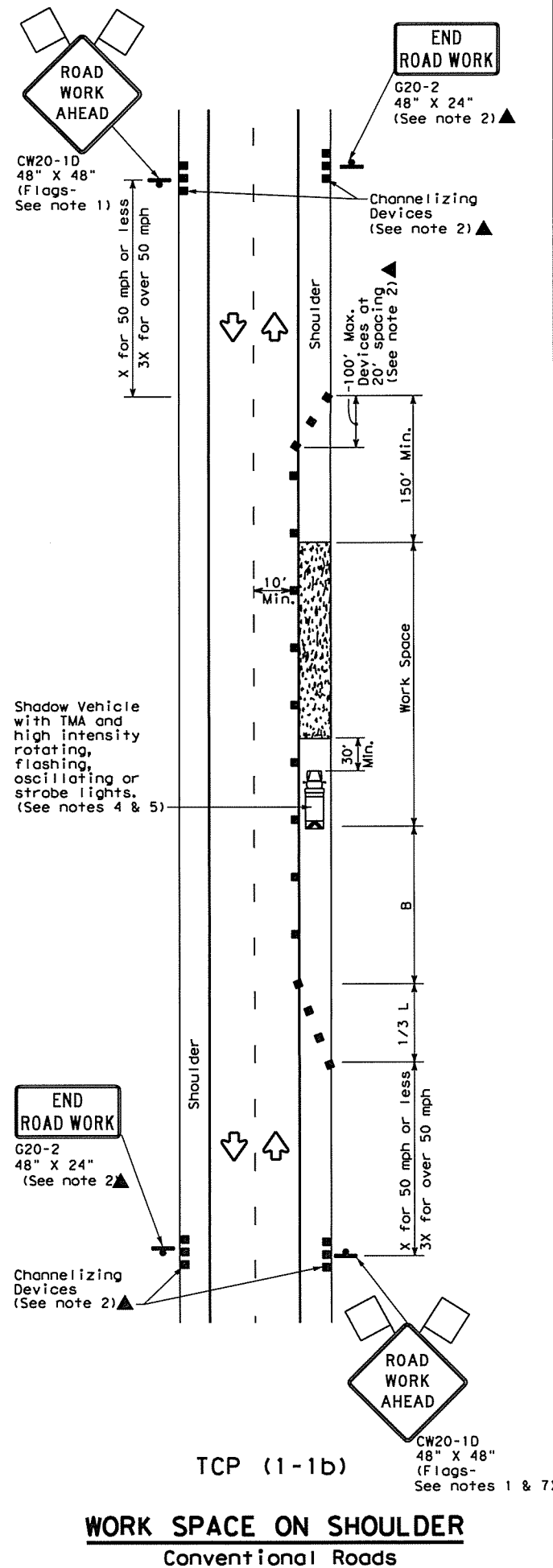
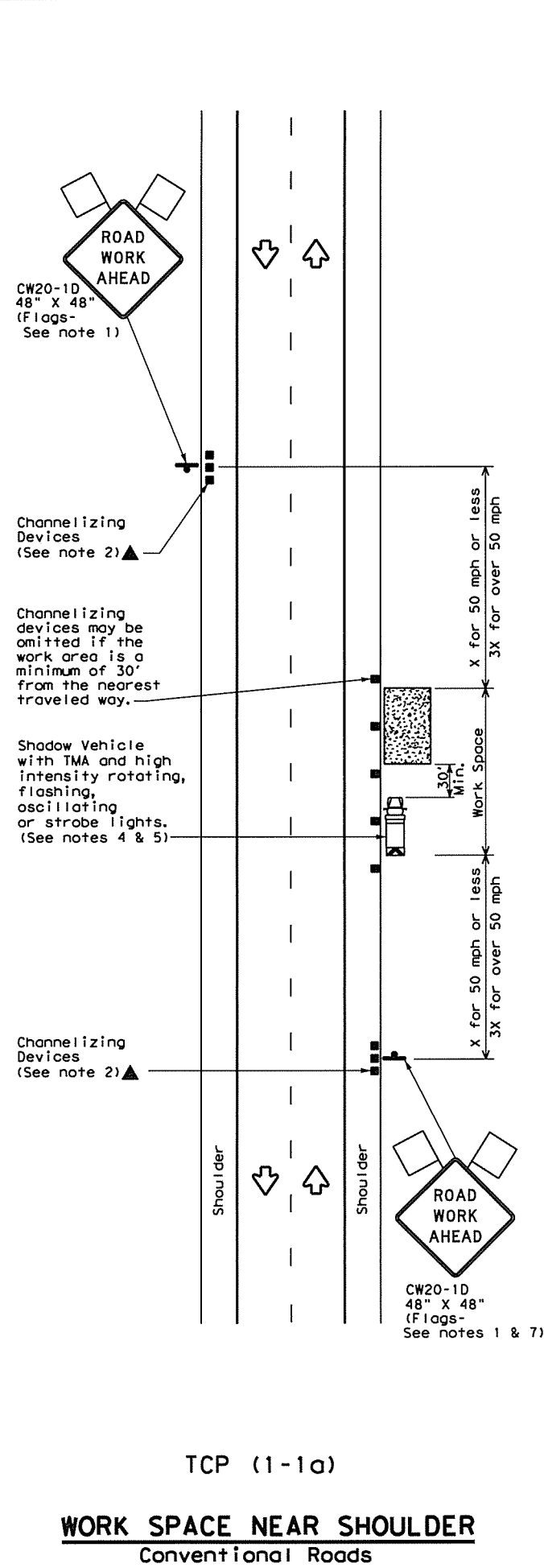
21. Bid TS-CF as subsidiary to Item 680.

TRAFFIC SIGNAL CONTROLLER CABINET BASE AND PAD TS-CF-21			
FILE: ts-cf-21.dgn	DATE: October 2000	CONTRACT: 6459	SHEET: 93
© TxDOT	REVISIONS	JOB: 001	HIGHWAY: I-610, etc.
12-04		DIST: HOU	COUNTY: HARRIS, etc.
2-21			SHEET NO.: 82

DATE: FILE:

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DATE: FILE:



LEGEND			
	Type 3 Barricade		Channelizing Devices
	Heavy Work Vehicle		Truck Mounted Attenuator (TMA)
	Trailer Mounted Flashing Arrow Board		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 = 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)

TYPICAL USAGE				
MOBILE	SHORT DURATION	SHORT TERM STATIONARY	INTERMEDIATE TERM STATIONARY	LONG TERM STATIONARY
	✓	✓		

- GENERAL NOTES**
- Flags attached to signs where shown are REQUIRED.
 - All traffic control devices illustrated are REQUIRED, except those denoted with the triangle symbol may be omitted when stated elsewhere in the plans, or for routine maintenance work, when approved by the Engineer.
 - Inactive work vehicles or other equipment should be parked near the right-of-way line and not parked on the paved shoulder.
 - A Shadow Vehicle with a TMA should be used anytime it can be positioned 30 to 100 feet in advance of the area of crew exposure without adversely affecting the performance or quality of the work. If workers are no longer present but road or work conditions require the traffic control to remain in place, Type 3 Barricades or other channelizing devices may be substituted for the Shadow Vehicle and TMA.
 - Additional Shadow Vehicles with TMAs may be positioned off the paved surface, next to those shown in order to protect wider work spaces.
 - See TCP(5-1) for shoulder work on divided highways, expressways and freeways.
 - CW21-5 "SHOULDER WORK" signs may be used in place of CW20-1D "ROAD WORK AHEAD" signs for shoulder work on conventional roadways.

Texas Department of Transportation
Traffic Operations Division Standard

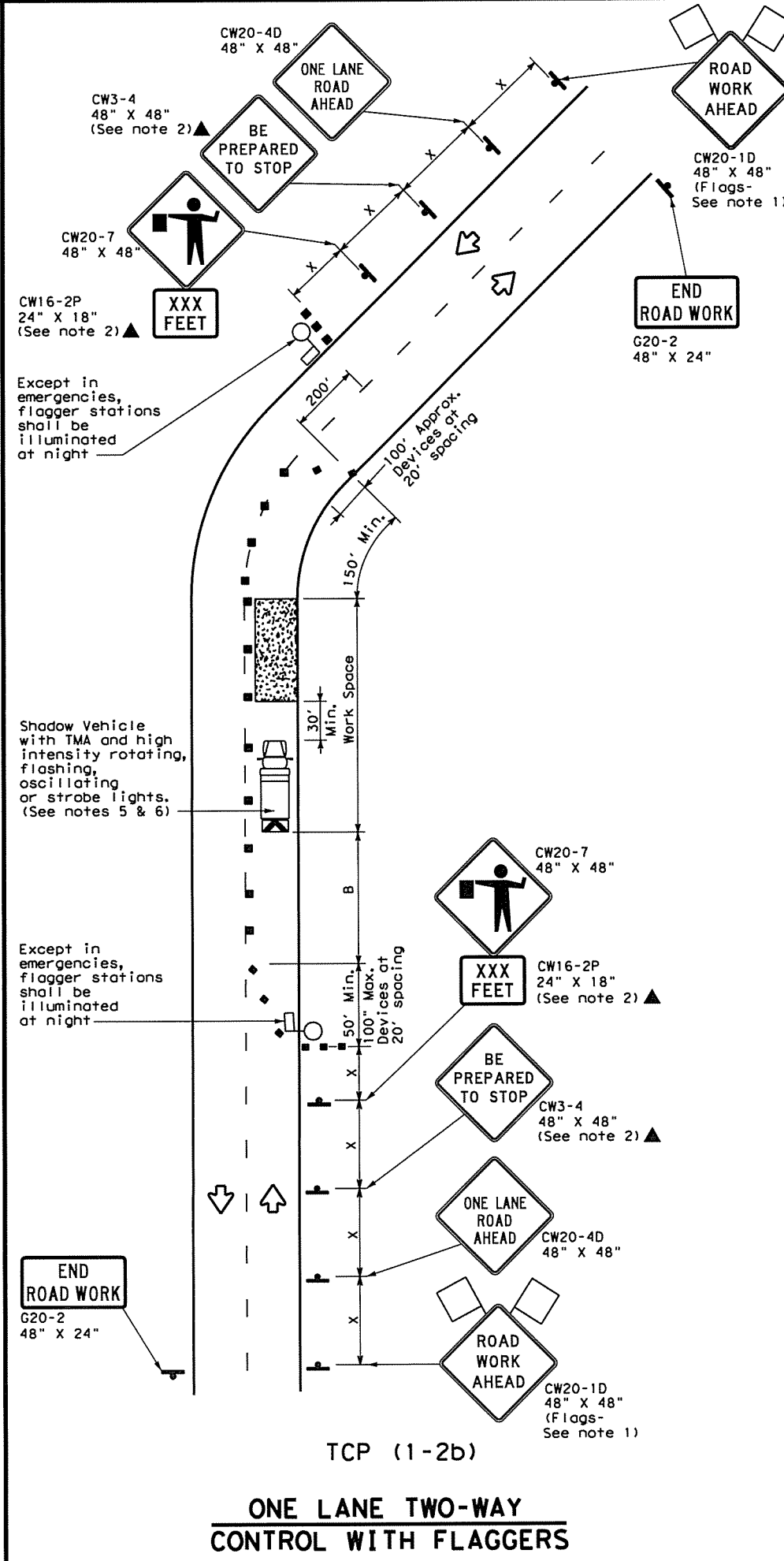
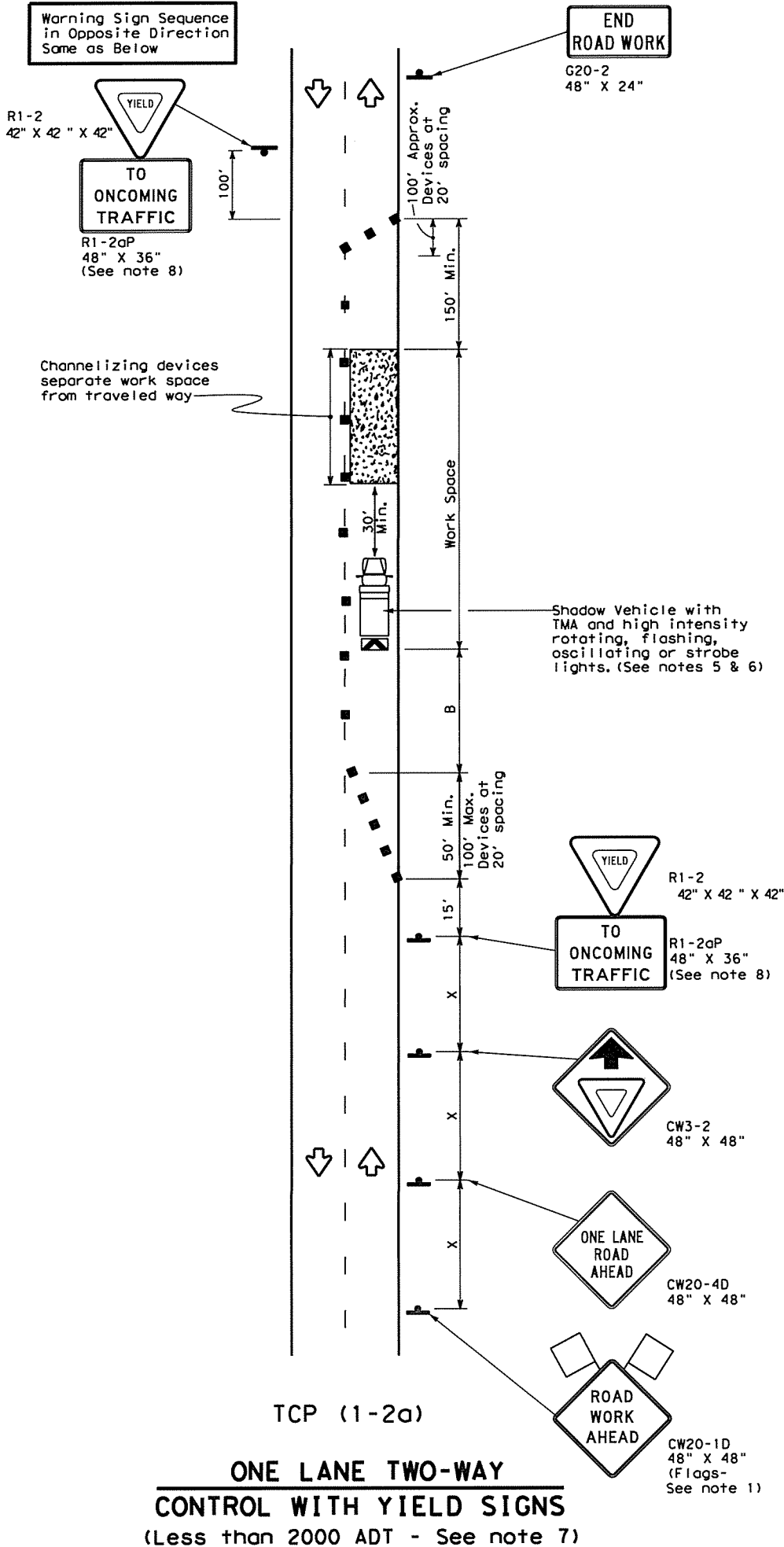
TRAFFIC CONTROL PLAN
CONVENTIONAL ROAD
SHOULDER WORK

TCP (1-1) - 18

FILE: tcp1-1-18.dgn	DN:	CK:	DW:	CK:
© TxDOT December 1985	CONF	SECT	JOB	HIGHWAY
REVISIONS	6459	93	001	I-610, etc.
2-94 4-98	DIST	COUNTY	SHEET NO.	
8-95 2-12	HOU	HARRIS, etc.	83	
1-97 2-18				

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DATE: FILE:



LEGEND			
	Type 3 Barricade		Channelizing Devices
	Heavy Work Vehicle		Truck Mounted Attenuator (TMA)
	Trailer Mounted Flashing Arrow Board		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"	Stopping Sight Distance
		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'	200'
35		205'	225'	245'	35'	70'	160'	120'	250'
40		265'	295'	320'	40'	80'	240'	155'	305'
45	L = WS	450'	495'	540'	45'	90'	320'	195'	360'
50		500'	550'	600'	50'	100'	400'	240'	425'
55		550'	605'	660'	55'	110'	500'	295'	495'
60		600'	660'	720'	60'	120'	600'	350'	570'
65		650'	715'	780'	65'	130'	700'	410'	645'
70		700'	770'	840'	70'	140'	800'	475'	730'
75		750'	825'	900'	75'	150'	900'	540'	820'

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

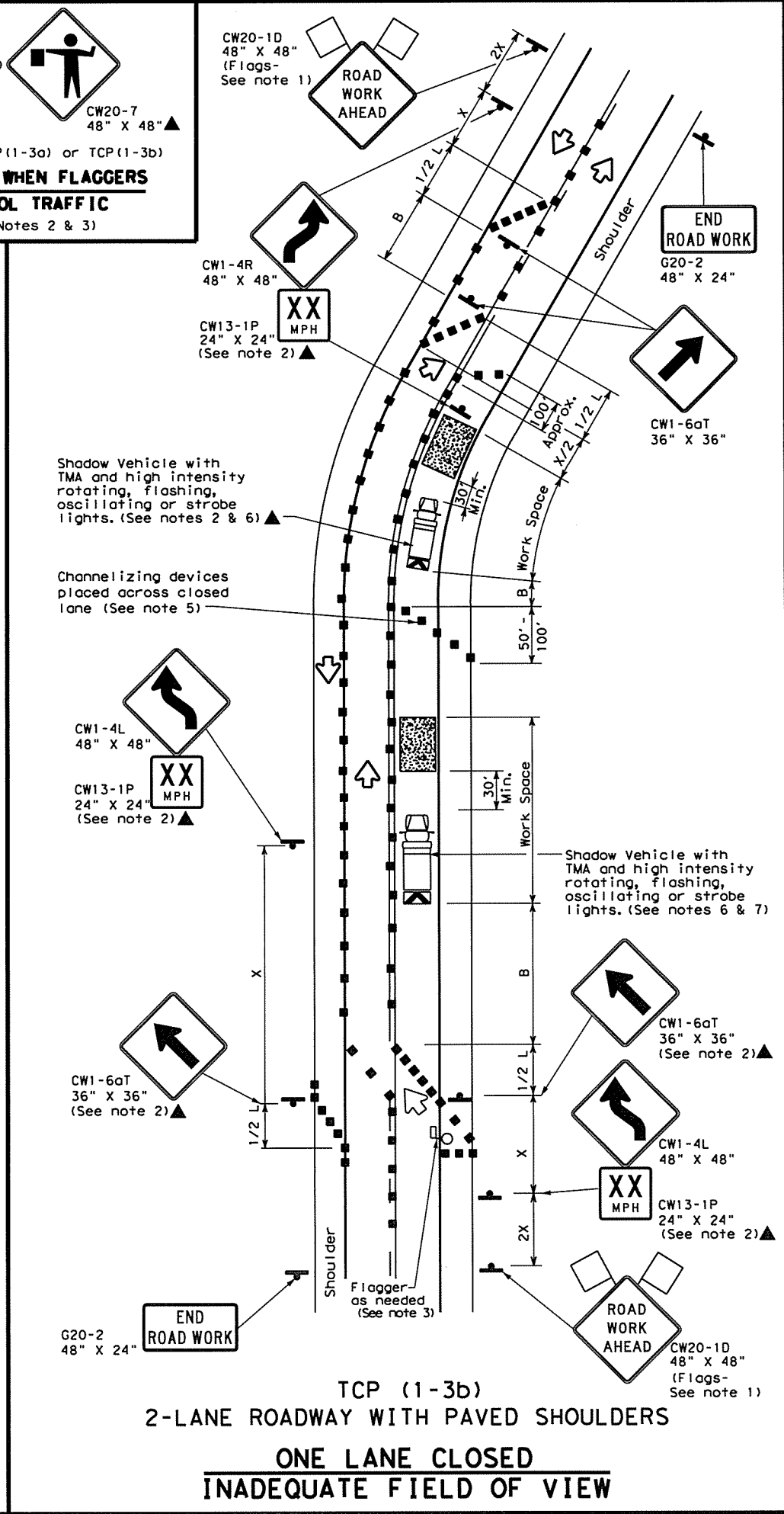
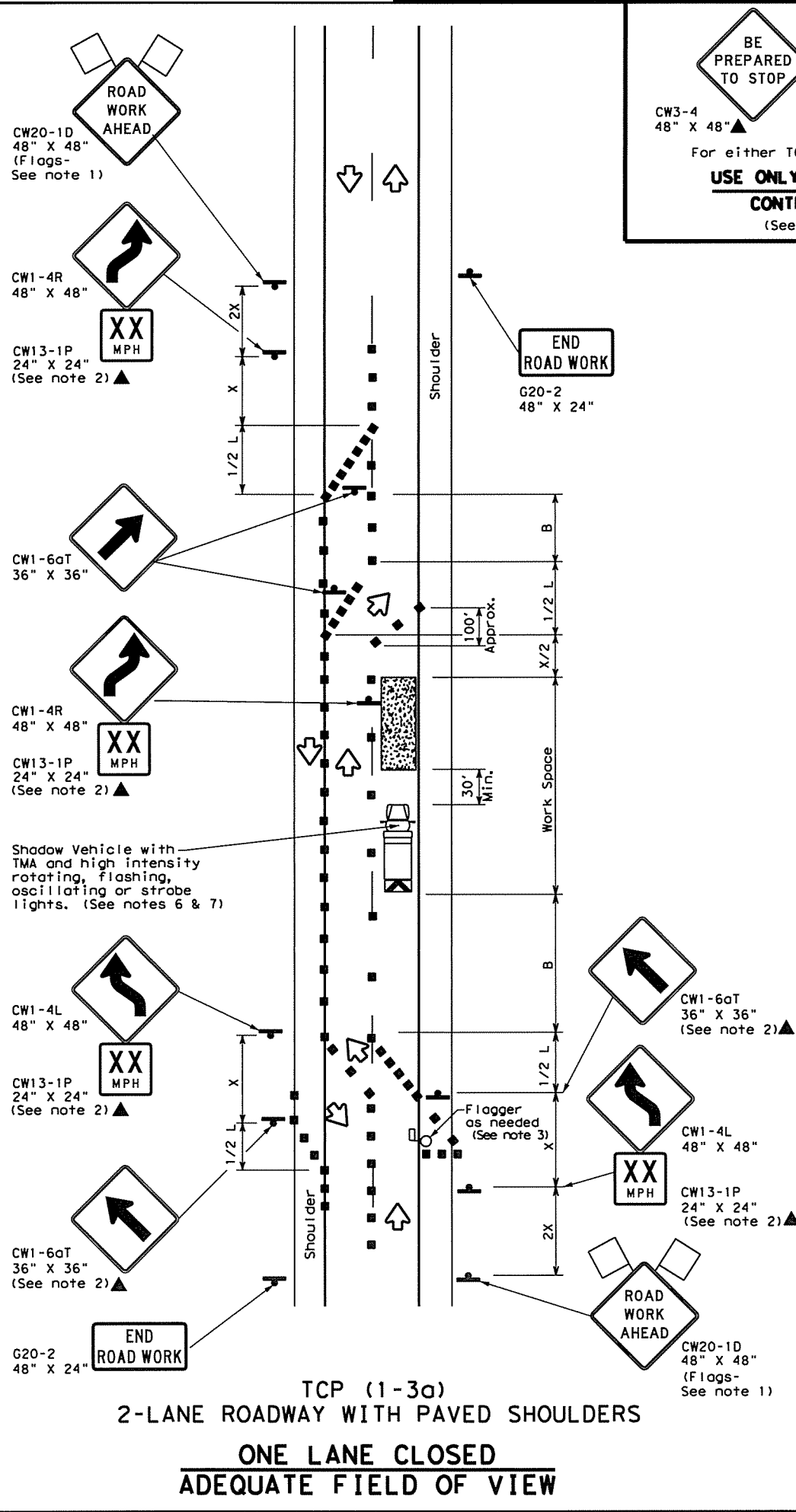
TYPICAL USAGE				
MOBILE	SHORT DURATION	SHORT TERM STATIONARY	INTERMEDIATE TERM STATIONARY	LONG TERM STATIONARY
	✓	✓		

GENERAL NOTES

- Flags attached to signs where shown are REQUIRED.
 - All traffic control devices illustrated are REQUIRED, except those denoted with the triangle symbol may be omitted when stated elsewhere in the plans, or for routine maintenance work, when approved by the Engineer.
 - The CW3-4 "BE PREPARED TO STOP" sign may be installed after the CW20-4D "ONE LANE ROAD AHEAD" sign, but proper sign spacing shall be maintained.
 - Sign spacing may be increased or an additional CW20-1D "ROAD WORK AHEAD" sign may be used if advance warning ahead of the flagger or R1-2 "YIELD" sign is less than 1500 feet.
 - A Shadow Vehicle with a TMA should be used anytime it can be positioned 30 to 100 feet in advance of the area of crew exposure without adversely affecting the performance or quality of the work. If workers are no longer present but road or work conditions require the traffic control to remain in place, Type 3 Barricades or other channelizing devices may be substituted for the Shadow Vehicle and TMA.
 - Additional Shadow Vehicles with TMAs may be positioned off the paved surface, next to those shown in order to protect wider work spaces.
- TCP (1-2a)**
- R1-2 "YIELD" sign traffic control may be used on projects with approaches that have adequate sight distance. For projects in urban areas, work spaces should be no longer than one half city block. In rural areas on roadways with less than 2000 ADT, work spaces should be no longer than 400 feet.
 - R1-2 "YIELD" sign with R1-2aP "TO ONCOMING TRAFFIC" plaque shall be placed on a support at a 7 foot minimum mounting height.
- TCP (1-2b)**
- Flaggers should use two-way radios or other methods of communication to control traffic.
 - Length of work space should be based on the ability of flaggers to communicate.
 - If the work space is located near a horizontal or vertical curve, the buffer distances should be increased in order to maintain adequate stopping sight distance to the flagger and a queue of stopped vehicles (see table above).
 - Channelizing devices on the center-line may be omitted when a pilot car is leading traffic and approved by the Engineer.
 - Flaggers should use 24" STOP/SLOW paddles to control traffic. Flags should be limited to emergency situations.

		Traffic Operations Division Standard		
TRAFFIC CONTROL PLAN ONE-LANE TWO-WAY TRAFFIC CONTROL				
TCP (1-2) - 18				
FILE:	tcp1-2-18.dgn	DIV:	CKI	CKI
© TxDOT	December 1985	CONT	SECT	JOB
	REVISIONS	6459	93	001
4-90	4-98	DIST	COUNTY	SHEET NO.
2-94	2-12	1-97	HOU	HARRIS, etc.
1-97	2-18			84

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BE PREPARED TO STOP

CW3-4 48" X 48" ▲ CW20-7 48" X 48" ▲

For either TCP(1-3a) or TCP(1-3b)

USE ONLY WHEN FLAGGERS CONTROL TRAFFIC

(See Notes 2 & 3)

LEGEND

	Type 3 Barricade		Channelizing Devices
	Heavy Work Vehicle		Truck Mounted Attenuator (TMA)
	Trailer Mounted Flashing Arrow Board		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 = 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)

TYPICAL USAGE

MOBILE	SHORT DURATION	SHORT TERM STATIONARY	INTERMEDIATE TERM STATIONARY	LONG TERM STATIONARY
	✓	✓		

- GENERAL NOTES**
- Flags attached to signs where shown are REQUIRED.
 - All traffic control devices illustrated are REQUIRED, except those denoted with the triangle symbol may be omitted when stated elsewhere in the plans, or for routine maintenance work, when approved by the Engineer.
 - Flagger control should NOT be used unless roadway conditions or heavy traffic volume require additional emphasis to safely control traffic. Additional flaggers may be positioned in advance of traffic queues to alert traffic to reduce speed.
 - DO NOT PASS, PASS WITH CARE and construction regulatory speed zone signs may be installed downstream of the ROAD WORK AHEAD signs.
 - When the work zone is made up of several work spaces, channelizing devices should be placed laterally across the closed lane to re-emphasize closure. Laterally placed channelizing devices should be repeated every 500 to 1000 feet in urban areas and every 1/4 to 1/2 mile in rural areas.
 - A Shadow Vehicle with a TMA should be used anytime it can be positioned 30 to 100 feet in advance of the area of crew exposure without adversely affecting the performance or quality of the work. If workers are no longer present but road or work conditions require the traffic control to remain in place, Type 3 Barricades or other channelizing devices may be substituted for the Shadow Vehicle and TMA.
 - Additional Shadow Vehicles with TMAs may be positioned off the paved surface, next to those shown in order to protect wider work spaces.
 - Where traffic is directed over a yellow centerline, channelizing devices which separate two-way traffic should be spaced on tapers at 20', or 15' if posted speed are 35 mph or slower, and for tangent sections, at 1/2S where S is the speed in mph. This tighter device spacing is intended for the area of conflicting markings not the entire work zone.

Texas Department of Transportation
Traffic Operations Division Standard

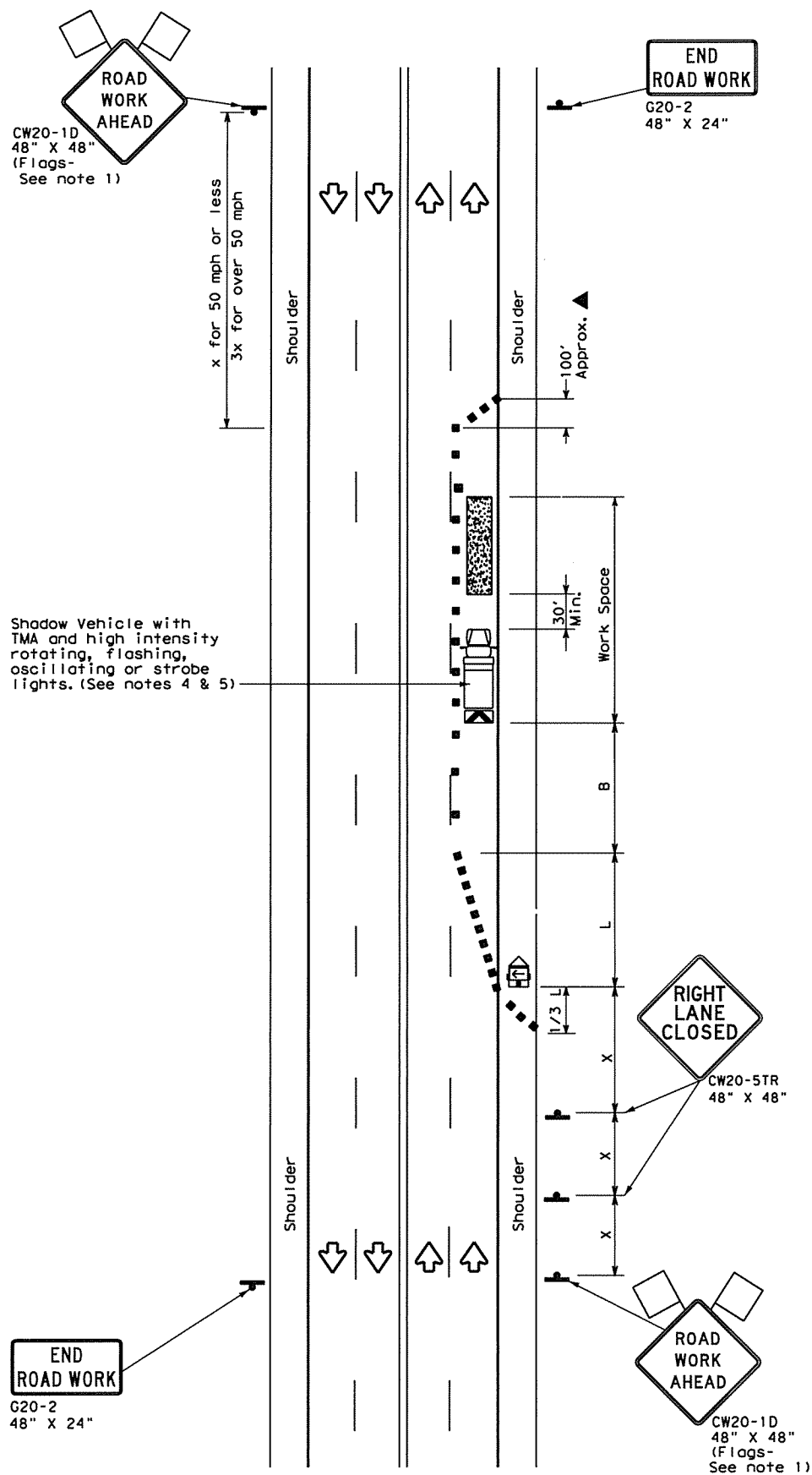
TRAFFIC CONTROL PLAN
TRAFFIC SHIFTS ON
TWO LANE ROADS
TCP (1-3) - 18

FILE: tcp1-3-18.dgn	DW: December 1985	CON: 6459	SECT: 93	JOB: 001	HIGHWAY: I-610, etc.
REVISIONS:	2-94 4-98	8-95 2-12	1-97 2-18	DIST: HOU	COUNTY: HARRIS, etc.
					SHEET NO.: 85

DATE: FILE:

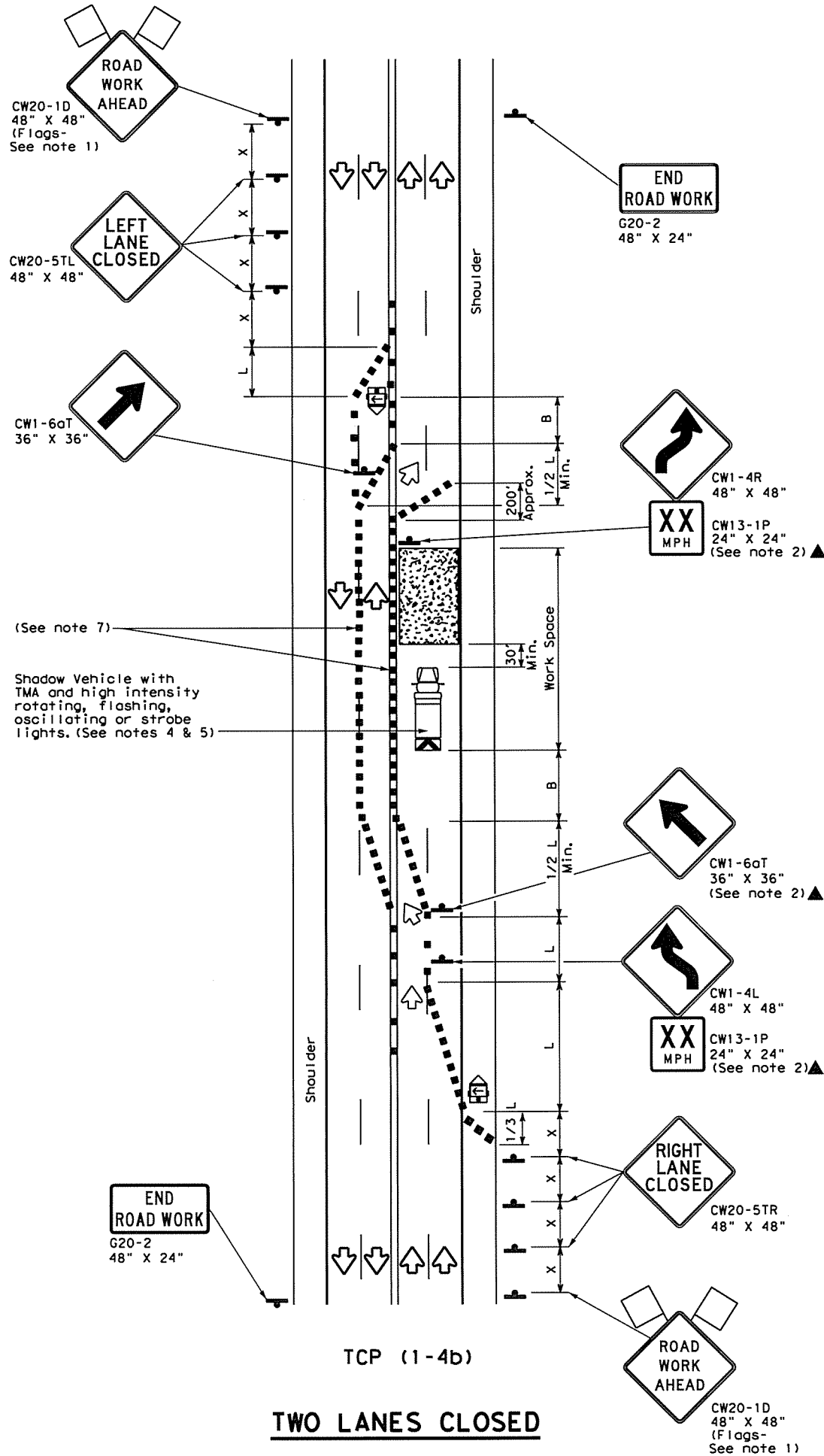
DISCLAIMER: The use of this standard is governed by the "Texas Engineering Practice Act". No warranty of any kind is made by TxDOT for any purpose whatsoever. TxDOT assumes no responsibility for the conversion of this standard to other formats or for incorrect results or damages resulting from its use.

DATE: FILE:



TCP (1-4a)

ONE LANE CLOSED



TCP (1-4b)

TWO LANES CLOSED

LEGEND			
	Type 3 Barricade		Channelizing Devices
	Heavy Work Vehicle		Truck Mounted Attenuator (TMA)
	Trailer Mounted Flashing Arrow Board		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)

TYPICAL USAGE				
MOBILE	SHORT DURATION	SHORT TERM STATIONARY	INTERMEDIATE TERM STATIONARY	LONG TERM STATIONARY
	✓	✓		

GENERAL NOTES

- Flags attached to signs where shown are REQUIRED.
 - All traffic control devices illustrated are REQUIRED, except those denoted with the triangle symbol may be omitted when stated elsewhere in the plans, or for routine maintenance work, when approved by the Engineer.
 - The CW20-1D "ROAD WORK AHEAD" sign may be repeated if the visibility of the work zone is less than 1500 feet.
 - A Shadow Vehicle with a TMA should be used anytime it can be positioned 30 to 100 feet in advance of the area of crew exposure without adversely affecting the performance or quality of the work. If workers are no longer present but road or work conditions require the traffic control to remain in place, Type 3 Barricades or other channelizing devices may be substituted for the Shadow Vehicle and TMA.
 - Additional Shadow Vehicles with TMAs may be positioned off the paved surface, next to those shown in order to protect wider work spaces.
- TCP (1-4a)**
- If this TCP is used for a left lane closure, CW20-5TL "LEFT LANE CLOSED" signs shall be used and channelizing devices shall be placed on the centerline where needed to protect the work space from opposing traffic with the arrow panel placed in the closed lane near the end of the merging taper.

TCP (1-4b)

- Where traffic is directed over a yellow centerline, channelizing devices which separate two-way traffic should be spaced on tapers at 20' or 15' if posted speeds are 35 mph or slower, and for tangent sections, at 1/2S where S is the speed in mph. This tighter device spacing is intended for the areas of conflicting markings, not the entire work zone.

Texas Department of Transportation
 Traffic Operations Division Standard

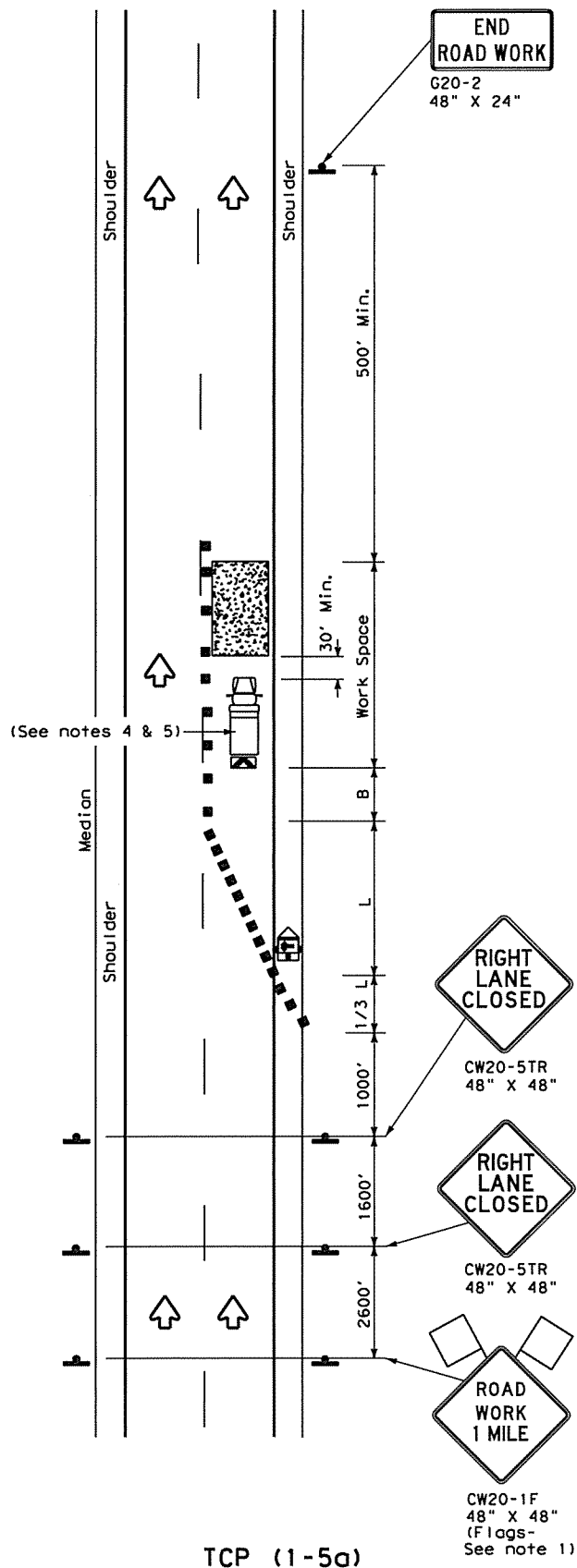
**TRAFFIC CONTROL PLAN
 LANE CLOSURES ON MULTILANE
 CONVENTIONAL ROADS**

TCP (1-4) - 18

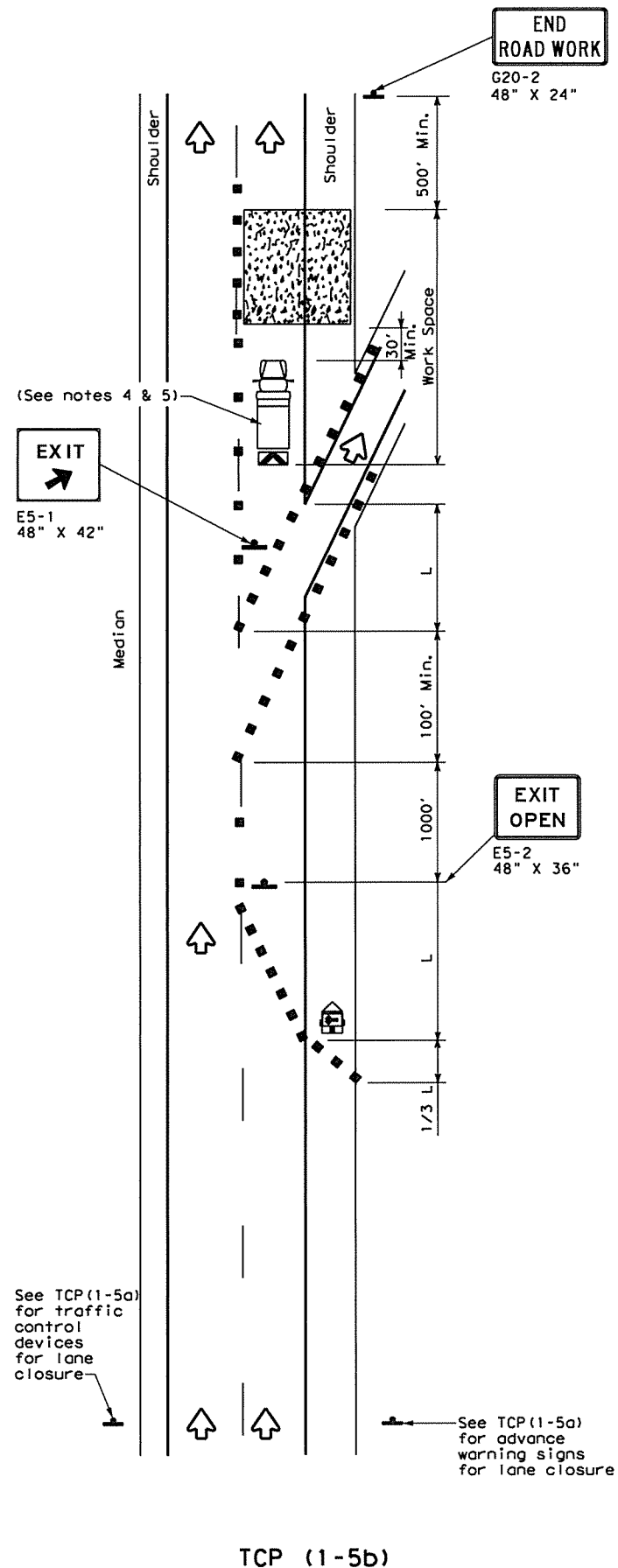
FILE: tcp1-4-18.dgn	DN:	CK:	DW:	CK:
© TxDOT December 1985	CONT	SECT	JOB	HIGHWAY
REVISIONS	6459	93	001	1-610, etc.
2-94 4-98	DIST	COUNTY	SHEET NO.	
8-95 2-12	HOU	HARRIS, etc.	86	
1-97 2-18				

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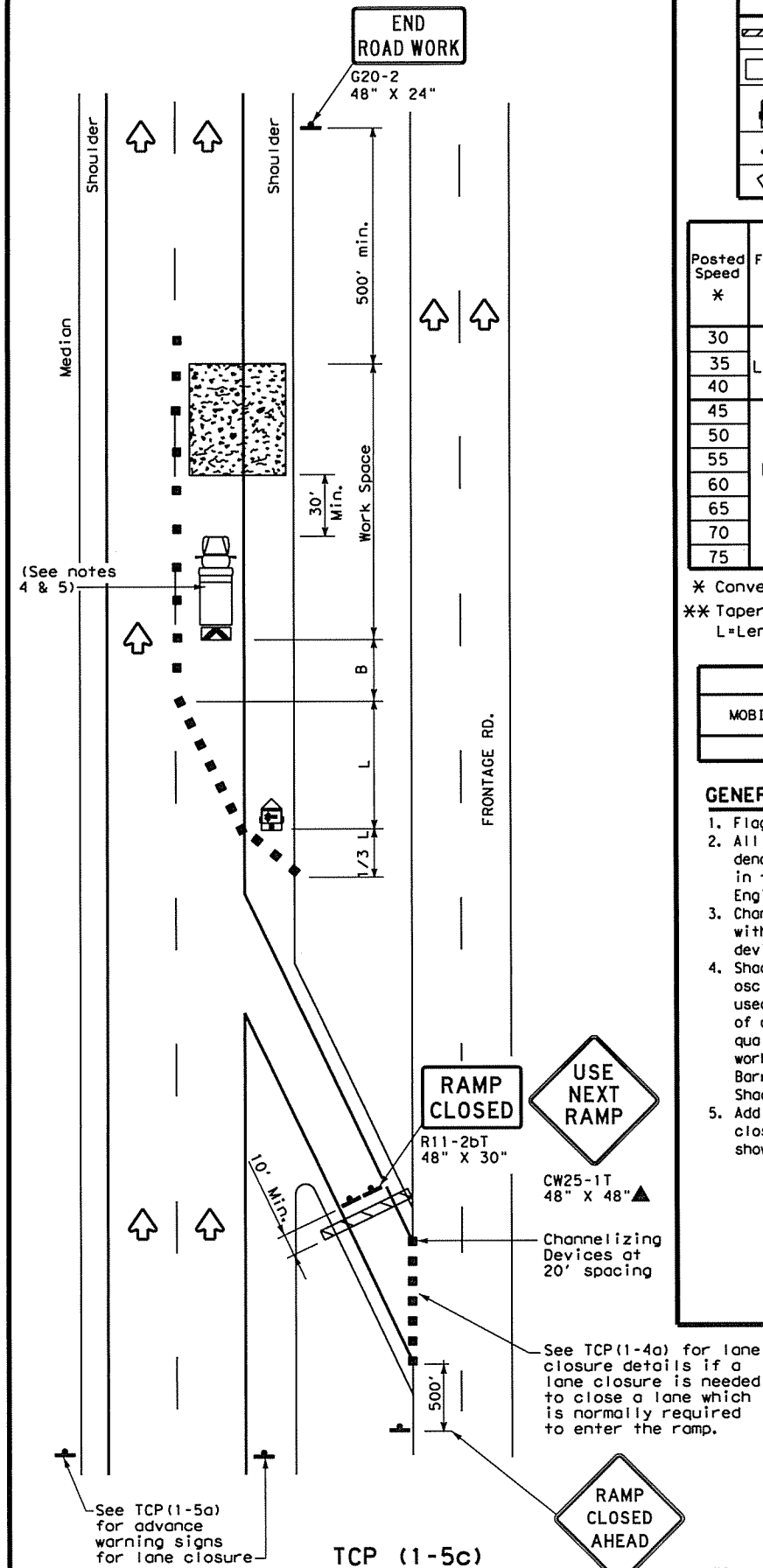
DATE: FILE:



ONE LANE CLOSURE



LANE CLOSURE NEAR EXIT RAMP



LANE CLOSURE NEAR ENTRANCE RAMP

LEGEND			
	Type 3 Barricade		Channelizing Devices
	Heavy Work Vehicle		Truck Mounted Attenuator (TMA)
	Trailer Mounted Flashing Arrow Board		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)

TYPICAL USAGE				
MOBILE	SHORT DURATION	SHORT TERM STATIONARY	INTERMEDIATE TERM STATIONARY	LONG TERM STATIONARY
		✓		

- GENERAL NOTES**
- Flags attached to signs where shown, are REQUIRED.
 - All traffic control devices illustrated are REQUIRED, except those denoted with the triangle symbol may be omitted when stated elsewhere in the plans, or for routine maintenance work, when approved by the Engineer.
 - Channelizing devices used to close lanes may be supplemented with the Chevron Alignment Sign placed on every other channelizing device. Chevrons may be attached to plastic drums as per BC Standards.
 - Shadow Vehicle with TMA and high intensity rotating, flashing, oscillating or strobe lights. A Shadow Vehicle with a TMA should be used anytime it can be positioned 30 to 100 feet in advance of the area of crew exposure without adversely affecting the performance or quality of the work. If workers are no longer present but road or work conditions require the traffic control to remain in place, Type 3 Barricades or other channelizing devices may be substituted for the Shadow Vehicle and TMA.
 - Additional Shadow Vehicles with TMAs may be positioned in each closed lane, on the shoulder or off the paved surface, next to those shown in order to protect a wider work space.

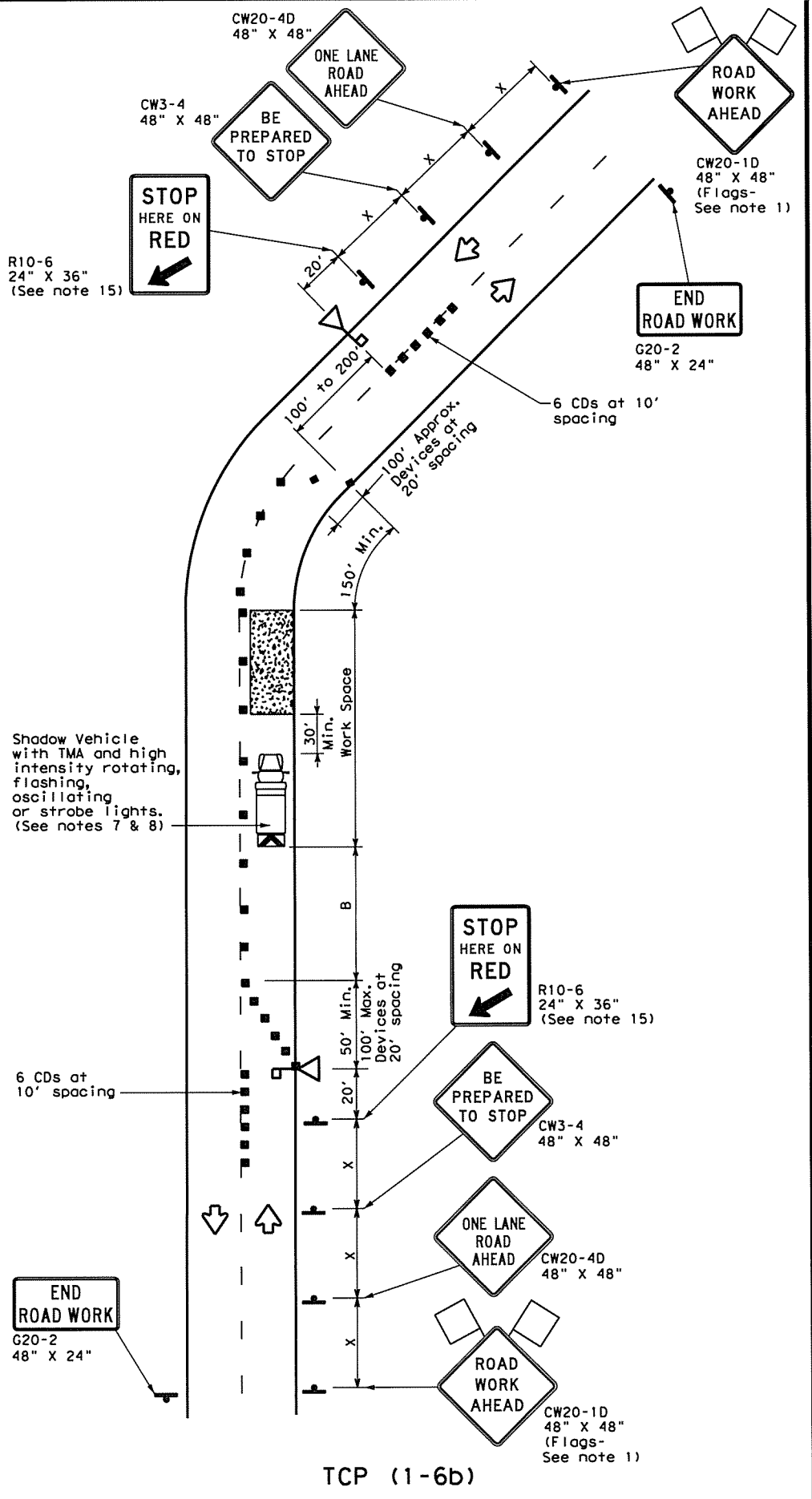
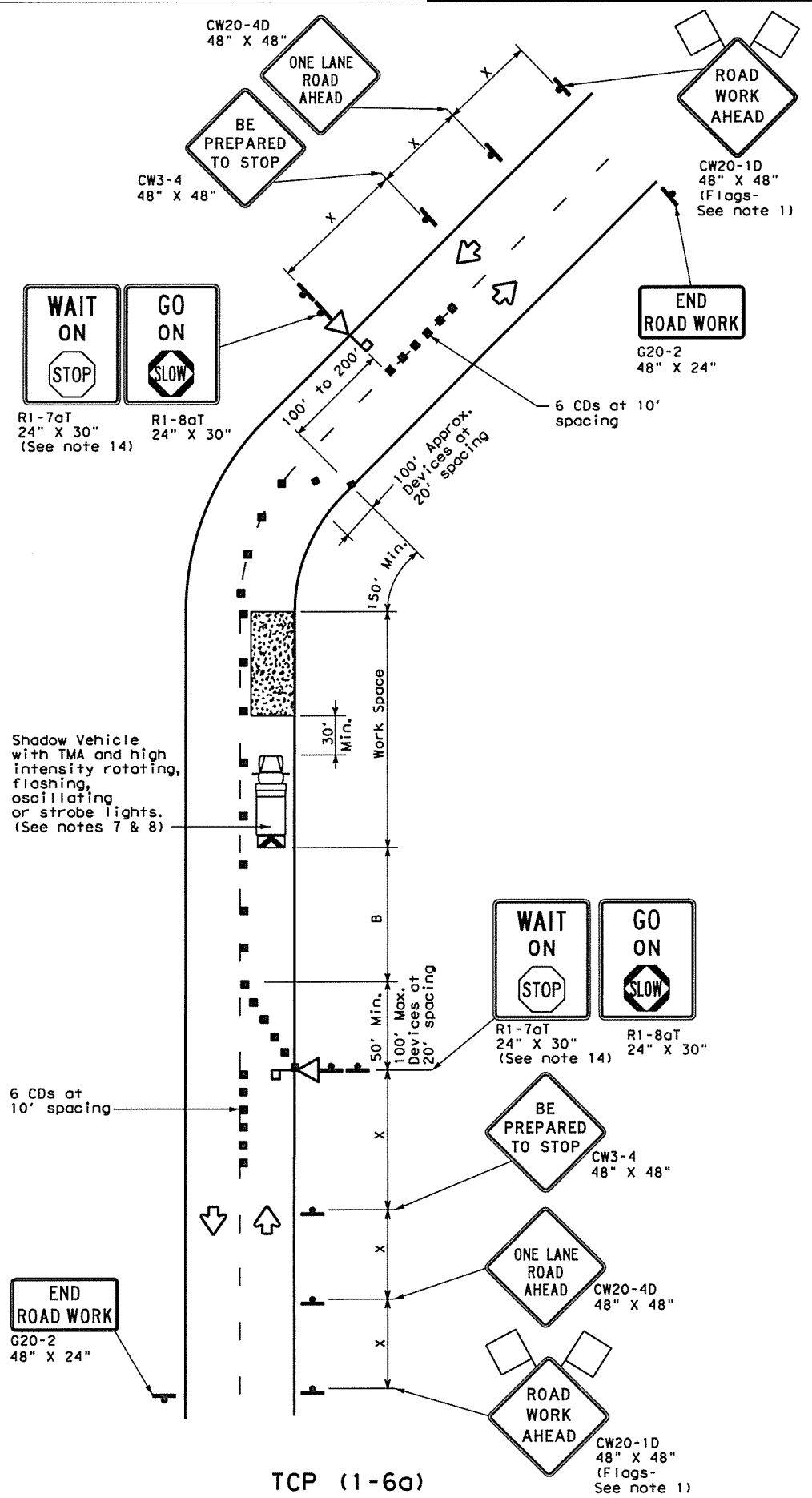


**TRAFFIC CONTROL PLAN
LANE CLOSURES FOR
DIVIDED HIGHWAYS**

TCP (1-5) - 18

FILE: tcp1-5-18.dgn	DN: 6459	CK: 93	DN: 001	CK: I-610, etc
© TxDOT February 2012	CONT: 6459	SECT: 93	JOB: 001	HIGHWAY: I-610, etc
2-18 REVISIONS	DIST: HOU	COUNTY: HARRIS, etc.	SHEET NO.: 87	

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LEGEND

	Type 3 Barricade		Channelizing Devices (CDs)
	Heavy Work Vehicle		Truck Mounted Attenuator (TMA)
	Automated Flagger Assistance Device (AFAD)		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"	Stopping Sight Distance
		10' Offset	11' Offset	12' Offset	On a Taper	On a Tangent			
30	L = WS ² / 60	150'	165'	180'	30'	60'	120'	90'	200'
35		205'	225'	245'	35'	70'	160'	120'	250'
40		265'	295'	320'	40'	80'	240'	155'	305'
45	L = WS	450'	495'	540'	45'	90'	320'	195'	360'
50		500'	550'	600'	50'	100'	400'	240'	425'
55		550'	605'	660'	55'	110'	500'	295'	495'
60		600'	660'	720'	60'	120'	600'	350'	570'
65		650'	715'	780'	65'	130'	700'	410'	645'
70		700'	770'	840'	70'	140'	800'	475'	730'
75		750'	825'	900'	75'	150'	900'	540'	820'

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

TYPICAL USAGE

MOBILE	SHORT DURATION	SHORT TERM STATIONARY	INTERMEDIATE TERM STATIONARY	LONG TERM STATIONARY
	✓	✓		

GENERAL NOTES

- Flags attached to signs where shown are REQUIRED.
- AFADs shall only be used in situations where there is one lane of approaching traffic in the direction to be controlled.
- Adequate stopping sight distance must be provided to each AFAD location for approaching traffic. (See table above).
- Each AFAD shall be operated by a qualified/certified flagger. Flaggers operating AFADs shall not leave them unattended while they are in use.
- One flagger may operate two AFADs only when the flagger has an unobstructed view of both AFADs and of the approaching traffic in both directions.
- When pilot cars are used, a flagger controlling traffic shall be located on each approach. AFADs shall not be operated by the pilot car operator.
- All AFADs shall be equipped with gate arms with an orange or fluorescent red-orange flag attached to the end of the gate arm. The flag shall be a minimum of 16" square.
- A Shadow Vehicle with a TMA should be used anytime it can be positioned 30 to 100 feet in advance of the area of crew exposure without adversely affecting the performance or quality of the work. If workers are no longer present but road or work conditions require the traffic control to remain in place, Type 3 Barricades or other channelizing devices may be substituted for the Shadow Vehicle and TMA.
- Additional Shadow Vehicles with TMAs may be positioned off the paved surface, next to those shown in order to protect wider work spaces.
- Flaggers should use two-way radios or other methods of communication to control traffic.
- Length of work space should be based on the ability of flaggers to communicate.
- If the work space is located near a horizontal or vertical curve, the buffer distances should be increased in order to maintain stopping sight distance to the AFAD.
- Channelizing devices on the center line may be omitted when a pilot car is leading traffic and approved by the Engineer.
- The R1-7aT "WAIT ON STOP" sign and the R1-8aT "GO ON SLOW" sign shall be installed at the AFAD location on separate supports or they may be fabricated as one 48" x 30" sign. They shall not obscure the face of the STOP/SLOW AFAD.
- The R10-6 "STOP HERE ON RED" arrow sign shall be offset so as not to obscure the lenses of the AFAD.

Texas Department of Transportation
 Traffic Operations Division Standard

**TRAFFIC CONTROL PLAN
 AUTOMATED FLAGGER ASSISTANCE DEVICES (AFADS)**

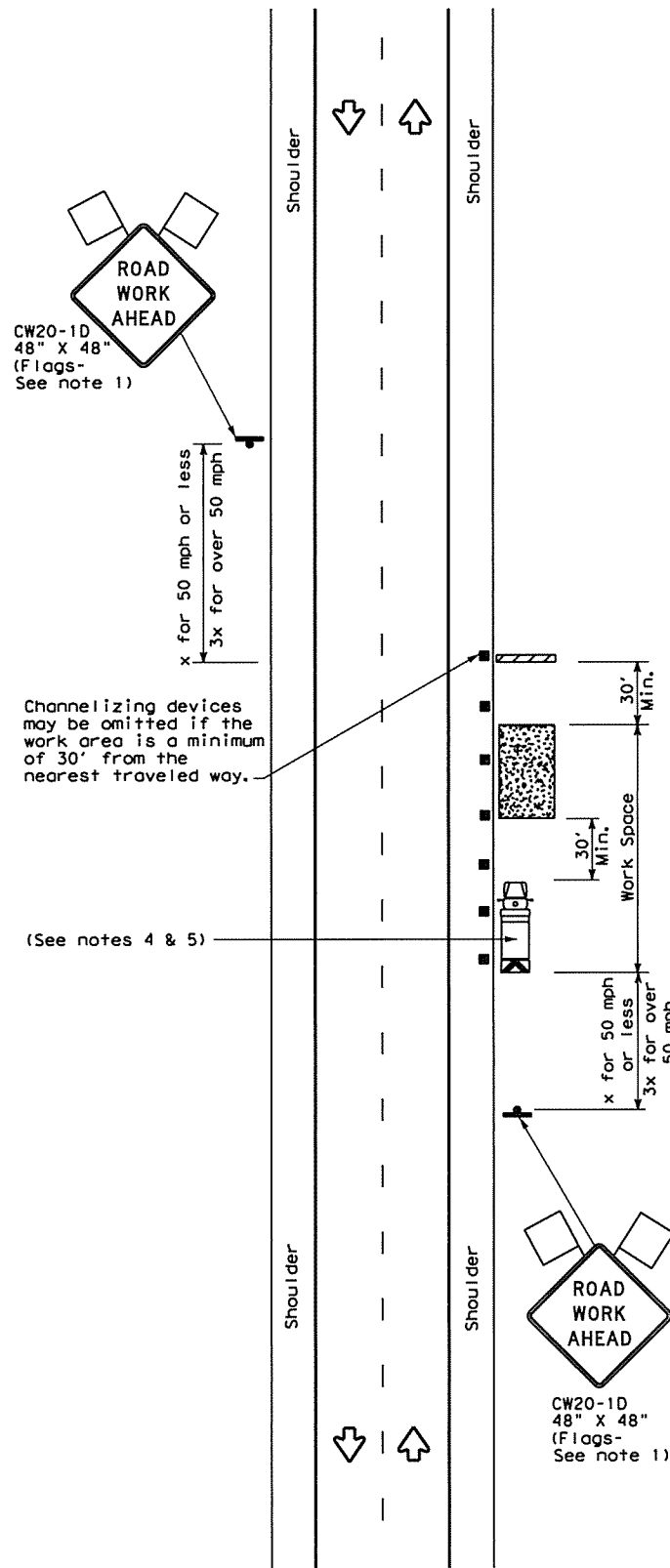
TCP (1-6) - 18

FILE: tcp1-6-18.dgn	DN:	CK:	DW:	CK:
© TxDOT February 2012	CONT	SECT	JOB	HIGHWAY
REVISIONS	6459	93	001	1-610, etc.
2-18	DIST	COUNTY	SHEET NO.	
	HOU	HARRIS, etc.	88	

DATE: FILE:

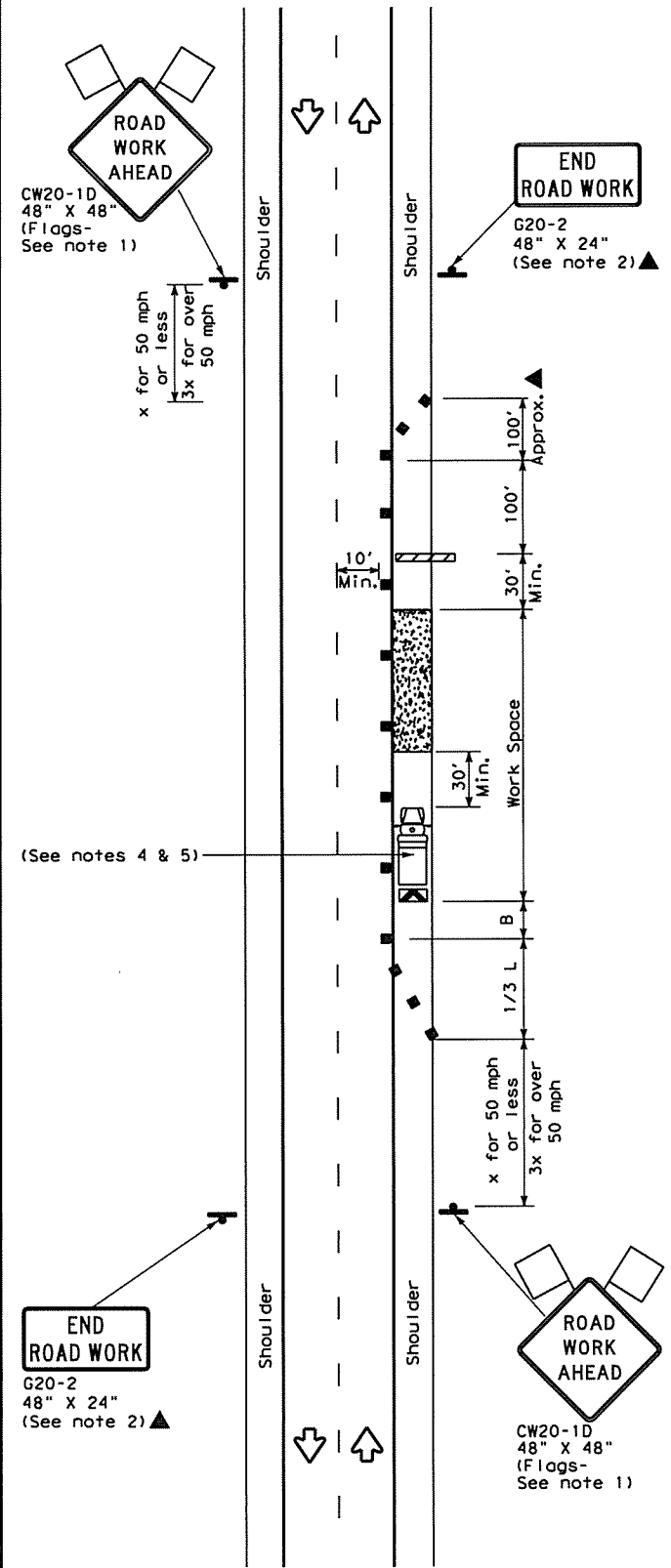
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DATE: FILE:



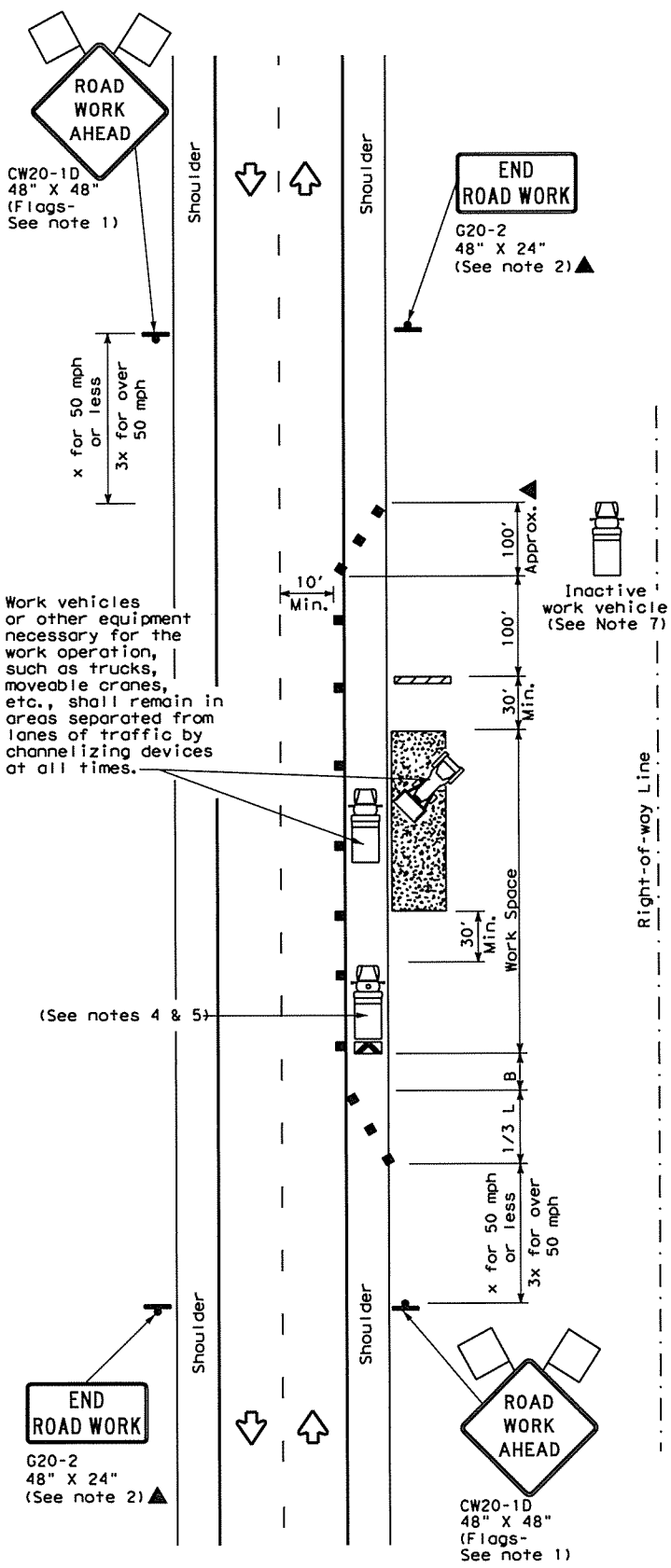
TCP (2-1a)

WORK SPACE NEAR SHOULDER
Conventional Roads



TCP (2-1b)

WORK SPACE ON SHOULDER
Conventional Roads



TCP (2-1c)

WORK VEHICLES ON SHOULDER
Conventional Roads

LEGEND			
	Type 3 Barricade		Channelizing Devices
	Heavy Work Vehicle		Truck Mounted Attenuator (TMA)
	Trailer Mounted Flashing Arrow Board		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 = 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)

TYPICAL USAGE				
MOBILE	SHORT DURATION	SHORT TERM STATIONARY	INTERMEDIATE TERM STATIONARY	LONG TERM STATIONARY
	✓	✓	✓	✓

- GENERAL NOTES**
- Flags attached to signs where shown, are REQUIRED.
 - All traffic control devices illustrated are REQUIRED, except those denoted with the triangle symbol may be omitted when stated in the plans, or for routine maintenance work, when approved by the Engineer.
 - Stackpiled material should be placed a minimum of 30 feet from nearest traveled way.
 - Shadow Vehicle with TMA and high intensity rotating, flashing, oscillating or strobe lights. A Shadow Vehicle with a TMA should be used anytime it can be positioned 30 to 100 feet in advance of the area of crew exposure without adversely affecting the performance or quality of the work. If workers are no longer present but road or work conditions require the traffic control to remain in place, Type 3 Barricades or other channelizing devices may be substituted for the Shadow Vehicle and TMA.
 - Additional Shadow Vehicles with TMAs may be positioned off the paved surface, next to those shown in order to protect a wider work space.
 - See TCP(5-1) for shoulder work on divided highways, expressways and freeways.
 - Inactive work vehicles or other equipment should be parked near the right-of-way line and not parked on the paved shoulder.
 - CW21-5 "SHOULDER WORK" signs may be used in place of CW21-1D "ROAD WORK AHEAD" signs for shoulder work on conventional roadways.

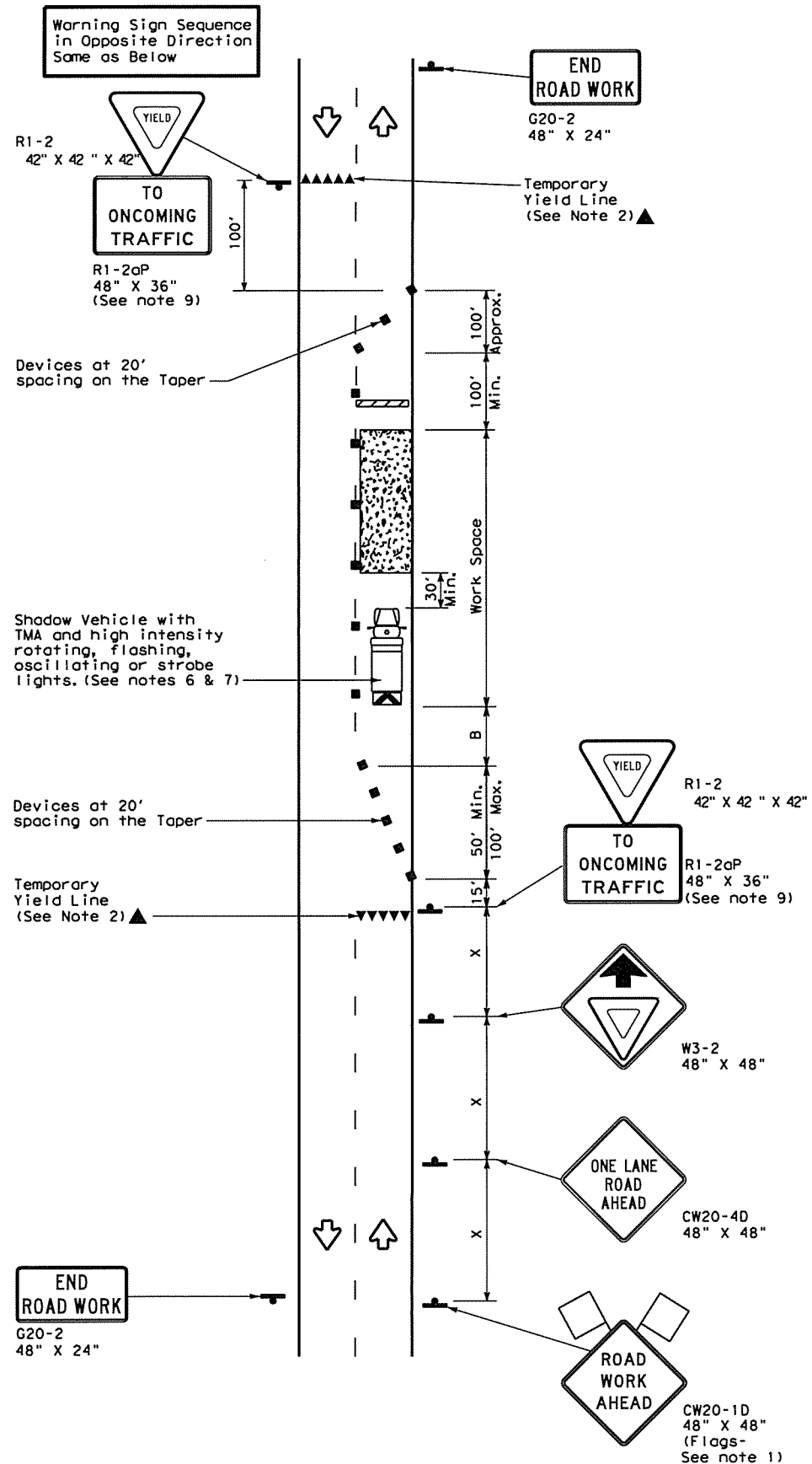


**TRAFFIC CONTROL PLAN
CONVENTIONAL ROAD
SHOULDER WORK**

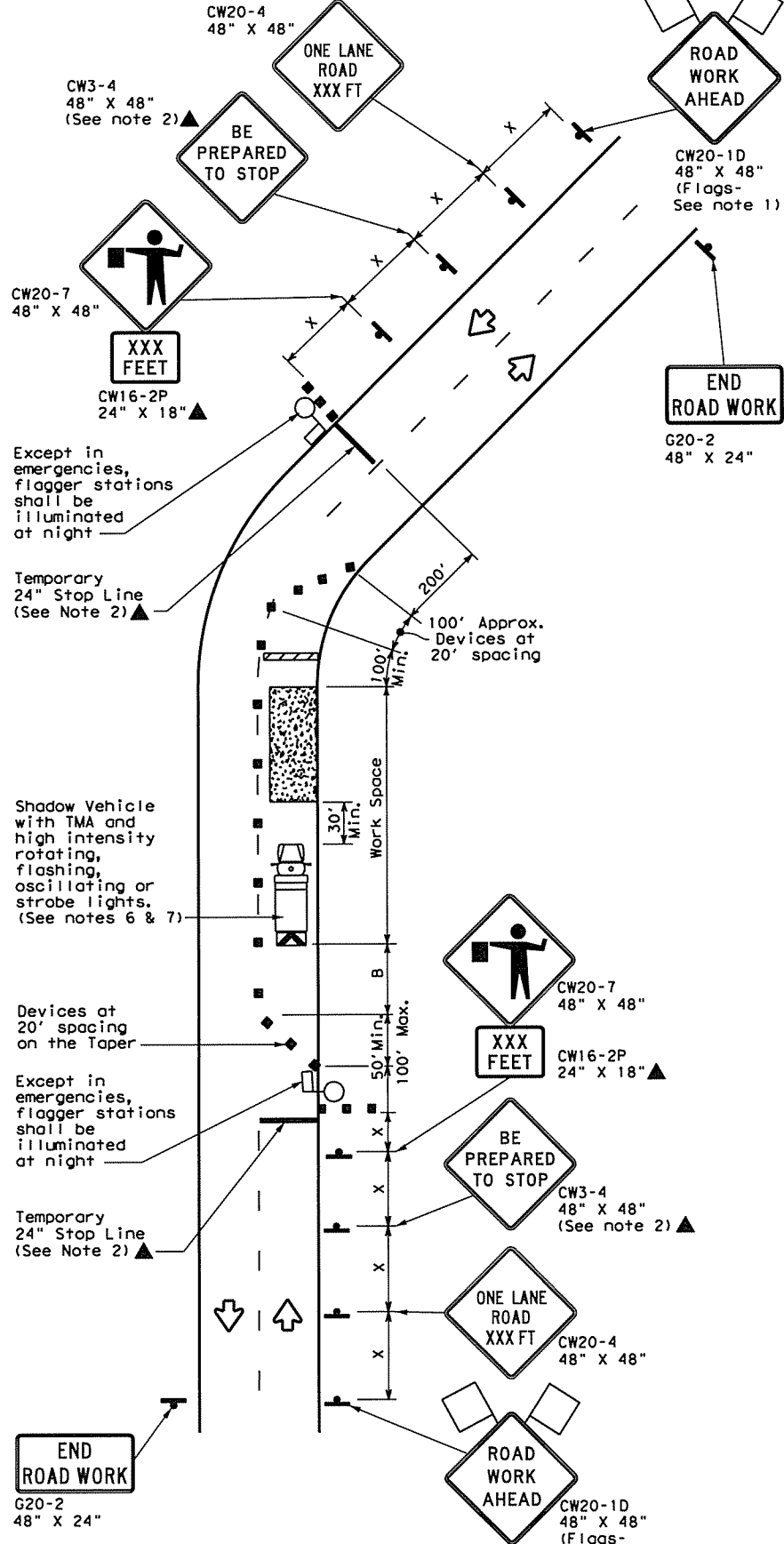
TCP (2-1) - 18

FILE: tcp2-1-18.dgn	DW1	CK1	DW1	CK1
© TxDOT December 1985	CONT	SECT	JOB	HIGHWAY
REVISIONS	6459	93	001	I-610, etc.
2-94 4-98	DIST	COUNTY	SHEET NO.	
8-95 2-12	HOU	HARRIS, etc.	89	
1-97 2-18				

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TCP (2-2a)
 2-LANE ROADWAY WITHOUT PAVED SHOULDERS
 ONE LANE TWO-WAY
 CONTROL WITH YIELD SIGNS
 (Less than 2000 ADT - See Note 9)



TCP (2-2b)
 2-LANE ROADWAY WITHOUT PAVED SHOULDERS
 ONE LANE TWO-WAY
 CONTROL WITH FLAGGERS

LEGEND			
	Type 3 Barricade		Channelizing Devices
	Heavy Work Vehicle		Truck Mounted Attenuator (TMA)
	Trailer Mounted Flashing Arrow Board		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"	Stopping Sight Distance
		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'	200'
35		205'	225'	245'	35'	70'	160'	120'	250'
40		265'	295'	320'	40'	80'	240'	155'	305'
45	L = WS	450'	495'	540'	45'	90'	320'	195'	360'
50		500'	550'	600'	50'	100'	400'	240'	425'
55		550'	605'	660'	55'	110'	500'	295'	495'
60		600'	660'	720'	60'	120'	600'	350'	570'
65		650'	715'	780'	65'	130'	700'	410'	645'
70		700'	770'	840'	70'	140'	800'	475'	730'
75		750'	825'	900'	75'	150'	900'	540'	820'

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

TYPICAL USAGE				
MOBILE	SHORT DURATION	SHORT TERM STATIONARY	INTERMEDIATE TERM STATIONARY	LONG TERM STATIONARY
	✓	✓	✓	

GENERAL NOTES

- Flags attached to signs where shown, are REQUIRED.
 - All traffic control devices illustrated are REQUIRED, except those denoted with the triangle symbol may be omitted when stated elsewhere in the plans, or for routine maintenance work, when approved by the Engineer.
 - The CW3-4 "BE PREPARED TO STOP" sign may be installed after the CW20-4 "ONE LANE ROAD XXX FT" sign, but proper sign spacing shall be maintained.
 - Flaggers should use two-way radios or other methods of communication to control traffic.
 - Length of work space should be based on the ability of flaggers to communicate.
 - A Shadow Vehicle with a TMA should be used anytime it can be positioned 30 to 100 feet in advance of the area of crew exposure without adversely affecting the performance or quality of the work. If workers are no longer present but road or work conditions require the traffic control to remain in place, Type 3 Barricades or other channelizing devices may be substituted for the Shadow Vehicle and TMA.
 - Additional Shadow Vehicles with TMAs may be positioned off the paved surface, next to those shown in order to protect a wider work space.
- TCP (2-2a)**
- The R1-2 "YIELD" sign traffic control may be used on projects with approaches that have adequate sight distance. For projects in urban areas, work space should be no longer than one half city block. In rural areas, roadways with less than 2000 ADT, work space should be no longer than 400 feet.
 - The R1-2aP "YIELD TO ONCOMING TRAFFIC" sign shall be placed on a support at a 7 foot minimum mounting height.
- TCP (2-2b)**
- Channelizing devices on the center line may be omitted when a pilot car is leading traffic and approved by the Engineer.
 - If the work space is located near a horizontal or vertical curve, the buffer distances should be increased in order to maintain stopping sight distance to the flagger and a queue of stopped vehicles. (See table above).
 - Flaggers should use 24" STOP/SLOW paddles to control traffic. Flags should be limited to emergency situations.

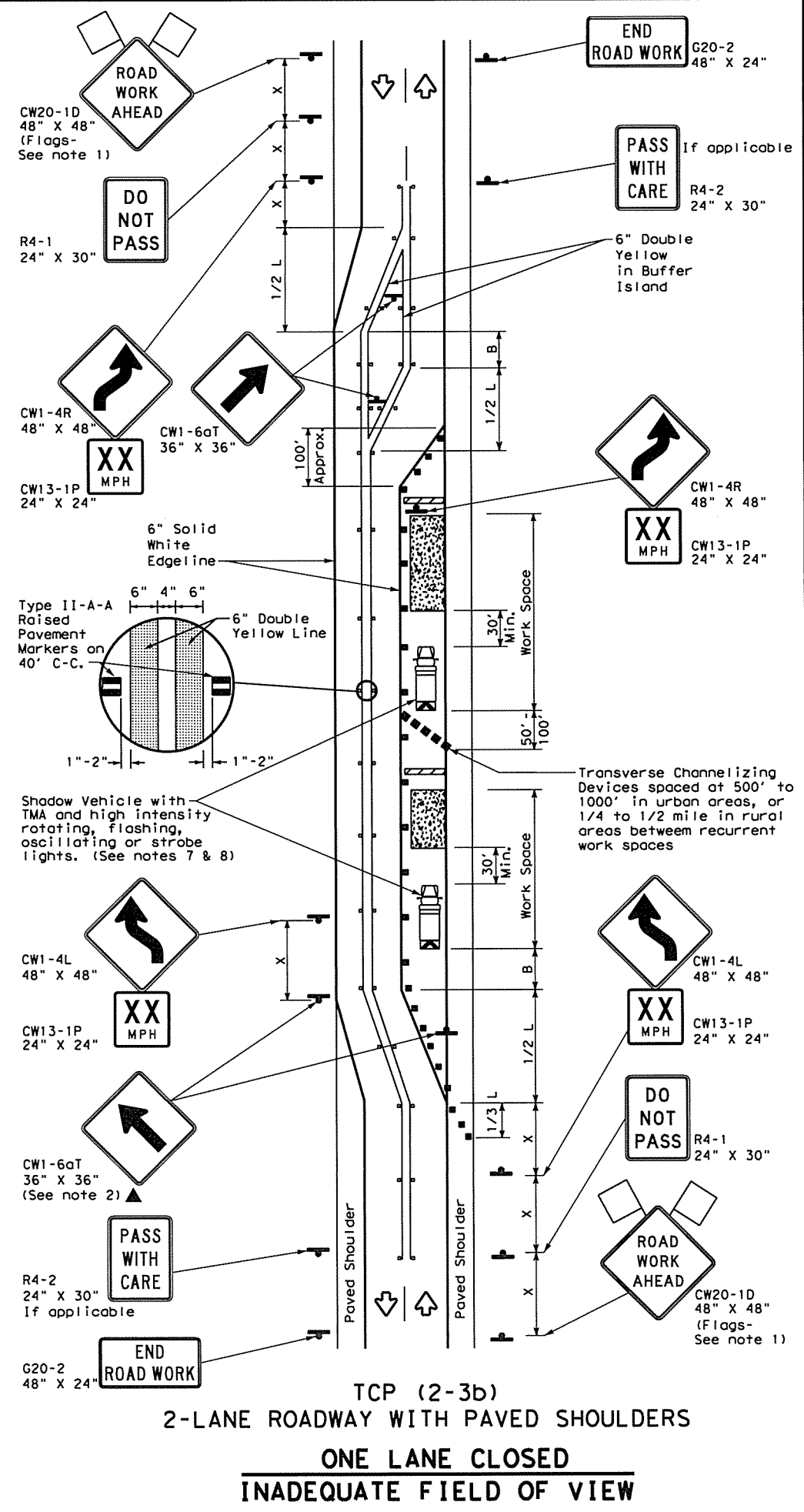
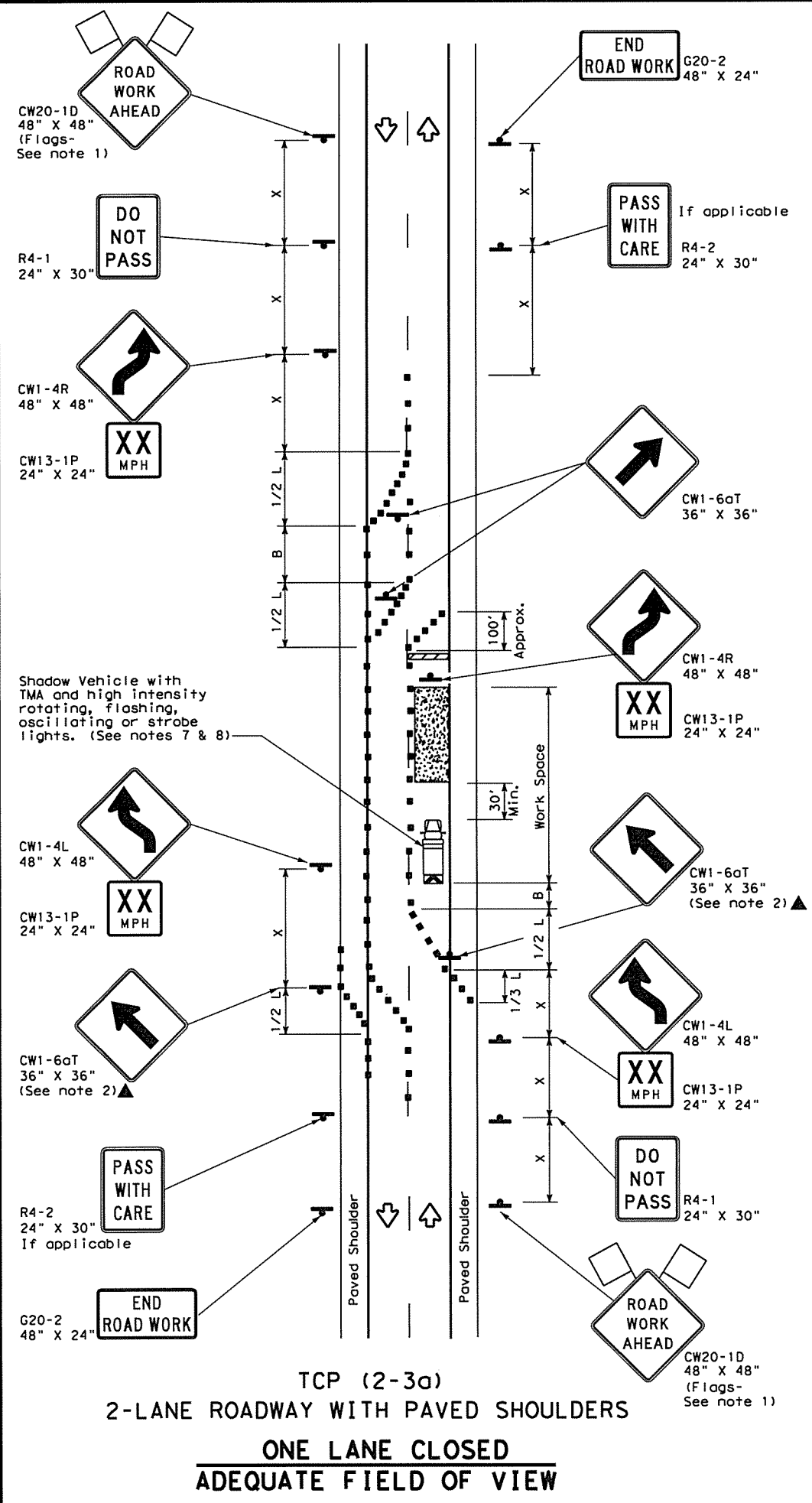
Traffic Operations Division Standard

TRAFFIC CONTROL PLAN
ONE-LANE TWO-WAY
TRAFFIC CONTROL

TCP (2-2) - 18

FILE: tcp2-2-18.dgn	DW: CK1	DN: CK1	CK1
© TxDOT December 1985	CONT	SECT	JOB
REVISIONS	6459	93	001
8-95 3-03	DIST	COUNTY	SHEET NO.
1-97 2-12	HOU	HARRIS, etc.	90
4-98 2-18			

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LEGEND			
	Type 3 Barricade		Channelizing Devices
	Heavy Work Vehicle		Truck Mounted Attenuator (TMA)
	Trailer Mounted Flashing Arrow Board		Raised Pavement Markers Ty II-AA
	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 = 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)

TYPICAL USAGE				
MOBILE	SHORT DURATION	SHORT TERM STATIONARY	INTERMEDIATE TERM STATIONARY	LONG TERM STATIONARY
			✓	✓
				TCP (2-3b) ONLY

- GENERAL NOTES**
- Flags attached to signs where shown, are REQUIRED.
 - All traffic control devices illustrated are REQUIRED, except those denoted with the triangle symbol may be omitted when stated elsewhere in the plans, or for routine maintenance work, when approved by the Engineer.
 - When work space will be in place less than three days existing pavement markings may remain in place. Channelizing devices shall be used to separate traffic.
 - Flagger control should NOT be used unless roadway conditions or heavy traffic volume require additional emphasis to safely control traffic. Flagger should be positioned at end of traffic queue.
 - The R4-1 "DO NOT PASS," R4-2 "PASS WITH CARE" and construction regulatory speed zone signs may be installed with CW20-1D "ROAD WORK AHEAD" signs. Proper spacing of signs shall be maintained.
 - Conflicting pavement marking shall be removed for long term projects.
 - A Shadow Vehicle with a TMA should be used anytime it can be positioned 30 to 100 feet in advance of the area of crew exposure without adversely affecting the performance or quality of the work. If workers are no longer present but road or work conditions require the traffic control to remain in place, Type 3 Barricades or other channelizing devices may be substituted.
 - Additional Shadow Vehicles with TMAs may be positioned off the paved surface, next to those shown in order to protect a wider work space.

- TCP (2-3a)**
- Conflicting pavement markings shall be removed for long-term projects. For shorter durations where traffic is directed over a yellow centerline, channelizing devices which separate two-way traffic should be spaced on tapers at 20' or 15' if posted speeds are 35 mph or slower, and for tangent sections, at 1/2(S) where S is the speed in mph. This tighter device spacing is intended for the area of the conflicting markings, not the entire work zone.



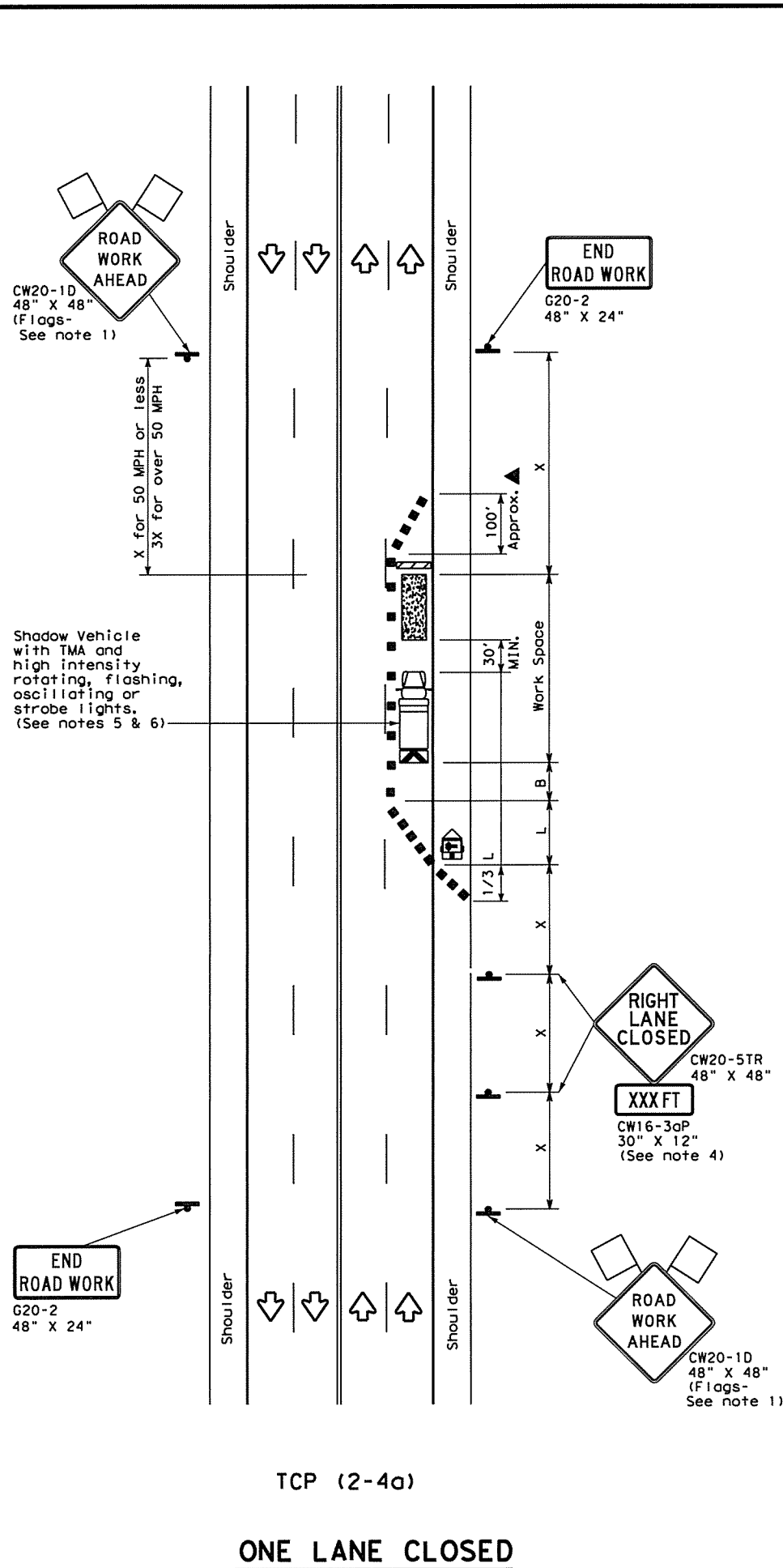
TRAFFIC CONTROL PLAN
TRAFFIC SHIFTS ON
TWO-LANE ROADS

TCP (2-3) - 23

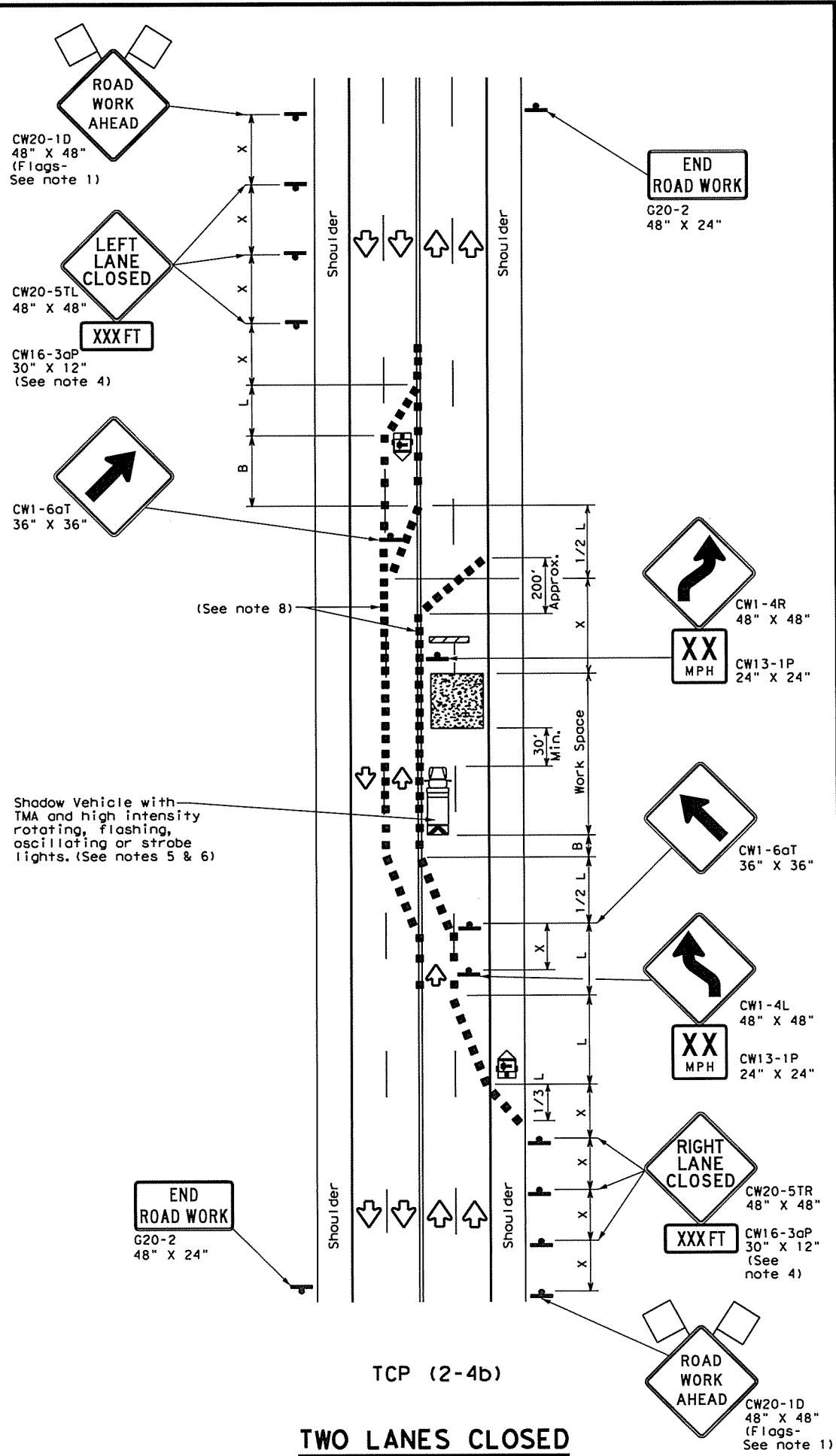
FILE: tcp(2-3)-23.dgn	DN:	CK:	DW:	CK:
© TxDOT April 2023	CONT	SECT	JOB	HIGHWAY
12-85 4-98 2-18	6459	93	001	1-610, etc.
8-95 3-03 4-23	DIST	COUNTY	SHEET NO.	
1-97 2-12	HOU	HARRIS, etc.	91	

DATE: FILE:

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TCP (2-4a)
ONE LANE CLOSED



TCP (2-4b)
TWO LANES CLOSED

LEGEND			
	Type 3 Barricade		Channelizing Devices
	Heavy Work Vehicle		Truck Mounted Attenuator (TMA)
	Trailer Mounted Flashing Arrow Board		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		450'	495'	540'	45'	90'	320'	195'
50	L = WS	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)

TYPICAL USAGE				
MOBILE	SHORT DURATION	SHORT TERM STATIONARY	INTERMEDIATE TERM STATIONARY	LONG TERM STATIONARY
		✓	✓	

GENERAL NOTES

- Flags attached to signs where shown, are REQUIRED.
- All traffic control devices illustrated are REQUIRED, except those denoted with the triangle symbol may be omitted when stated elsewhere in the plans, or for routine maintenance work, when approved by the Engineer.
- The downstream taper is optional. When used, it should be 100 feet minimum length per lane.
- For short term applications, when post mounted signs are not used, the distance legend may be shown on the sign face rather than on a CW16-3aP supplemental plaque.
- A Shadow Vehicle with a TMA should be used anytime it can be positioned 30 to 100 feet in advance of the area of crew exposure without adversely affecting the performance or quality of the work. If workers are no longer present but road or work conditions require the traffic control to remain in place, Type 3 Barricades or other channelizing devices may be substituted for the Shadow Vehicle and TMA.
- Additional Shadow Vehicles with TMAs may be positioned in each closed lane, on the shoulder or off the paved surface, next to those shown in order to protect a wider work space.

TCP (2-4a)

- If this TCP is used for a left lane closure, CW20-5TL "LEFT LANE CLOSED" signs shall be used and channelizing devices shall be placed on the centerline to protect the work space from opposing traffic with the arrow board placed in the closed lane near the end of the merging taper.

TCP (2-4b)

- For shorter durations where traffic is directed over a yellow centerline, channelizing devices which separate two-way traffic should be spaced on tapers at 20' or 15' if posted speeds are 35 mph or slower, and for tangent sections, at 1/2(S) where S is the speed in mph. This tighter devices spacing is intended for the area of conflicting markings, not the entire work zone.

Texas Department of Transportation
Traffic Operations Division Standard

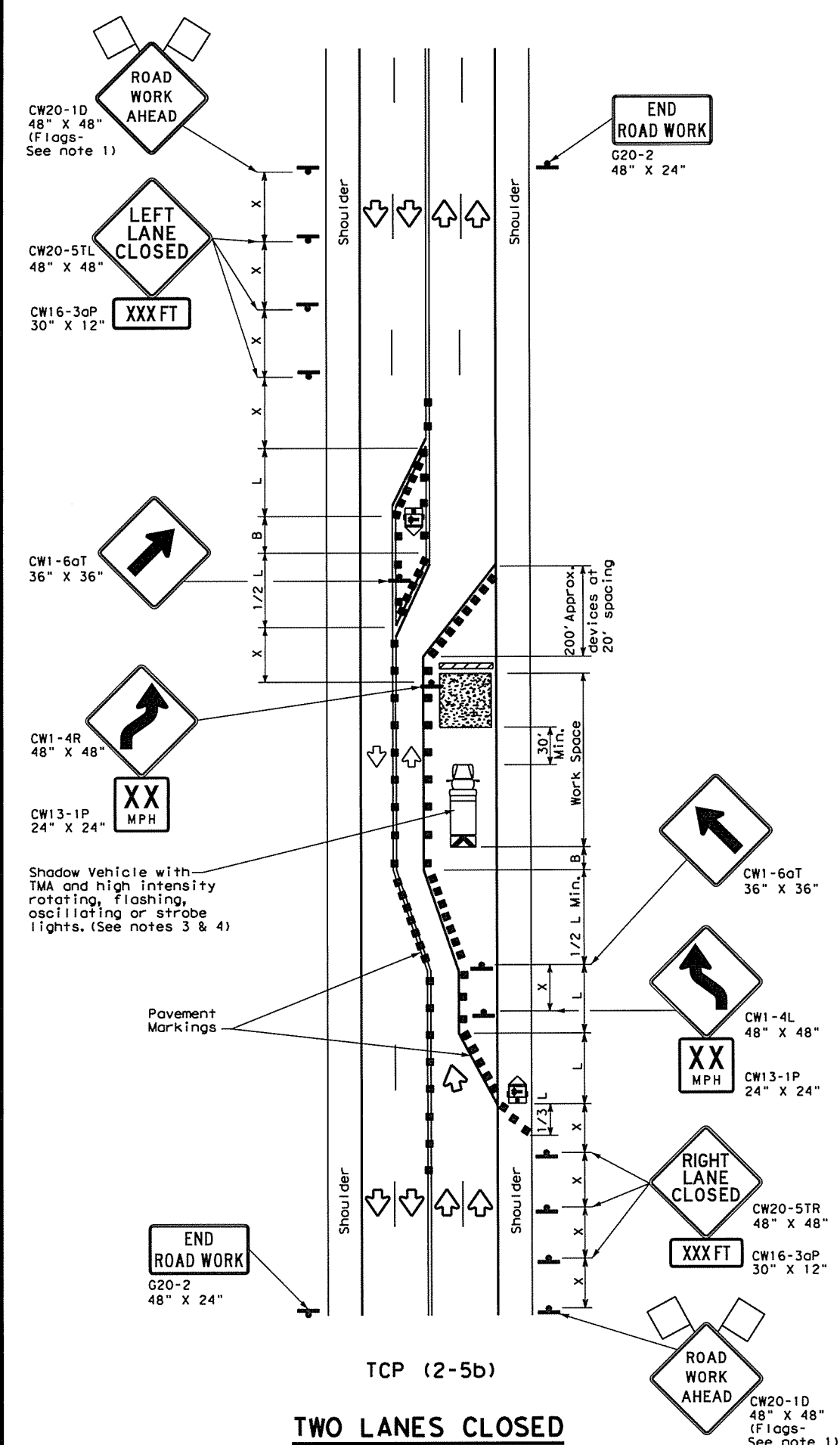
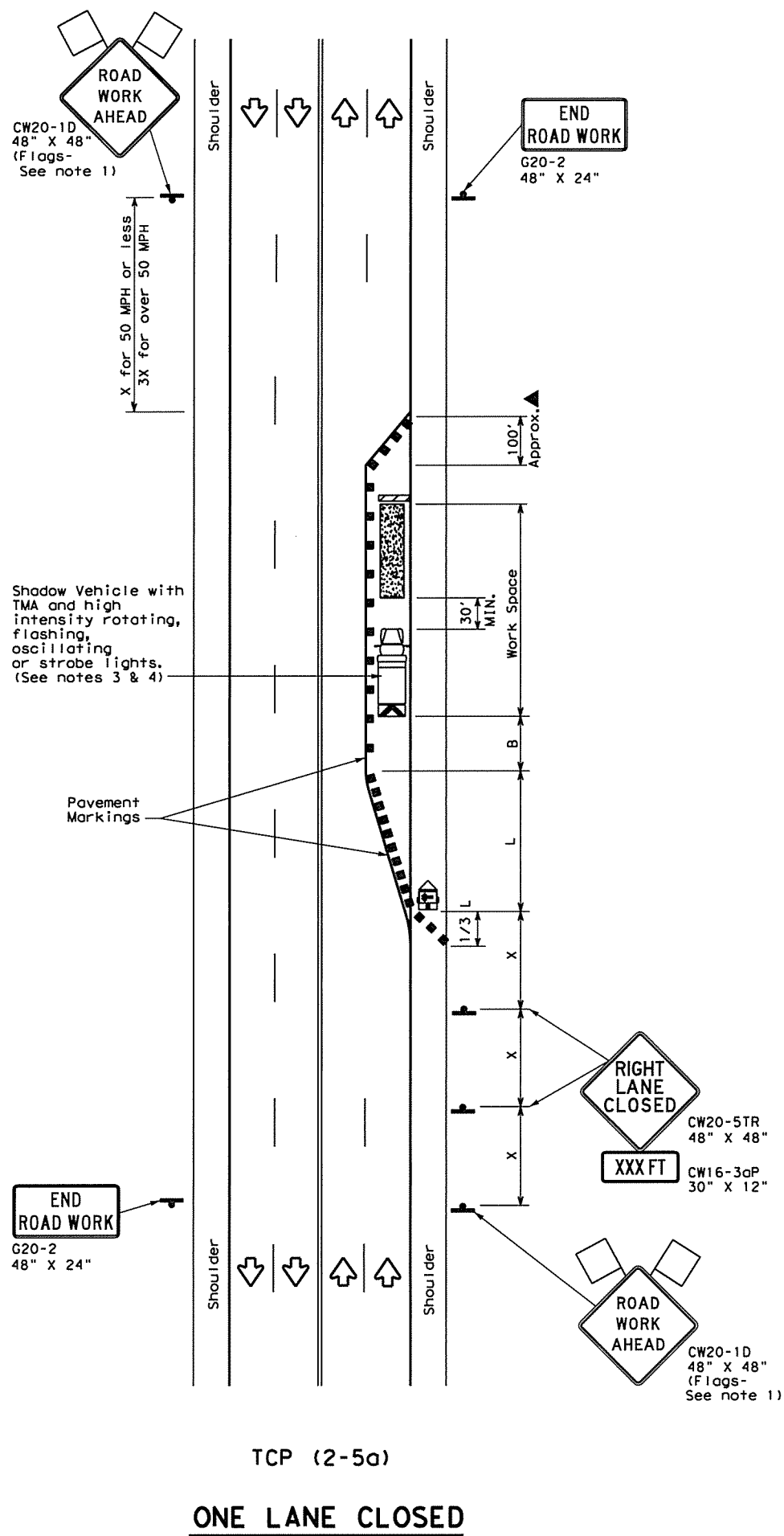
**TRAFFIC CONTROL PLAN
LANE CLOSURES ON MULTILANE
CONVENTIONAL ROADS**

TCP (2-4) - 18

FILE: tcp2-4-18.dgn	DN:	CK:	DW:	CK:
© TxDOT December 1985	CONT	SECT	JOB	HIGHWAY
8-95 3-03	6459	93	001	I-610, etc.
1-97 2-12	DIST	COUNTY	SHEET NO.	
4-98 2-18	HOU	HARRIS, etc.	92	

DATE: FILE:

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LEGEND			
	Type 3 Barricade		Channelizing Devices
	Heavy Work Vehicle		Truck Mounted Attenuator (TMA)
	Trailer Mounted Flashing Arrow Board		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 = WS ² / 60	150'	165'	180'	30'	60'	120'	90'
35		205'	225'	245'	35'	70'	160'	120'
40	L = WS	265'	295'	320'	40'	80'	240'	155'
45		450'	495'	540'	45'	90'	320'	195'
50	L = WS	500'	550'	600'	50'	100'	400'	240'
55		550'	605'	660'	55'	110'	500'	295'
60	L = WS	600'	660'	720'	60'	120'	600'	350'
65		650'	715'	780'	65'	130'	700'	410'
70	L = WS	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)

TYPICAL USAGE				
MOBILE	SHORT DURATION	SHORT TERM STATIONARY	INTERMEDIATE TERM STATIONARY	LONG TERM STATIONARY
			✓	✓

- GENERAL NOTES**
- Flags attached to signs where shown, are REQUIRED.
 - All traffic control devices illustrated are REQUIRED, except those denoted with the triangle symbol may be omitted when stated elsewhere in the plans, or for routine maintenance work, when approved by the Engineer.
 - A Shadow Vehicle with a TMA should be used anytime it can be positioned 30 to 100 feet in advance of the area of crew exposure without adversely affecting the performance or quality of the work. If workers are no longer present but road or work conditions require the traffic control to remain in place, Type 3 Barricades or other channelizing devices may be substituted for the Shadow Vehicle and TMA.
 - Additional Shadow Vehicles with TMAs may be positioned in each closed lane, on the shoulder or off the paved surface, next to those shown in order to protect a wider work space.
 - The downstream taper is optional. When used, it should be 100 feet approximately per lane, with channelizing devices spaced at 20 feet.

- TCP (2-5a)**
- If this TCP is used for a left lane closure, CW20-5TL "LEFT LANE CLOSED" signs shall be used and channelizing devices shall be placed on the centerline to protect the work space from opposing traffic, with the arrow board placed in the closed lane near the end of the merging taper.
- TCP (2-5b)**
- Conflicting pavement markings shall be removed for long-term projects.

Traffic Operations Division Standard

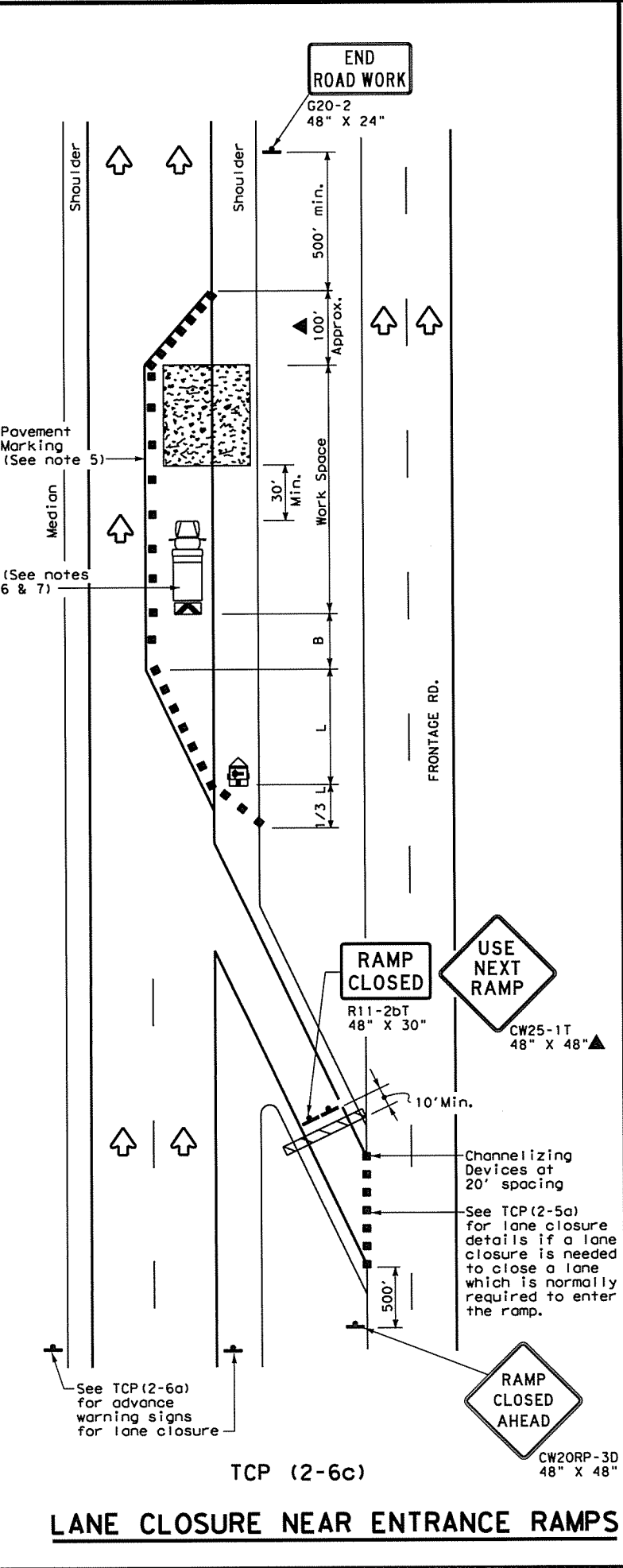
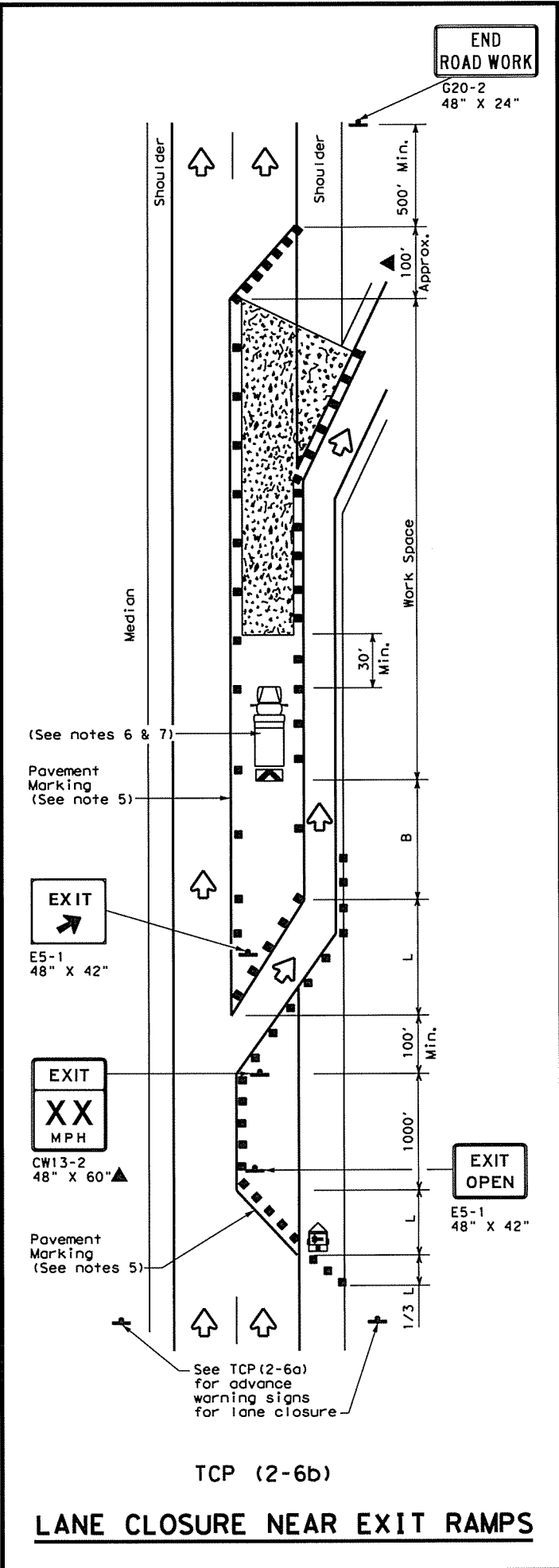
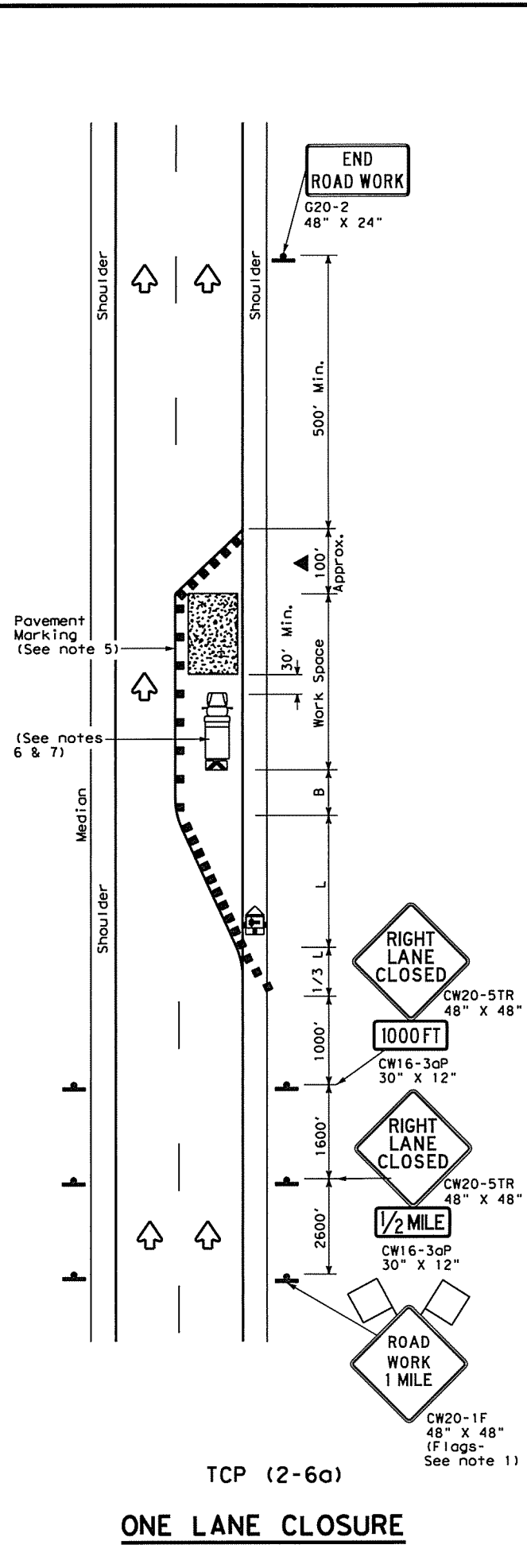
TRAFFIC CONTROL PLAN
LONG TERM LANE CLOSURES
MULTILANE CONVENTIONAL RDS.

TCP (2-5) - 18

FILE: tcp2-5-18.dgn	DN:	CK:	DW:	DR:
© TxDOT December 1985	CONT	SECT	JOB	HIGHWAY
8-95 2-12 REVISIONS	6459	93	001	I-610, etc.
1-97 3-03	DIST	COUNTY	SHEET NO.	
4-98 2-18	HOU	HARRIS, etc.	93	

DATE: FILE:

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LEGEND			
	Type 3 Barricade		Channelizing Devices
	Heavy Work Vehicle		Truck Mounted Attenuator (TMA)
	Trailer Mounted Flashing Arrow Board		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 = 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)

TYPICAL USAGE				
MOBILE	SHORT DURATION	SHORT TERM STATIONARY	INTERMEDIATE TERM STATIONARY	LONG TERM STATIONARY
			✓	✓

- GENERAL NOTES**
- Flags attached to signs where shown, are REQUIRED.
 - All traffic control devices illustrated are REQUIRED, except those denoted with the triangle symbol may be omitted when stated elsewhere in the plans, or for routine maintenance work, when approved by the Engineer.
 - Channelizing devices used to close lanes may be supplemented with the Chevron Alignment Sign placed on every other channelizing device. Chevrons may be attached to plastic drums as per BC Standards.
 - Channelizing devices used along the work space or along tangent sections may be supplemented with vertical panels (VP) placed on every other channelizing device. If night time conditions make it difficult to see at least two VPs, the VPs may be placed on each channelizing device.
 - The placement of pavement markings may be omitted on Intermediate-term stationary work zones with the approval of the Engineer.
 - Shadow Vehicle with TMA and high intensity rotating, flashing, oscillating or strobe lights. Shadow Vehicle with TMA and high intensity rotating, flashing, oscillating or strobe lights. A Shadow Vehicle with a TMA should be used anytime it can be positioned 30 to 100 feet in advance of the area of crew exposure without adversely affecting the performance or quality of the work. If workers are no longer present but road or work conditions require the traffic control to remain in place, Type 3 Barricades or other channelizing devices may be substituted for the Shadow Vehicle and TMA.
 - Additional Shadow Vehicles with TMAs may be positioned in each closed lane, on the shoulder or off the paved surface, next to those shown in order to protect a wider work space.

TRAFFIC CONTROL PLAN
LANE CLOSURES ON
DIVIDED HIGHWAYS
TCP (2-6) - 18

FILE:	tcp2-6-18.dgn	DN:	CK1	DR:	CK1
© TxDOT	December 1985	CONT	SECT	JOB	HIGHWAY
REVISIONS		6459	93	001	1-610, etc.
2-94	4-98	DIST	COUNTY	SHEET NO.	
8-95	2-12	HOU	HARRIS, etc.	94	
1-97	2-18				

DATE:
FILE:

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Traffic Control Devices shown for one direction

New pavement surface should extend to this point. (See note 2)

CW1-6
48" X 24"
(See note 2) ▲

6" Solid White Edgeline

OM-3 Object Markers

Type II-A-A Raised Pavement Markers on 40' C-C.
6" 4" 6"
1"-2" 1"-2"

6" Double Yellow Line

New pavement surface should extend to this point. (See note 5)

END ROAD WORK
G20-2
48" X 24"

CW1-6
48" X 24"
(See note 2) ▲

Warning Reflectors may be added on top of channelizing devices for additional conspicuity at night. Warning Reflectors, chevrons or steady-burn warning lights may be added if drums or longitudinal channelizing devices are used. (Both directions)

Barricades may be offset to permit workers and equipment to enter and exit work space.

CW1-4R
48" X 48"

CW13-1P
24" X 24"

ROAD CLOSED
R11-2
48" X 30"

CW1-6
48" X 24"

CW1-4L
48" X 48"

CW13-1P
24" X 24"
(See note 2) ▲

ROAD WORK XXX FT
CW20-1A, B, or C
48" X 48"

ROAD WORK AHEAD
CW20-1D
48" X 48"
(Flags- See note 1)

TCP (2-7a)

ROADWAY DIVERSION

Traffic Control Devices shown for one direction

END ROAD WORK
G20-2
48" X 24"

PASS WITH CARE
If applicable
R4-2
24" X 30"

CTB with safety end treatment, or other barrier system as detailed elsewhere in the plans.

6" Solid White Edgeline

Type II-A-A Raised Pavement Markers on 40' C-C.
6" 4" 6"
1"-2" 1"-2"

6" Double Yellow Line

NARROW BRIDGE
CW5-2
48" X 48"
(See note 6)

DO NOT PASS
R4-1
24" X 30"

ROAD WORK AHEAD
CW20-1D
48" X 48"
(Flags- See note 1)

TCP (2-7b)

BRIDGE WIDENING

LEGEND			
	Type 3 Barricade		Channelizing Devices
	Heavy Work Vehicle		Truck Mounted Attenuator (TMA)
	Trailer Mounted Flashing Arrow Board		Raised Pavement Markers Ty II-AA
	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 = WS / 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)

TYPICAL USAGE				
MOBILE	SHORT DURATION	SHORT TERM STATIONARY	INTERMEDIATE TERM STATIONARY	LONG TERM STATIONARY
			✓	✓

- GENERAL NOTES**
- Flags attached to signs where shown are REQUIRED.
 - All traffic control devices illustrated are REQUIRED, except those denoted with the triangle symbol may be omitted when stated elsewhere in the plans, or for routine maintenance work, when approved by the Engineer.

- TCP (2-7a)**
- Raised pavement markers shall be placed 40 feet c-c on centerline throughout project.
 - Roadway diversion design requirements should be based on posted speed limit or prevailing speed.
 - New pavement surface should be extended across existing roadway edge to a point where existing pavement markings left in place during project do not conflict with construction area pavement marking.

- TCP (2-7b)**
- The CW5-2 "Narrow Bridge" sign may be omitted if lane and shoulder widths are maintained.

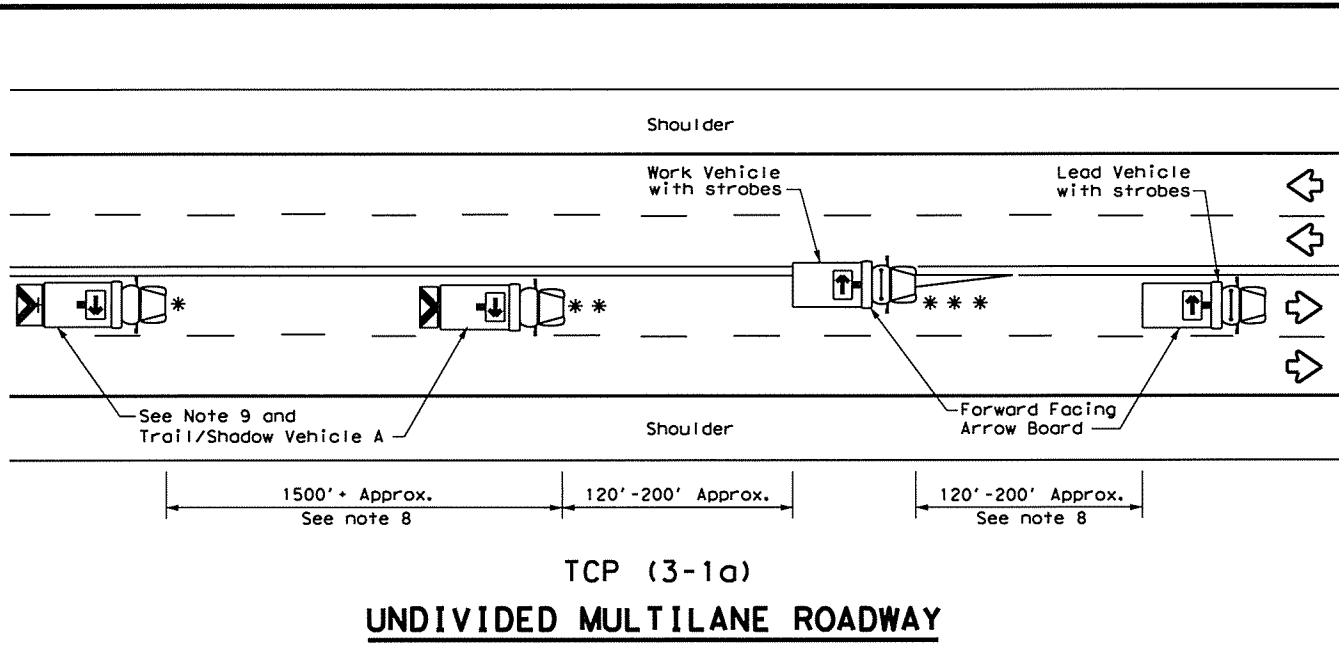


**TRAFFIC CONTROL PLAN
 DIVERSIONS AND
 NARROW BRIDGES**

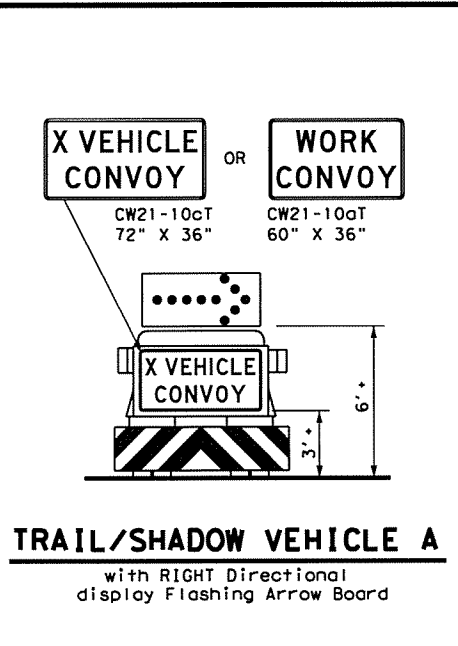
TCP (2-7) - 23

FILE: tcp2-7-23.dgn	DN:	CK:	DN:	CK:
© TxDOT April 2023	CONT	SECT	JOB	HIGHWAY
12-85 4-98 2-18	6459	93	001	I-610, etc.
8-95 3-03 4-23	DIST	COUNTY	SHEET NO.	
1-97 2-12	HOU	HARRIS, etc.	95	

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TCP (3-1a)
UNDIVIDED MULTILANE ROADWAY

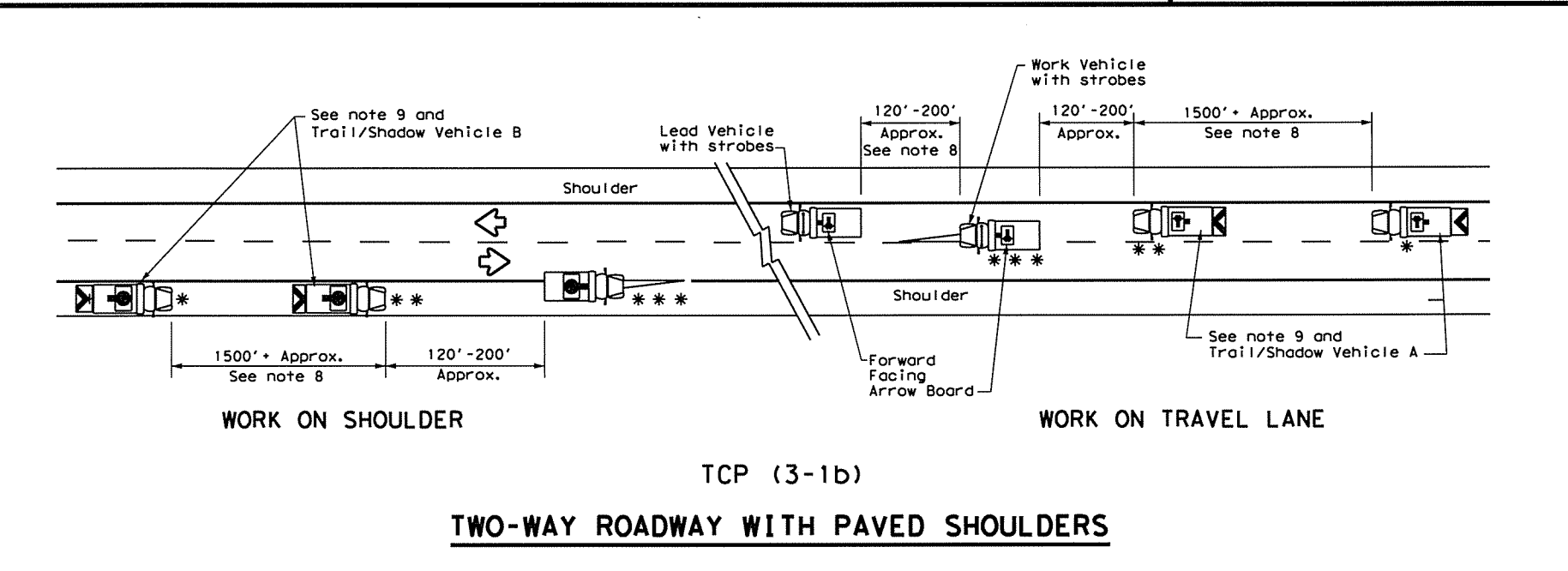


LEGEND		
* Trail Vehicle		ARROW BOARD DISPLAY
** Shadow Vehicle		
*** Work Vehicle		RIGHT Directional
		LEFT Directional
		Double Arrow
		CAUTION (Alternating Diamond or 4 Corner Flash)

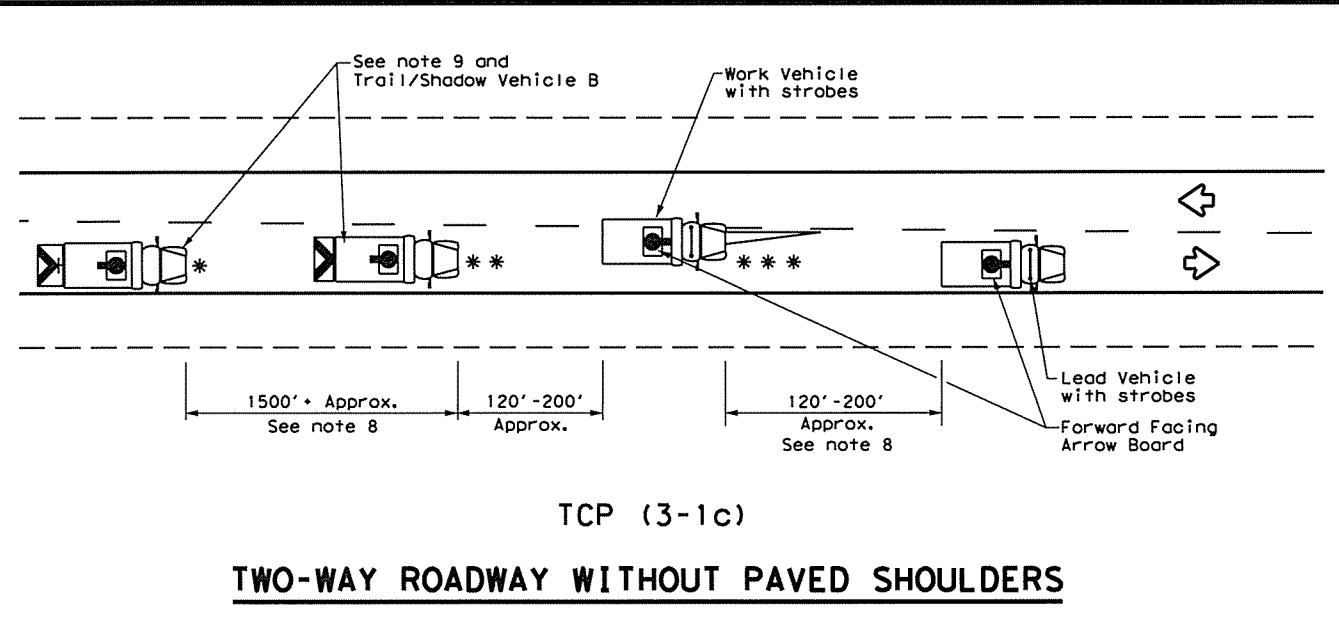
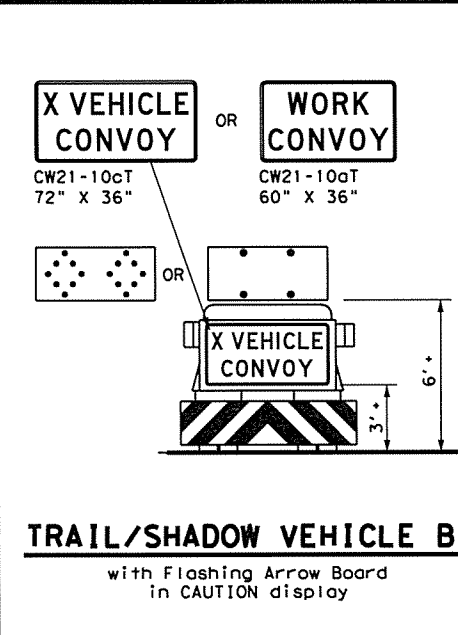
TYPICAL USAGE				
MOBILE	SHORT DURATION	SHORT TERM STATIONARY	INTERMEDIATE TERM STATIONARY	LONG TERM STATIONARY
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GENERAL NOTES

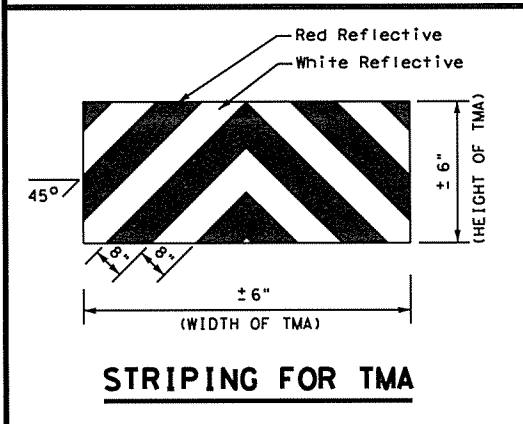
1. TRAIL, SHADOW, and LEAD vehicles shall be equipped with arrow boards as illustrated. When a LEAD vehicle is not used the WORK vehicle must be equipped with an arrow board. The Engineer will determine if the LEAD VEHICLE and/or TRAIL VEHICLE are required based on prevailing roadway conditions, traffic volume, and sight distance restrictions.
2. The use of amber high intensity rotating, flashing, oscillating, or strobe lights on vehicles are required. Blue high intensity rotating, flashing, oscillating or strobe lights when mounted on the driver's side of the vehicle may be operated simultaneously with the amber beacons or strobe lights.
3. The use of truck mounted attenuators (TMA) on the SHADOW VEHICLE and TRAIL VEHICLE are required.
4. Reflective sheeting on the rear of the TMA shall meet or exceed the reflectivity and color requirements of DEPARTMENTAL MATERIAL SPECIFICATION DMS 8300, Type A.
5. Flashing arrow boards shall be Type B or Type C as per the Barricade and Construction (BC) standards. The board shall be controlled from inside the vehicle.
6. Each vehicle shall have two-way radio communication capability.
7. When work convoys must change lanes, the TRAIL VEHICLE should change lanes first to shadow the other convoy vehicles.
8. Vehicle spacing between the TRAIL VEHICLE and the SHADOW VEHICLE will vary depending on sight distance restrictions. Motorists approaching the work convoy should be able to see the TRAIL VEHICLE in time to slow down and/or change lanes as they approach the TRAIL VEHICLE. Vehicle spacing between the WORK VEHICLE and SHADOW VEHICLE and vehicle spacing between WORK VEHICLE and LEAD VEHICLE may vary according to terrain, work activity and other factors.
9. "X VEHICLE CONVOY" (CW21-10cT) or "WORK CONVOY" (CW21-10aT) signs shall be used on TRAIL VEHICLES and SHADOW VEHICLES as shown. As an option 48" X 48" diamond shaped "WORK CONVOY" (CW21-10T) or "X VEHICLE CONVOY" (CW21-10bT) signs may be used where adequate mounting space exists. When used, the X VEHICLE CONVOY sign shall have the number of the convoy vehicles displayed on the sign in the number designation "X" location. The "X VEHICLE CONVOY" sign shall not be used on the SHADOW VEHICLE if a TRAIL VEHICLE is used.
10. On two-lane two-way roadways, the work and protection vehicles should pull over periodically to allow motor vehicle traffic to pass. If motorists are not allowed to pass the work convoy, a "DO NOT PASS" (R4-1) sign should be placed on the back of the rearmost protection vehicle.



TCP (3-1b)
TWO-WAY ROADWAY WITH PAVED SHOULDERS



TCP (3-1c)
TWO-WAY ROADWAY WITHOUT PAVED SHOULDERS



Texas Department of Transportation
Traffic Operations Division Standard

**TRAFFIC CONTROL PLAN
MOBILE OPERATIONS
UNDIVIDED HIGHWAYS**

TCP (3-1) - 13

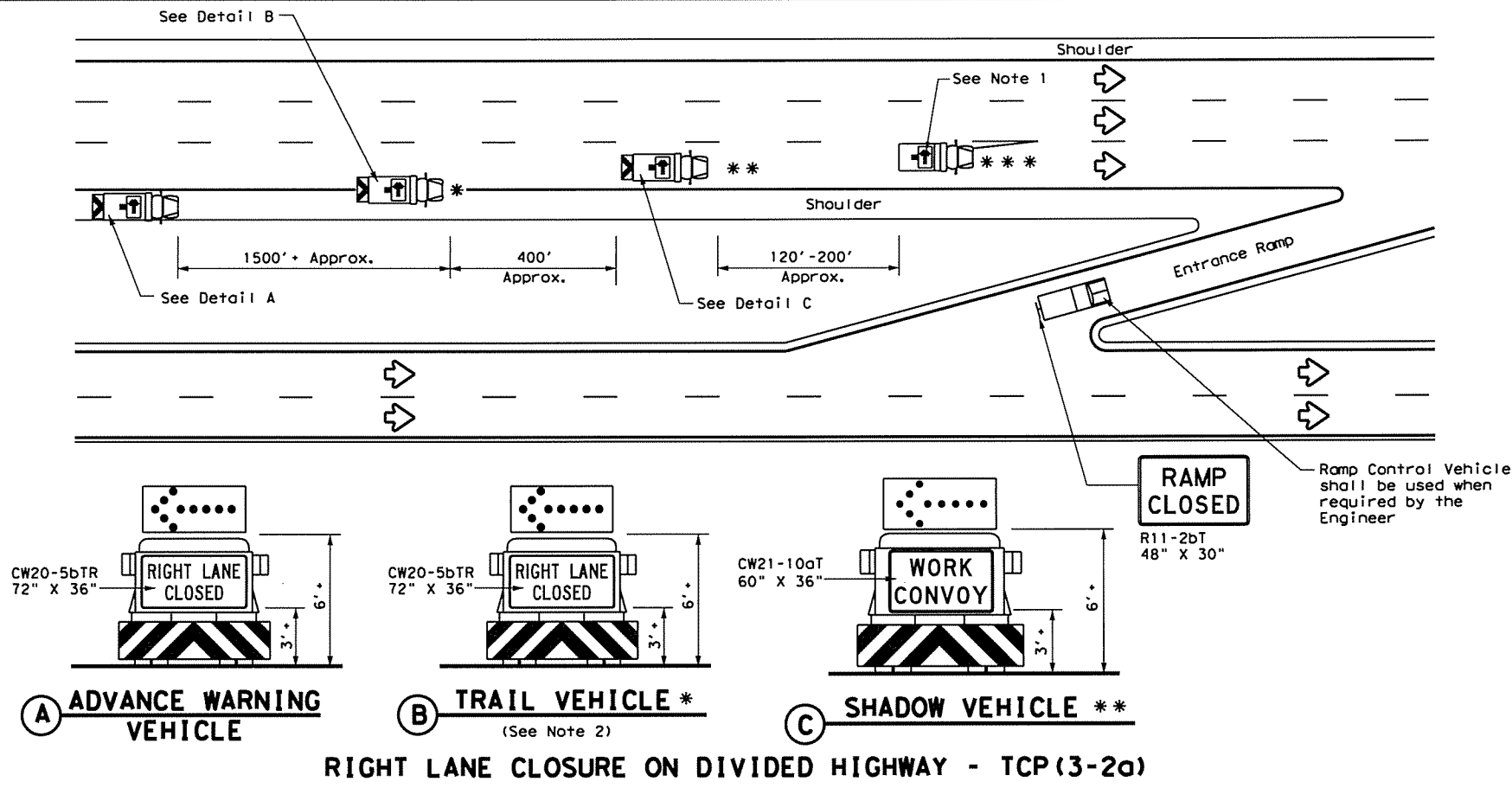
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© TxDOT December 1985	CONT	SECT	JOB	HIGHWAY
REVISIONS	6459	93	001	1-610, etc.
2-94 4-98				
8-95 7-13				
1-97				
	DIST	COUNTY	SHEET NO.	
	HOU	HARRIS, etc.	97	

175

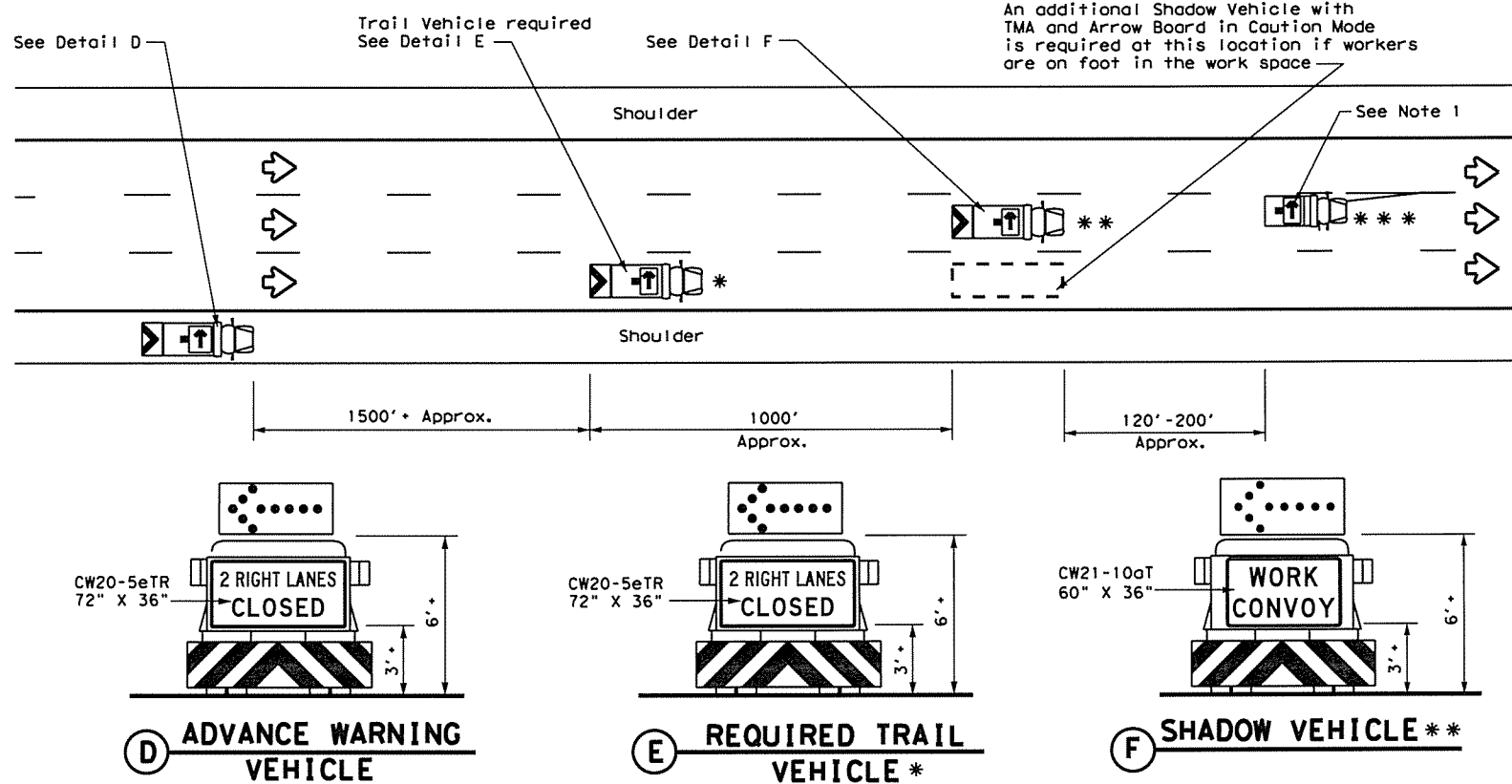
DATE: FILE:

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DATE: FILE:



RIGHT LANE CLOSURE ON DIVIDED HIGHWAY - TCP(3-2a)



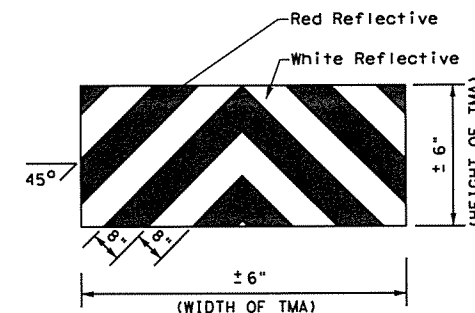
INTERIOR LANE CLOSURE ON MULTI-LANE DIVIDED HIGHWAY - TCP(3-2b)

LEGEND		
*	Trail Vehicle	ARROW BOARD DISPLAY
**	Shadow Vehicle	
** *	Work Vehicle	RIGHT Directional
☐	Heavy Work Vehicle	LEFT Directional
☐	Truck Mounted Attenuator (TMA)	Double Arrow
↔	Traffic Flow	CAUTION (Alternating Diamond or 4 Corner Flash)

TYPICAL USAGE				
MOBILE	SHORT DURATION	SHORT TERM STATIONARY	INTERMEDIATE TERM STATIONARY	LONG TERM STATIONARY
✓				

GENERAL NOTES

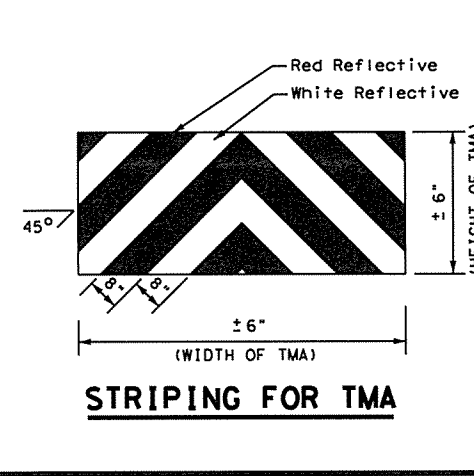
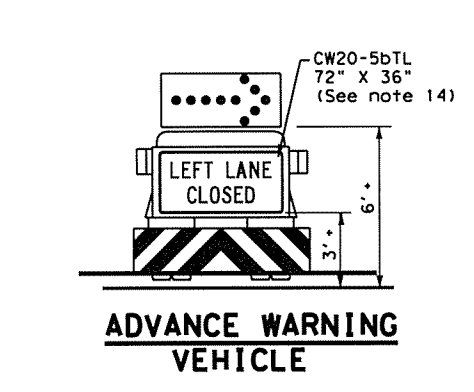
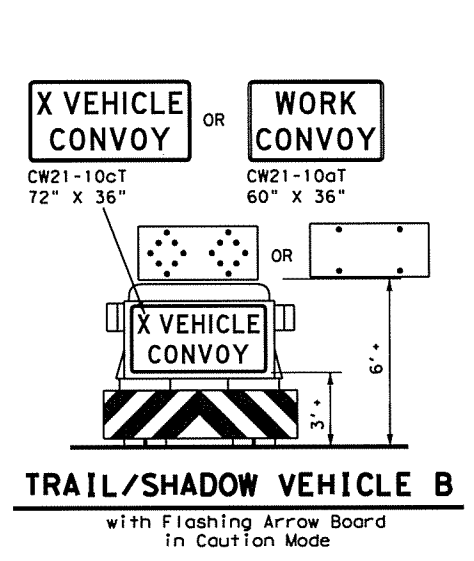
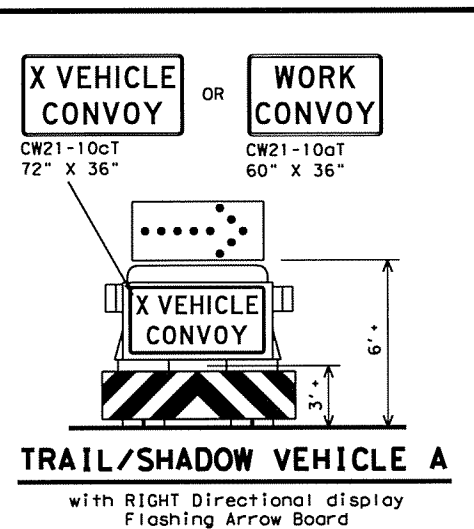
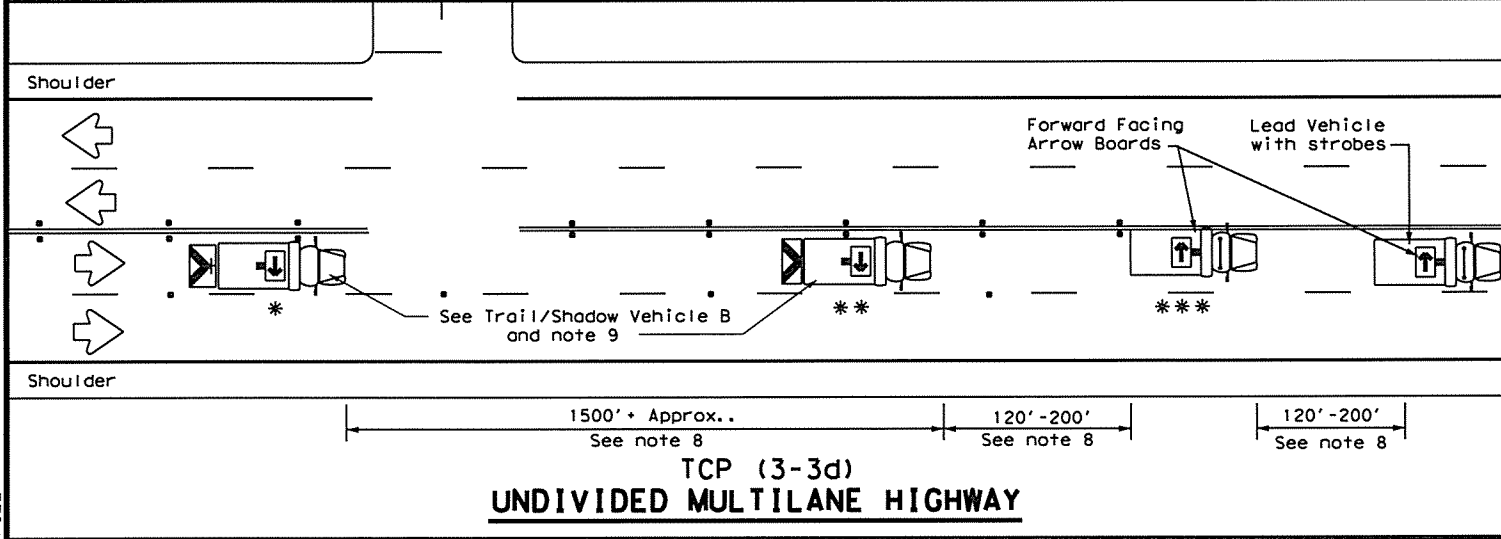
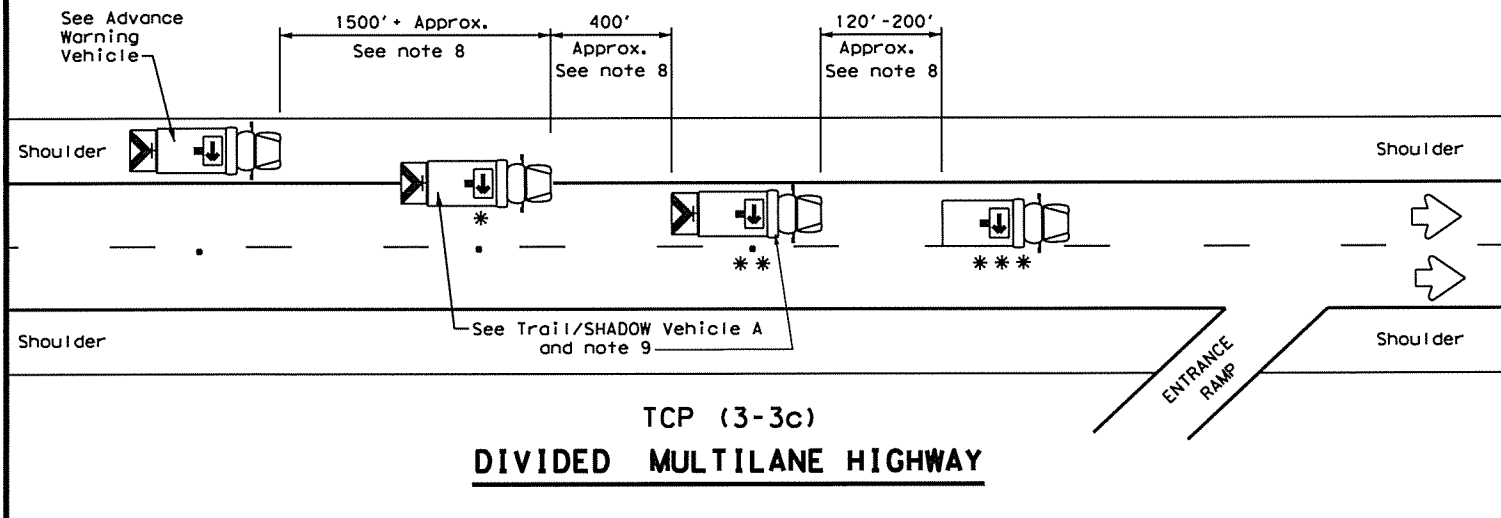
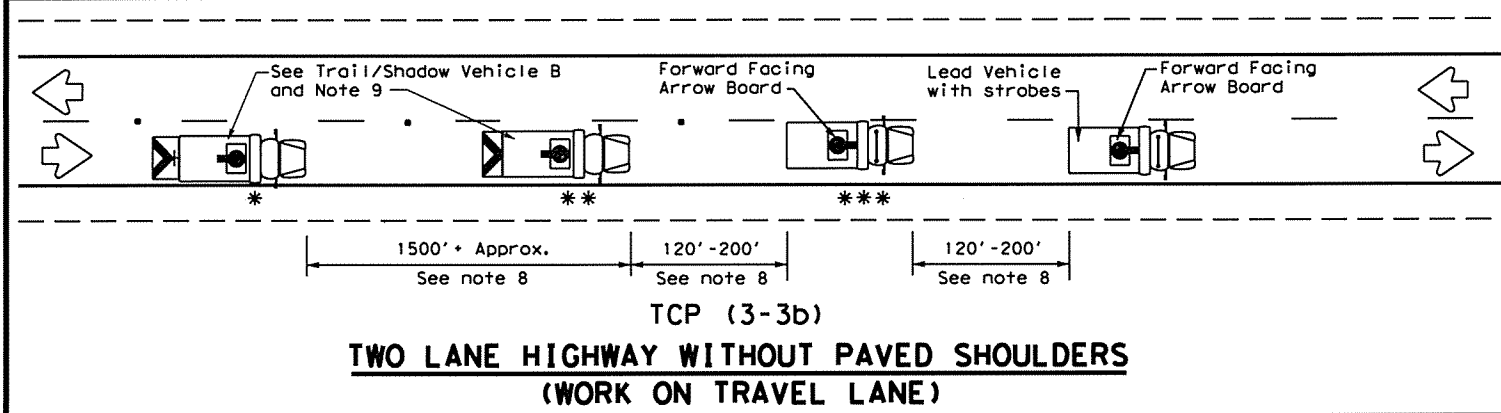
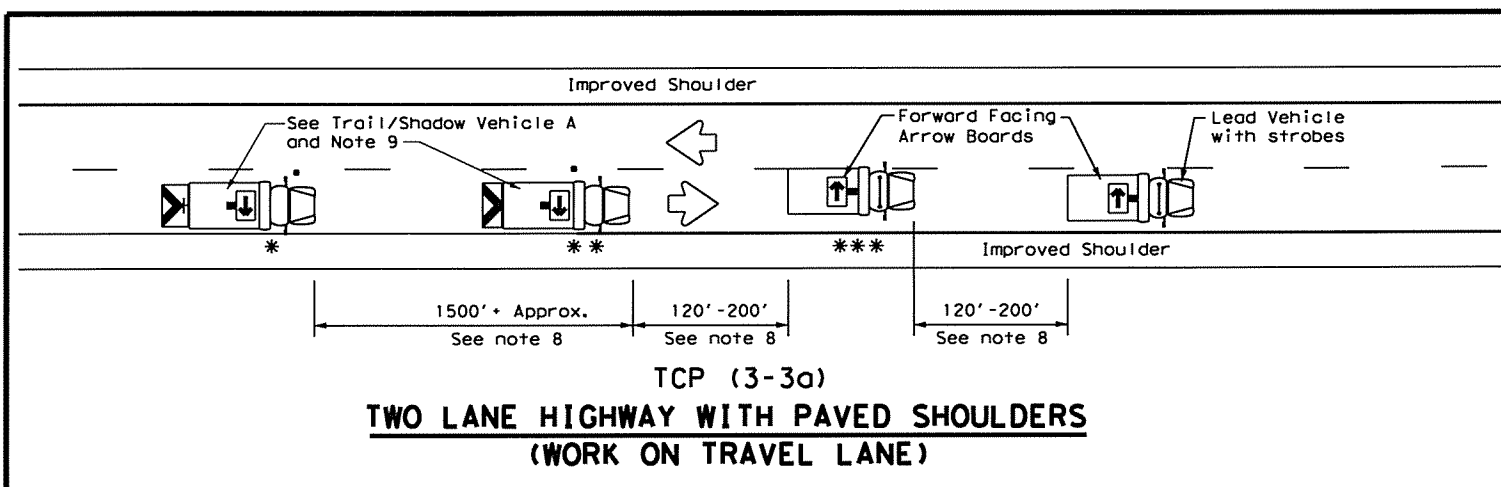
- ADVANCE WARNING, TRAIL and SHADOW vehicles shall be equipped with Type B or Type C flashing arrow boards as per the Barricade and Construction (BC) standards. Arrow boards on WORK vehicles will be optional based on the type of work being performed. The arrow boards shall be operated from inside the vehicle.
- For TCP(3-2a) the Engineer will determine if the TRAIL VEHICLE is required based on prevailing roadway conditions, traffic volume, and sight distance restrictions. All other vehicles shown for both TCP(3-2a) and TCP(3-2b) are required.
- The use of amber high intensity rotating, flashing, oscillating, or strobe lights on vehicles are required. Blue high intensity rotating, flashing, oscillating or strobe lights when mounted on the driver's side of the vehicle may be operated simultaneously with the amber beacons or strobe lights.
- The use of truck mounted attenuators (TMA) on the ADVANCE WARNING, SHADOW, and TRAIL vehicles are required.
- Reflective sheeting on the rear of the TMA shall meet or exceed the reflectivity and color requirements of DMS 8300, Type A.
- Each vehicle shall have two-way radio communication capability.
- When work convoys must change lanes, the TRAIL VEHICLE should change lanes first to shadow the other convoy vehicles.
- Vehicle spacing between the TRAIL VEHICLE and the SHADOW VEHICLE will vary depending on sight distance restrictions. Motorists approaching the work convoy should be able to see the TRAIL VEHICLE in time to slow down and/or change lanes as they approach the TRAIL VEHICLE. Vehicle spacing between the WORK VEHICLE and SHADOW VEHICLE may vary according to terrain, work activity and other factors.
- Standard 48" X 48" diamond shaped warning signs with the same message as those shown may be used where adequate mounting space exists.
- The signs shown should be used on the Advance Warning Vehicle. As an option, a portable changeable message sign (PCMS) or a truck mounted changeable message sign (TMCMS) with a minimum character height of 12", and displaying the same legend may be substituted for these signs. An appropriate directional arrow display, simulating the size and legibility of the flashing arrow board, must be used in the second phase of the PCMS/TMCMS message. When this is done, the arrow board will not be required on the Advance Warning Vehicle.
- Standard diamond shape versions of the CW20-5 series signs may be used as an option if the rectangular signs shown are not available.
- The principles on this sheet may be used to close lanes from the left side of the roadway considering the number of lanes, shoulder width, sight distance, and ramp frequency.
- Signs and flashing arrow board modes shall be appropriately altered when implementing left lane closures or interior closures which close the left lanes.
- The Advance Warning Vehicle may straddle the edgeline when shoulder width makes it necessary.



STRIPING FOR TMA

		Traffic Operations Division Standard	
TRAFFIC CONTROL PLAN MOBILE OPERATIONS DIVIDED HIGHWAYS			
TCP(3-2)-13			
FILE:	tcp3-2.dgn	DN:	TxDOT
© TxDOT	December 1985	CK:	TxDOT
REVISIONS		DR:	TxDOT
2-94	4-98	CONT	SECT
8-95	7-13	6459	93
1-97			
		JOB	001
		HIGHWAY	1-610, etc.
		DIST	COUNTY
		HOU	HARRIS, etc.
		SHEET NO.	98

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LEGEND		
* Trail Vehicle		ARROW BOARD DISPLAY
** Shadow Vehicle		
*** Work Vehicle		RIGHT Directional
		LEFT Directional
		Double Arrow
		CAUTION (Alternating Diamond or 4 Corner Flash)

TYPICAL USAGE				
MOBILE	SHORT DURATION	SHORT TERM STATIONARY	INTERMEDIATE TERM STATIONARY	LONG TERM STATIONARY
✓				

GENERAL NOTES

1. TRAIL, SHADOW, and LEAD vehicles shall be equipped with arrow boards as illustrated. When a LEAD vehicle is not used on two way roads the WORK vehicle must have an arrow board. For divided roadways, the arrow board on the WORK vehicle is optional based on the type of work being performed. The Engineer will determine if the LEAD vehicle and/or TRAIL vehicle are required based on prevailing roadway conditions, traffic volume, and sight distance restrictions.
2. The use of amber high intensity rotating, flashing, oscillating, or strobe lights on vehicles are required. Blue high intensity rotating, flashing, oscillating, or strobe lights when mounted on the driver's side of the vehicle may be operated simultaneously with the amber beacons or strobe lights.
3. The use of truck mounted attenuators (TMA) on the SHADOW VEHICLE, ADVANCE WARNING and TRAIL VEHICLE are required.
4. Reflective sheeting on the rear of the TMA shall meet or exceed the reflectivity and color requirements of DEPARTMENTAL MATERIAL SPECIFICATION DMS 8300, Type A.
5. Flashing arrow boards shall be Type B or Type C as per the Barricade and Construction (BC) standards. The board shall be controlled from inside the vehicle.
6. Each vehicle shall have two-way radio communication capability.
7. When work convoys must change lanes, the TRAIL VEHICLE should change lanes first to shadow the other convoy vehicles.
8. Vehicle spacing between the TRAIL VEHICLE and the SHADOW VEHICLE will vary depending on sight distance restrictions. Motorists approaching the convoy should be able to see the TRAIL VEHICLE in time to slow down and/or change lanes as they approach the TRAIL VEHICLE. Vehicle spacing between the WORK VEHICLE and SHADOW VEHICLE and vehicle spacing between WORK VEHICLE and LEAD VEHICLE may vary according to terrain, work activity and other factors.
9. X VEHICLE CONVOY (CW21-10cT) or WORK CONVOY (CW21-10aT) signs shall be used on TRAIL VEHICLES and SHADOW VEHICLES as shown. As an option 48" x 48" diamond shaped WORK CONVOY (CW21-10T) or X VEHICLE CONVOY (CW21-10bT) signs may be used where adequate mounting space exists. When used, the X VEHICLE CONVOY sign shall have the number of the convoy vehicles displayed on the sign in the number designation "X" location. The X VEHICLE CONVOY sign shall not be used on the SHADOW VEHICLE if a TRAIL VEHICLE is used.
10. For divided highways with two or three lanes in one direction, the appropriate LEFT LANE CLOSED (CW20-5bTL), RIGHT LANE CLOSED (CW20-5bTR), or CENTER LANE CLOSED (CW20-5dT) sign should be used on the Advance Warning Vehicle. As an option, a portable changeable message sign (PCMS) or truck mounted changeable message sign (TMCMS) with a minimum character height of 12", and displaying the same legend may be substituted for these signs. An appropriate directional arrow display, simulating the size and legibility of the flashing arrow board may be used in the second phase of the PCMS/TMCMS message. When this is done, the arrow board will not be required on the Advance Warning Vehicle.
11. A double arrow shall not be displayed on the arrow board on the Advance Warning Vehicle.
12. For divided highways with three or four lanes in each direction, use TCP(3-2).
13. Standard diamond shape versions of the CW20-5 series signs may be used as an option if the rectangular signs shown are not available.
14. The Advance Warning Vehicle may straddle the edgeline when Shoulder width makes it necessary.
15. On two-lane two-way roadways, the work and protection vehicles should pull over periodically to allow motor vehicle traffic to pass. If motorists are not allowed to pass the work convoy, a DO NOT PASS (R4-1) sign should be placed on the back of the rearmost protection vehicle.

Traffic Operations Division Standard

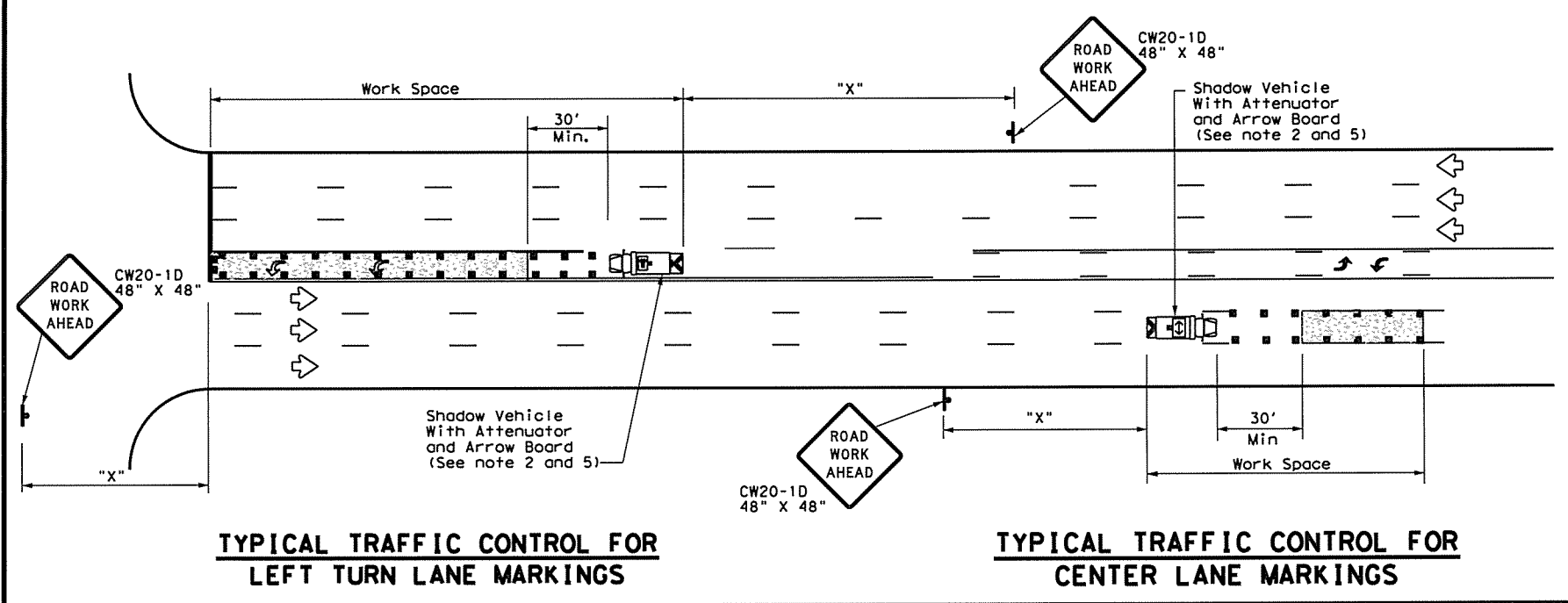
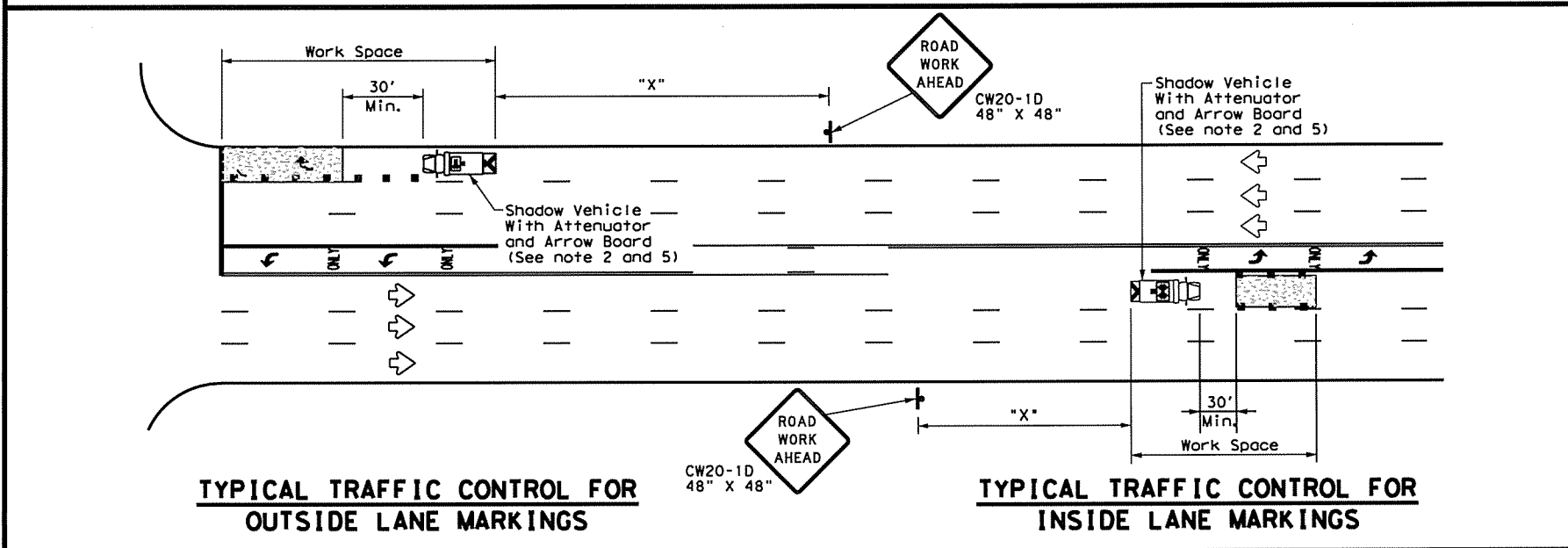
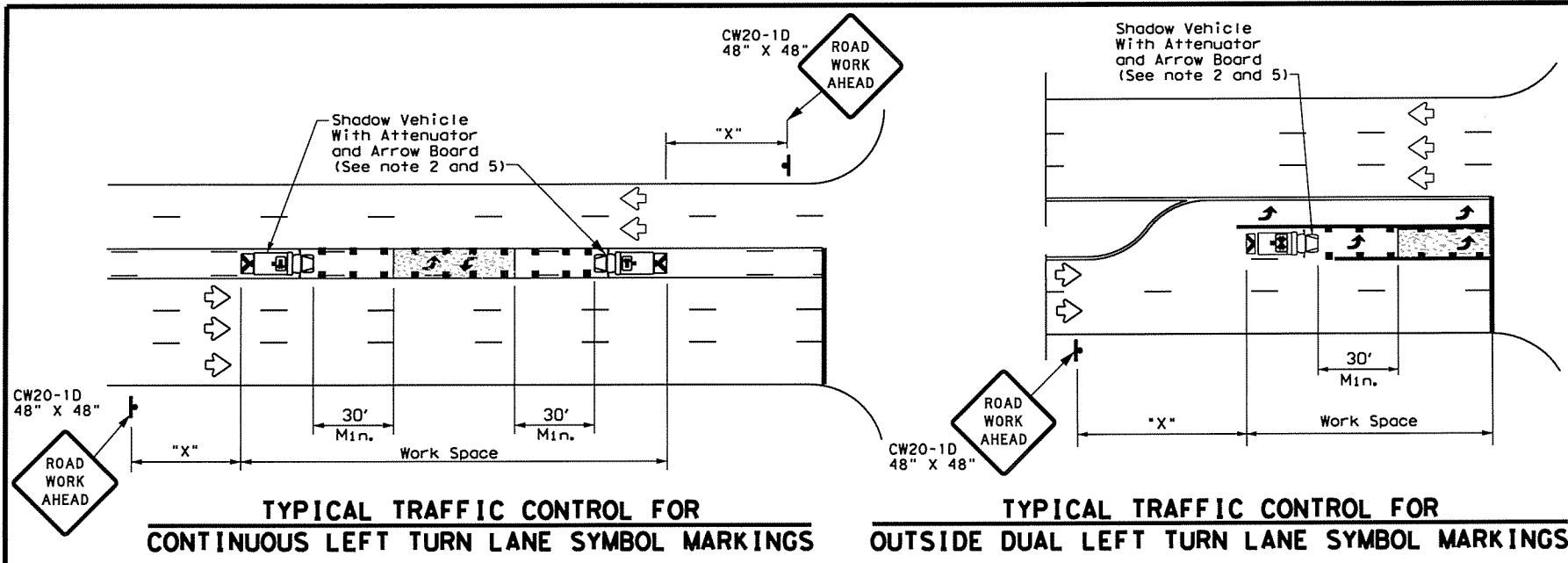
TRAFFIC CONTROL PLAN
MOBILE OPERATIONS
RAISED PAVEMENT
MARKER INSTALLATION/
REMOVAL
TCP (3-3) - 14

FILE: tcp3-3.dgn	DN: TxDOT	CK: TxDOT	DN: TxDOT	CK: TxDOT
© TxDOT September 1987	CONT	SECT	JOB	HIGHWAY
REVISIONS	6459	93	001	1-610, etc.
2-94 4-98	DIST	COUNTY	SHEET NO.	
8-95 7-13	HOU	HARRIS, etc.	99	
1-97 7-14				

DATE: FILE:

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DATE: FILE:



LEGEND		
* Trail Vehicle		ARROW BOARD DISPLAY
** Shadow Vehicle		
*** Work Vehicle		RIGHT Directional
Heavy Work Vehicle		LEFT Directional
Truck Mounted Attenuator (TMA)		Double Arrow
Traffic Flow		Channelizing Devices

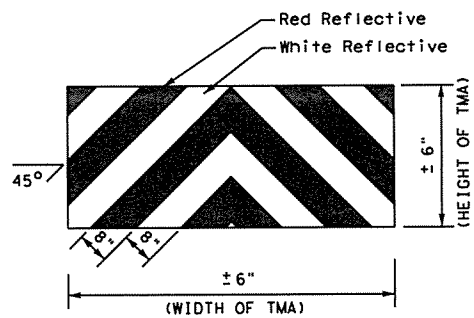
Posted Speed *	Formula	Minimum Desirable Taper Lengths **			Suggested Maximum Spacing of Channelizing Devices		Minimum Sign Spacing "X" Distance	Suggested Longitudinal Buffer Space "B"
		10' Offset	11' Offset	12' Offset	On a Taper	On a Tangent		
30	$L = \frac{WS^2}{60}$	150'	165'	180'	30'	60'	120'	90'
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)

TYPICAL USAGE				
MOBILE	SHORT DURATION	SHORT TERM STATIONARY	INTERMEDIATE TERM STATIONARY	LONG TERM STATIONARY
✓				

GENERAL NOTES

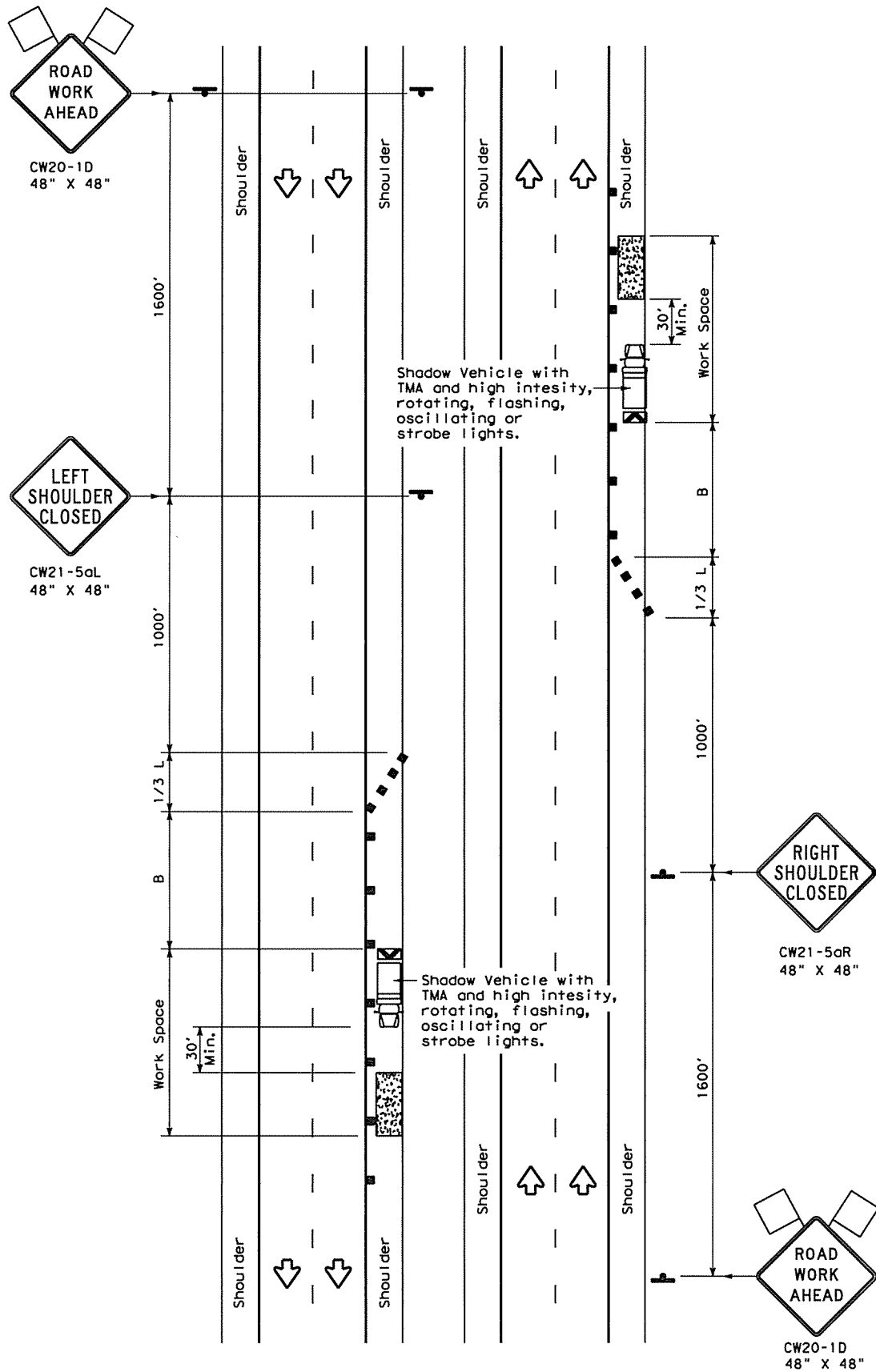
1. This traffic control plan is for use on conventional roads posted at 45 mph or less and is intended for mobile operations that move continuously or intermittently (stopping up to approximately 15 minutes) such as short-line striping and in-lane rumble strips. When activities are anticipated to take longer amounts of time or traffic conditions warrant, a short duration or short-term stationary traffic control plan should be used.
2. A Truck Mounted Attenuator shall be used on Shadow Vehicle. Striping on the back panel of all truck mounted attenuators shall be 8" red and white reflective sheeting placed in an inverted "V" design. Reflective sheeting shall meet or exceed the reflectivity and color requirements of departmental material specification DMS-8300, Type A.
3. All traffic control devices shall be in accordance with the "Texas Manual on Uniform Traffic Control Devices" (TMUTCD), latest edition.
4. The use of yellow rotating beacons or strobe lights on vehicles are required. Blue high intensity rotating, flashing, oscillating or strobe lights when mounted on the drivers side of the vehicle may be operated simultaneously with the amber beacons or strobe lights.
5. Flashing arrow board shall be used on Shadow Vehicle. Flashing arrow board shall be Type B or Type C as per BC Standards. The arrow board operation shall be controlled from inside the truck.



STRIPING FOR TMA

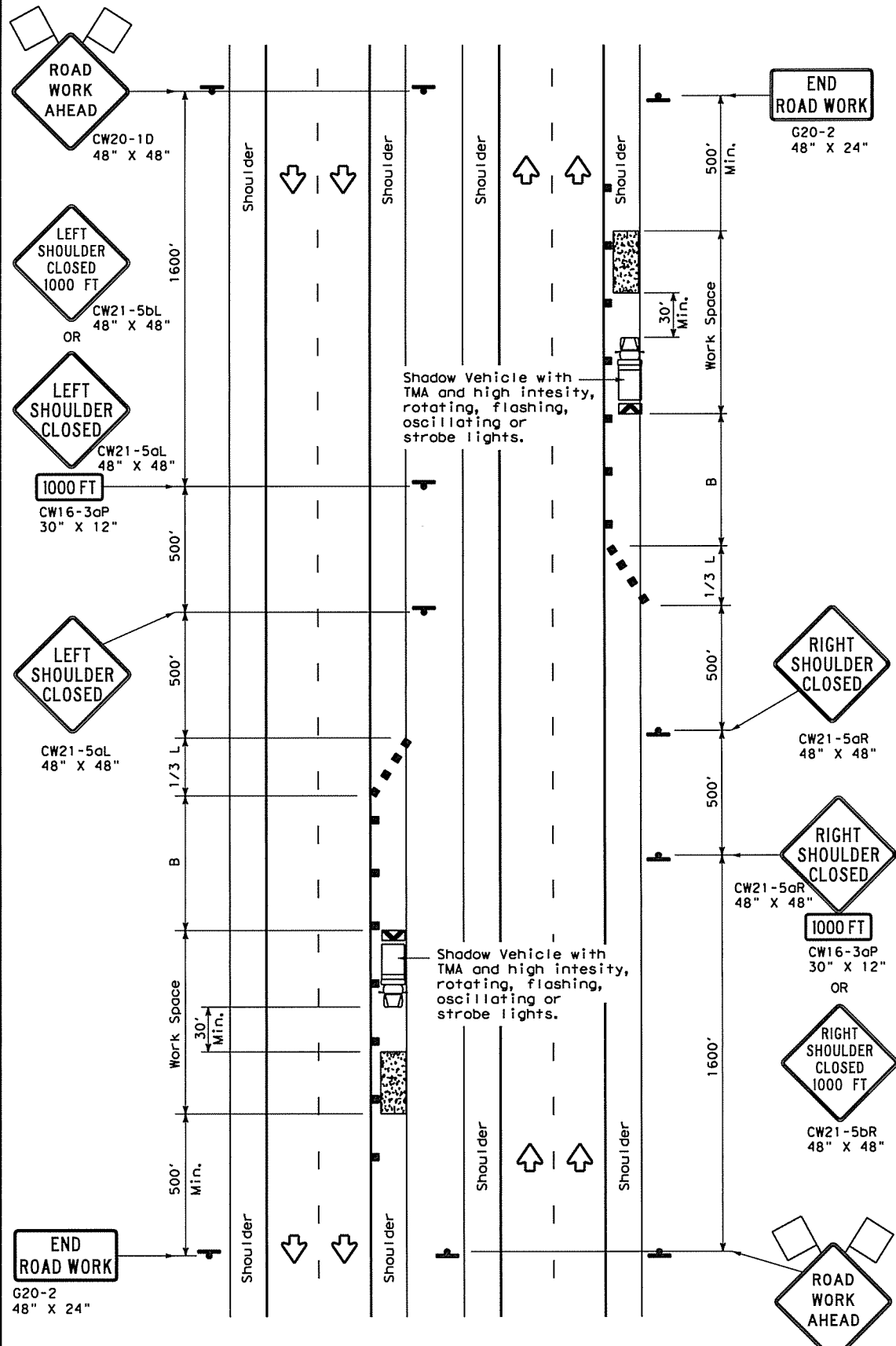
Texas Department of Transportation		Traffic Operations Division Standard	
TRAFFIC CONTROL PLAN MOBILE OPERATIONS FOR ISOLATED WORK AREAS UNDIVIDED HIGHWAYS TCP (3-4) - 13			
FILE: tcp3-4.dgn	DN: TxDOT	CR: TxDOT	DW: TxDOT
© TxDOT July, 2013	CONT SECT	JOB	HIGHWAY
REVISIONS	6459 93	001	I-610, etc
DIST	COUNTY	SHEET NO.	
HOU	HARRIS, etc.	100	

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TCP (5-1a)

WORK AREA ON SHOULDER



TCP (5-1b)

WORK AREA ON SHOULDER

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

Posted Speed *	Formula	Minimum Desirable Taper Lengths **			Suggested Maximum Spacing of Channelizing Devices		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'	90'
35		205'	225'	245'	35'	70'	120'
40		265'	295'	320'	40'	80'	155'
45		450'	495'	540'	45'	90'	195'
50	L = WS	500'	550'	600'	50'	100'	240'
55		550'	605'	660'	55'	110'	295'
60		600'	660'	720'	60'	120'	350'
65		650'	715'	780'	65'	130'	410'
70		700'	770'	840'	70'	140'	475'
75		750'	825'	900'	75'	150'	540'
80		800'	880'	960'	80'	160'	615'

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

TYPICAL USAGE				
MOBILE	SHORT DURATION	SHORT TERM STATIONARY	INTERMEDIATE TERM STATIONARY	LONG TERM STATIONARY
	TCP (5-1a)	TCP (5-1b)	TCP (5-1b)	

GENERAL NOTES

- A Shadow Vehicle with a TMA should be used anytime it can be positioned 30' to 100' in advance of the area of crew exposure without adversely affecting the performance or quality of the work. Type 3 barricades or drums may be substituted when workers on foot are no longer present when approved by the Engineer.
- 28" tall or taller one-piece cones will be allowed only for Short Duration or Short Term stationary operations when workers are present to maintain the devices upright and in proper location. Intermediate Term stationary work areas should use Drums, Vertical Panels or 42" tall two-piece cones.

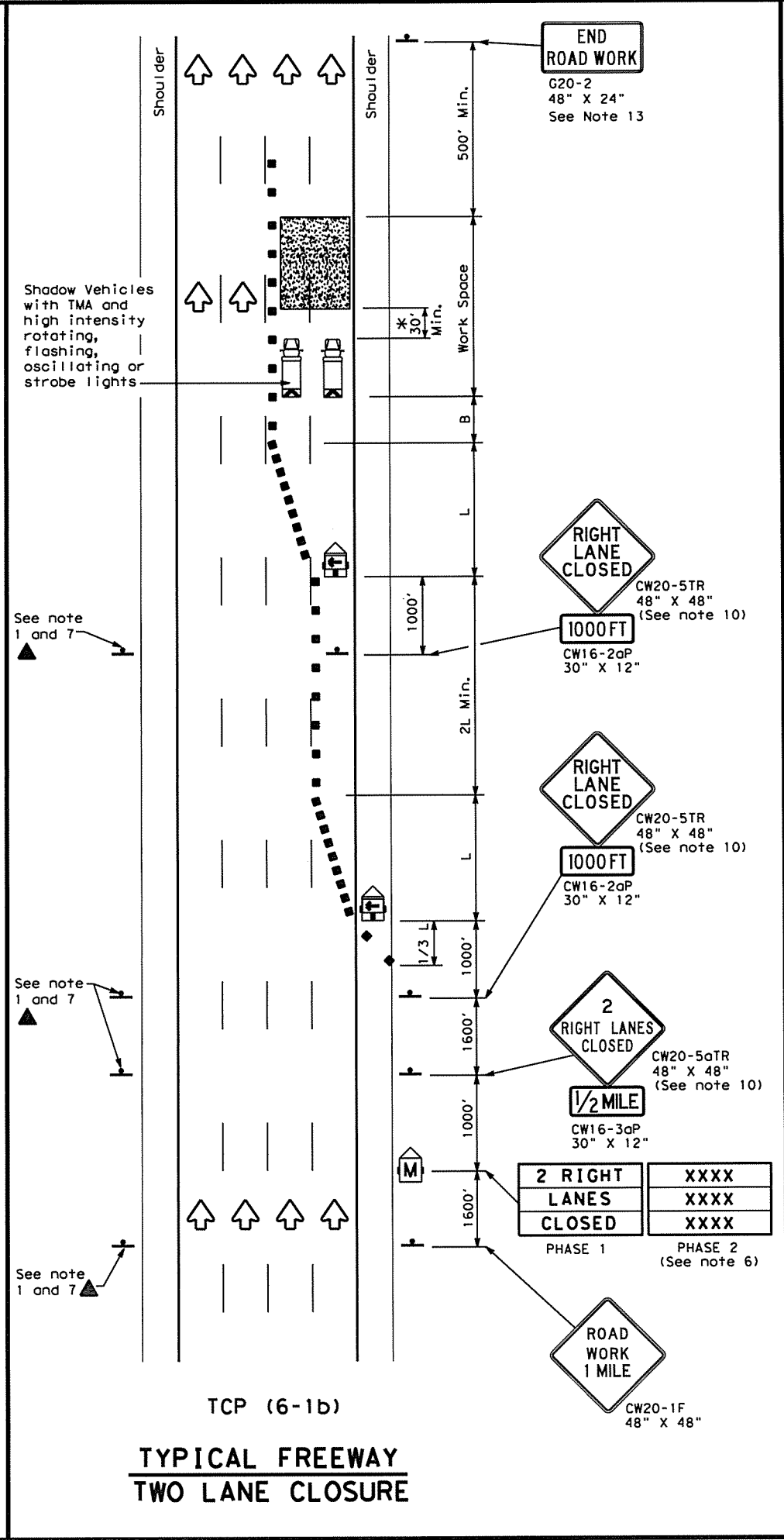
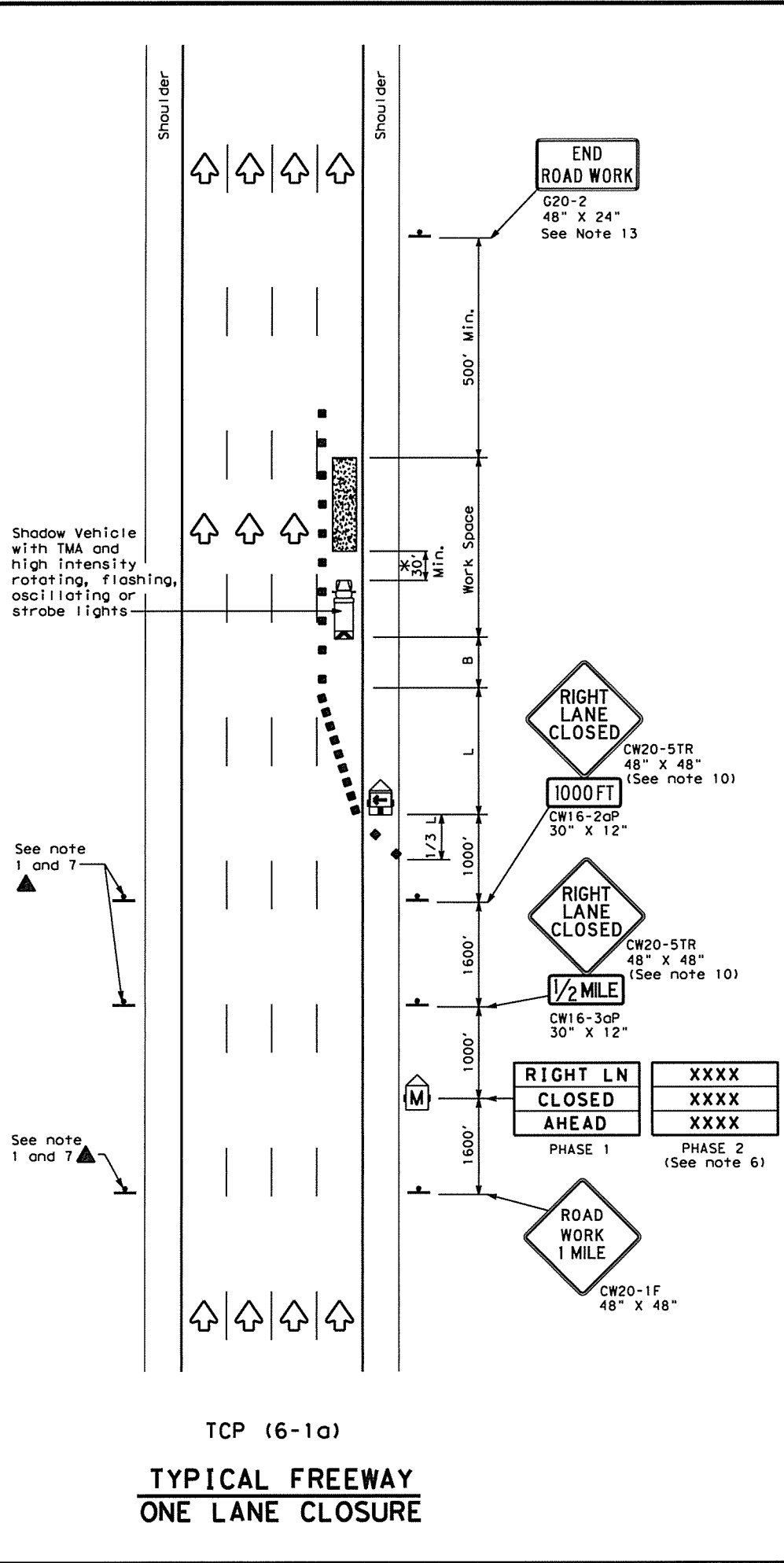


**TRAFFIC CONTROL PLAN
 SHOULDER WORK FOR
 FREEWAYS / EXPRESSWAYS**

TCP (5-1) - 18

FILE: tcp5-1-18.dgn	DN: CK1	DN: CK1	CK1
© TxDOT February 2012	CONT	SECT	JOB
REVISIONS	6459	93	001
2-18	DIST	COUNTY	SHEET NO.
	HOU	HARRIS, etc.	101

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

Posted Speed	Formula	Minimum Desirable Taper Lengths "L"			Suggested Maximum Spacing of Channelizing Devices		Suggested Longitudinal Buffer Space "B"
		10' Offset	11' Offset	12' Offset	On a Taper	On a Tangent	
45	L = WS	450'	495'	540'	45'	90'	195'
50		500'	550'	600'	50'	100'	240'
55		550'	605'	660'	55'	110'	295'
60		600'	660'	720'	60'	120'	350'
65		650'	715'	780'	65'	130'	410'
70		700'	770'	840'	70'	140'	475'
75		750'	825'	900'	75'	150'	540'
80		800'	880'	960'	80'	160'	615'

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

TYPICAL USAGE				
MOBILE	SHORT DURATION	SHORT TERM STATIONARY	INTERMEDIATE TERM STATIONARY	LONG TERM STATIONARY
	✓	✓	✓	

GENERAL NOTES

- All traffic control devices illustrated are REQUIRED. Devices denoted with the triangle symbol may be omitted when stated elsewhere in the plans.
- Drums or 42" cones are the typical channelizing devices. For Intermediate Term Stationary work, drums shall be used on tapers with drums or 42" cones used on tangent sections. Other channelizing devices may be used as directed by the Engineer.
- All construction signs and barricades placed during any phase of work shall remain in place until removal is approved by the Engineer.
- The Engineer may direct the Contractor to furnish additional signs and barricades as required to maintain traffic flow, detours and motorist safety during construction.
- Static message boards or changeable message signs stating the date and duration of ramp or freeway lane closures shall be placed a minimum of seven (7) calendar days in advance of the actual closure.
- Phase 2 of the PCMS message should include appropriate information formatted as shown on BC(6), such as "MERGE LEFT," recommended advisory speed, delay information, or other specific warnings.
- Duplicate construction warning signs should be erected on the medians side of freeways where median width will permit and traffic volume justifies the signing.
- The number of closed lanes may be increased provided the spacing of traffic control devices, taper lengths and tangent lengths meet the requirements of the TMUTCD.
- Warning signs for intermediate term stationary work should be mounted at 7' to the bottom of the sign.
- Warning signs shown shall be appropriately altered for left lane closures. When signs are mounted at 1' height for short term stationary or short duration work, sign versions shown in the SHSD for Texas with distances on the sign face rather than mounted on a plaque below the sign may be used.
- When possible, PCMS units should be located in advance of the last available exit ramp prior to the lane closure to allow motorists an alternate route. They may also be relocated to improve advance warning in case of unanticipated queuing or congestion.
- For Intermediate Term Stationary work at night, floodlights should be used to illuminate the work area and equipment crossings. Floodlights shall not produce a disabling glare condition for road users or workers.
- The END ROAD WORK (G20-2) sign may be omitted when it conflicts with G20-2 signs already in place on the project.

* A shadow vehicle equipped with a Truck Mounted Attenuator is typically required. A shadow vehicle equipped with a TMA shall be used if it can be positioned 30' to 100' in advance of the area of crew exposure without adversely affecting the work performance.

Texas Department of Transportation
Traffic Operations Division Standard

TRAFFIC CONTROL PLAN
FREEWAY LANE CLOSURES

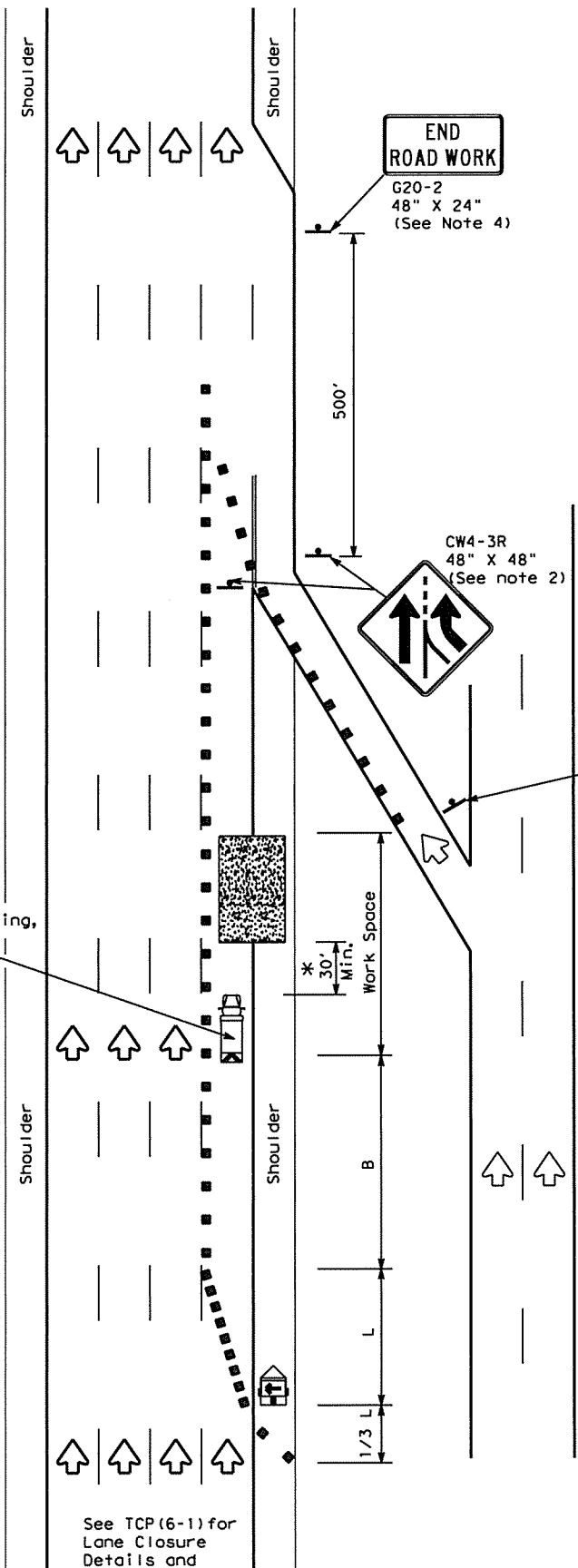
TCP (6-1) - 12

FILE: tcp6-1.dgn	DN: TxDOT	CK: TxDOT	DM: TxDOT	CR: TxDOT
© TxDOT February 1998	CONT	SECT	JOB	HIGHWAY
8-12	6459	93	001	I-610, etc.
	DIST	COUNTY	SHEET NO.	
	HOU	HARRIS, etc.	102	

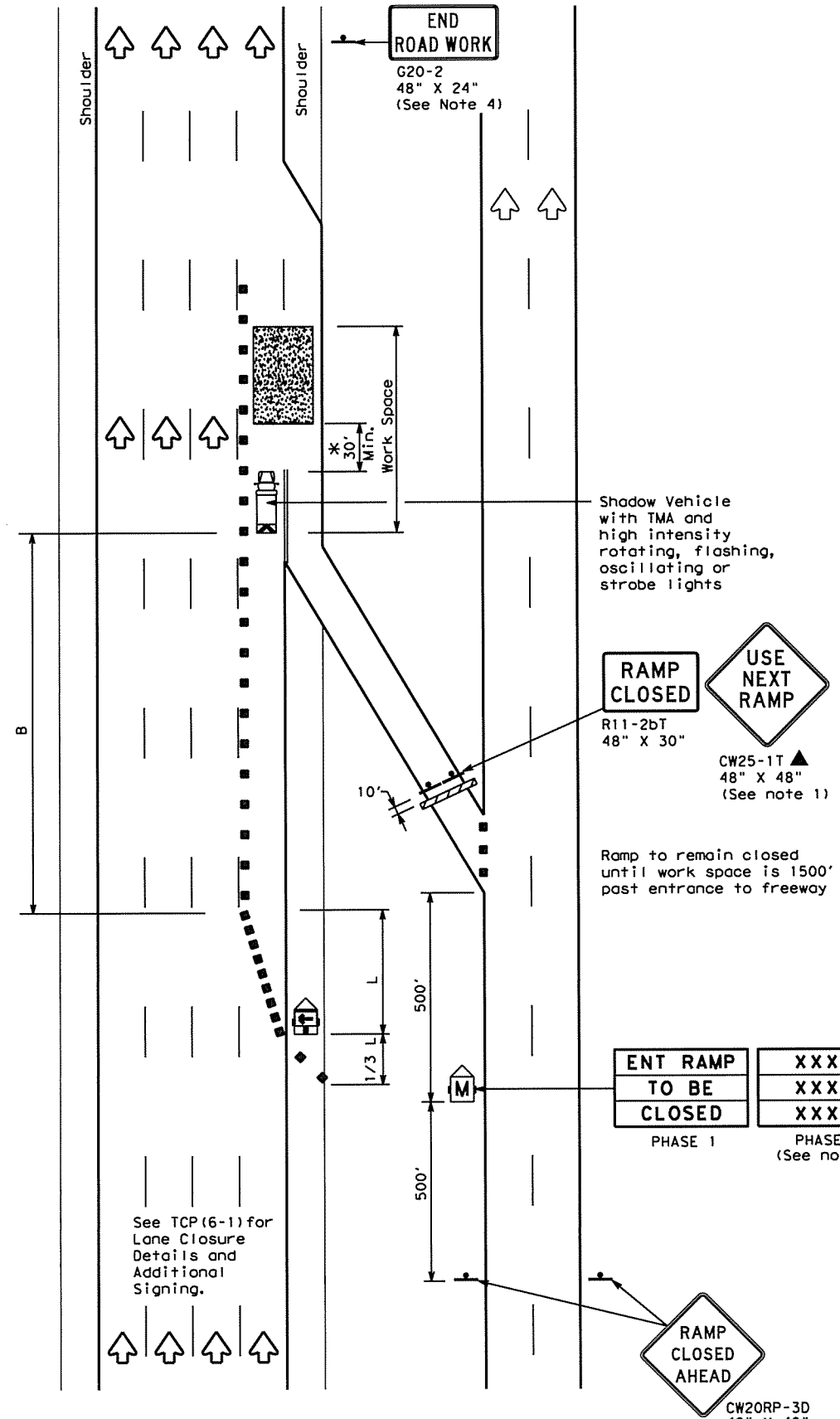
DATE: FILE:

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Shadow Vehicle with TMA and high intensity rotating, flashing, oscillating or strobe lights



TCP (6-2a)
ENTRANCE RAMP OPEN
WORK WITHIN 500' OF RAMP



TCP (6-2b)
ENTRANCE RAMP CLOSED

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

Posted Speed	Formula	Minimum Desirable Taper Lengths "L"			Suggested Maximum Spacing of Channelizing Devices		Suggested Longitudinal Buffer Space "B"
		10' Offset	11' Offset	12' Offset	On a Taper	On a Tangent	
45	L = WS	450'	495'	540'	45'	90'	195'
50		500'	550'	600'	50'	100'	240'
55		550'	605'	660'	55'	110'	295'
60		600'	660'	720'	60'	120'	350'
65		650'	715'	780'	65'	130'	410'
70		700'	770'	840'	70'	140'	475'
75		750'	825'	900'	75'	150'	540'
80		800'	880'	960'	80'	160'	615'

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

TYPICAL USAGE				
MOBILE	SHORT DURATION	SHORT TERM STATIONARY	INTERMEDIATE TERM STATIONARY	LONG TERM STATIONARY
	✓	✓	✓	

GENERAL NOTES

- All traffic control devices illustrated are REQUIRED. Devices denoted with the triangle symbol may be omitted when stated elsewhere in the plans.
- ADDED LANE Symbol (CW4-3) sign may be omitted when sign between ramp and mainline can be seen from both roadways.
- See "Advance Notice List" on BC(6) for recommended date and time formatting options for PCMS Phase 2 message.
- The END ROAD WORK (G20-2) sign may be omitted when it conflicts with G20-2 signs already in place on the project.

*A shadow vehicle equipped with a Truck Mounted Attenuator is typically required. A shadow vehicle equipped with a TMA shall be used if it can be positioned 30' to 100' in advance of the area of crew exposure without adversely affecting the work performance.

Additional requirements for lane closures and advance signing shall be as shown on TCP (6-1) or as directed by the Engineer.

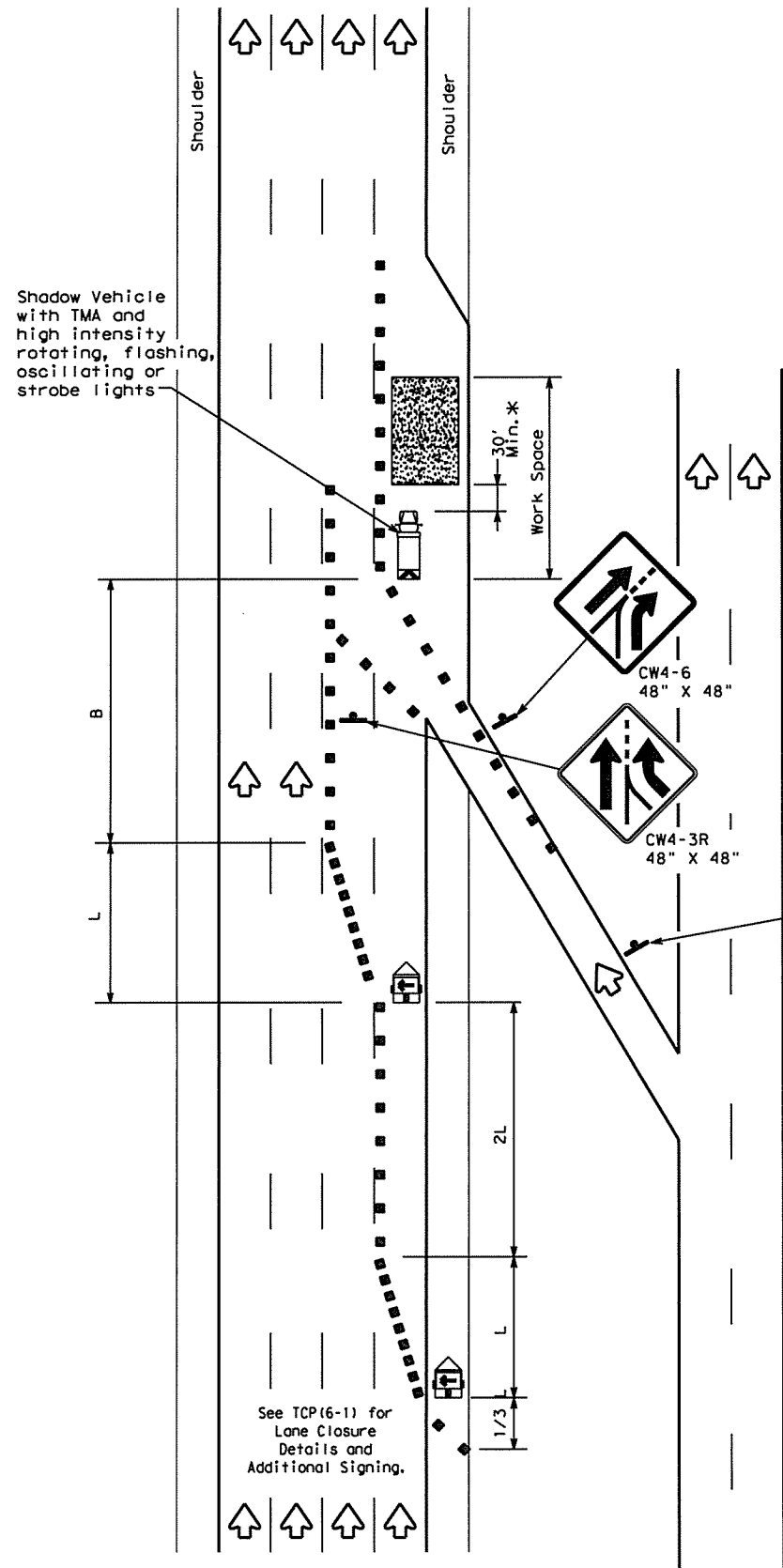


TRAFFIC CONTROL PLAN
WORK AREA NEAR RAMP

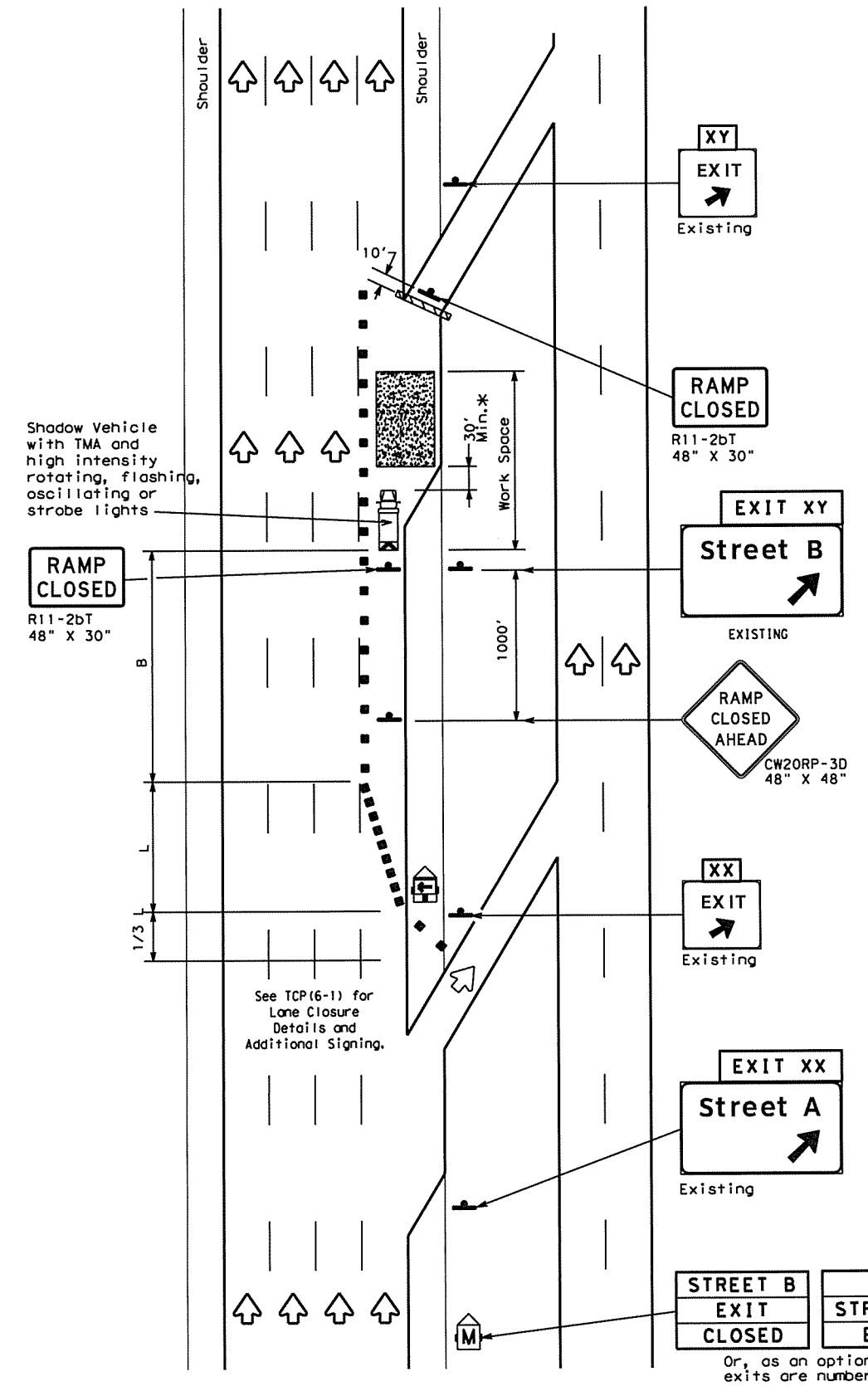
TCP (6-2) - 12

FILE: tcp6-2.dgn	DW: TxDOT	CK: TxDOT	DW: TxDOT	CK: TxDOT
© TxDOT February 1994	CONT	SECT	JOB	HIGHWAY
REVISIONS	6459	93	001	I-610, etc.
1-97 8-98	DIST	COUNTY	SHEET NO.	
4-98 8-12	HOU	HARRIS, etc.	103	

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TCP (6-3a)
ENTRANCE RAMP OPEN



TCP (6-3b)
EXIT RAMP CLOSED
TRAFFIC EXITS PRIOR TO CLOSED RAMP

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

Posted Speed	Formula	Minimum Desirable Taper Lengths "L"			Suggested Maximum Spacing of Channelizing Devices		Suggested Longitudinal Buffer Space "B"
		10' Offset	11' Offset	12' Offset	On a Taper	On a Tangent	
45	L = WS	450'	495'	540'	45'	90'	195'
50		500'	550'	600'	50'	100'	240'
55		550'	605'	660'	55'	110'	295'
60		600'	660'	720'	60'	120'	350'
65		650'	715'	780'	65'	130'	410'
70		700'	770'	840'	70'	140'	475'
75		750'	825'	900'	75'	150'	540'
80		800'	880'	960'	80'	160'	615'

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

TYPICAL USAGE				
MOBILE	SHORT DURATION	SHORT TERM STATIONARY	INTERMEDIATE TERM STATIONARY	LONG TERM STATIONARY
	✓	✓	✓	

GENERAL NOTES:
1. All traffic control devices illustrated are REQUIRED. Devices denoted with the triangle symbol may be omitted when stated elsewhere in the plans.

*A shadow vehicle equipped with a Truck Mounted Attenuator is typically required. A shadow vehicle equipped with a TMA shall be used if it can be positioned 30' to 100' in advance of the area of crew exposure without adversely affecting the work performance.

Additional requirements for lane closures and advance signing shall be as shown on TCP (6-1) or as directed by the Engineer.

Texas Department of Transportation
Traffic Operations Division Standard

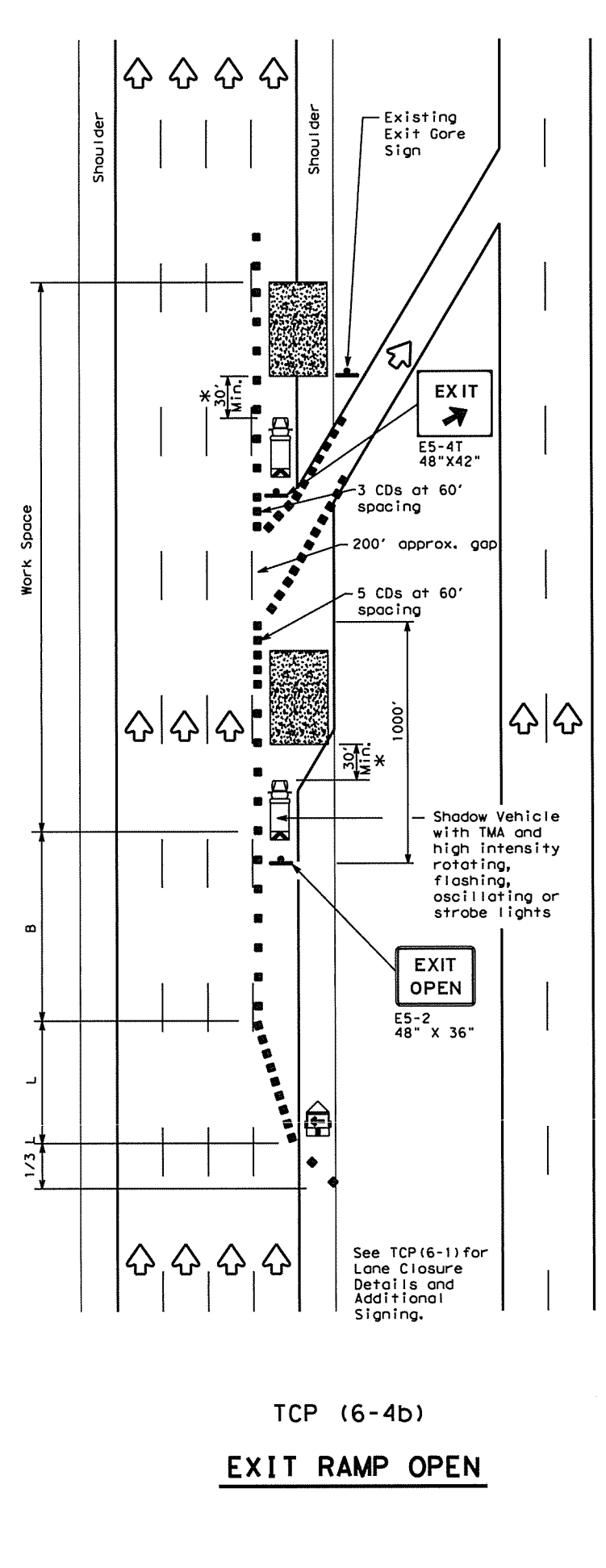
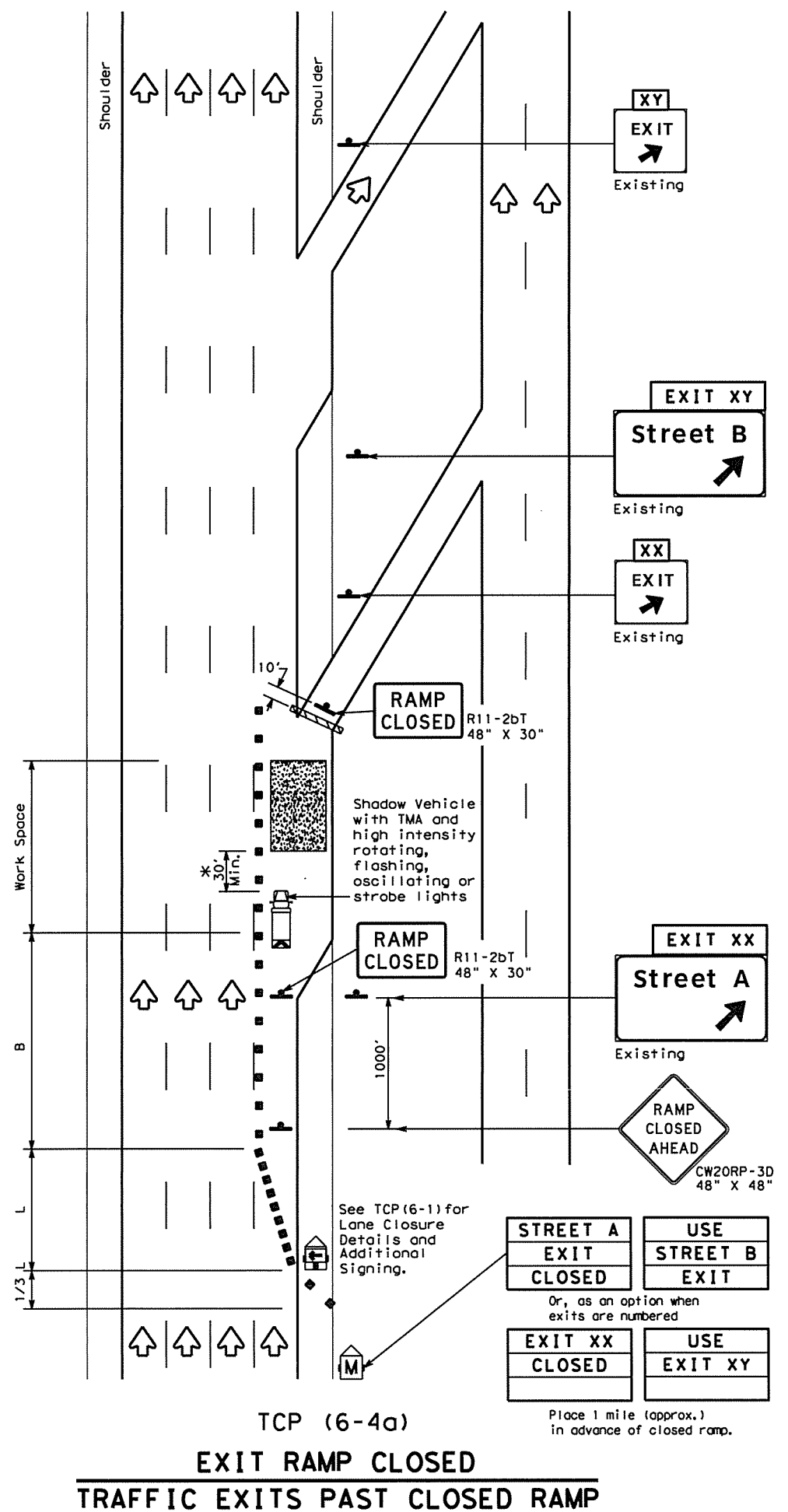
TRAFFIC CONTROL PLAN
WORK AREA BEYOND RAMP

TCP (6-3) - 12

FILE: tcp6-3.dgn	DN: TxDOT	CK: TxDOT	DN: TxDOT	CK: TxDOT
© TxDOT February 1994	CONT	SECT	JOB	HIGHWAY
REVISIONS	6459	93	001	I-610, etc.
1-97 8-98	DIST	COUNTY	SHEET NO.	
4-98 8-12	HOU	HARRIS, etc.	104	

DATE:
FILE:

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

Posted Speed	Formula	Minimum Desirable Taper Lengths "L"			Suggested Maximum Spacing of Channelizing Devices		Suggested Longitudinal Buffer Space "B"
		10' Offset	11' Offset	12' Offset	On a Taper	On a Tangent	
45	L = WS	450'	495'	540'	45'	90'	195'
50		500'	550'	600'	50'	100'	240'
55		550'	605'	660'	55'	110'	295'
60		600'	660'	720'	60'	120'	350'
65		650'	715'	780'	65'	130'	410'
70		700'	770'	840'	70'	140'	475'
75		750'	825'	900'	75'	150'	540'
80	800'	880'	960'	80'	160'	615'	

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

TYPICAL USAGE				
MOBILE	SHORT DURATION	SHORT TERM STATIONARY	INTERMEDIATE TERM STATIONARY	LONG TERM STATIONARY
	✓	✓	✓	

- GENERAL NOTES**
- All traffic control devices illustrated are REQUIRED. Devices denoted with the triangle symbol may be omitted when stated elsewhere in the plans.
 - See BC Standards for sign details.

*A shadow vehicle equipped with a Truck Mounted Attenuator is typically required. A shadow vehicle equipped with a TMA shall be used if it can be positioned 30' to 100' in advance of the area of crew exposure without adversely affecting the work performance.

Additional requirements for lane closures and advance signing shall be as shown on TCP (6-1) or as directed by the Engineer.

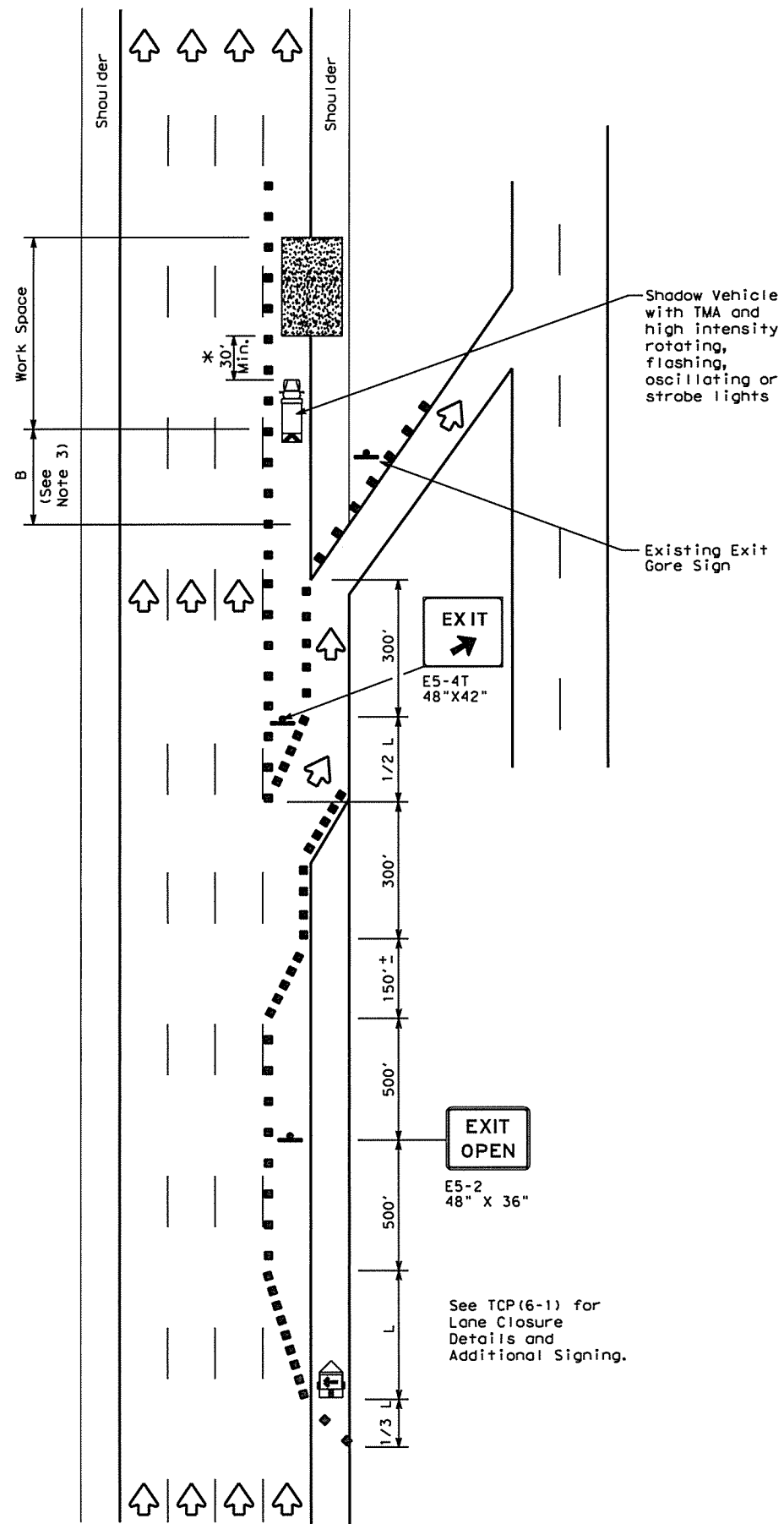
Texas Department of Transportation
Traffic Operations Division Standard

TRAFFIC CONTROL PLAN
WORK AREA AT EXIT RAMP

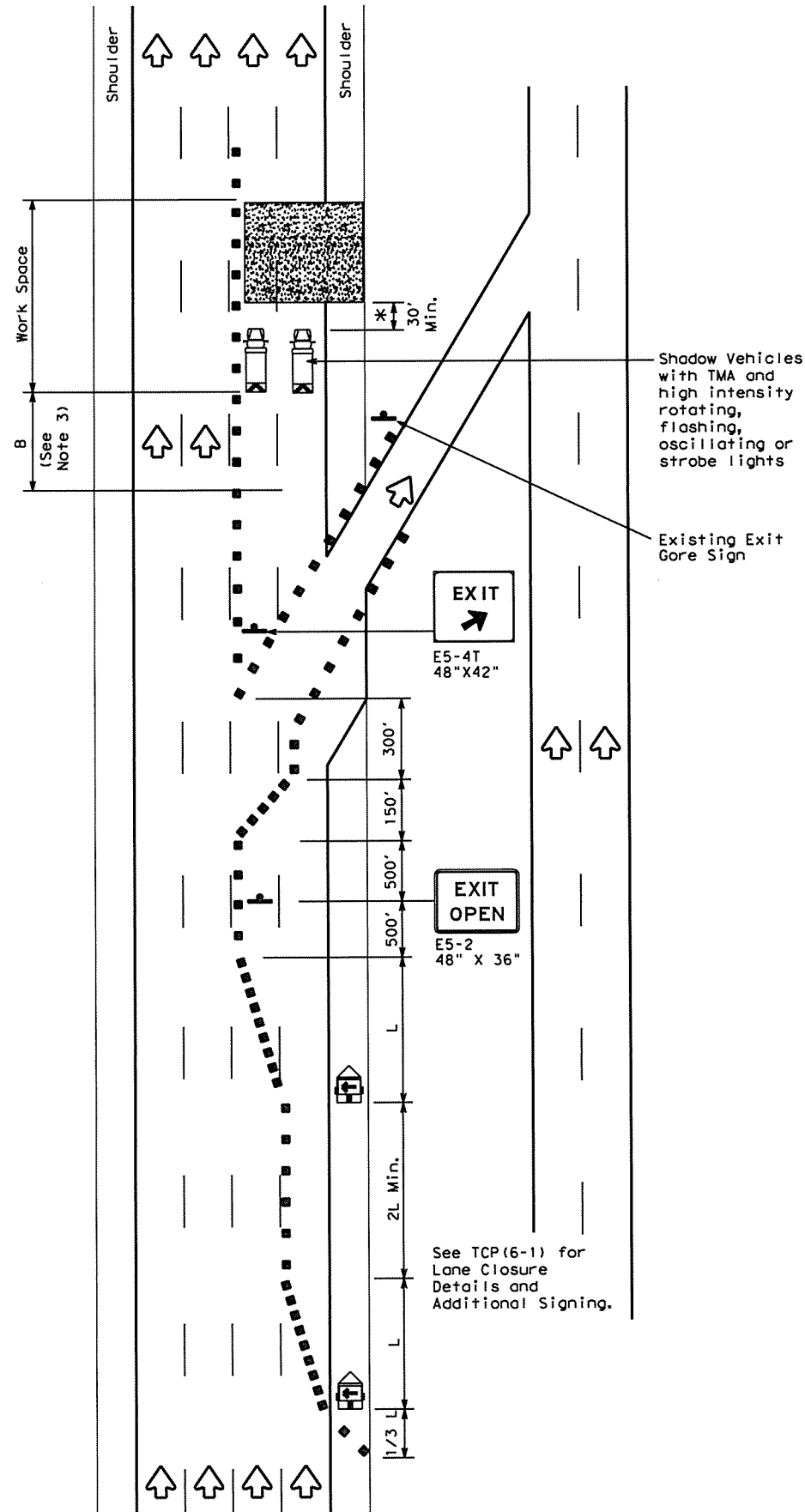
TCP (6-4) - 12

FILE: tcp6-4.dgn	DN: TxDOT	CK: TxDOT	DW: TxDOT	CK: TxDOT
©TxDOT February 1994	CONT SECT	JOB	HIGHWAY	
REVISIONS	6459 93	001	I-610, etc	
1-97 8-98	DIST	COUNTY	SHEET NO.	
4-98 8-12	HOU	HARRIS, etc.	105	

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TCP (6-5a)
EXIT RAMP OPEN



TCP (6-5b)
EXIT RAMP OPEN
TWO LANE CLOSURE WITHIN
1500' PAST EXIT RAMP

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

Posted Speed	Formula	Minimum Desirable Taper Lengths "L"			Suggested Maximum Spacing of Channelizing Devices		Suggested Longitudinal Buffer Space "B"
		10' Offset	11' Offset	12' Offset	On a Taper	On a Tangent	
45	L = WS	450'	495'	540'	45'	90'	195'
50		500'	550'	600'	50'	100'	240'
55		550'	605'	660'	55'	110'	295'
60		600'	660'	720'	60'	120'	350'
65		650'	715'	780'	65'	130'	410'
70		700'	770'	840'	70'	140'	475'
75		750'	825'	900'	75'	150'	540'
80		800'	880'	960'	80'	160'	615'

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

TYPICAL USAGE				
MOBILE	SHORT DURATION	SHORT TERM STATIONARY	INTERMEDIATE TERM STATIONARY	LONG TERM STATIONARY
	✓	✓	✓	

GENERAL NOTES

- All traffic control devices illustrated are REQUIRED. Devices denoted with the triangle symbol may be omitted when stated elsewhere in the plans.
- See BC standards for sign details.
- If adequate longitudinal buffer length "B" does not exist between the work space and the exit ramp, consideration should be given to closing the ramp.

*A shadow vehicle equipped with a Truck Mounted Attenuator is typically required. A shadow vehicle equipped with a TMA shall be used if it can be positioned 30' to 100' in advance of the area of crew exposure without adversely affecting the work performance.

Additional requirements for lane closures and advance signing shall be as shown on TCP (6-1) or as directed by the Engineer.

Texas Department of Transportation
Traffic Operations Division Standard

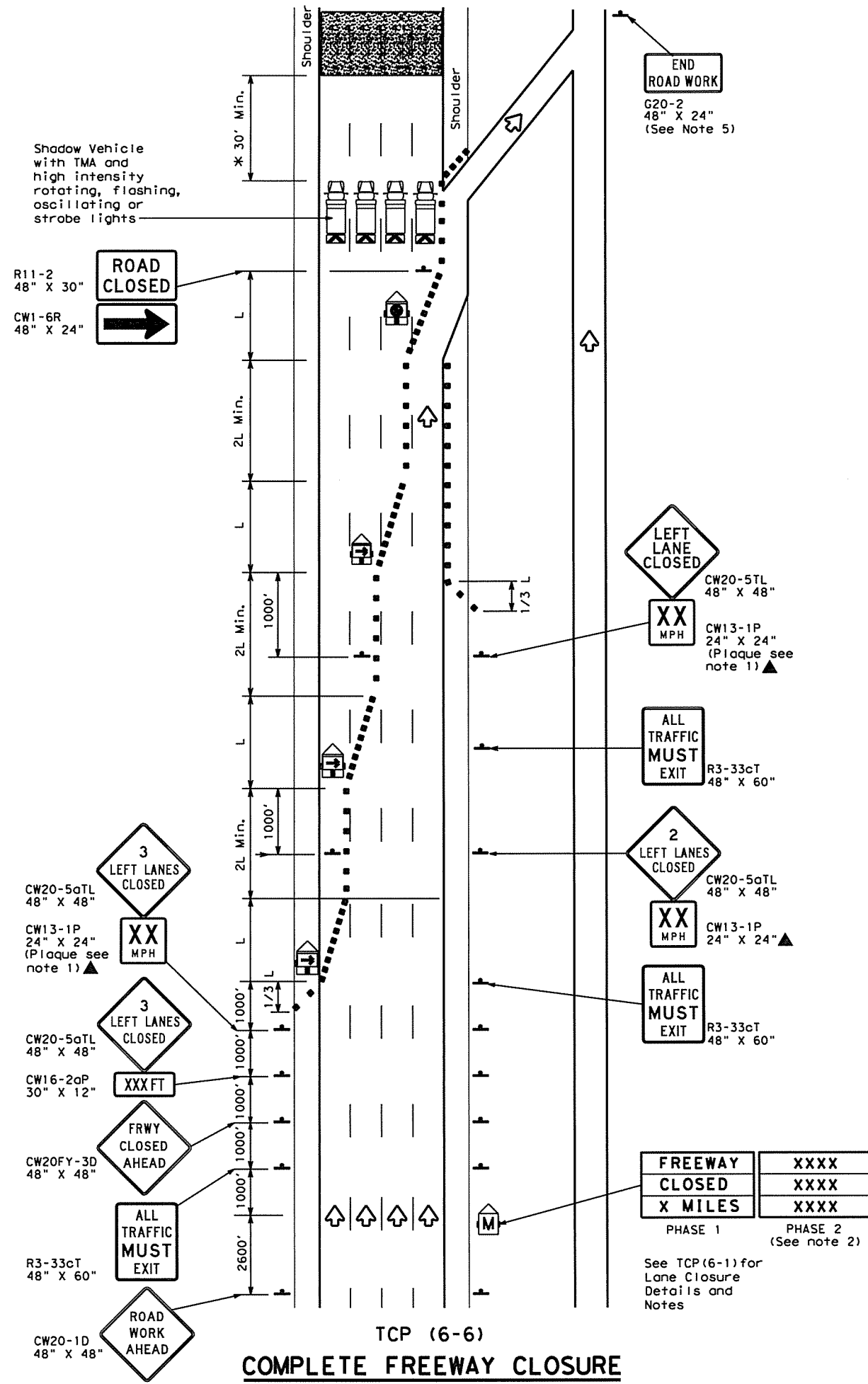
TRAFFIC CONTROL PLAN
WORK AREA BEYOND EXIT RAMP

TCP (6-5) - 12

FILE: tcp6-5.dgn	DN: TxDOT	CK: TxDOT	DR: TxDOT	CR: TxDOT
© TxDOT February 1998	CONT	SECT	JOB	HIGHWAY
REVISIONS	6459	93	001	I-610, etc
1-97 8-98	DIST	COUNTY	SHEET NO.	
4-98 8-12	HOU	HARRIS, etc.	106	

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DATE: FILE:



LEGEND			
	Type 3 Barricade		Channelizing Devices
	Heavy Work Vehicle		Truck Mounted Attenuator (TMA)
	Trailer Mounted Flashing Arrow Board		Portable Changeable Message Sign (PCMS)
	Flashing Arrow Board in Caution Mode		Traffic Flow
	Sign		

Posted Speed	Formula	Minimum Desirable Taper Lengths "L" **			Suggested Maximum Spacing of Channelizing Devices		Suggested Longitudinal Buffer Space "B"
		10' Offset	11' Offset	12' Offset	On a Taper	On a Tangent	
45	L = WS	450'	495'	540'	45'	90'	195'
50		500'	550'	600'	50'	100'	240'
55		550'	605'	660'	55'	110'	295'
60		600'	660'	720'	60'	120'	350'
65		650'	715'	780'	65'	130'	410'
70		700'	770'	840'	70'	140'	475'
75		750'	825'	900'	75'	150'	540'
80		800'	880'	960'	80'	160'	615'

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

TYPICAL USAGE				
MOBILE	SHORT DURATION	SHORT TERM STATIONARY	INTERMEDIATE TERM STATIONARY	LONG TERM STATIONARY
	✓	✓	✓	

GENERAL NOTES

- All traffic control devices illustrated are REQUIRED. Devices denoted with the triangle symbol may be omitted when stated elsewhere in the plans.
- Phase 2 of the PCMS message should include appropriate information formatted as shown on BC(6), such as "MERGE RIGHT," recommended speed, delay, exit information, or other specific warnings.
- Where queuing is anticipated beyond signing shown, additional PCMS signs, other warning signs, devices or Law Enforcement Officers should be available to warn approaching high speed traffic of the end of the queue, as directed by the Engineer.
- Entrance ramps located from the advance warning area to the exit ramp should be closed whenever possible.
- The END ROAD WORK (G20-2) sign may be omitted when it conflicts with G20-2 signs already in place on the project.

*A shadow vehicle equipped with a Truck Mounted Attenuator is typically required. A shadow vehicle equipped with a TMA shall be used if it can be positioned 30' to 100' in advance of the area of crew exposure without adversely affecting the work performance.

Additional requirements for lane closures and advance signing shall be as shown on TCP (6-1) or as directed by the Engineer.

Texas Department of Transportation
Traffic Operations Division Standard

TRAFFIC CONTROL PLAN FREEWAY CLOSURE

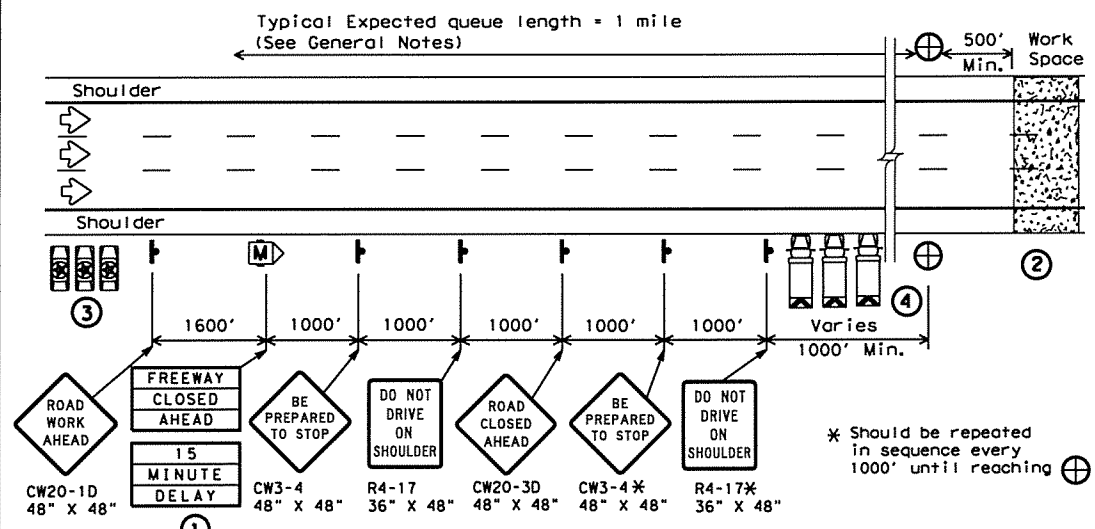
TCP (6-6) - 12

FILE: tcp6-6.dgn	DN: TxDOT	CR: TxDOT	DR: TxDOT	CK: TxDOT
©TxDOT February 1994	CONT	SECT	JOB	HIGHWAY
REVISIONS	6459	93	001	I-610, etc.
1-97 8-98	DIST	COUNTY	SHEET NO.	
4-98 8-12	HOU	HARRIS, etc.	107	

206

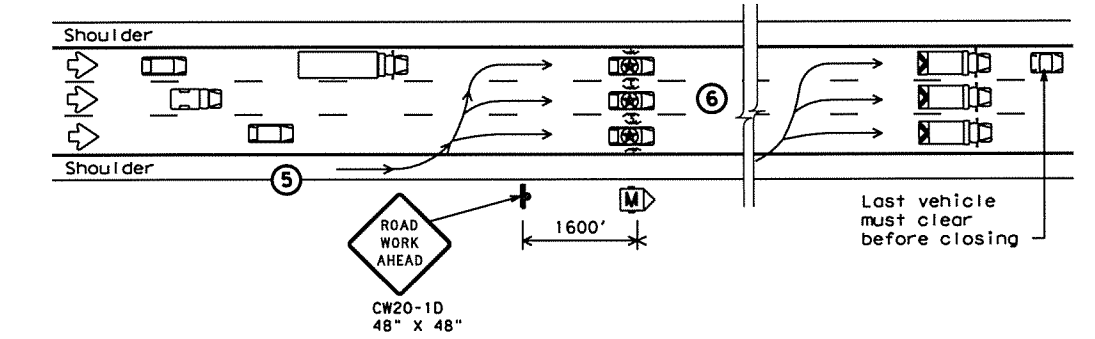
TCP (6-6)
COMPLETE FREEWAY CLOSURE

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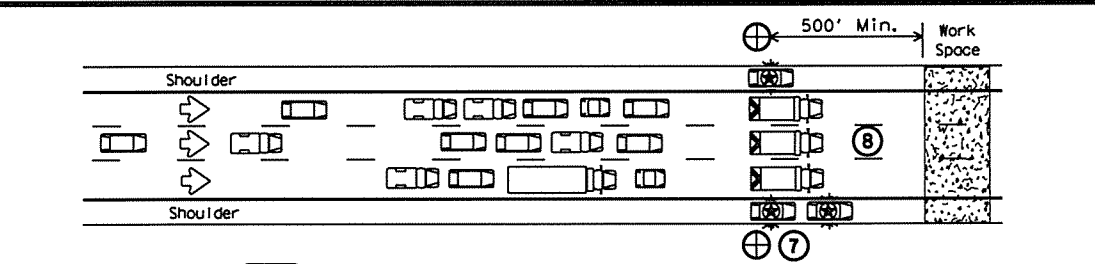
1 STARTING POSITION

- Traffic control devices should be installed or located near their intended position prior to beginning temporary roadway closure sequence. Duplicate signs should be erected on the median side of the roadway when median width permits. Warning signs should not be placed on the paved shoulders that will be used by the WARNING LEOV, or where movement of the LEOVs or barrier vehicles will be impeded.
- Prior to beginning the roadway closure sequence, all equipment, materials, personnel, and other items necessary to complete the work should be gathered near the work area. Entrance ramps located in the area where a queue is expected to build should be closed.
- There should be one LEOV for every lane to be controlled, plus a minimum of one to warn traffic approaching a queue. An additional lead law enforcement officer is desirable to remain with the Engineer's or Contractor's point of contact (POC) during the operation in order to improve communication with all LEOVs involved.
- One barrier vehicle with a Truck Mounted Attenuator and amber or blue and amber high intensity flashing/oscillating/strobe lighting shall be used for each lane to be closed.



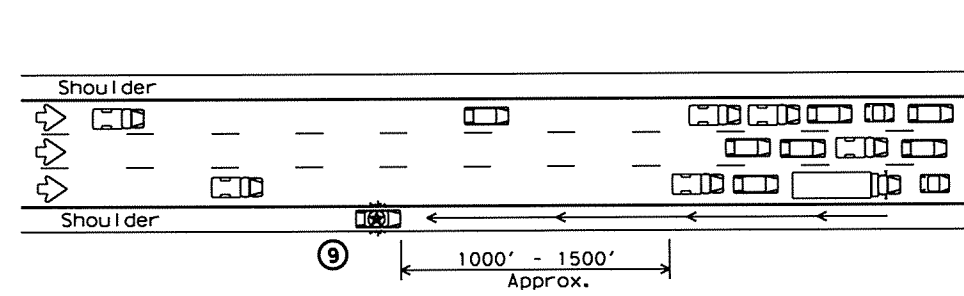
2 REDUCING SPEED OPERATION

- Starting position of the LEOVs should be in advance of the most distant warning signs.
- Once the LEOVs have achieved an abreast blocking formation while traveling toward the CP, emergency lights and headlights should be turned "ON". The LEOVs should maintain formation, not allow traffic to pass, and begin to decelerate. The LEOVs should continue to decelerate, giving the barrier vehicles opportunity to be staged upstream of the work space after traffic has cleared. The LEOVs should then continue to decelerate slowly until bringing traffic to a stop near the barrier vehicles.



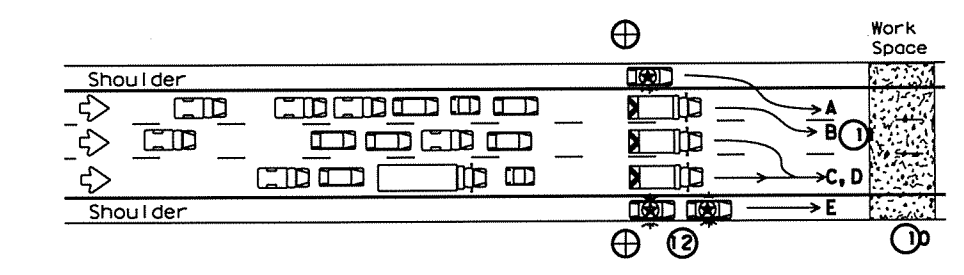
3 ALL TRAFFIC STOPPED AT CP

- Once traffic is stopped the LEOVs should park on the shoulders with emergency lighting "ON" in order to provide law enforcement presence at the closure and keep shoulders blocked ahead of the work space. They should stay in radio contact with the WARNING LEOV.
- The barrier vehicles should be parked, one in each lane, the parking brake set, with the high visibility flashing/oscillating/strobe lighting "ON," and the transmission in gear.



4 WARNING THE TRAFFIC QUEUE

- The WARNING LEOV should proceed to the right shoulder of the roadway, with emergency lights on approximately 1000' in advance of the traffic queue (stopped traffic) as the queue develops. When determined that limited sight distance situations (crest of hills, sharp roadway curvature, etc.) may occur to motorists approaching the queue, the WARNING LEOV may proceed 1/4 mile or more in advance of the queue.



5 RELEASING STOPPED TRAFFIC

- All equipment, materials, personnel, and other items should be removed from the roadway and maintain an adequate clear zone.
- When the roadway is clear for traffic, the LEOV should proceed forward from the left shoulder followed by the barrier vehicles, from left to right, as shown alphabetically in the plan view.
- The LEOV or LEOVs on the right shoulder may remain on the shoulder until satisfied that traffic is moving satisfactorily before merging or proceeding.
- LEOVs and barrier vehicles should re-group at their respective starting positions if necessary.

LEGEND			
■	Channelizing Devices	⊕	Control Position (CP)
Ⓜ	Portable Changeable Message Sign (PCMS)	Ⓜ	Barrier Vehicle with Truck Mounted Attenuator
Ⓜ	Law Enforcement Officer's Vehicle (LEOV)	←	Traffic Flow

TYPICAL USAGE				
MOBILE	SHORT DURATION	SHORT TERM STATIONARY	INTERMEDIATE TERM STATIONARY	LONG TERM STATIONARY
	✓			

GENERAL NOTES

- All traffic control devices shall conform with the latest edition of the Texas Manual on Uniform Traffic Control Devices (TMUTCD). Additional guidelines for traffic control devices may be found in the TMUTCD. Signs conflicting with the roadway closure sequence should be completely removed or covered. Additional traffic control devices may be required for closure of access roads, cross streets, exit and entrance ramps as directed by the Engineer.
- Law enforcement officers and all workers involved should review and understand all procedures before the roadway closure sequence begins. Pre-work meetings may be held for this purpose. Local emergency services and media should have advance notification of roadway closure, expected dates and approximate times of closures.
- Law enforcement officers shall be in uniform and have jurisdiction in the locale of the work area. An additional WARNING Law Enforcement Officer's Vehicle (LEOV) may be used on the median side of the roadway where median shoulder width permits (See sequence #9).
- The roadway closure should be during off-peak hours, as shown in the plans, or as directed by the Engineer.
- Work should be limited to approximately 15 minutes maximum duration unless otherwise directed by the Engineer based on existing roadway conditions. If the work is not complete within 15 minutes, or if the end of the traffic queue extends past the most distant advance warning signs, the work area should be cleared of all equipment, materials, personnel, and other items, and the roadway reopened. When the queue has dissipated and the traffic flow appears normal the roadway closure sequence may be repeated.
- For traffic volumes greater than 1000 Passenger Cars Per Hour Per Lane (PCPHPL), or for roadway closures that exceed 15 minutes, see details elsewhere in the plan.
- If traffic queues beyond the advance warning signs during one road closure sequence, the advance warning should be extended prior to repeating the road closure sequence. When possible, PCMS signs should be located in advance of the last available exit prior to the closure to allow motorists the choice of an alternate route.

THIS PLAN IS INTENDED TO BE USED AT LOCATIONS/TIMES WHEN TRAFFIC VOLUMES ARE LESS THAN 1000 PASSENGER CARS PER HOUR PER LANE.

Texas Department of Transportation

 Traffic Operations Division Standard

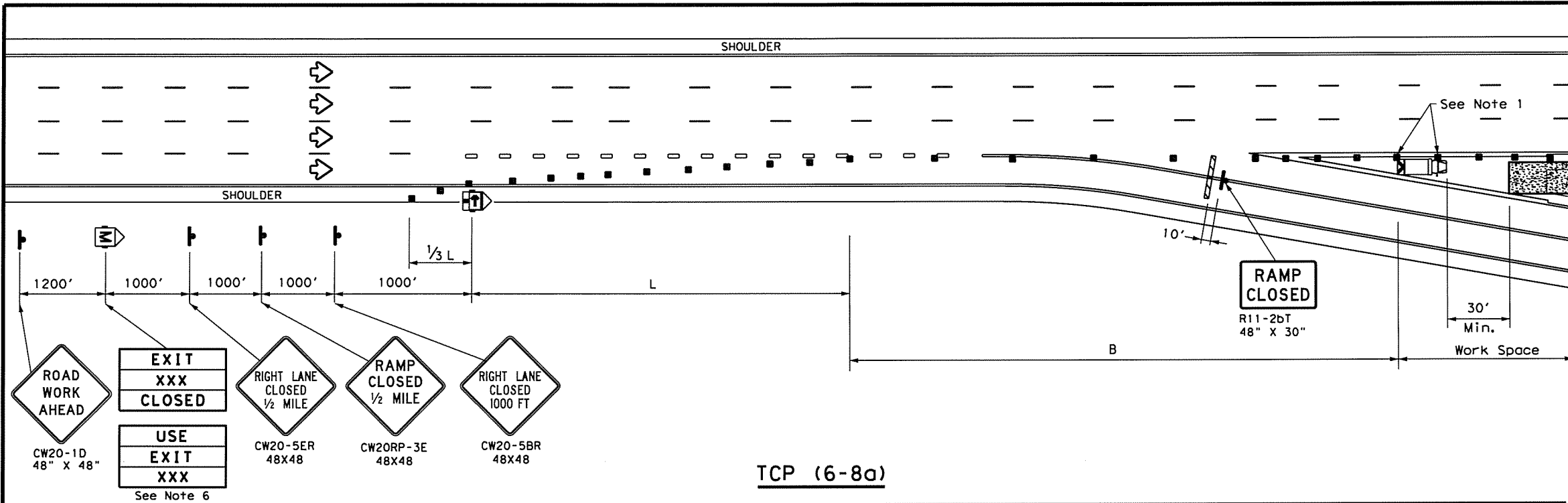
TRAFFIC CONTROL PLAN SHORT DURATION FREEWAY CLOSURE SEQUENCE

TCP (6-7) - 12

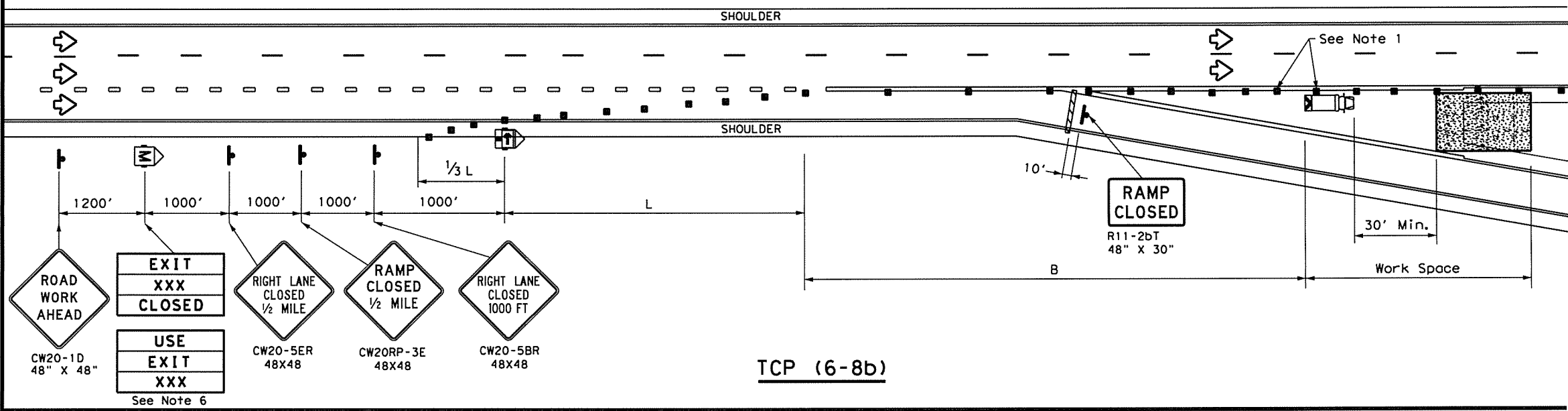
FILE: tcp6-7.dgn	DN: TxDOT	CK: TxDOT	DR: TxDOT	CK: TxDOT
© TxDOT February 1998	CONT: 6459	SECT: 93	JOB: 001	HIGHWAY: I-610, etc.
REVISIONS	6459	93	001	I-610, etc.
1-97 8-12	DIST: HOU	COUNTY: HARRIS, etc.	SHEET NO.: 108	
4-98				

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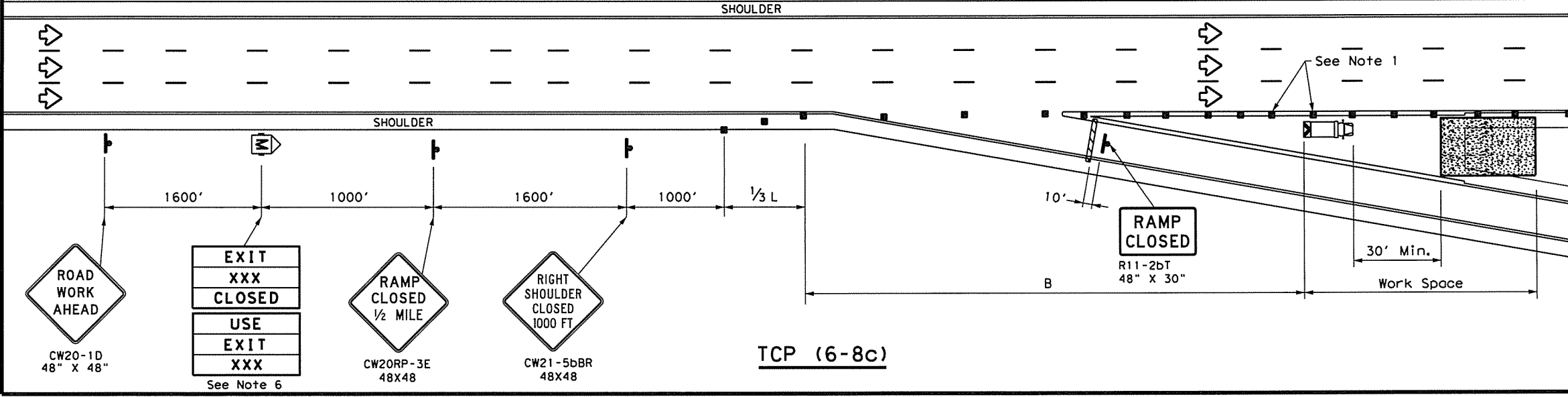
DATE: FILE:



TCP (6-8a)



TCP (6-8b)



TCP (6-8c)

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

Posted Speed	Formula	Minimum Desirable Taper Lengths "L"			Suggested Maximum Spacing of Channelizing Devices		Suggested Longitudinal Buffer Space "B"
		10' Offset	11' Offset	12' Offset	On a Taper	On a Tangent	
45	L = WS	450'	495'	540'	45'	90'	195'
50		500'	550'	600'	50'	100'	240'
55		550'	605'	660'	55'	110'	295'
60		600'	660'	720'	60'	120'	350'
65		650'	715'	780'	65'	130'	410'
70		700'	770'	840'	70'	140'	475'
75		750'	825'	900'	75'	150'	540'
80		800'	880'	960'	80'	160'	615'

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

TYPICAL USAGE				
MOBILE	SHORT DURATION	SHORT TERM STATIONARY	INTERMEDIATE TERM STATIONARY	LONG TERM STATIONARY
	✓	✓		

GENERAL NOTES

- Place channelizing devices in the gore at 20' spacing.
- See the Standard Highway Sign Design for Texas (SHSD) for sign details.
- The PCMS may be omitted when a permanent DMS sign is available in an appropriate location to display a similar message as called for on the PCMS.
- When it is determined that a through lane should be closed in addition to the exit ramp, refer to TCP(6-4) for traffic control details.
- Truck mounted attenuator is required.
- The PCMS may be omitted if replaced with a "RAMP CLOSED" AHEAD (CW20RP-3D) Sign.
- Roadway ADT should be greater than 10,000.



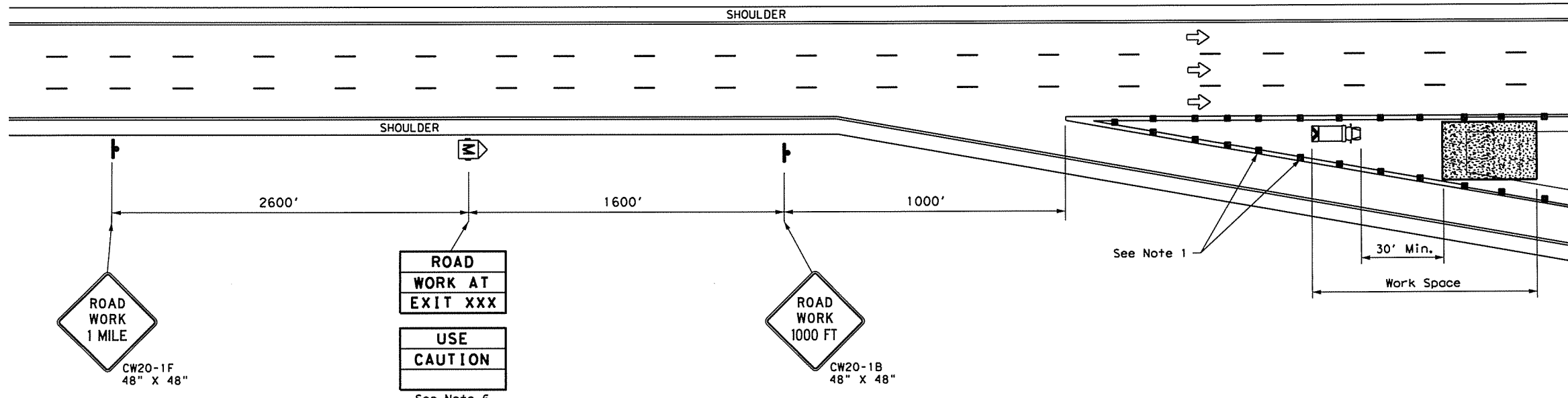
WORK IN EXIT GORE FOR ADT GREATER THAN 10,000

TCP (6-8) - 14

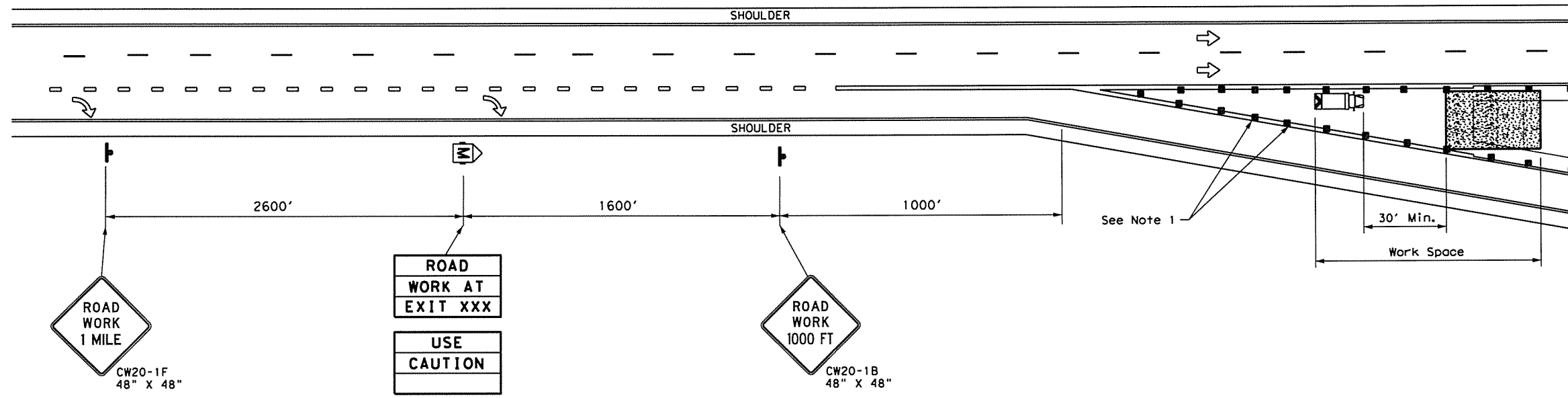
FILE:	tcp6-8.dgn	DW:	TxDOT	CK:	TxDOT	DR:	TxDOT	CK:	TxDOT
© TxDOT	February 2014	CONT:	SECT:	JOB:	HIGHWAY:				
REVISIONS:		6459	93	001	I-610, etc.				
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		HOU:	HARRIS, etc.	109					

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DATE:
FILE:



TCP (6-9a)



TCP (6-9b)

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

Posted Speed	Formula	Minimum Desirable Taper Lengths "L"			Suggested Maximum Spacing of Channelizing Devices		Suggested Longitudinal Buffer Space "B"
		10' Offset	11' Offset	12' Offset	On a Taper	On a Tangent	
45	L = WS	450'	495'	540'	45'	90'	195'
50		500'	550'	600'	50'	100'	240'
55		550'	605'	660'	55'	110'	295'
60		600'	660'	720'	60'	120'	350'
65		650'	715'	780'	65'	130'	410'
70		700'	770'	840'	70'	140'	475'
75		750'	825'	900'	75'	150'	540'
80		800'	880'	960'	80'	160'	615'

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

TYPICAL USAGE				
MOBILE	SHORT DURATION	SHORT TERM STATIONARY	INTERMEDIATE TERM STATIONARY	LONG TERM STATIONARY
	✓	✓		

- GENERAL NOTES**
- Place channelizing devices in the gore at 20' spacing.
 - See the Standard Highway Sign Design for Texas (SHSD) for sign details.
 - The PCMS may be omitted when a permanent DMS sign is available in an appropriate location to display a similar message as called for on the PCMS.
 - When it is determined that a through lane should be closed in addition to the exit ramp, refer to TCP(6-4) and TCP(6-8) for traffic control details.
 - Truck mounted attenuators are required.
 - The PCMS may be omitted if replaced with a "ROAD WORK 1/2 MILE" (CW20-1E).
 - Roadway ADT should be less than 10,000.

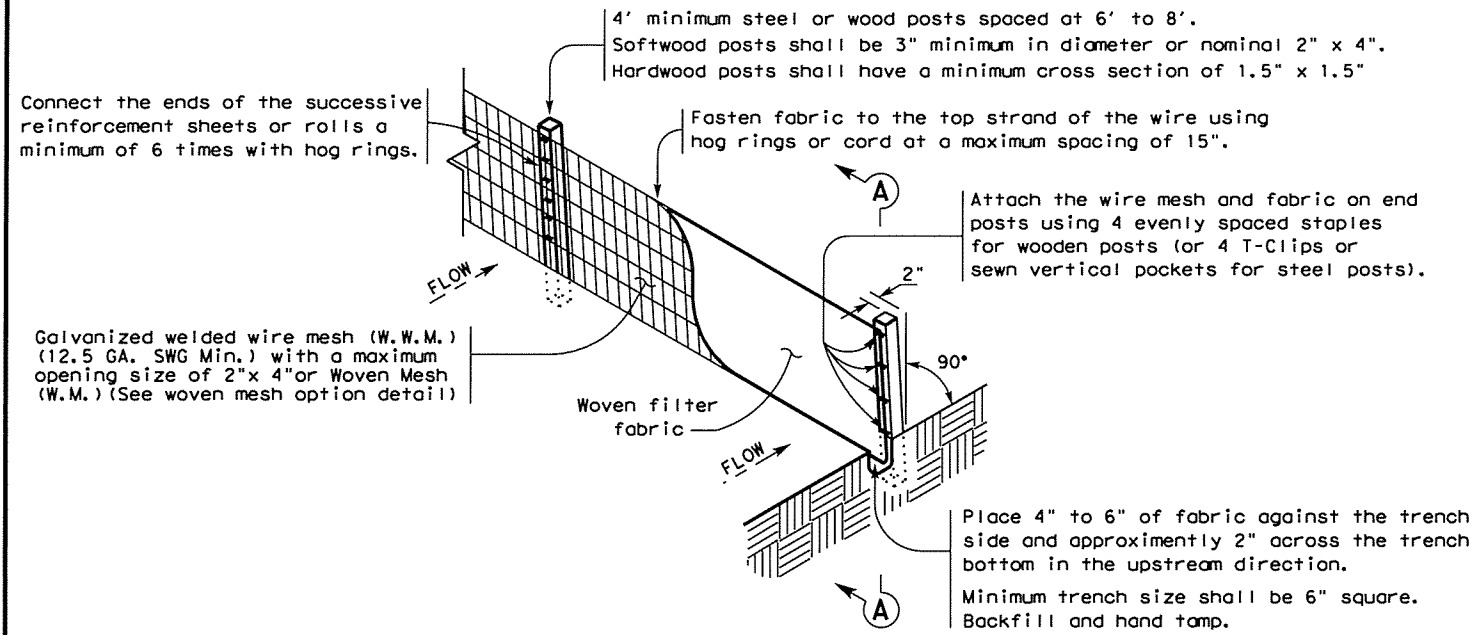


WORK IN EXIT GORE FOR ADT LESS THAN 10,000

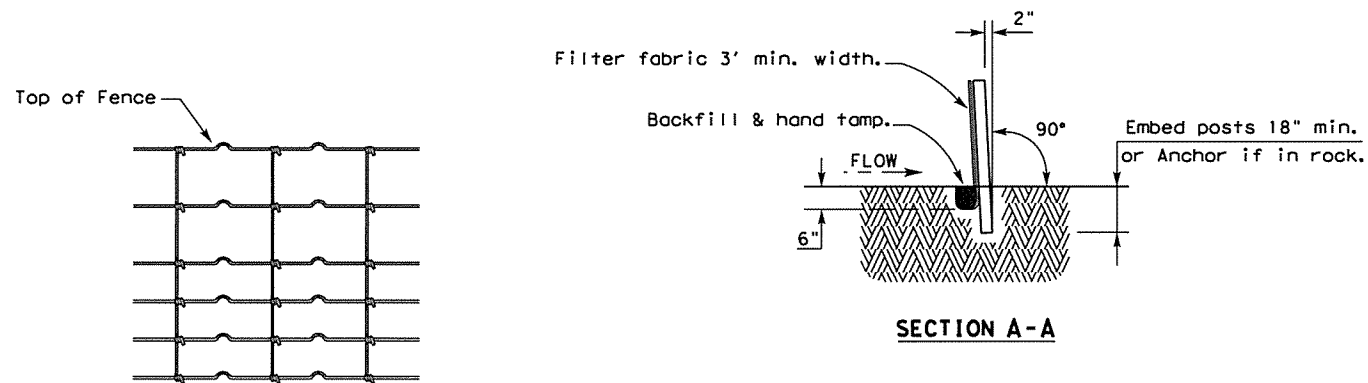
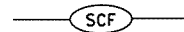
TCP (6-9) - 14

FILE: tcp6-9.dgn	DN: TxDOT	CK: TxDOT	DW: TxDOT	CR: TxDOT
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TEMPORARY SEDIMENT CONTROL FENCE



HINGE JOINT KNOT WOVEN MESH (OPTION) DETAIL

Galvanized hinge joint knot woven mesh (12.5 GA. SWG Min.) requires a minimum of five horizontal wires spaced at a maximum of 12 inches apart and all vertical wires spaced at a maximum of 12 inches apart.

SEDIMENT CONTROL FENCE USAGE GUIDELINES

A sediment control fence may be constructed near the downstream perimeter of a disturbed area along a contour to intercept sediment from overland runoff. A 2 year storm frequency may be used to calculate the flow rate to be filtered.

Sediment control fence should be sized to filter a maximum flow through rate of 100 GPM/FT². Sediment control fence is not recommended to control erosion from a drainage area larger than 2 acres.

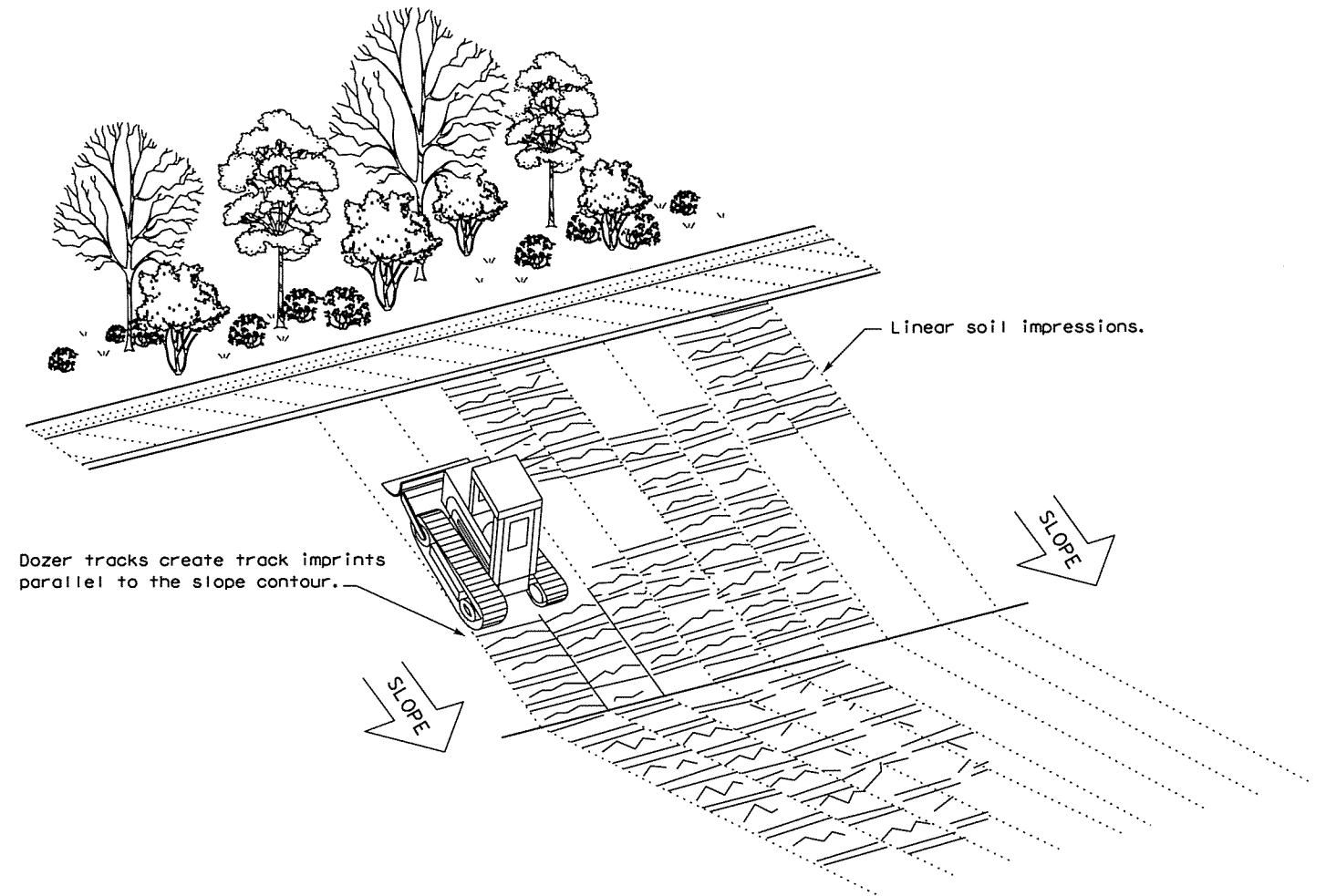
LEGEND

Sediment Control Fence



GENERAL NOTES

1. Vertical tracking is required on projects where soil distributing activities have occurred unless otherwise approved.
2. Perform vertical tracking on slopes to temporarily stabilize soil.
3. Provide equipment with a track undercarriage capable of producing linear soil impressions measuring a minimum of 12" in length by 2" to 4" in width by 1/2" to 2" in depth.
4. Do not exceed 12" between track impressions.
5. Install continuous linear track impressions where the minimum 12" length impressions are perpendicular to the slope or direction of water flow.



		Design Division Standard	
TEMPORARY EROSION, SEDIMENT AND WATER POLLUTION CONTROL MEASURES FENCE & VERTICAL TRACKING			
EC(1)-16			
FILE: ec116	DW: TxDOT	CK: KM	DW: VP
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