

STATE OF TEXAS  
DEPARTMENT OF TRANSPORTATION

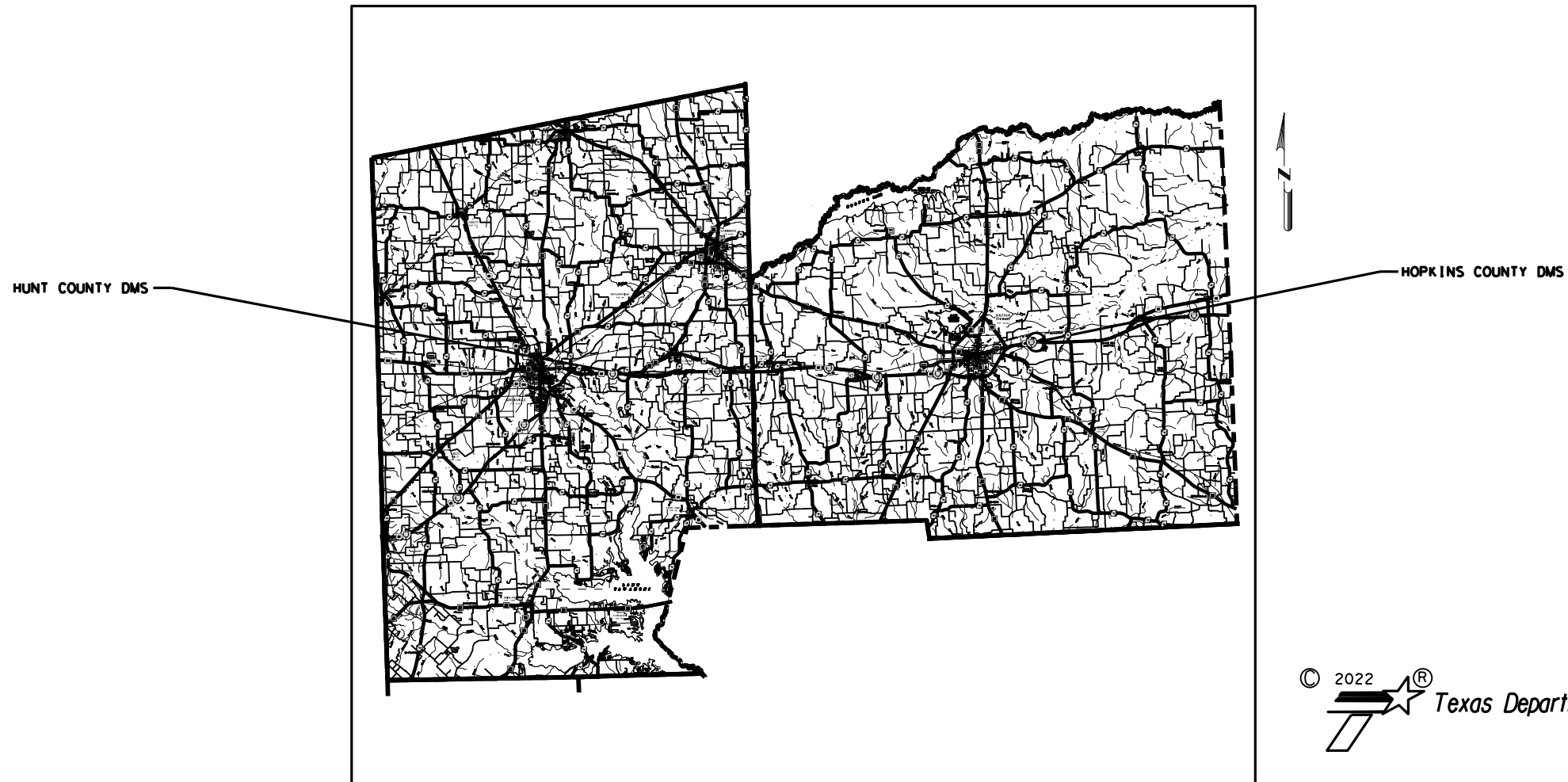
PLANS OF PROPOSED  
STATE HIGHWAY IMPROVEMENT

MAINTENANCE PROJECT RMC 6385-38-001

IH 30 DMS  
HUNT COUNTY, ETC

FOR THE CONSTRUCTION OF DYNAMIC MESSAGE SIGNS

FHWA TEXAS DIVISION		PROJECT NO. RMC 6385-38-001		SHEET NO. 1
STATE	DISTRICT	COUNTY		
TEXAS	PAR	HUNT, ETC		
CONTROL	SECTION	JOB	HIGHWAY NO.	
6385	38	001	IH 30	



SUBMITTED FOR LETTING:

*[Signature]* P.E. 2/9/2022  
DISTRICT TRAFFIC ENGINEER

RECOMMENDED FOR LETTING:

*[Signature]* P.E. 02/09/2022  
DISTRICT MAINTENANCE ENGINEER

APPROVED FOR LETTING:

*[Signature]* P.E. 2/09/2022  
DIRECTOR OF OPERATIONS

EXCEPTIONS: NONE  
EQUATIONS: NONE  
RAILROAD CROSSINGS: N/A

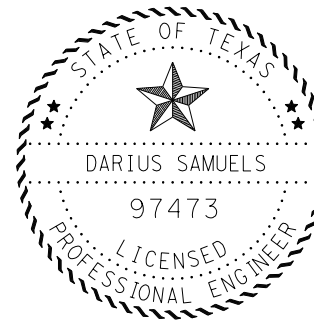
SPECIFICATIONS ADOPTED BY THE TEXAS DEPARTMENT OF TRANSPORTATION,  
NOVEMBER 1, 2014 AND SPECIFICATION ITEMS LISTED AND DATED AS FOLLOWS,  
SHALL GOVERN ON THIS PROJECT.

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THE STANDARD SHEETS SPECIFICALLY IDENTIFIED ON THIS SHEET  
HAVE BEEN ISSUED BY ME AND ARE APPLICABLE TO THIS PROJECT.

 P. E.

1/6/2022  
DATE

**Project Number: RMC 6385-38-001**

**County: Hunt, ETC**

**Control: 6385-38-001**

**Highway: IH 30**

## GENERAL NOTES

**Project Description:** Install in accordance with the current Texas Manual on Uniform Traffic Control Devices and the current National Electrical Code unless otherwise specified on the plans.

Furnish all signal equipment unless otherwise specified.

Questions prior to letting may be submitted by email to the name listed below:

District Traffic Office:

Darius Samuels, P.E. [-darius.samuels@txdot.gov](mailto:-darius.samuels@txdot.gov)

Contractor questions will be accepted through email, phone, and in person by the above individuals.

All contractor questions will be reviewed by the Engineer. Once a response is developed, it will be posted to TxDOT's Public FTP at the following Address:

<https://ftp.dot.state.tx.us/pub/txdot-info/Pre-Letting%20Responses/>

All questions submitted that generate a response will be posted through this site. The site is organized by District, Project Type (Construction or Maintenance), Letting Date, CCSJ/Project Name.

**TxDOT Project Supervisor:** All work on this contract will be scheduled and directed by the following person. Payments will be made on a monthly basis for work completed and accepted according to specifications. All payment requests shall be directed to the same:

Darius Samuels, P.E.  
1365 N. Main St.  
Paris, TX 75460  
Phone: (903) 737-9498

Prior to beginning operations, a pre-construction/conference meeting between the Contract's representative and the Department will be arranged by the Department. This meeting will be to outline the proposed work procedures, sequence of work to be followed, and discuss the required traffic control. Plans, specifications, unusual conditions, and other pertinent items regarding the work will be discussed. The Contractor's job superintendent is requested to attend this meeting. Plans are required on this project.

## ITEM 2 – INSTRUCTIONS TO BIDDERS

Article 5- This project includes plan sheets that are not part of the bid proposal. View plans on-line or download from the web at:

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**County: Hunt, ETC**

**Control: 6385-38-001**

**Highway: IH 30**

<http://www.txdot.gov/business/letting-bids/plans-online.html>

Order plans from any of the plan reproduction companies shown on the web at:

<http://www.txdot.gov/business/letting-bids/repro-companies.html>

## ITEM 7 – LEGAL RELATIONS AND RESPONSIBILITIES

No significant traffic generator events identified.

## ITEM 8 – PROSECUTION AND PROGRESS

Working days will be charged in accordance with item 8.3.A.6 Other.

Working days will be charged Monday through Friday, excluding national holidays, regardless of weather conditions or material availability. Work on Saturdays, Sundays and national holidays will not be permitted without written permission of the Engineer. If work requiring an Inspector to be present is performed on a Saturdays, Sundays and national holiday and weather and other conditions permit the performance of work for 7 hours between 7:00 a.m. and 6:00 p.m., a working day will be charged.

This project includes SP 008---003 which allows up to a 90-day delay to begin work on the project to acquire material such as DMS equipment.

## ITEM 9 – MEASUREMENT AND PAYMENT

Maintain equipment on the project until accepted by TxDOT.

## ITEM 502 – BARRICADES, SIGNS AND TRAFFIC HANDLING

Meet both of the following conditions on the roadway before work can begin:

1. The work schedule is approved and
2. No more than five workdays will pass between the beginning of Item 502 and the actual commencement of the roadway work bid Items.

Furnish a phone number reachable 24 hours a day. Be available to return call within two hours.

Truck mounted crash attenuator(s) shall be furnished by the Engineer. This work will be paid for under Item 6185 for stationary set-ups.

The traffic control plan for this contract consists of the installation and maintenance of warning signs and other traffic control devices shown in the plans, specification data which may be

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**County: Hunt, ETC**

**Control: 6385-38-001**

**Highway: IH 30**

included in the general notes, applicable provisions of the Texas Manual on Uniform Traffic Control Devices (TMUTCD), traffic control plan sheets included in the plans, standard BC sheets and Item 502 of the Standard Specifications. Traffic Control will be considered subsidiary to the various bid item.

At no time will equipment be parked on or within two feet of the edge of travel lane without proper lane closure set up and in place.

The Contractor's personnel shall be dressed in approved attire while outside vehicles and/or while performing work on the highway right of way. For daytime and nighttime activity, flaggers shall wear high-visibility safety apparel that meets the Performance Class 2 or 3 requirements of the ANSI/ISEA 107-2004 publication entitled "American National Standard for High-Visibility Apparel and Headwear".

#### **ITEM 618 – CONDUIT**

Use rigid metal sweep ells for all conduits entering the controller base.

Attach all conduits to any type pole with conduit straps spaced at maximum intervals of five feet and within three feet of each side of any enclosure.

Provide boring equipment capable of tracking location and depth of bore head at all times. Bore head must be able to change bore direction without removing bore head. Mark depth of conduit at ten foot intervals along the length of bore and provide a copy of depth and location information.

Shore pits for jacking or boring conduit when closer than five feet to the back of the curb. Consider shoring subsidiary to this Item.

Maintain a minimum vertical cover of 24 inches on all conduits except when it crosses flow line at which point it is a minimum of 36 inches.

Maximum depth of sweep ells will be 36 inches unless otherwise shown.

#### **ITEM 628 – ELECTRICAL SERVICES**

Install according to utility company requirements.

#### **ITEM 6028 – DYNAMIC MESSAGE SIGN SYSTEM**

Send all ITS related material submittals to District Traffic Operations for approval.

**Project Number: RMC 6385-38-001**

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**Control: 6385-38-001**

**Highway: IH 30**

Use pre-qualified materials and products from the TxDOT "Material Producer List" on the TxDOT website.

The dynamic message signs and controllers will be supplied by the Department. All DMS equipment furnished has been shop tested.

Pick up the furnished DMS equipment at the Greenville Area Office located at 3001 IH 30 East, Greenville, TX. The contractor must sign for the equipment received. Signal Shop. Once received up from the yard, assume responsibility for the DMS equipment until final acceptance of the project.

Construct controller/pedestal service foundation in accordance with standard sheets ITS(21) – 15, ED(9) – 14, and ITS Controller/Pedestal Service Foundation Details as shown on plans. The foundation is subsidiary to this Item in accordance with this special specification.

Electrical licenses and certifications for this project will be as per Item 7 of the current Texas Standard Specifications and any special provisions to Item 7.

Furnish all materials and repair any sod, pavement, sidewalk, or other property damaged during the construction, this is according to Article 7.12 of the standard specification.

Ensure that all materials furnished are corrosion resistant and exhibit no rust.

Verify actual location of utilities and take adequate precautions to prevent damage to utilities, storm sewers, and existing signal equipment.

After all construction is complete, all circuits are checked, and the DMS equipment is ready to turn on, notify District Transportation Operations. Inspectors will perform a preliminary check of all details. Prepare all field wiring inside the controller cabinet for termination prior to this inspection. When the installation is complete, all safety related items on the punch list are completed, place in normal operation, this will start the thirty-day test period.



# Estimate & Quantity Sheet

CONTROLLING PROJECT ID 6385-38-001

DISTRICT Paris  
HIGHWAY IH0030

COUNTY Hunt

CONTROL SECTION JOB				6385-38-001		TOTAL EST.	TOTAL FINAL
PROJECT ID				A00180057			
COUNTY				Hunt			
HIGHWAY				IH0030			
ALT	BID CODE	DESCRIPTION	UNIT	EST.	FINAL		
	416-6022	DRILL SHAFT (SIGN MTS) (48 IN)	LF	48.000		48.000	
	432-6045	RIPRAP (MOW STRIP)(4 IN)	CY	38.800		38.800	
	500-6001	MOBILIZATION	LS	1.000		1.000	
	502-6001	BARRICADES, SIGNS AND TRAFFIC HANDLING	MO	2.000		2.000	
	540-6002	MTL W-BEAM GD FEN (STEEL POST)	LF	400.000		400.000	
	544-6001	GUARDRAIL END TREATMENT (INSTALL)	EA	4.000		4.000	
	618-6023	CONDT (PVC) (SCH 40) (2")	LF	425.000		425.000	
	618-6075	CONDT (RM) (3") (BORE)	LF	140.000		140.000	
	620-6010	ELEC CONDR (NO.6) INSULATED	LF	260.000		260.000	
	624-6010	GROUND BOX TY D (162922)W/APRON	EA	3.000		3.000	
	628-6151	ELC SRV TY D 120/240 060(NS)SS(N)PS(U)	EA	2.000		2.000	
	650-6028	INS OH SN SUP(30 FT BAL TEE)	EA	2.000		2.000	
	6008-6025	ITS GRND MNT CAB (TY 4) (CONF 1) (REL)	EA	2.000		2.000	
	6028-6002	INSTALL DMS (FOUNDATION MTD CABINET)	EA	2.000		2.000	
	6185-6002	TMA (STATIONARY)	DAY	30.000		30.000	

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:

**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).

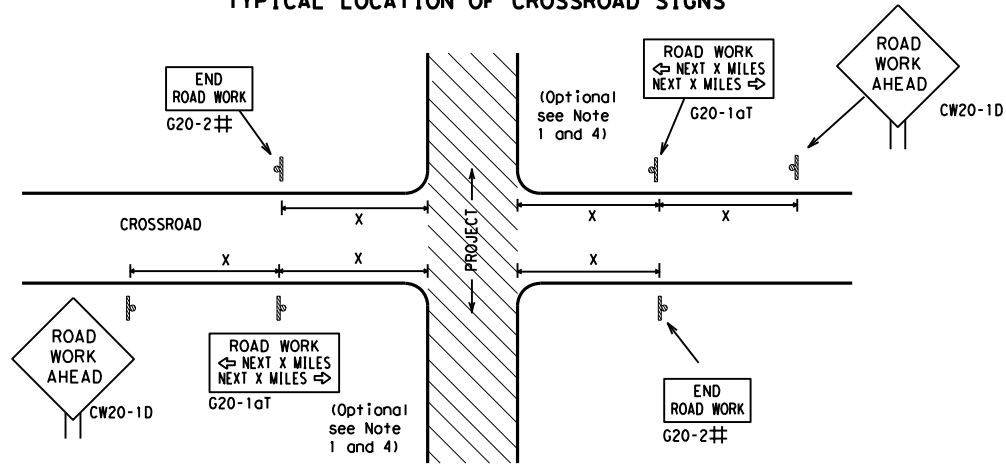
<p><b>THE DOCUMENTS BELOW CAN BE FOUND ON-LINE AT</b>  <a href="http://www.txdot.gov">http://www.txdot.gov</a></p>
COMPLIANT WORK ZONE TRAFFIC CONTROL DEVICES LIST (CWZTCD)
DEPARTMENTAL MATERIAL SPECIFICATIONS (DMS)
MATERIAL PRODUCER LIST (MPL)
ROADWAY DESIGN MANUAL - SEE "MANUALS (ONLINE MANUALS)"
STANDARD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

SHEET 1 OF 12

 Texas Department of Transportation		 Traffic Safety Division Standard	
<p><b>BARRICADE AND CONSTRUCTION GENERAL NOTES AND REQUIREMENTS</b></p> <p><b>BC (1) - 21</b></p>			
FILE:	bc-21.dgn	DN:	TxDOT
© TxDOT	November 2002	CK:	TxDOT
REVISIONS	CONT	SECT	JOB
4-03 7-13	6385	38	001
9-07 8-14	DIST	COUNTY	SHEET NO.
5-10 5-21	PAR	HUNT, ETC.	6

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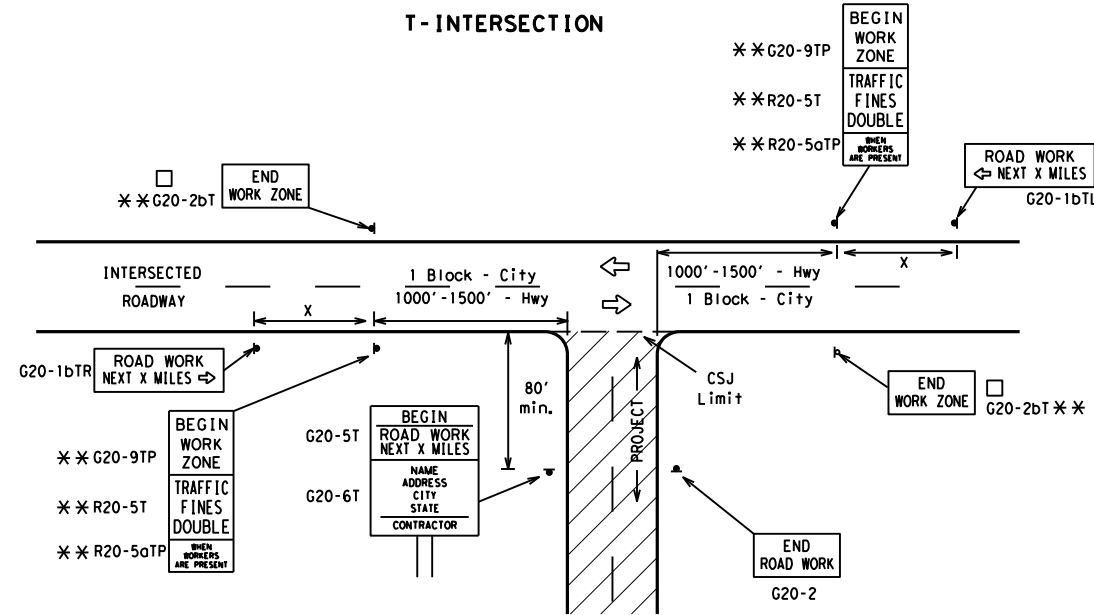
**TYPICAL LOCATION OF CROSSROAD SIGNS**



## May be mounted on back of "ROAD WORK AHEAD" (CW20-1D) sign with approval of Engineer. (See note 2 below)

1. 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.
2. 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.
3. 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.
4. 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.
5. Additional traffic control devices may be shown elsewhere in the plans for higher volume crossroads.
6. 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**

1. 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.
2. 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<sup>1,5,6</sup>**

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

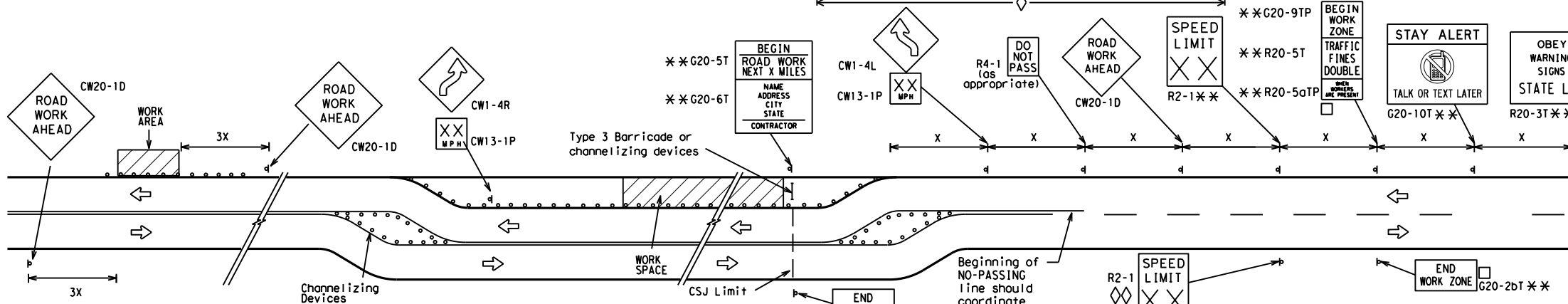
\* For typical sign spacings on divided highways, expressways and freeways, see Part 6 of the "Texas Manual on Uniform Traffic Control Devices" (TMUTCD) typical application diagrams or TCP Standard Sheets.

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

**GENERAL NOTES**

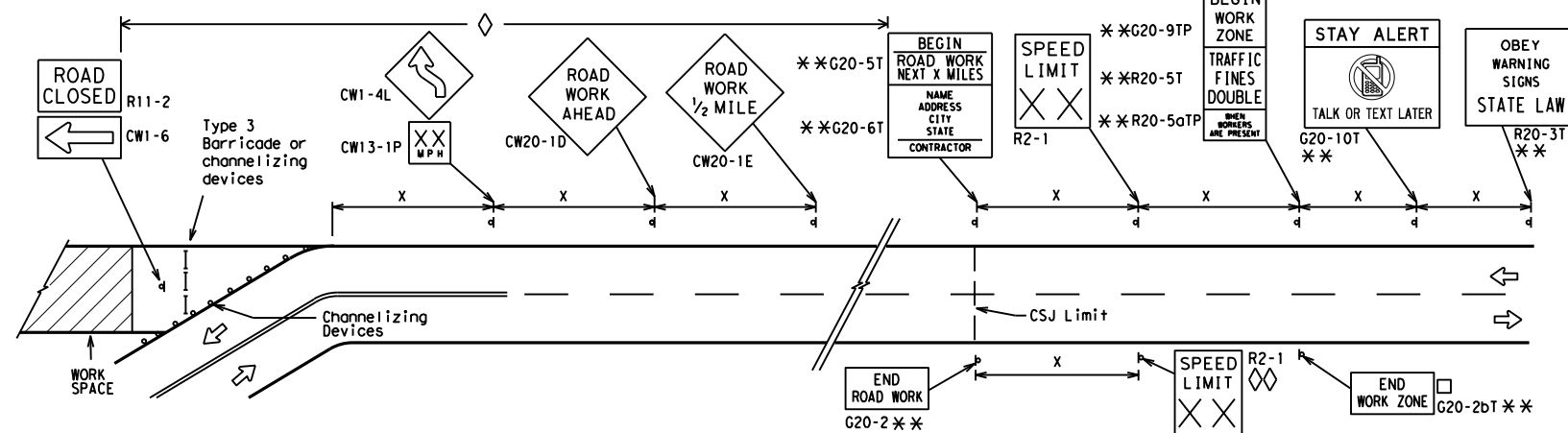
1. Special or larger size signs may be used as necessary.
2. Distance between signs should be increased as required to have 1500 feet advance warning.
3. Distance between signs should be increased as required to have 1/2 mile or more advance warning.
4. 36" x 36" "ROAD WORK AHEAD" (CW20-1D) signs may 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".
5. Only diamond shaped warning sign sizes are indicated.
6. 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**



**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**

**BC(2)-21**

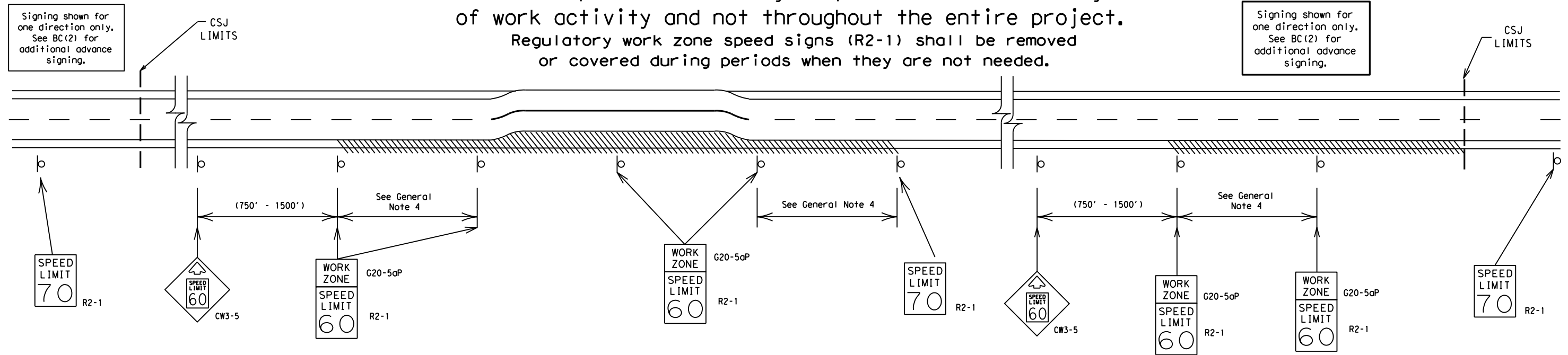
FILE: bc-21.dgn	DN: TxDOT	CK: TxDOT	DW: TxDOT	CK: TxDOT
© TxDOT November 2002	CONT	SECT	JOB	HIGHWAY
REVISIONS	6385	38	001	IH 30
9-07 8-14	DIST	COUNTY	SHEET NO.	
7-13 5-21	PAR	HUNT, ETC.	7	

DATE:  
FILE:

# 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:

- rough road or damaged pavement surface
- substantial alteration of roadway geometrics (diversions)
- construction detours
- grade
- width
- 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

- Regulatory work zone speed limits should be used only for sections of construction projects where speed control is of major importance.
- Regulatory work zone speed limit signs shall be placed on supports at a 7 foot minimum mounting height.
- Speed zone signs are illustrated for one direction of travel and are normally posted for each direction of travel.
- 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
- Regulatory speed limit signs shall have black legend and border on a white reflective background (See "Reflective Sheeting" on BC(4)).
- 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.
- Turning signs from view, laying signs over or down will not be allowed, unless as otherwise noted under "REMOVING OR COVERING" on BC(4).
- Techniques that may help reduce traffic speeds include but are not limited to:
  - Law enforcement.
  - Flagger stationed next to sign.
  - Portable changeable message sign (PCMS).
  - Low-power (drone) radar transmitter.
  - Speed monitor trailers or signs.
- Speeds shown on details above are for illustration only. Work Zone Speed Limits should only be posted as approved for each project.
- 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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SHEET 3 OF 12



## BARRICADE AND CONSTRUCTION WORK ZONE SPEED LIMIT

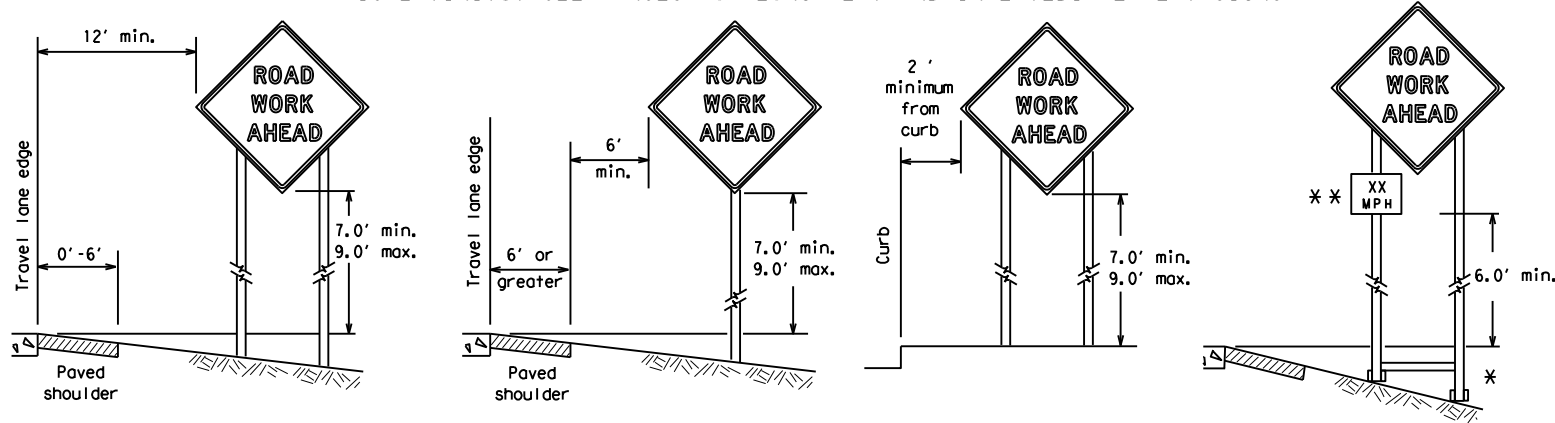
BC (3) - 21

FILE:	bc-21.dgn	DW:	TxDOT	CK:	TxDOT	DW:	TxDOT	CK:	TxDOT
© TxDOT	November 2002	CONT	SECT	JOB	HIGHWAY				
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7-13	5-21	PAR	HUNT, ETC.	8					



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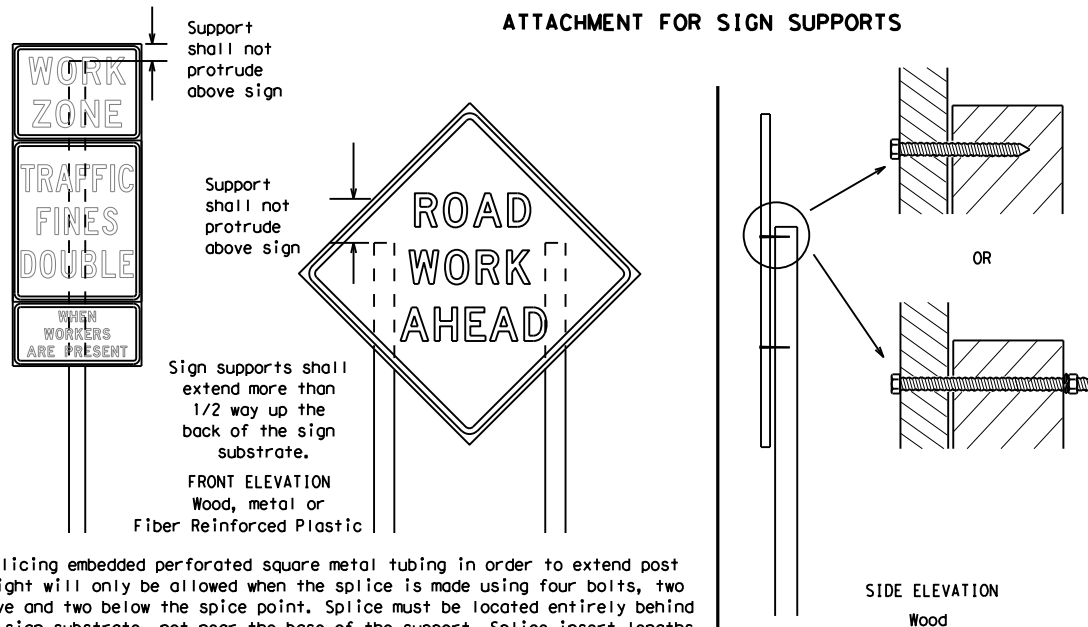
**TYPICAL MINIMUM CLEARANCES FOR LONG TERM AND INTERMEDIATE TERM SIGNS**



\* 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**



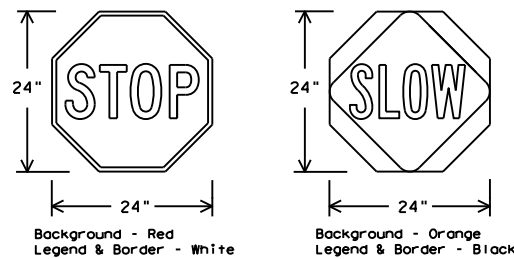
Attachment to wooden supports will be by bolts and nuts or screws. Use TxDOT's or manufacturer's recommended procedures for attaching sign substrates to other types of sign supports

Nails shall NOT be allowed. Each sign shall be attached directly to the sign support. Multiple signs shall not be joined or spliced by any means. Wood supports shall not be extended or repaired by splicing or other means.

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.

**STOP/SLOW PADDLES**

1. STOP/SLOW paddles are the primary method to control traffic by flaggers. The STOP/SLOW paddle size should be 24" x 24".
2. STOP/SLOW paddles shall be retroreflective when used at night.
3. STOP/SLOW paddles may be attached to a staff with a minimum length of 6' to the bottom of the sign.
4. 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.



SHEETING REQUIREMENTS (WHEN USED AT NIGHT)		
USAGE	COLOR	SIGN FACE MATERIAL
BACKGROUND	RED	TYPE B OR C SHEETING
BACKGROUND	ORANGE	TYPE B <sub>FL</sub> OR C <sub>FL</sub> SHEETING
LEGEND & BORDER	WHITE	TYPE B OR C SHEETING
LEGEND & BORDER	BLACK	ACRYLIC NON-REFLECTIVE FILM

**CONTRACTOR REQUIREMENTS FOR MAINTAINING PERMANENT SIGNS WITHIN THE PROJECT LIMITS**

1. 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.
2. 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.
3. When existing permanent signs are moved and relocated due to construction purposes, they shall be visible to motorists at all times.
4. 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.
5. 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.
6. 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.

**GENERAL NOTES FOR WORK ZONE SIGNS**

1. Contractor shall install and maintain signs in a straight and plumb condition and/or as directed by the Engineer.
2. Wooden sign posts shall be painted white.
3. Barricades shall NOT be used as sign supports.
4. 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.
5. 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.
6. 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.
7. 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.
8. 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.
9. 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)**

1. 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.
  - a. Long-term stationary - work that occupies a location more than 3 days.
  - b. 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.
  - c. Short-term stationary - daytime work that occupies a location for more than 1 hour in a single daylight period.
  - d. Short, duration - work that occupies a location up to 1 hour.
  - e. Mobile - work that moves continuously or intermittently (stopping for up to approximately 15 minutes.)

**SIGN MOUNTING HEIGHT**

1. 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.
2. 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.
3. Long-term/Intermediate-term Signs may be used in lieu of Short-term/Short Duration signing.
4. 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.
5. 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**

1. 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**

1. 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.
2. "Mesh" type materials are NOT an approved sign substrate, regardless of the tightness of the weave.
3. 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**

1. 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).
2. White sheeting, meeting the requirements of DMS-8300 Type A, shall be used for signs with a white background.
3. Orange sheeting, meeting the requirements of DMS-8300 Type B<sub>FL</sub> or Type C<sub>FL</sub>, shall be used for rigid signs with orange backgrounds.

**SIGN LETTERS**

1. 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**

1. When sign messages may be confusing or do not apply, the signs shall be removed or completely covered.
2. 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.
3. 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.
4. 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.
5. Burlap shall NOT be used to cover signs.
6. Duct tape or other adhesive material shall NOT be affixed to a sign face.
7. Signs and anchor stubs shall be removed and holes backfilled upon completion of work.

**SIGN SUPPORT WEIGHTS**

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

**FLAGS ON SIGNS**

1. 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.

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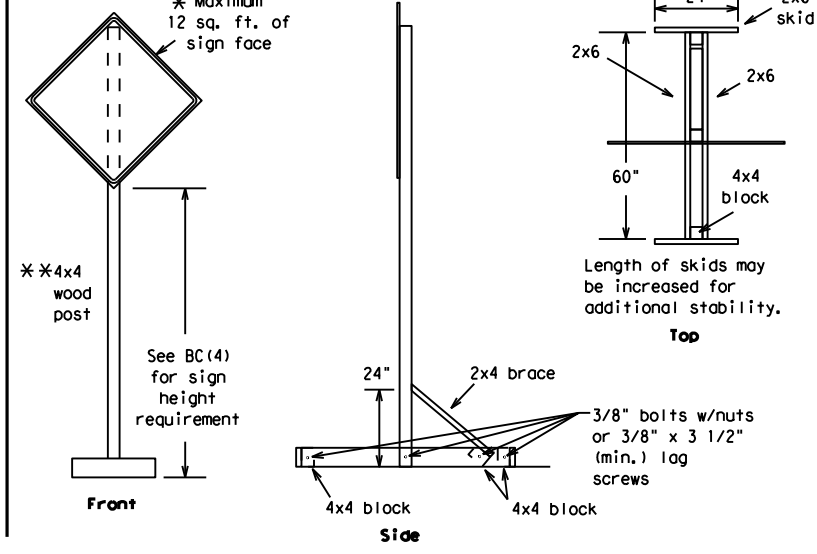
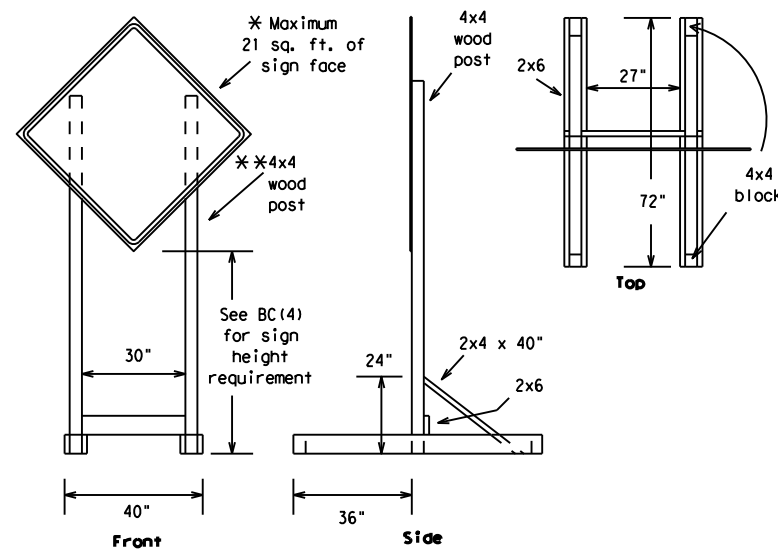
**BARRICADE AND CONSTRUCTION TEMPORARY SIGN NOTES**

**BC (4) - 21**

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© TxDOT	November 2002	CONT	SECT	JOB	HIGHWAY				
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7-13	5-21	PAR	HUNT, ETC.		9				

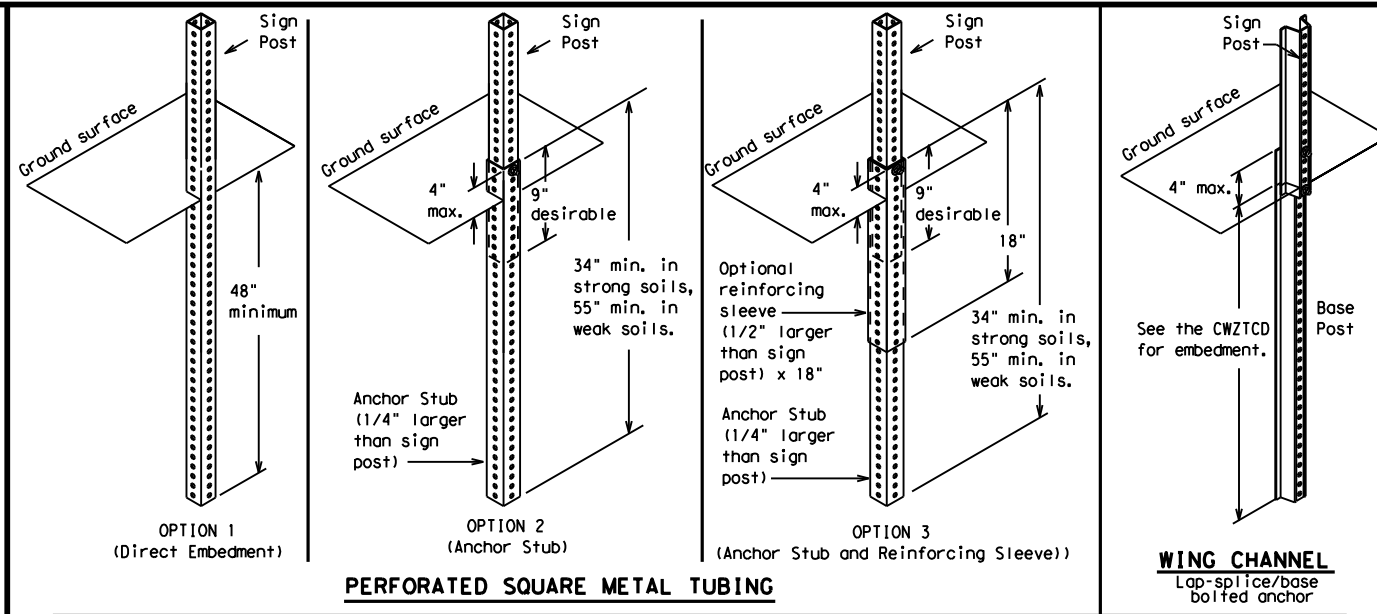
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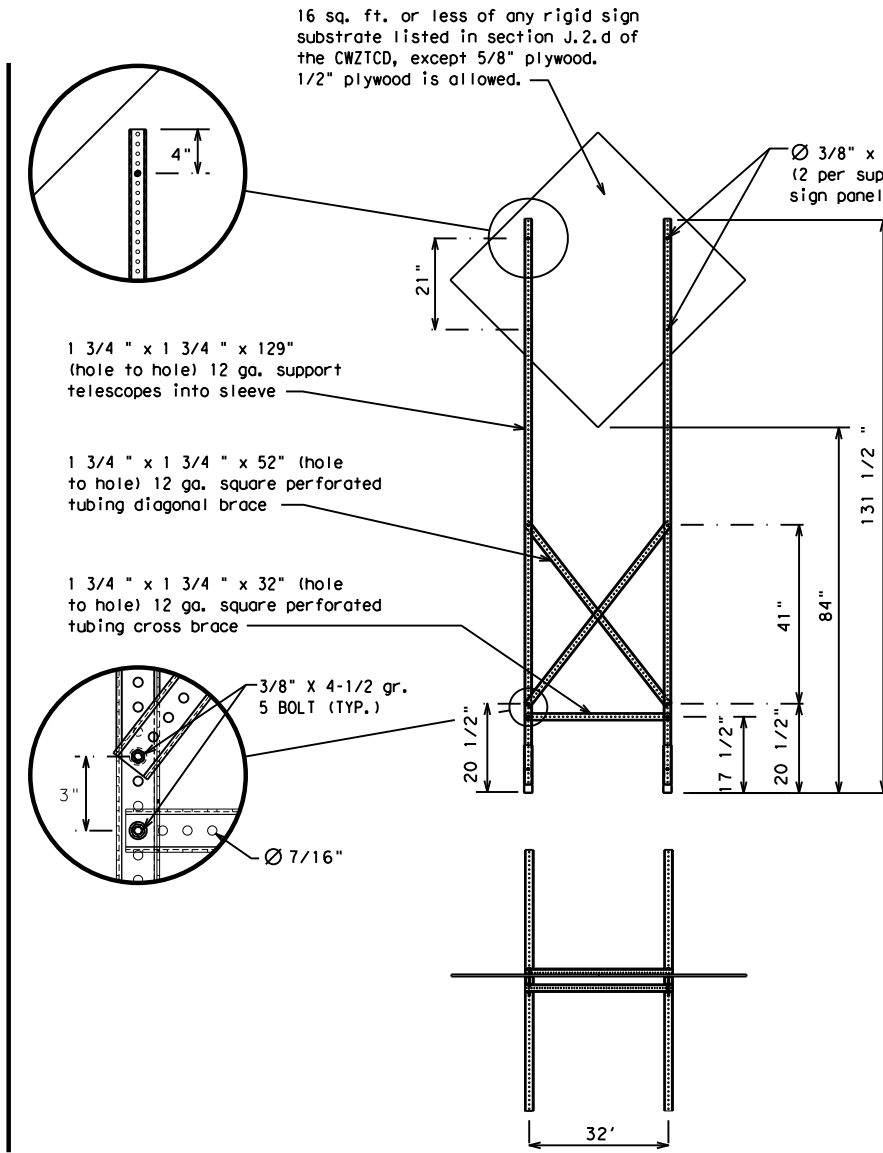
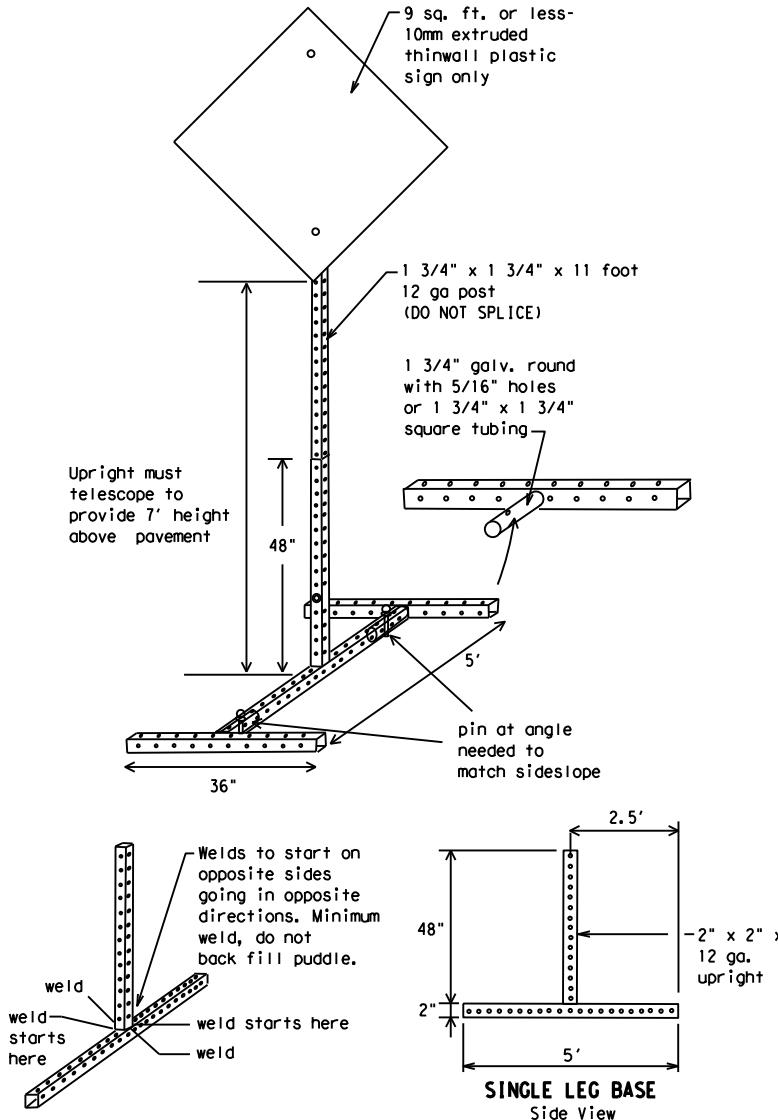
### SKID MOUNTED WOOD SIGN SUPPORTS

\* LONG/INTERMEDIATE TERM STATIONARY - PORTABLE SKID MOUNTED SIGN SUPPORTS



### GROUND MOUNTED SIGN SUPPORTS

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.



### SKID MOUNTED PERFORATED SQUARE STEEL TUBING SIGN SUPPORTS

\* LONG/INTERMEDIATE TERM STATIONARY - PORTABLE SKID MOUNTED SIGN SUPPORTS

### 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

1. 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.
2. No more than 2 sign posts shall be placed within a 7 ft. circle, except for specific materials noted on the CWZTCD List.
3. 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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## BARRICADE AND CONSTRUCTION TYPICAL SIGN SUPPORT

BC(5) - 21

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		PAR:	HUNT, ETC.						10

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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 TMUTCD.
- 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.

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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
Canal	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	TRVLR
High-Occupancy Vehicle	HOV	Tuesday	TUES
Highway	Hwy	Time Minutes	TIME MIN
Hour(s)	HR, HRS	Upper Level	UPR LEVEL
Information	INFO	Vehicles (s)	VEH, VEHS
It Is	ITS	Warning	WARN
Junction	JCT	Wednesday	WED
Left	LFT	Weight Limit	WT LIMIT
Left Lane	LFT LN	West	W
Lane Closed	LN CLOSED	Westbound	(route) W
Lower Level	LWR LEVEL	Wet Pavement	WET PVMT
Maintenance	MAINT	Will Not	WONT

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

## Phase 1: Condition Lists

### Road/Lane/Ramp Closure List

FREEWAY CLOSED X MILE
ROAD CLOSED AT SH XXX
ROAD CLSD AT FM XXXX
RIGHT X LANES CLOSED
CENTER LANE CLOSED
NIGHT LANE CLOSURES
VARIOUS LANES CLOSED
EXIT CLOSED
MALL DRIVEWAY CLOSED
XXXXXXXX BLVD CLOSED

### Other Condition List

FRONTAGE ROAD CLOSED
SHOULDER CLOSED XXX FT
RIGHT LN CLOSED XXX FT
RIGHT X LANES OPEN
DAYTIME LANE CLOSURES
I-XX SOUTH EXIT CLOSED
EXIT XXX CLOSED X MILE
RIGHT LN TO BE CLOSED
X LANES CLOSED TUE - FRI

\* 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
DETOUR NEXT X EXITS
USE EXIT XXX
STAY ON US XXX SOUTH
TRUCKS USE US XXX N
WATCH FOR TRUCKS
EXPECT DELAYS
REDUCE SPEED XXX FT
USE OTHER ROUTES
STAY IN LANE

### Location List

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

## 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.

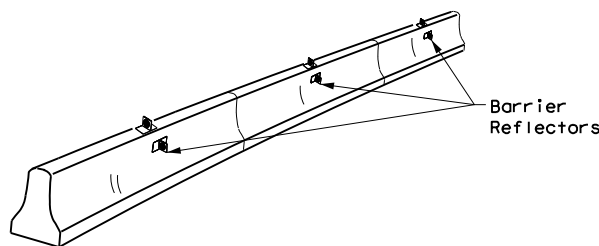
SHEET 6 OF 12

<h3>BARRICADE AND CONSTRUCTION PORTABLE CHANGEABLE MESSAGE SIGN (PCMS)</h3>			
<h2>BC (6) - 21</h2>			
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© TxDOT	November 2002	CONT:	6385
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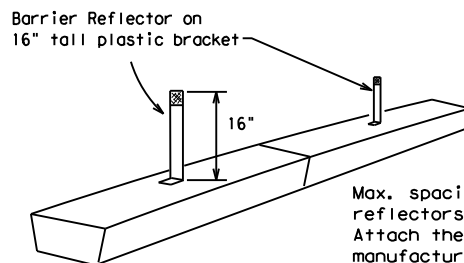
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- Barrier Reflectors shall be pre-qualified, and conform to the color and reflectivity requirements of DMS-8600. A list of prequalified Barrier Reflectors can be found at the Material Producer List web address shown on BC(1).
- Color of Barrier Reflectors 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.

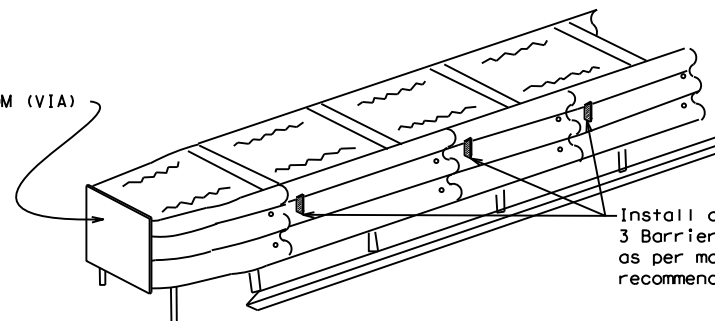


**LOW PROFILE CONCRETE BARRIER (LPCB) USED IN WORK ZONES**

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**

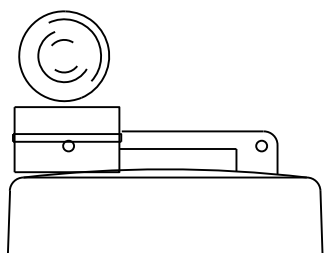
- Warning lights shall meet the requirements of the TMUTCD.
- Warning lights shall NOT be installed on barricades.
- Type A-Low Intensity Flashing Warning Lights are commonly used with drums. They are intended to warn of or mark a potentially hazardous area. Their use shall be as indicated on this sheet 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<sub>FL</sub> or C<sub>FL</sub> 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.

**WARNING LIGHTS MOUNTED ON PLASTIC DRUMS**

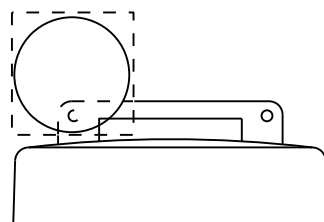
- Type A flashing warning lights are intended to warn drivers that they are approaching or are in a potentially hazardous area.
- Type A random flashing warning lights are not intended for delineation and shall not be used in a series.
- A series of sequential flashing warning lights placed on channelizing 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 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.



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

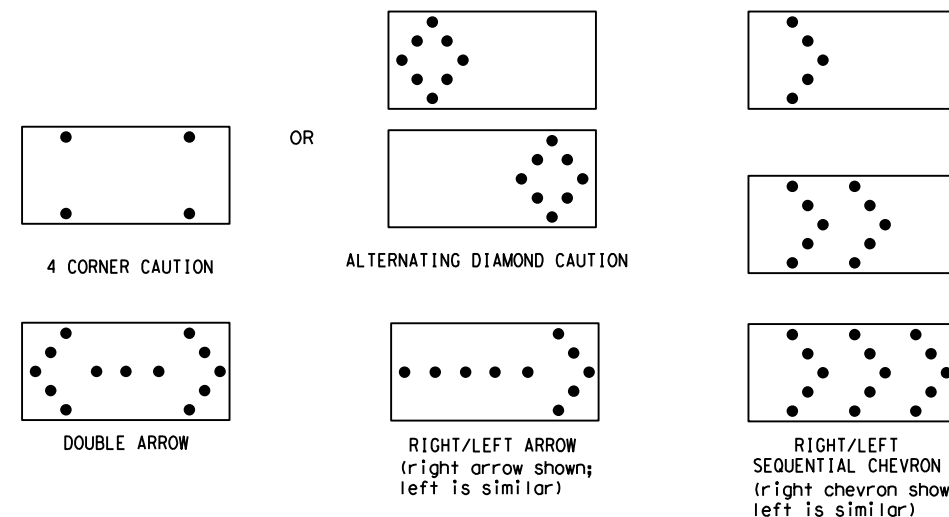


Warning reflector may be round or square. Must have a yellow reflective surface area of at least 30 square inches

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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**

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© TxDOT	November 2002	CONT	SECT	JOB	HIGHWAY				
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7-13	5-21	PAR	HUNT, ETC.	12					

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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:

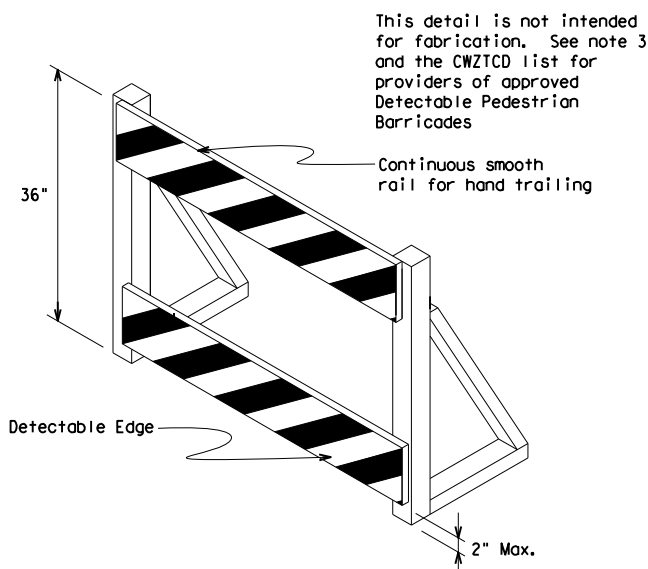
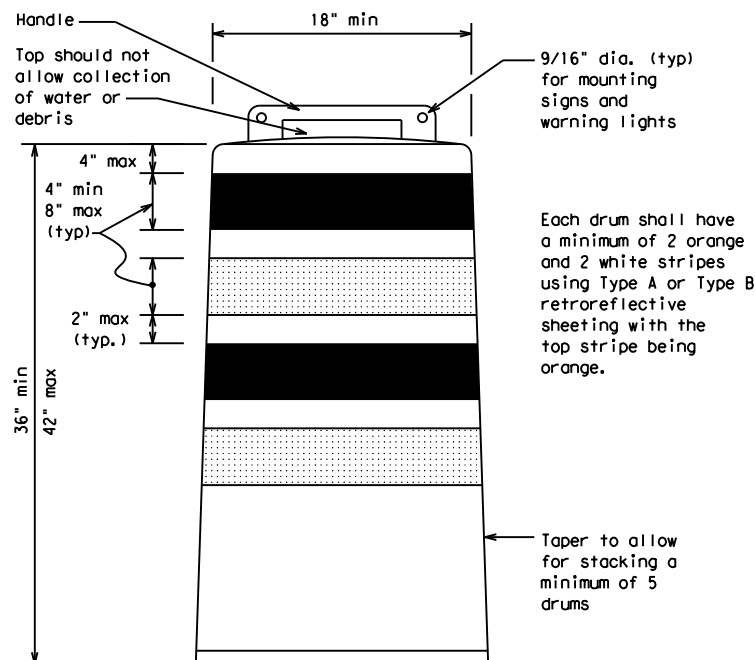
- Plastic drums shall be a two-piece design; the "body" of the drum shall be the top portion and the "base" shall be the bottom.
- The body and base shall lock together in such a manner that the body separates from the base when impacted by a vehicle traveling at a speed of 20 MPH or greater but prevents 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.

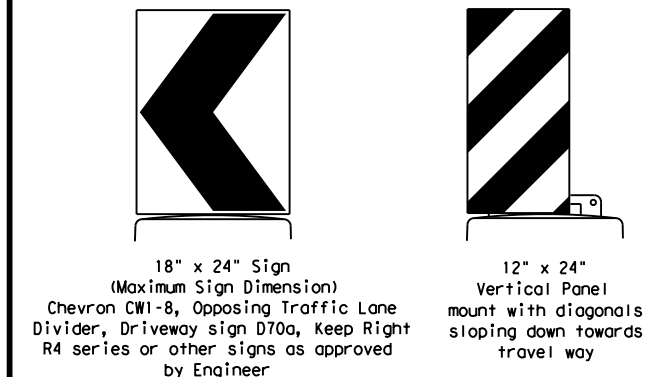
### BALLAST

- 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<sub>FL</sub> or Type C<sub>FL</sub> 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

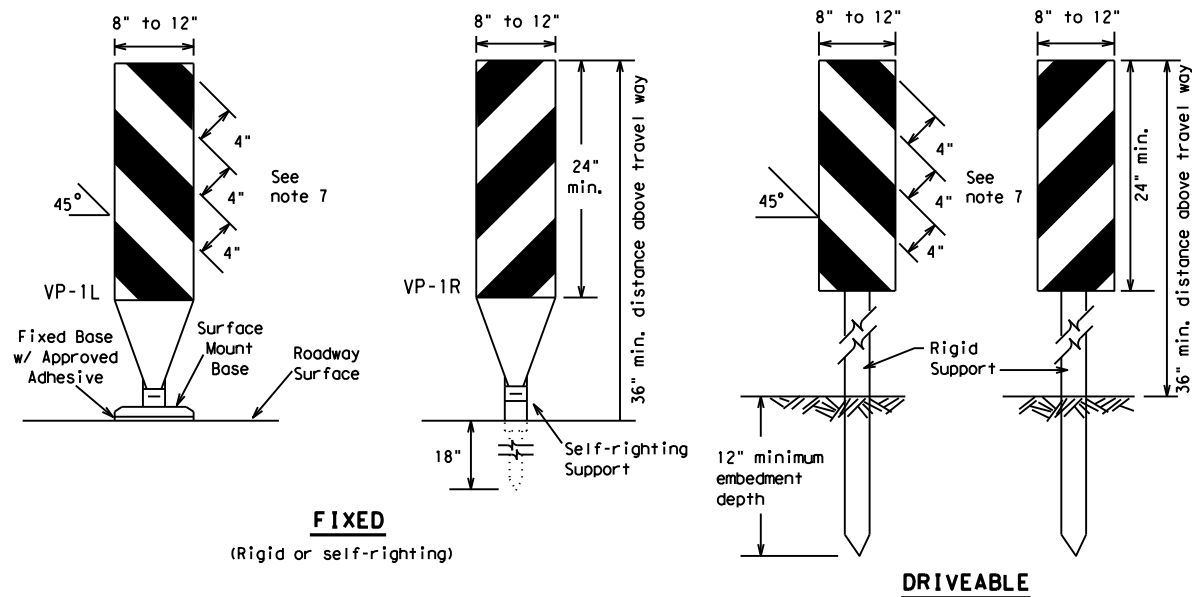


## BARRICADE AND CONSTRUCTION CHANNELIZING DEVICES

BC(8) - 21

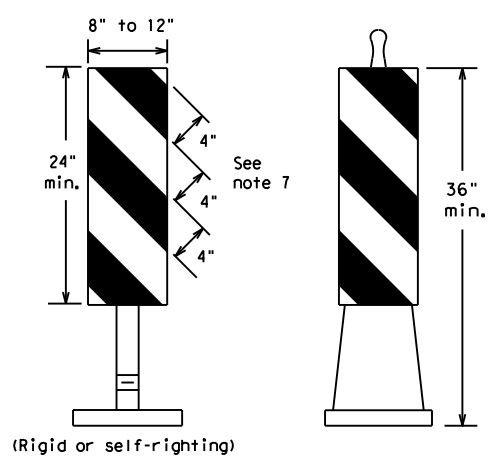
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**FIXED**  
(Rigid or self-righting)

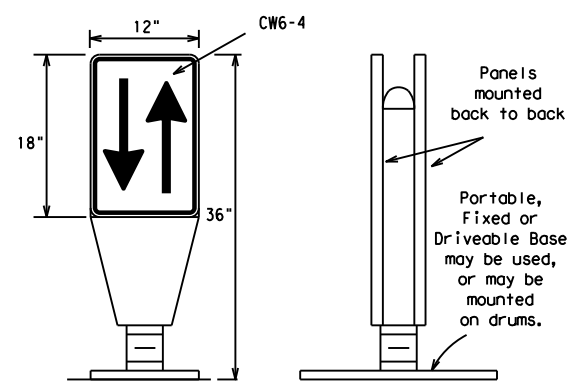
**DRIVEABLE**



**PORTABLE**

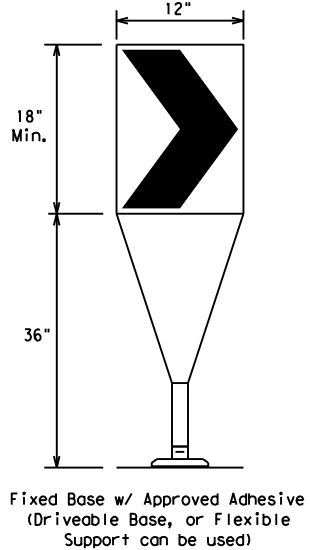
**VERTICAL PANELS (VPs)**

- 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.



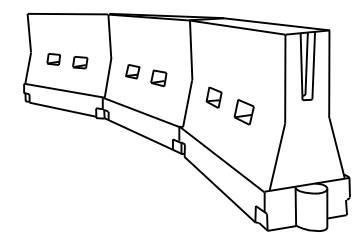
**OPPOSING TRAFFIC LANE DIVIDERS (OTLD)**

- 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 VPs.
- Spacing between the OTLD shall not exceed 500 feet. 42" cones or VPs 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<sub>FL</sub> or Type C<sub>FL</sub> conforming to Departmental Material Specification DMS-8300, unless noted otherwise. The legend shall meet the requirements of DMS-8300.



- 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<sub>FL</sub> or Type C<sub>FL</sub> 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 canes 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 <sup>2</sup> / 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**

SHEET 9 OF 12



**BARRICADE AND CONSTRUCTION CHANNELIZING DEVICES**

**BC (9) - 21**

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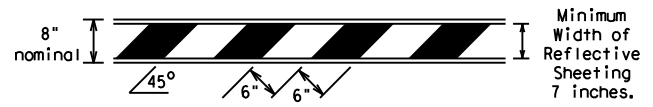
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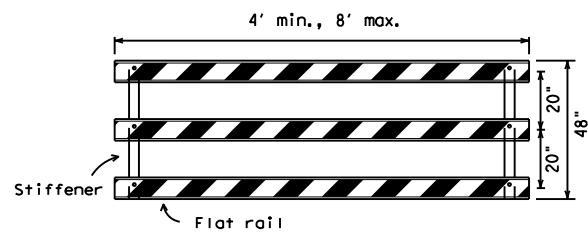
**TYPE 3 BARRICADES**

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.



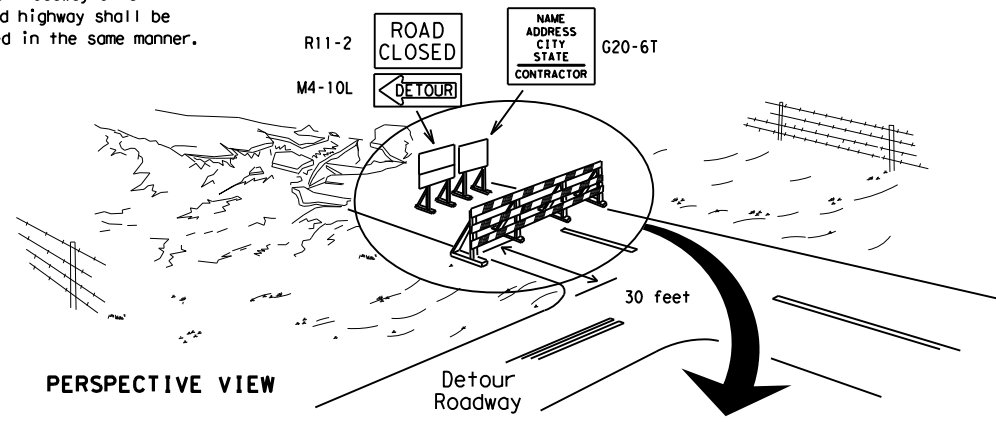
**TYPICAL STRIPING DETAIL FOR BARRICADE RAIL**



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

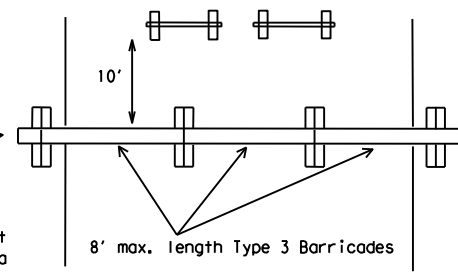
**TYPICAL PANEL DETAIL FOR SKID OR POST TYPE BARRICADES**

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



PERSPECTIVE VIEW

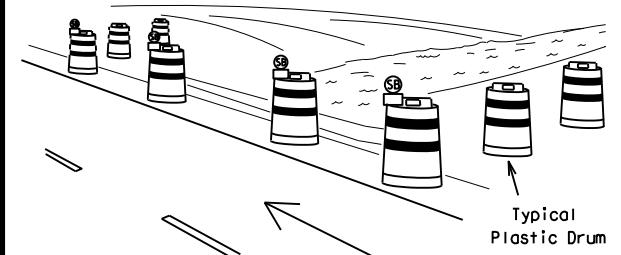
The three rails on Type 3 barricades shall be reflectorized orange and reflective white stripes on one side facing one-way traffic and both sides for two-way traffic. Barricade striping should slant downward in the direction of detour.



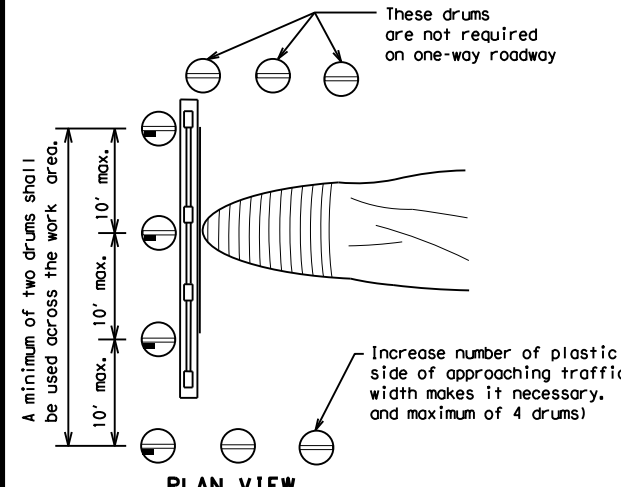
PLAN VIEW

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**



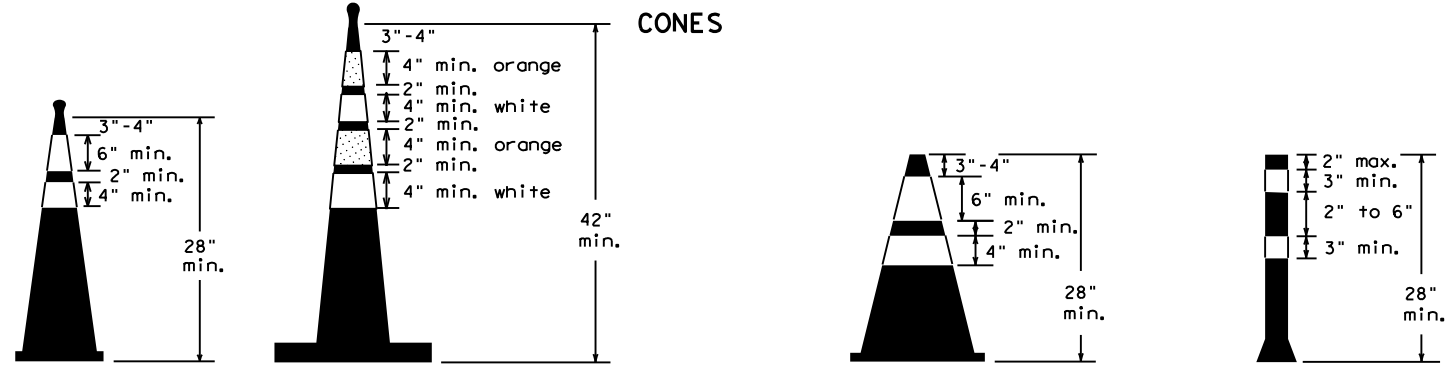
PERSPECTIVE VIEW



PLAN VIEW

**CULVERT WIDENING OR OTHER ISOLATED WORK WITHIN THE PROJECT LIMITS**

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



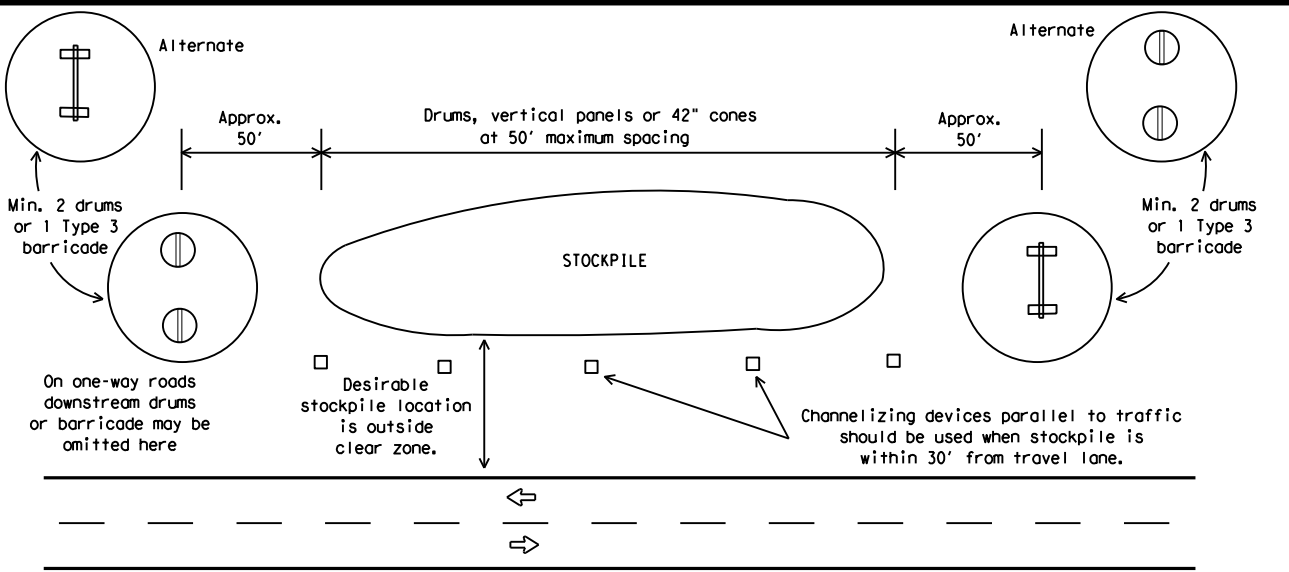
Two-Piece cones

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.

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.



**TRAFFIC CONTROL FOR MATERIAL STOCKPILES**



**BARRICADE AND CONSTRUCTION CHANNELIZING DEVICES**

**BC (10) - 21**

FILE: bc-21.dgn	DN: TxDOT	CK: TxDOT	OW: TxDOT	CR: TxDOT
© TxDOT November 2002	CONT	SECT	JOB	HIGHWAY
REVISIONS	6385	38	001	IH 30
9-07 8-14	DIST	COUNTY	SHEET NO.	
7-13 5-21	PAR	HUNT, ETC.	15	

DATE: FILE:

## WORK ZONE PAVEMENT MARKINGS

### GENERAL

- 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.
- Color, patterns and dimensions shall be in conformance with the "Texas Manual on Uniform Traffic Control Devices" (TMUTCD).
- Additional supplemental pavement marking details may be found in the plans or specifications.
- Pavement markings shall be installed in accordance with the TMUTCD and as shown on the plans.
- 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).
- 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.
- All work zone pavement markings shall be installed in accordance with Item 662, "Work Zone Pavement Markings."

### RAISED PAVEMENT MARKERS

- Raised pavement markers are to be placed according to the patterns on BC(12).
- 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

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

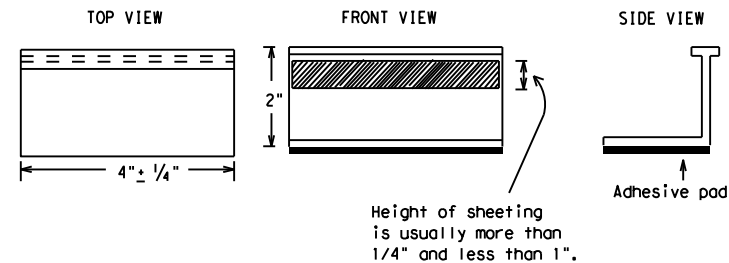
### MAINTAINING WORK ZONE PAVEMENT MARKINGS

- The Contractor will be responsible for maintaining work zone pavement markings within the work limits.
- 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.
- 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.
- 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

- 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.
- The above shall not apply to detours in place for less than three days, where flaggers and/or sufficient channelizing devices are used in lieu of markings to outline the detour route.
- 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".
- The removal of pavement markings may require resurfacing or seal coating portions of the roadway as described in Item 677.
- Subject to the approval of the Engineer, any method that proves to be successful on a particular type pavement may be used.
- Blast cleaning may be used but will not be required unless specifically shown in the plans.
- Over-painting of the markings SHALL NOT BE permitted.
- Removal of raised pavement markers shall be as directed by the Engineer.
- 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.
- 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



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

- Temporary flexible-reflective roadway marker tabs used as guidemarks shall meet the requirements of DMS-8242.
- 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.
  - 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.
  - 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.
- Small design variances may be noted between tab manufacturers.
- 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

- Raised pavement markers used as guidemarks shall be from the approved product list, and meet the requirements of DMS-4200.
- All temporary construction raised pavement markers provided on a project shall be of the same manufacturer.
- 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

<span style="font-size: small; vertical-align: middle;">Texas Department of Transportation</span>		<span style="font-size: x-small;">Traffic Safety Division Standard</span>
<h1 style="margin: 0;">BARRICADE AND CONSTRUCTION PAVEMENT MARKINGS</h1>		
<h2 style="margin: 0;">BC(11)-21</h2>		
FILE: bc-21.dgn	DN: TxDOT	CK: TxDOT
© TxDOT February 1998	CONT: 6385	SECT: 38
REVISIONS	JOB: 001	HIGHWAY: IH 30
2-98 9-07 5-21	DIST: PAR	COUNTY: HUNT, ETC.
1-02 7-13	SHEET NO.:	16
11-02 8-14		

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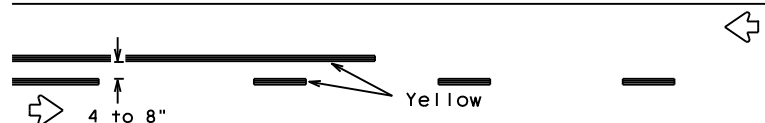
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## PAVEMENT MARKING PATTERNS

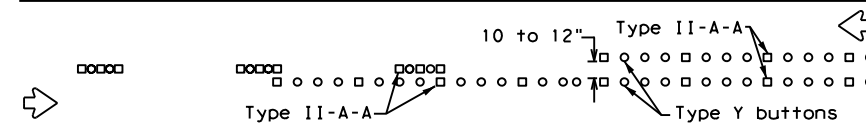


REFLECTORIZED PAVEMENT MARKINGS - PATTERN A

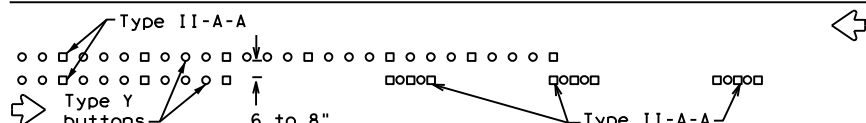


REFLECTORIZED PAVEMENT MARKINGS - PATTERN B

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.

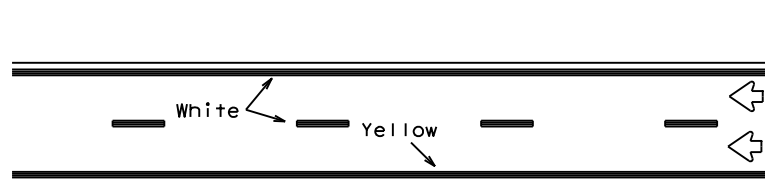


RAISED PAVEMENT MARKERS - PATTERN A



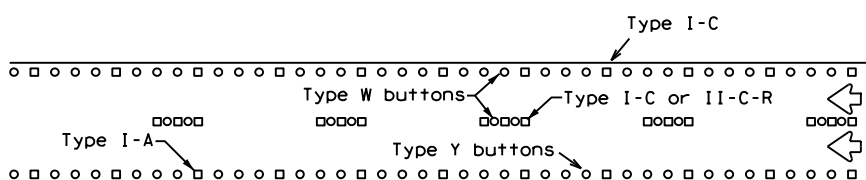
RAISED PAVEMENT MARKERS - PATTERN B

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



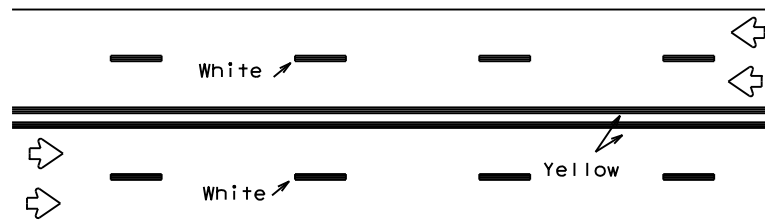
REFLECTORIZED PAVEMENT MARKINGS

Prefabricated markings may be substituted for reflectORIZED pavement markings.



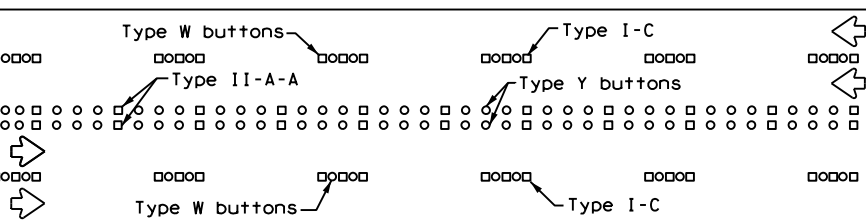
RAISED PAVEMENT MARKERS

## EDGE & LANE LINES FOR DIVIDED HIGHWAY



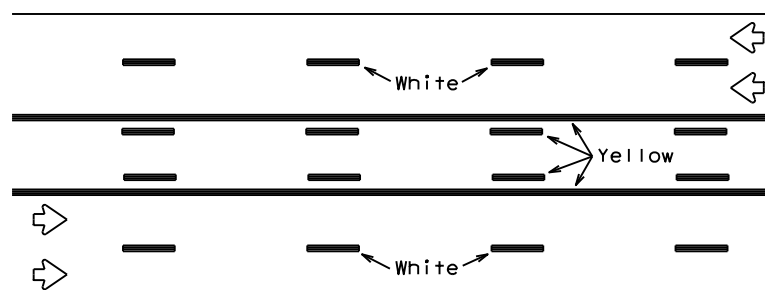
REFLECTORIZED PAVEMENT MARKINGS

Prefabricated markings may be substituted for reflectORIZED pavement markings.



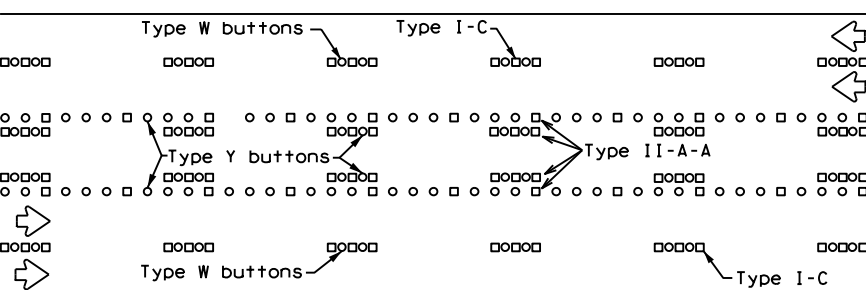
RAISED PAVEMENT MARKERS

## LANE & CENTER LINES FOR MULTILANE UNDIVIDED HIGHWAYS



REFLECTORIZED PAVEMENT MARKINGS

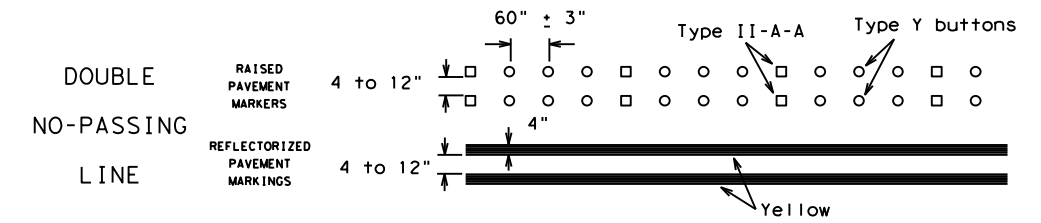
Prefabricated markings may be substituted for reflectORIZED pavement markings.



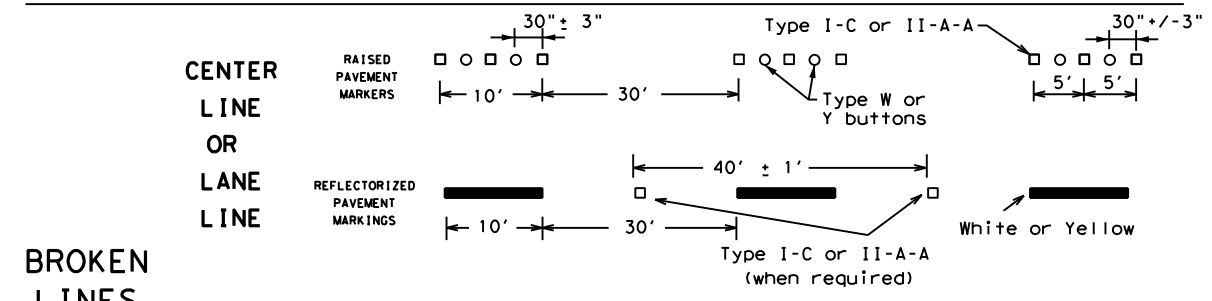
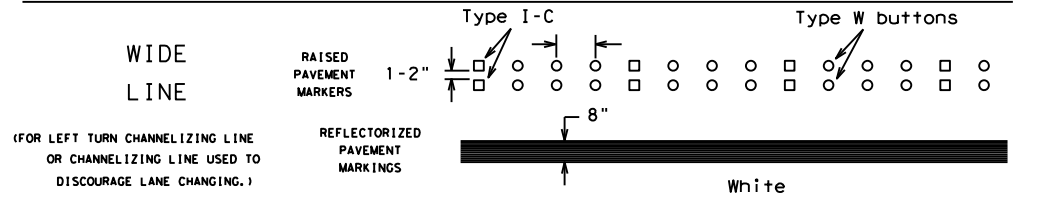
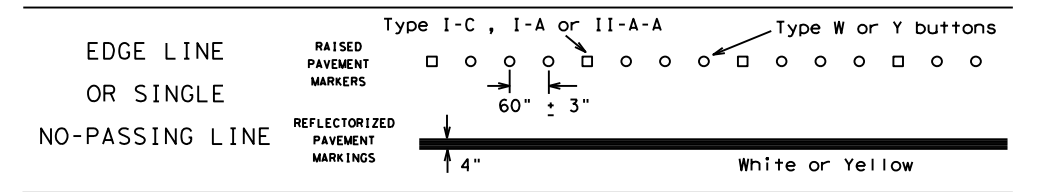
RAISED PAVEMENT MARKERS

## TWO-WAY LEFT TURN LANE

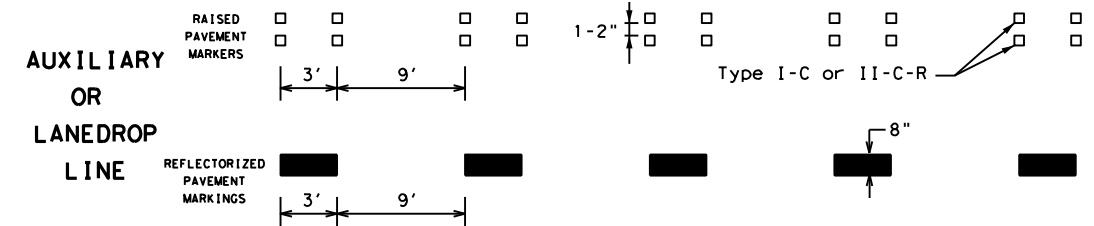
## STANDARD WORK ZONE PAVEMENT MARKINGS DETAILS



### SOLID LINES

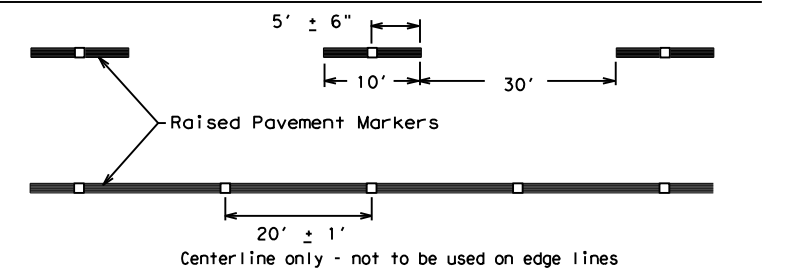


### BROKEN LINES



### REMOVABLE MARKINGS WITH RAISED PAVEMENT MARKERS

If raised pavement markers are used to supplement REMOVABLE markings, the markers shall be applied to the top of the tape at the approximate mid length of tape used for broken lines or at 20 foot spacing for solid lines. This allows an easier removal of raised pavement markers and tape.



SHEET 12 OF 12



## BARRICADE AND CONSTRUCTION PAVEMENT MARKING PATTERNS

BC(12)-21

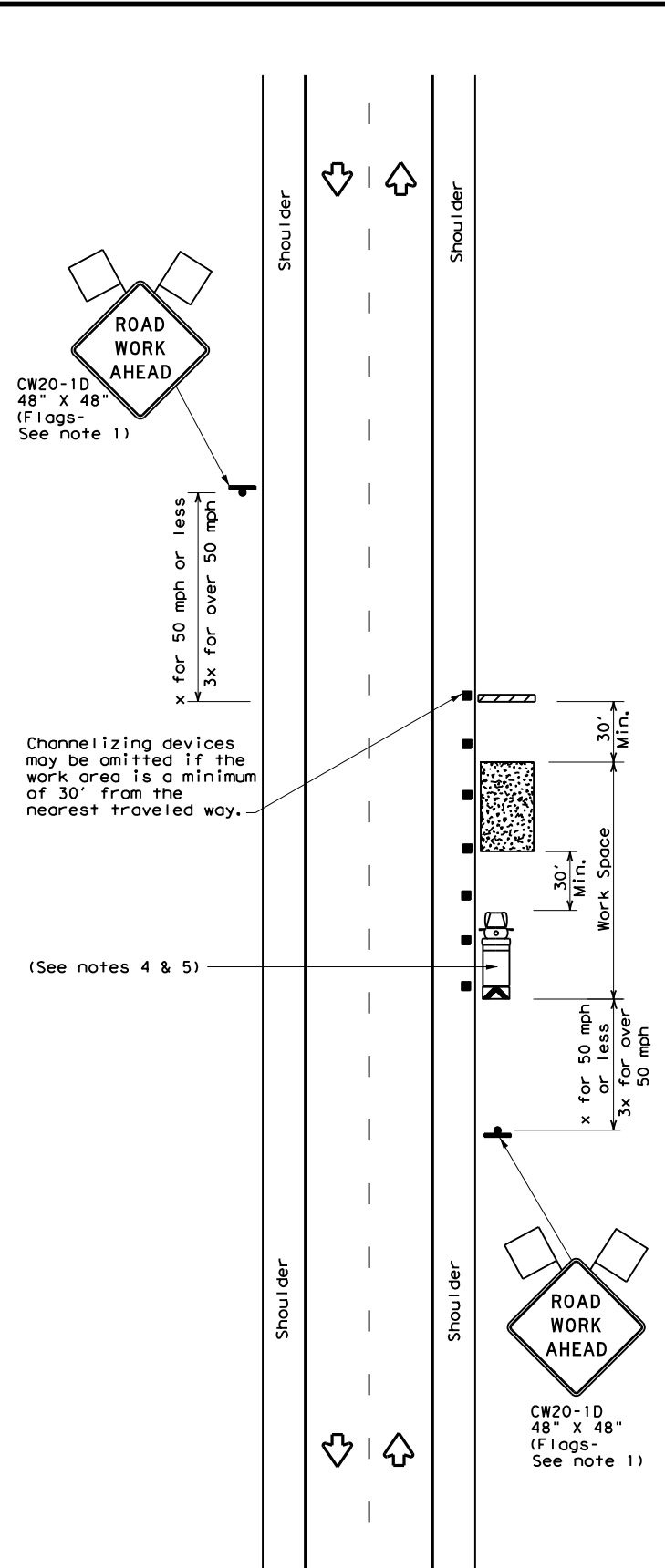
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©TxDOT February 1998	CONT	SECT	JOB	HIGHWAY
REVISIONS	6385	38	001	IH 30
1-97 9-07 5-21	DIST	COUNTY	SHEET NO.	
2-98 7-13	PAR	HUNT, ETC.	17	
11-02 8-14				

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DATE: FILE:

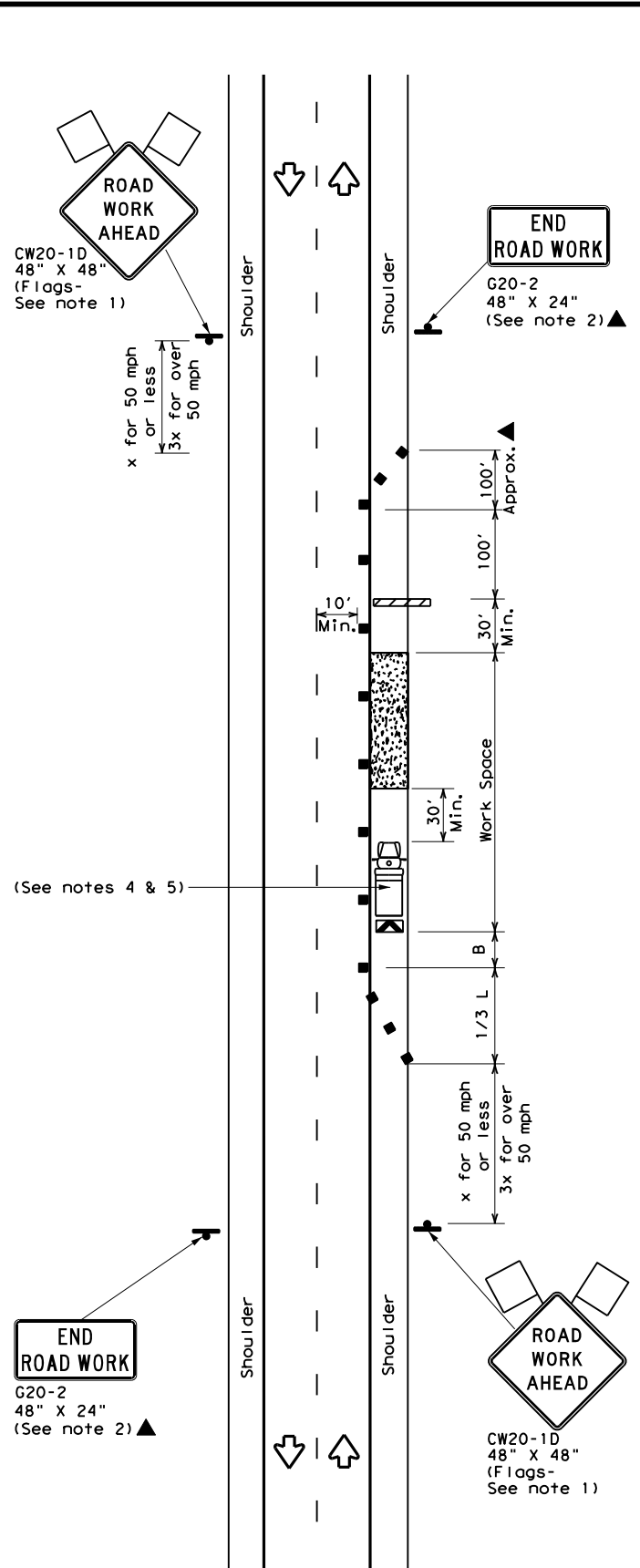
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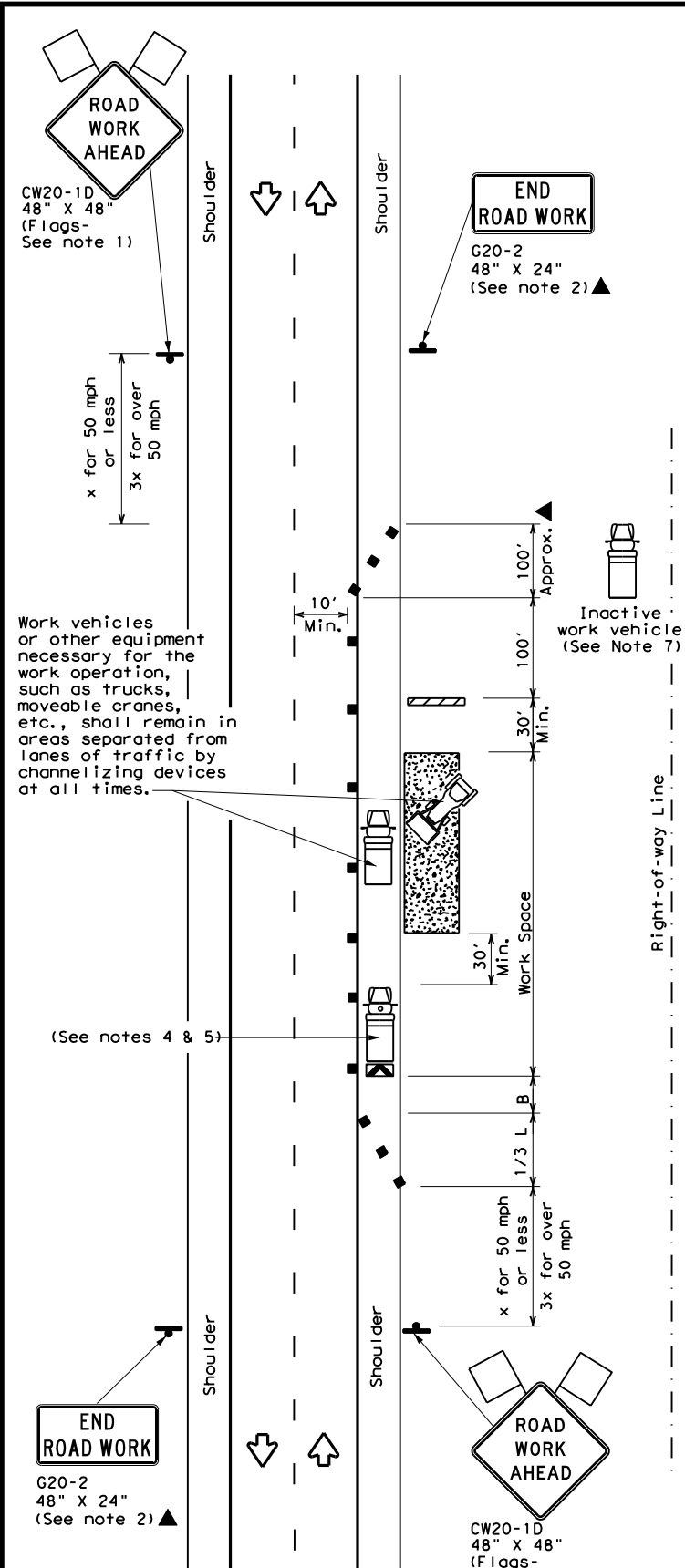
TCP (2-1a)

**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	$L = \frac{WS^2}{60}$	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 in the plans, or for routine maintenance work, when approved by the Engineer.
- Stockpiled 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 CW20-1D "ROAD WORK AHEAD" signs for shoulder work on conventional roadways.



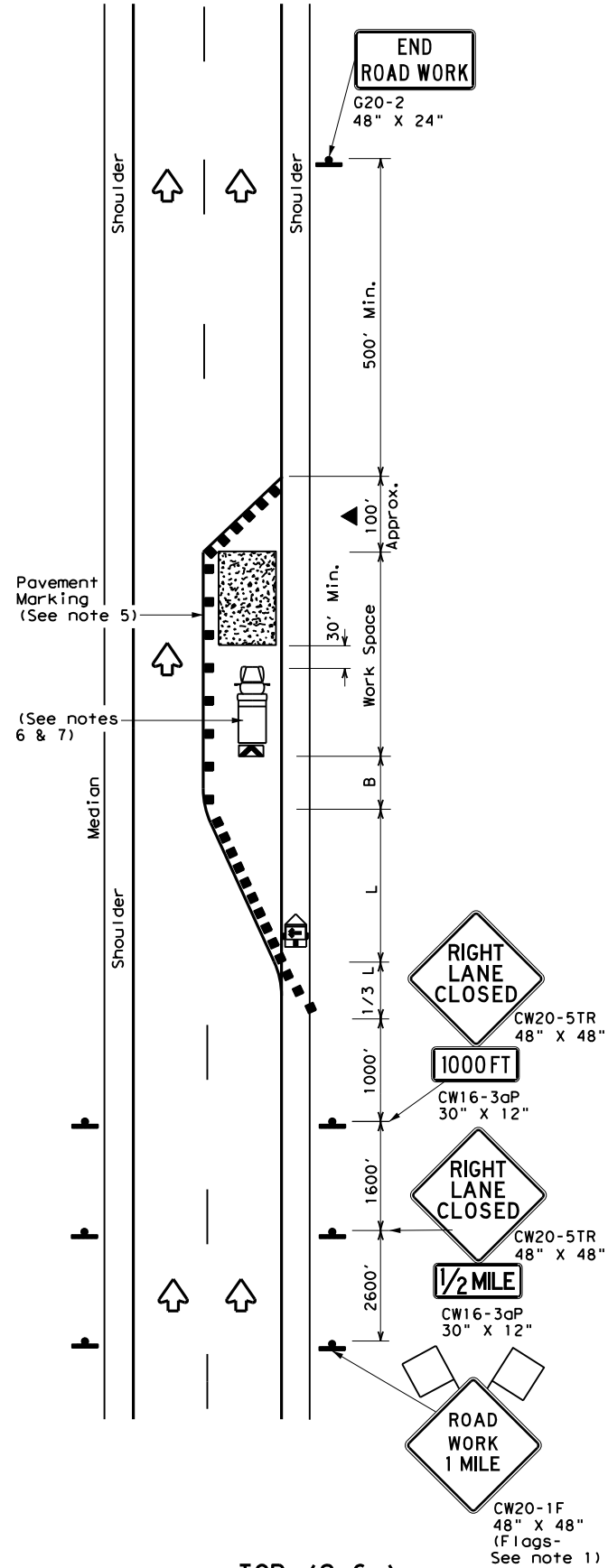
**TRAFFIC CONTROL PLAN**  
**CONVENTIONAL ROAD**  
**SHOULDER WORK**

**TCP (2-1) - 18**

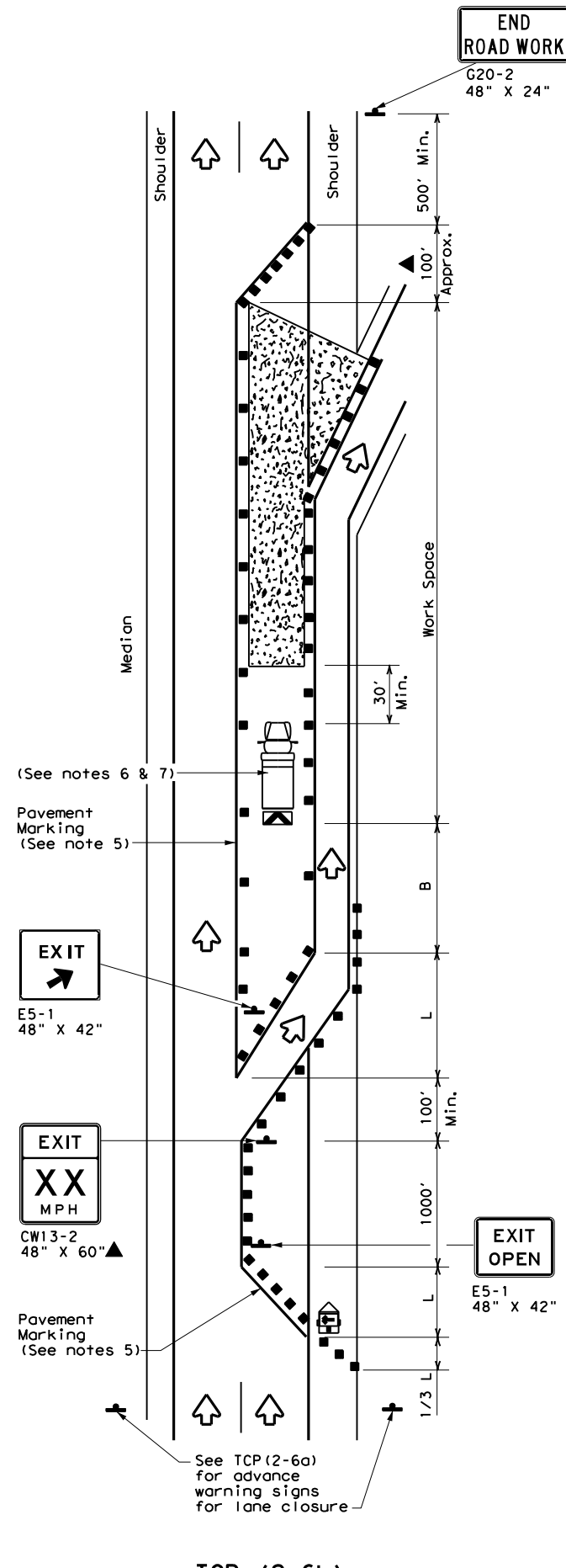
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© TxDOT	December 1985	CONT	SECT	JOB	HIGHWAY
REVISIONS		6385	38	001	IH 30
2-94	4-98	DIST	COUNTY	SHEET NO.	
8-95	2-12	PAR	HUNT, ETC	18	
1-97	2-18				

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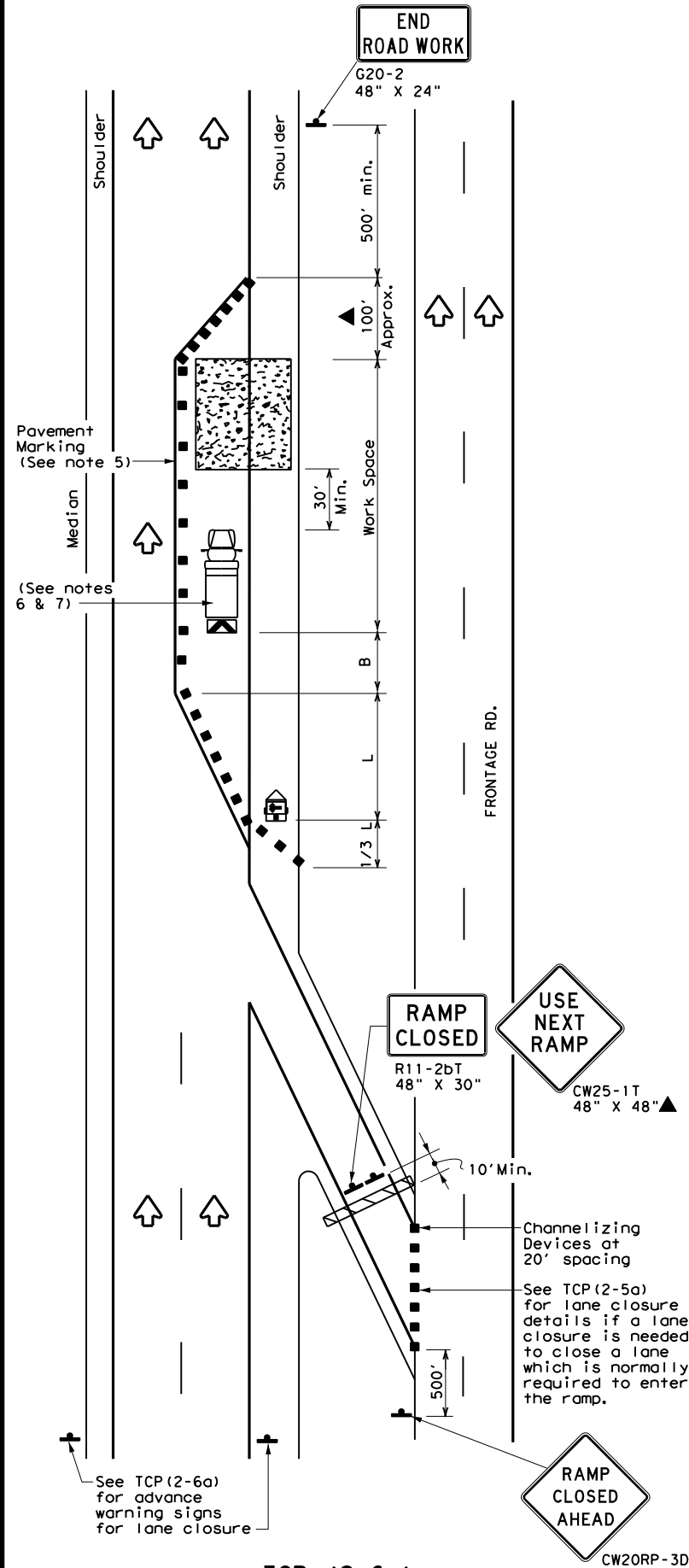
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TCP (2-6a)  
**ONE LANE CLOSURE**



TCP (2-6b)  
**LANE CLOSURE NEAR EXIT RAMP**



TCP (2-6c)  
**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.
  - 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. 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.

Texas Department of Transportation  
 Traffic Operations Division Standard

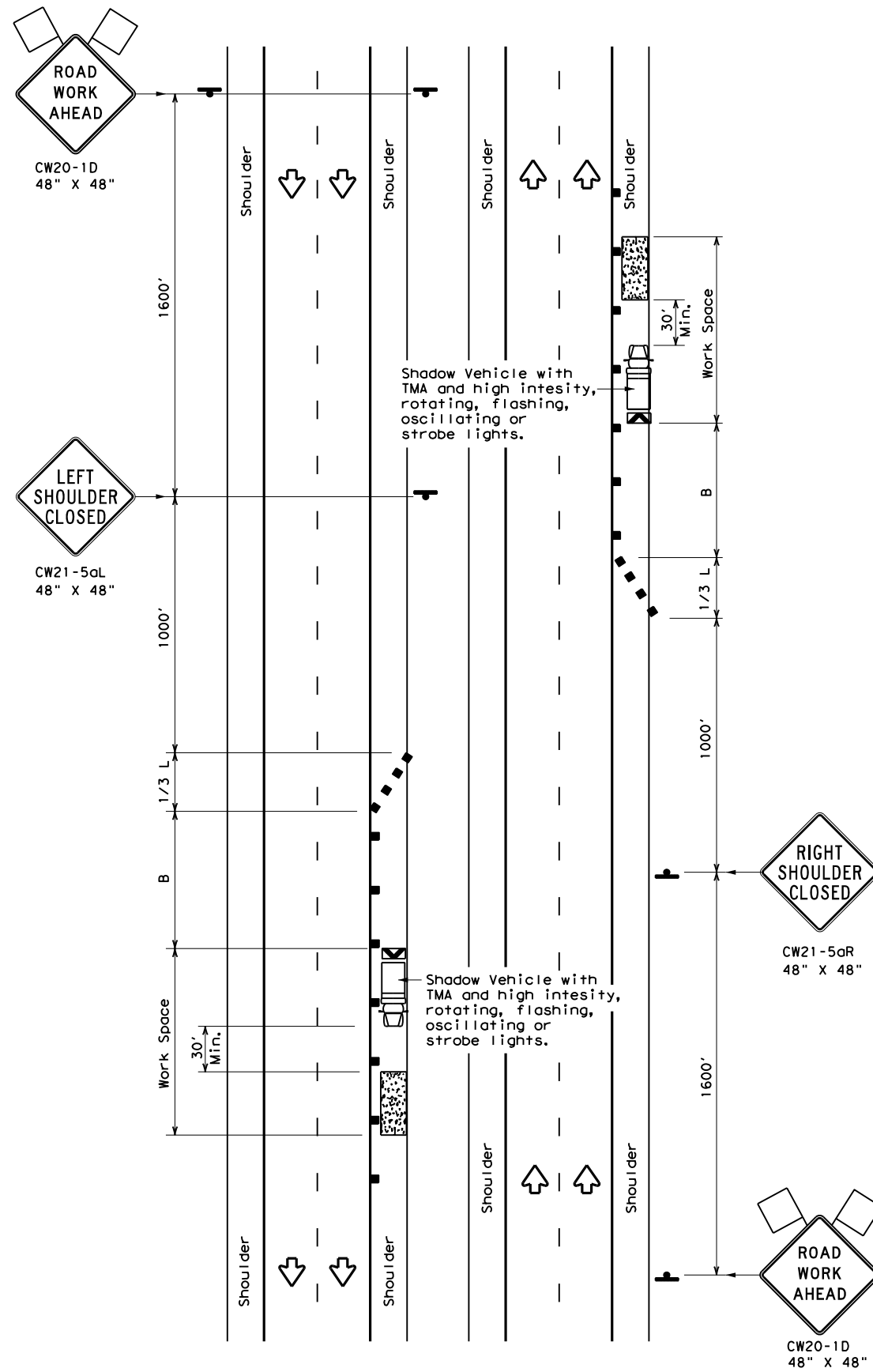
## TRAFFIC CONTROL PLAN LANE CLOSURES ON DIVIDED HIGHWAYS

### TCP (2-6) - 18

FILE: tcp2-6-18.dgn	DN:	CK:	DW:	CK:
© TxDOT December 1985	CONT	SECT	JOB	HIGHWAY
REVISIONS	6385	38	001	IH 30
2-94 4-98	DIST	COUNTY	SHEET NO.	
8-95 2-12	PAR	HUNT, ETC	19	
1-97 2-18				

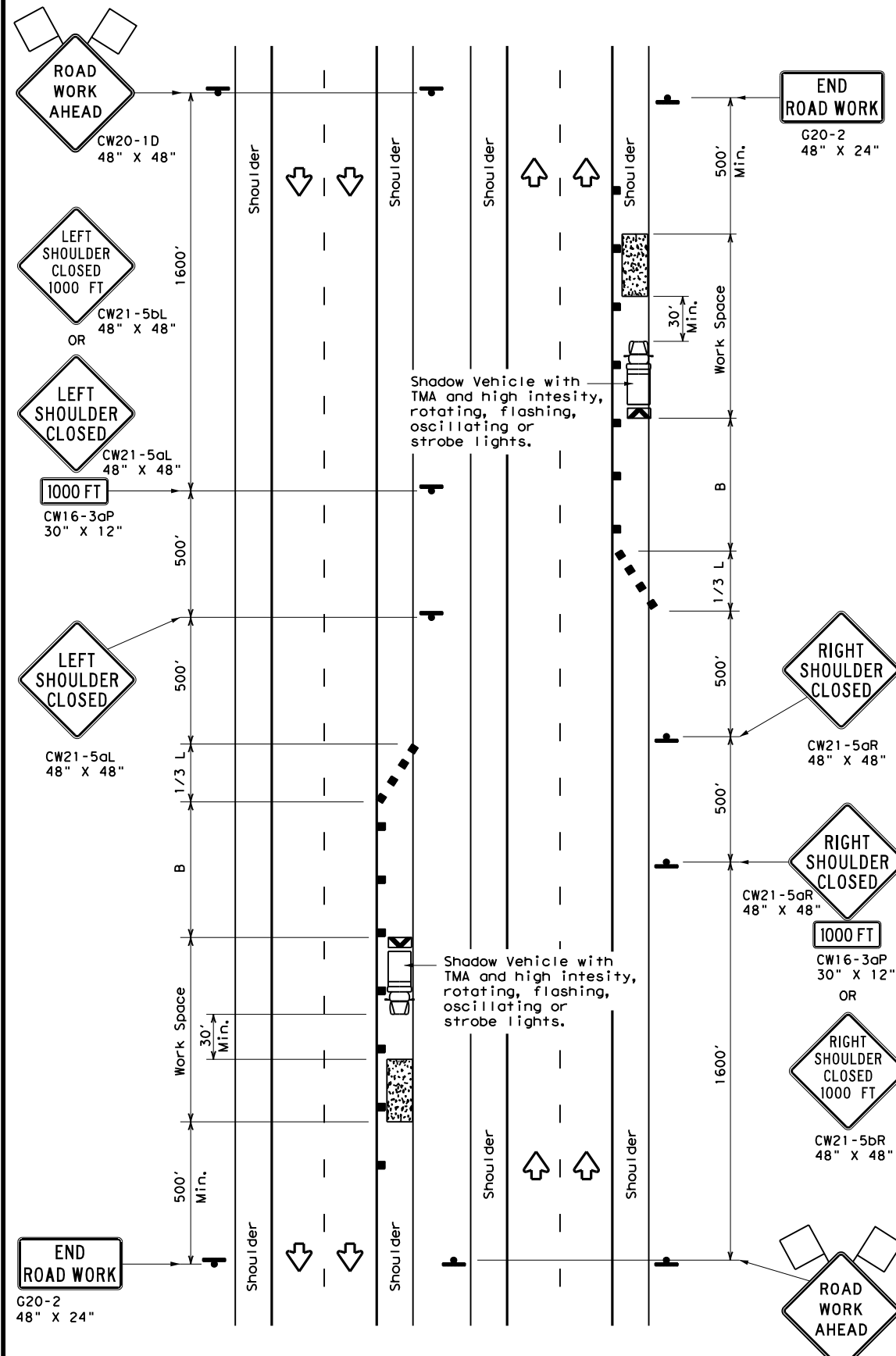
DISCLAIMER: The use of this standard is governed by the "Texas Engineering Practice Act". No warranty of any kind is made by TxDOT for any purpose whatsoever. TxDOT assumes no responsibility for the conversion of this standard to other formats or for incorrect results or damages resulting from its use.

DATE: 1/5/2022 4:11:56 PM  
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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 = WS <sup>2</sup> / 60	150'	165'	180'	30'	60'	90'
35		205'	225'	245'	35'	70'	120'
40		265'	295'	320'	40'	80'	155'
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'

\* 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**

1. 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.
2. 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.



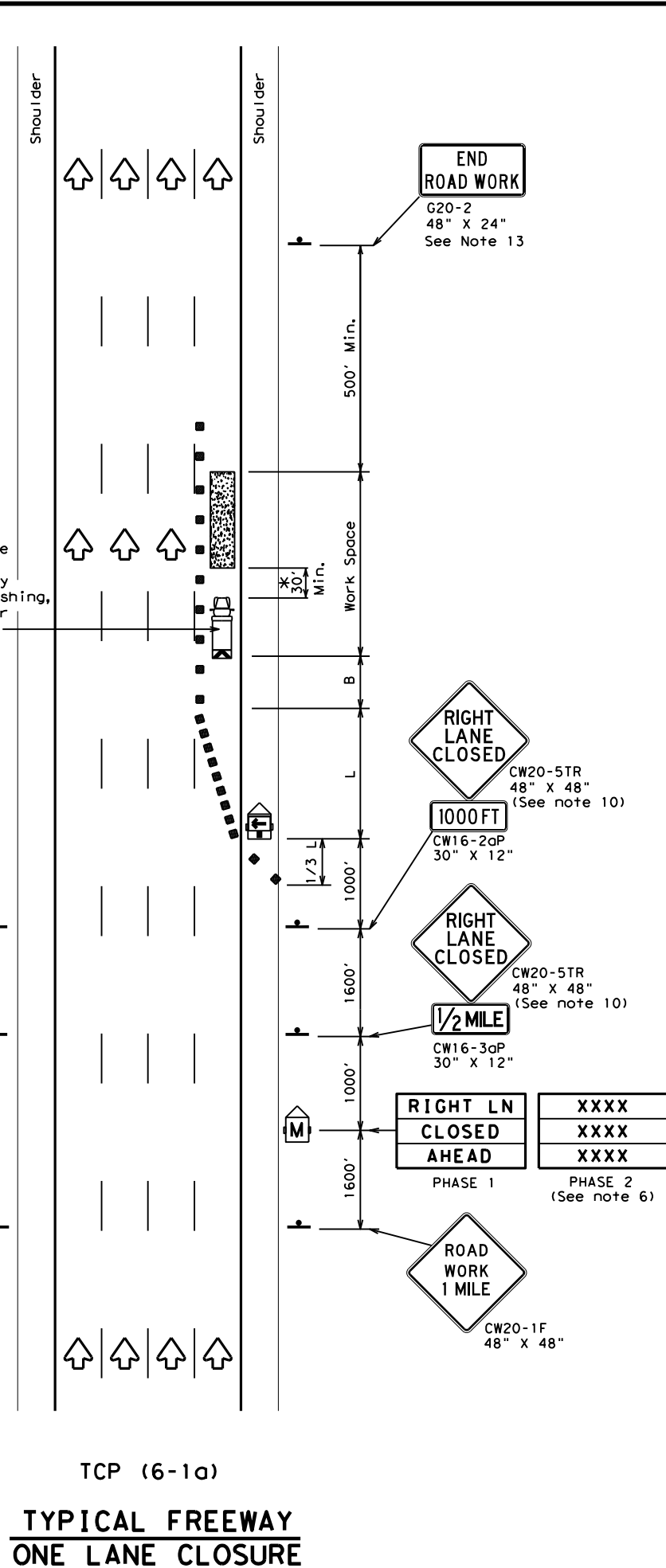
**TRAFFIC CONTROL PLAN  
 SHOULDER WORK FOR  
 FREEWAYS / EXPRESSWAYS**

**TCP (5-1) - 18**

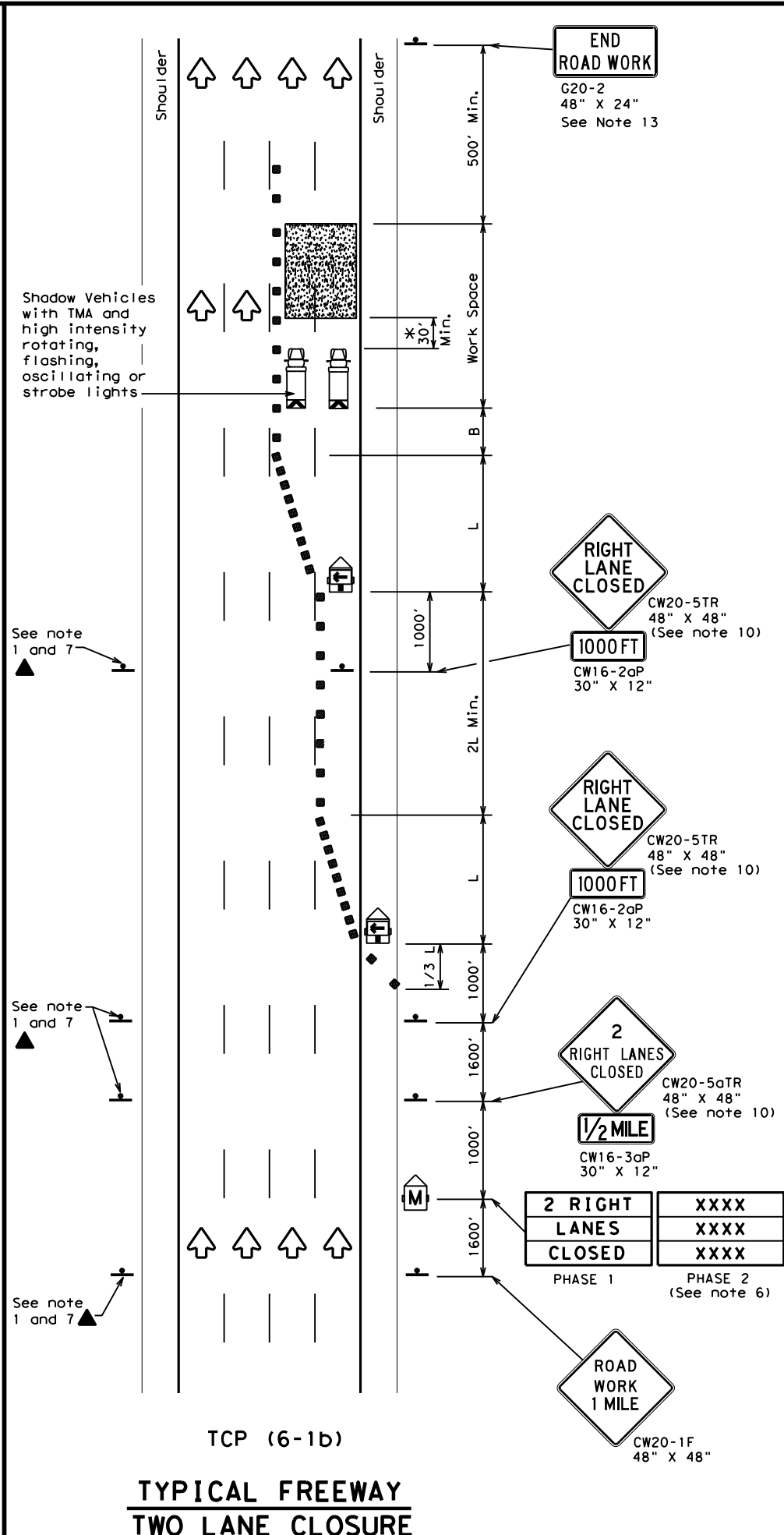
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© TxDOT February 2012	CONT	SECT	JOB	HIGHWAY
REVISIONS	6385	38	001	IH 30
2-18	DIST	COUNTY	SHEET NO.	
	PAR	HUNT, ETC	20	

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DATE: 1/5/2022 4:11:58 PM  
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TCP (6-1a)  
**TYPICAL FREEWAY ONE LANE CLOSURE**



TCP (6-1b)  
**TYPICAL FREEWAY TWO LANE CLOSURE**

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 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

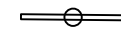
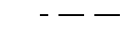
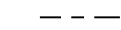
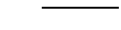
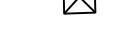
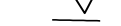
**TRAFFIC CONTROL PLAN  
 FREEWAY LANE CLOSURES**

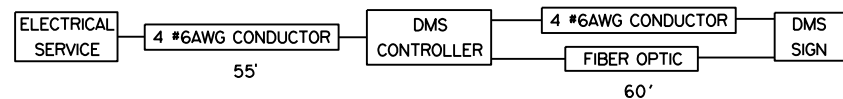
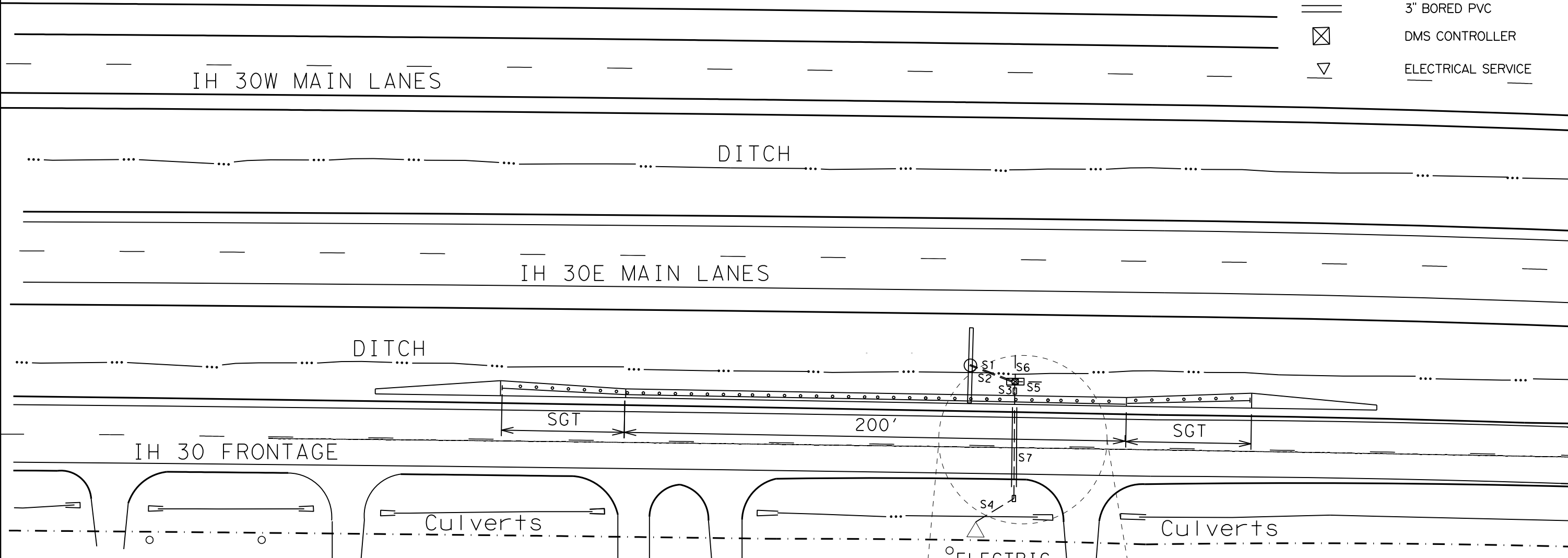
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© TxDOT	February 1998	CONT	SECT	JOB	HIGHWAY				
8-12	REVISIONS	6385	38	001	IH 30				
	DIST	COUNTY		SHEET NO.					
	PAR	HUNT, ETC		21					

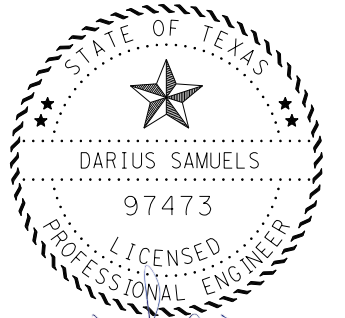
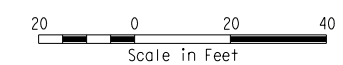
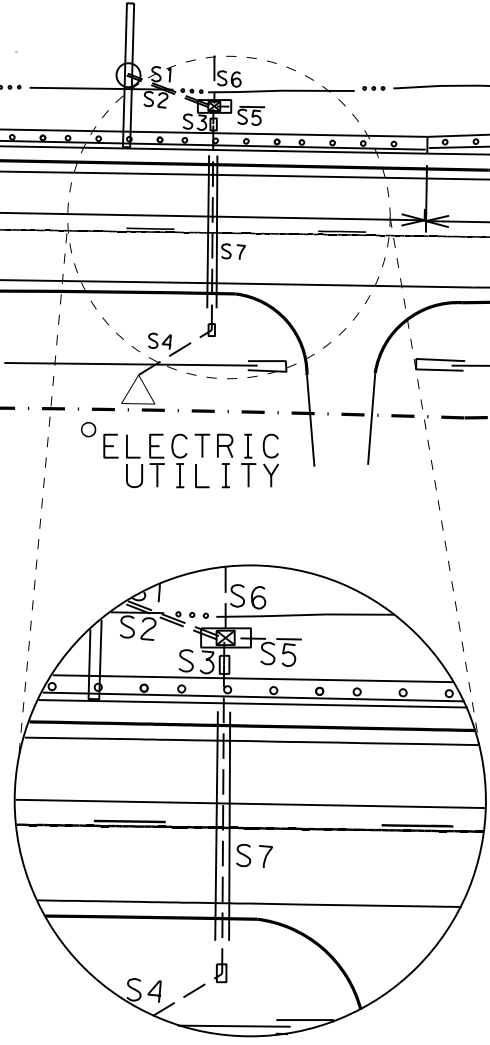
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**LEGEND**

-  DYNAMIC MESSAGE SIGN
-  PVC CONDUIT
-  2" HDPE
-  3" BORED PVC
-  DMS CONTROLLER
-  ELECTRICAL SERVICE



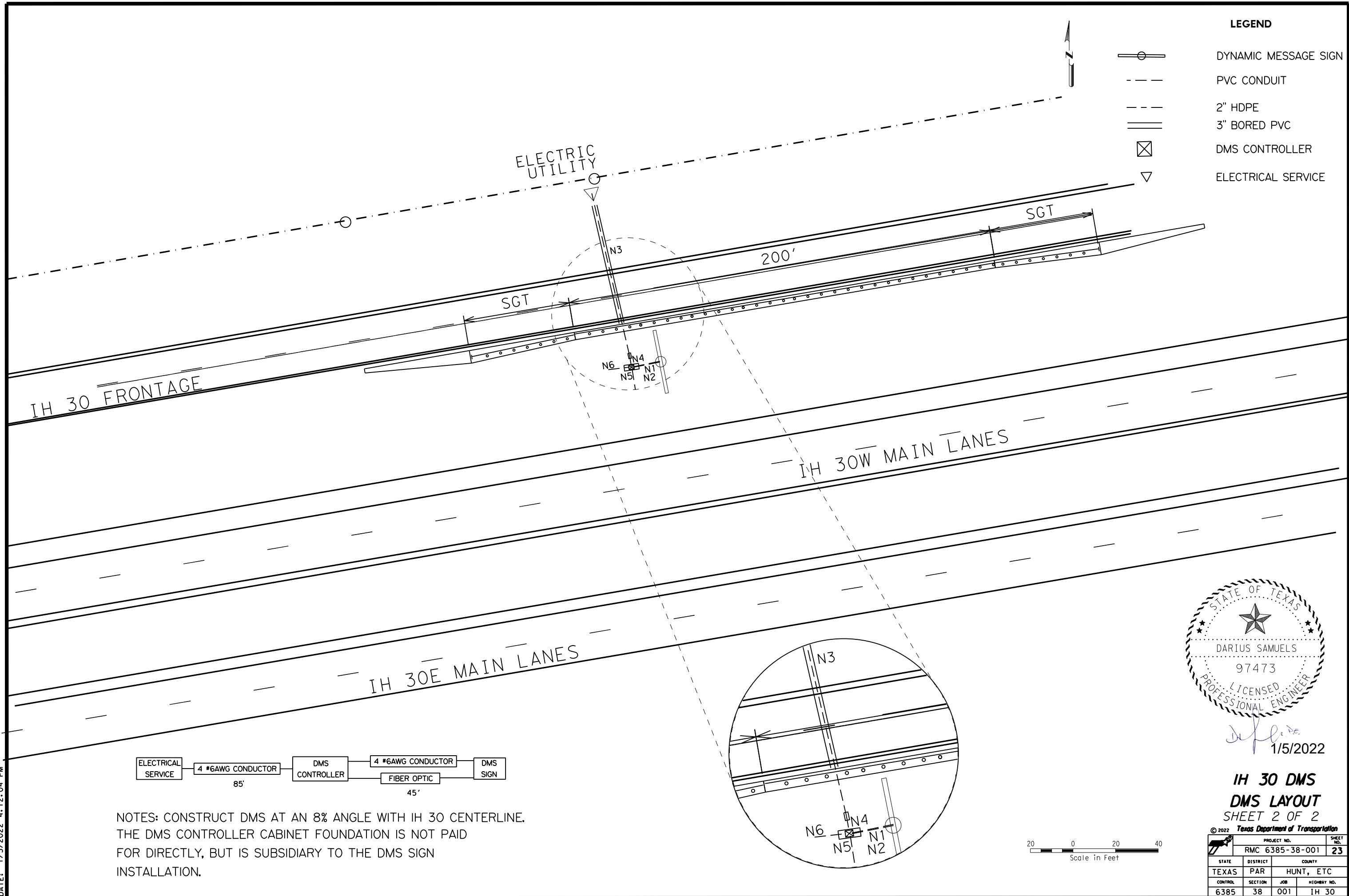
NOTES: CONSTRUCT DMS AT AN 8% ANGLE WITH IH 30 CENTERLINE.  
 THE DMS CONTROLLER CABINET FOUNDATION IS NOT PAID FOR DIRECTLY, BUT IS SUBSIDIARY TO THE DMS SIGN INSTALLATION.









1/5/2022  
 IH 30 DMS  
 DMS LAYOUT  
 SHEET 1 OF 2

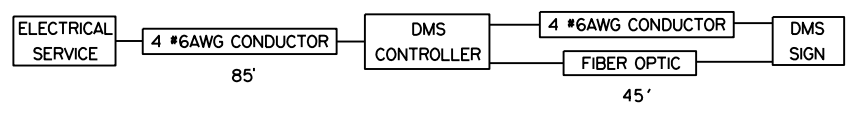
© 2021 Texas Department of Transportation			
PROJECT NO.		SHEET NO.	
RMC 6385-38-001		22	
STATE	DISTRICT	COUNTY	
TEXAS	PAR	HUNT, ETC	
CONTROL	SECTION	JOB	HIGHWAY NO.
6385	38	001	IH 30

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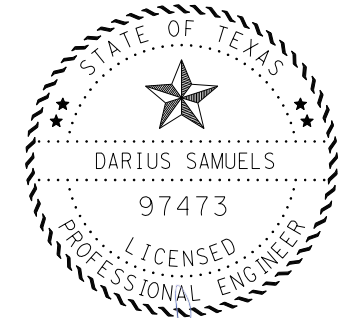
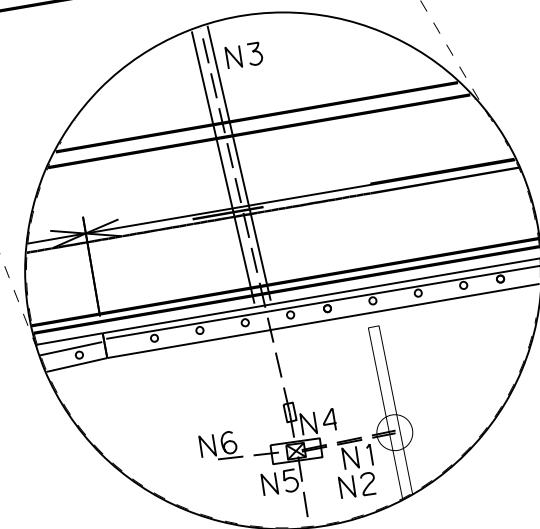


**LEGEND**

-  DYNAMIC MESSAGE SIGN
-  PVC CONDUIT
-  2" HDPE
-  3" BORED PVC
-  DMS CONTROLLER
-  ELECTRICAL SERVICE

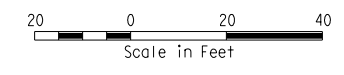


NOTES: CONSTRUCT DMS AT AN 8% ANGLE WITH IH 30 CENTERLINE.  
 THE DMS CONTROLLER CABINET FOUNDATION IS NOT PAID FOR DIRECTLY, BUT IS SUBSIDIARY TO THE DMS SIGN INSTALLATION.



*Darius Samuels*  
 1/5/2022

**IH 30 DMS  
 DMS LAYOUT  
 SHEET 2 OF 2**



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PROJECT NO.		SHEET NO.	
RMC 6385-38-001		23	
STATE	DISTRICT	COUNTY	
TEXAS	PAR	HUNT, ETC	
CONTROL	SECTION	JOB	HIGHWAY NO.
6385	38	001	IH 30

### DMS ELECTRICAL SERVICE DATA

ELECTRICAL SERVICE DESCRIPTION (SEE ED(4) (5))	SERVICE CONDUIT SIZE (RMC)	SERVICE CONDUCTORS NO./SIZE	SAFETY SWITCH AMPS	MAIN DISCONNECT		TWO-POLE CONTACTOR AMPS	PANELBD/LOADCENTER AMP RATING (MIN)	BRANCH CKT. BRK. POLE/AMPS	CIRCUIT NO.	KVA LOAD
				SWITCH AMP/FUSES	CKT. BRK. POLE/AMP					
TY D (120/240)60(NS)SS(N)PS(U)	2"	SUPPLIED BY OTHERS	N/A	N/A	2P/70	N/A	100	2P/50	DMS	<7.0

### MISC. DMS ITEMS

ITEM #	DESC CODE	DESCRIPTION	UNIT
416	6022	DRILL SHAFT (SIGN MTS) (48 IN)	48 LF
620	6010	ELEC CONDR (NO. 6) INSULATED	260 LF
624	6010	GROUND BOX TY D (162922)W/APRON	3 EA
628	6151	ELC SRV TY D 120/240 060(NS)SS(N)PS(U)	2 EA
650	6028	INS OH SN SUP (30 FT BAL TEE)	2 EA
6008	6025	ITS GRND MNT CAB (TY 4) (CONF 1) (REL)	2 EA
6028	6002	INSTALL DMS (FOUNDATION MTD CABINET)	2 EA
		FIBER OPTIC CBL (PROVIDED WITH SIGN)	105 LF

### METAL BEAM GUARD FENCE

LOCATION	540 6002 MTL W-BEAM GD FEN (STEEL POST)	544 6001 GUARDRAIL END TREATMENT (INSTALL)	432 6045 RIPRAP (MOW STRIP) (4 IN)
HUNT- IH 30 S FRONTAGE	200 LF	2 EA	19.4 CY
HOPKINS- IH 30 N FRONTAGE	200 LF	2 EA	19.4 CY

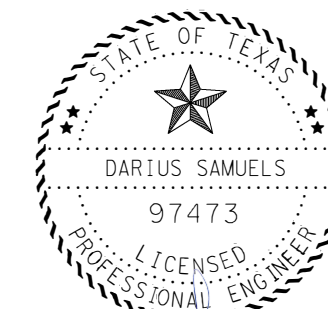
### CONDUIT TABLE

				**FIBER OPTIC	ELEC. CONDR NO. 6	LENGTH	
						DMS SOUTH	DMS NORTH
N1	618	6023	CONDT (PVC)(SCHD 40)(2")	3			15'
N2	618	6023	CONDT (PVC)(SCHD 40)(2")		4		15'
N3	618	6075	CONDT (RM) (3") (BORE) *				85'
N4	618	6023	CONDT (PVC)(SCHD 40)(2")		EMPTY #		15'
N5	618	6023	CONDT (PVC)(SCHD 40)(2")		EMPTY #		15'
S1	618	6023	CONDT (PVC)(SCHD 40)(2")	3		20'	
S2	618	6023	CONDT (PVC)(SCHD 40)(2")		4	20'	
S3	618	6023	CONDT (PVC)(SCHD 40)(2")		4	10'	
S4	618	6023	CONDT (PVC) (SCH 40) (2")		4	20'	
S5	618	6023	CONDT (PVC)(SCHD 40)(2")		EMPTY #	15'	
S6	618	6023	CONDT (PVC)(SCHD 40)(2")		EMPTY #	15'	
S7	618	6075	CONDT (RM) (3") (BORE) *			55'	

\*USED AS A SHEATH FOR HDPE BORES UNDER PAVEMENT

\*EMPTY CONDUIT FOR FUTURE USE STUBBED OUT PAST CONTROLLER FOUNDATION PAD

\*\* PROVIDED WITH SIGN



1/5/2022  
**DMS SUMMARY SHEET**

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PROJECT NO.		SHEET	
RMC 6385-38-001		24	
STATE	DISTRICT	COUNTY	
TEXAS	PAR	HUNT, ETC	
CONTROL	SECTION	JOB	HIGHWAY NO.
6385	38	001	IH 30

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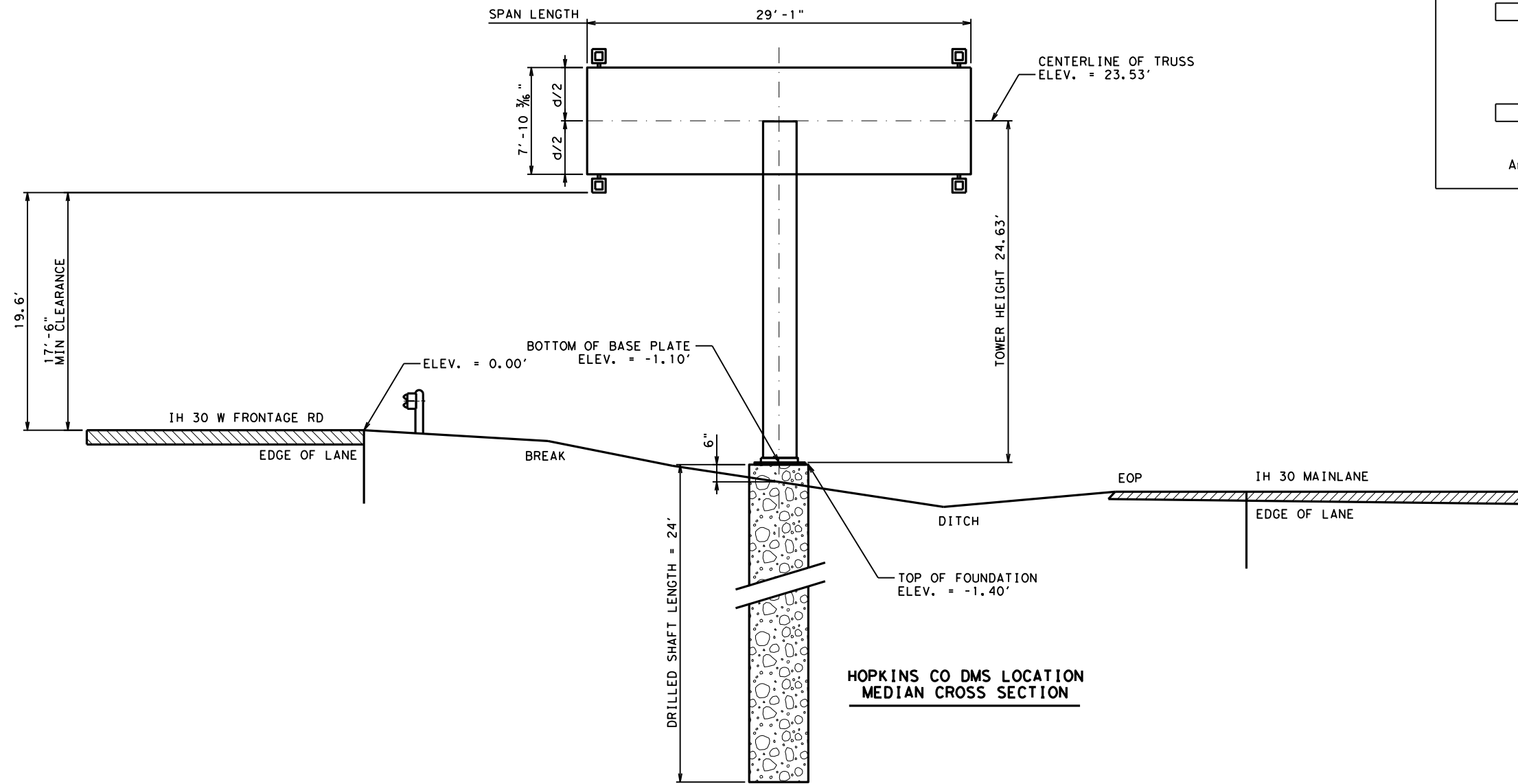


**GENERAL NOTES:**

THE DIMENSIONS SHOWN ON THE OVERHEAD SIGN STRUCTURE ARE FURNISHED TO THE CONTRACTOR FOR BIDDING PURPOSES ONLY.

IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO TAKE ACTUAL MEASUREMENTS BEFORE ORDERING FABRICATION OF THE COMPONENT PARTS OF THE OVERHEAD SIGN STRUCTURE.

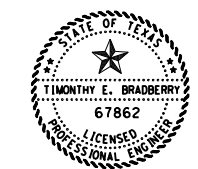
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<b>Design Data</b>	
Span L = 29'-1"	
Wind Design H = < 30'	
Tower H = 24.63	
<b>Structural Data</b>	
Structure Code COSS-Z3&Z3I-10	
Truss Size = 4 x 4	
Tower Size = 24 x 0.344	
<b>Design Loads</b>	
Moment = 283.74 k-ft	
Torsion = 155.44 k-ft	
Shear = 11.28 kips	
<b>Foundation Data</b>	
Length = 24 ft	
Diameter = 48" Dia	
Anchor Bolts = 2" Dia x 4'-3" Length	



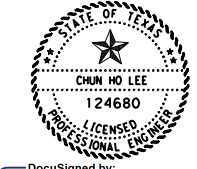
**HOPKINS CO DMS LOCATION  
MEDIAN CROSS SECTION**

**IH 30**

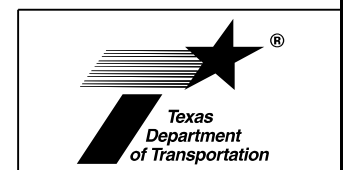
**OVERHEAD SIGN  
STRUCTURE DETAILS**



DocuSigned by:  
*Timothy E. Bradberry*  
11/9/2021



DocuSigned by:  
*Chun Ho Lee*  
11/9/2021



CONT	SECT	JOB	HIGHWAY
6385	38	001	IH 30
DIST	COUNTY	SHEET NO.	
PAR	HUNT, ETC	25	

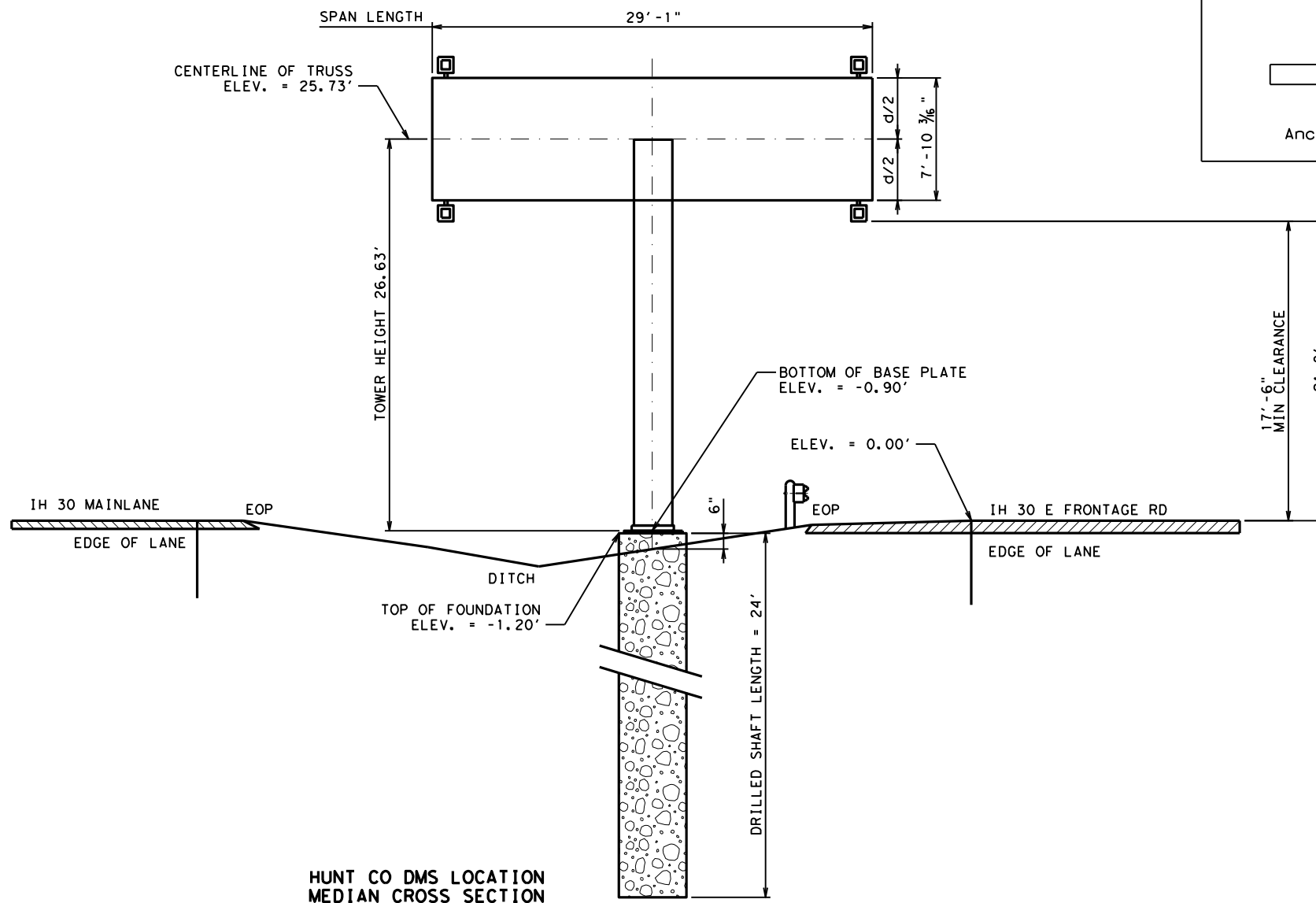
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FILE:

**GENERAL NOTES:**

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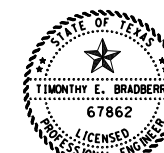
Hunt DMS Data	
<b>Design Data</b>	
Span L	= 29'-1"
Wind Design H	< 30'
Tower H	= 26.63
<b>Structural Data</b>	
Structure Code	COSS-Z3&Z3I-10
Truss Size	= 4 x 4
Tower Size	= 24 x 0.344
<b>Design Loads</b>	
Moment	= 305.77 k-ft
Torsion	= 155.44 k-ft
Shear	= 11.33 kips
<b>Foundation Data</b>	
Length	= 24 ft
Diameter	= 48" Dia
Anchor Bolts	= 2" Dia x 4'-3" Length



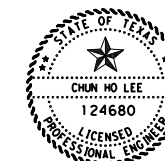
**HUNT CO DMS LOCATION  
MEDIAN CROSS SECTION**

**IH 30**

**OVERHEAD SIGN  
STRUCTURE DETAILS**



DocuSigned by:  
*Timothy E. Bradberry*  
E79B556139E6461  
11/9/2021



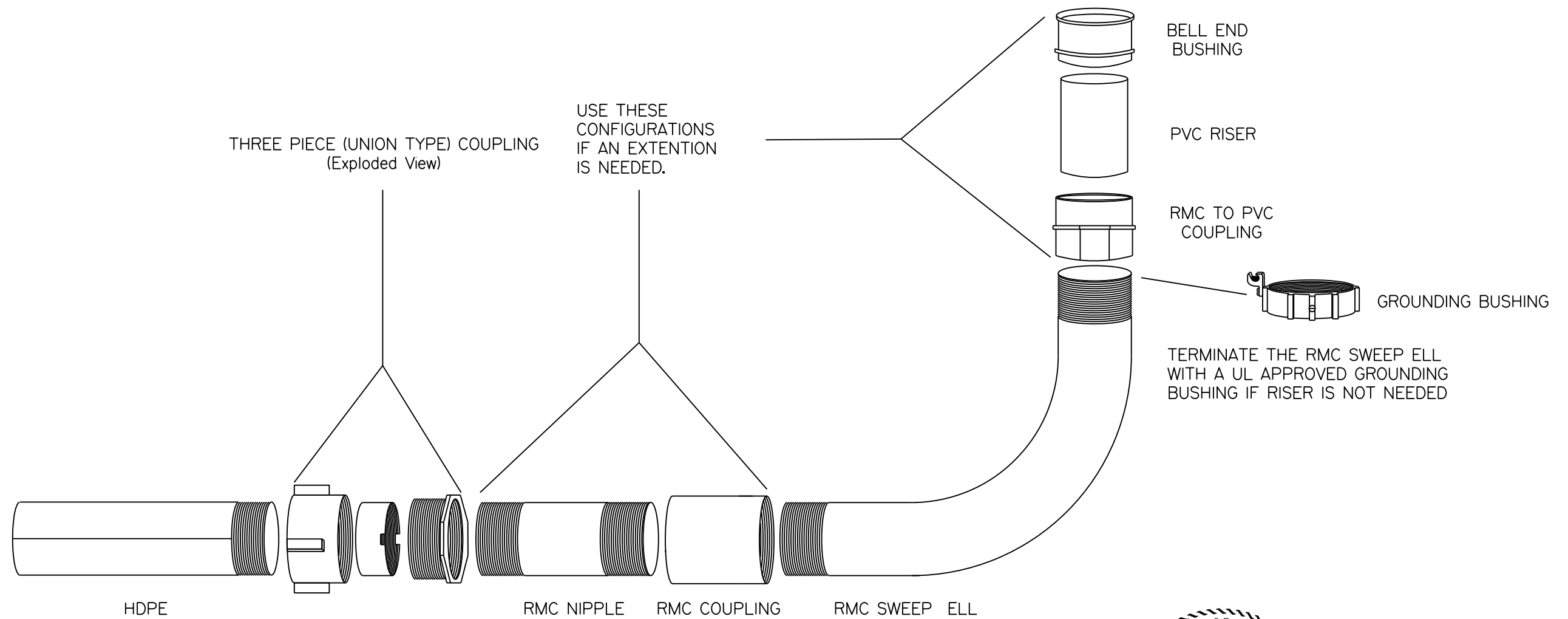
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*Chun Ho Lee*  
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11/9/2021



CONT	SECT	JOB	HIGHWAY
6385	38	001	IH 30
DIST	COUNTY	SHEET NO.	
PAR	HUNT, ETC	26	

DATE:  
FILE:

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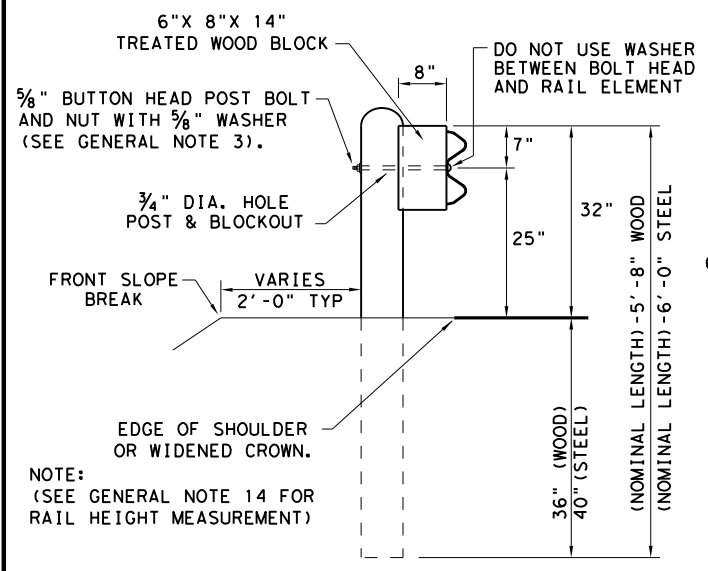
STATE OF TEXAS  
 DARIUS SAMUELS  
 97473  
 LICENSED PROFESSIONAL ENGINEER  
*Darius Samuels*  
 1/5/2022

# RIGID METAL CONDUIT SWEEP ELL

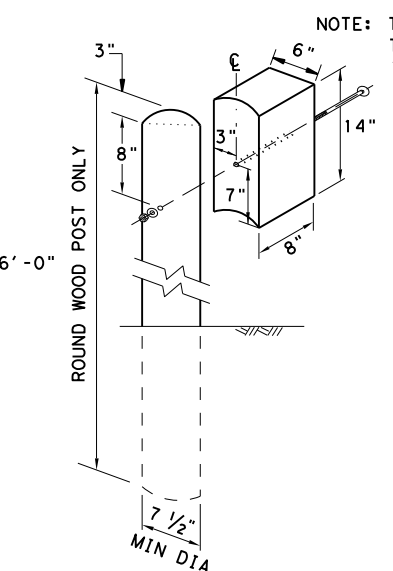
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FHWA TEXAS DIVISION	FEDERAL AID PROJECT NO. RMC 6385-38-001	SHEET NO. 27
STATE TEXAS	DISTRICT PAR	COUNTY HUNT, ETC
CONTROL 6385	SECTION 38	JOB 001
		HIGHWAY NO. IH 30

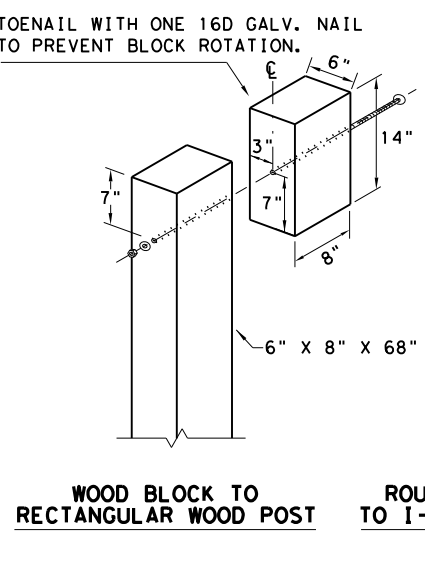
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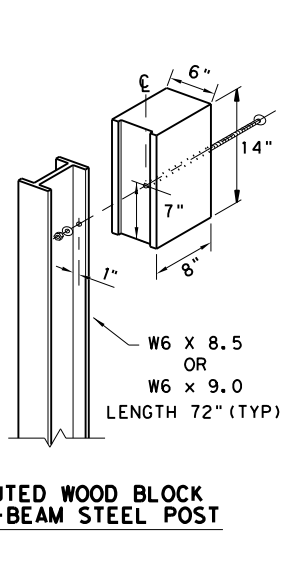
**TYPICAL POST PLACEMENT**



**WOOD BLOCK TO ROUND WOOD POST**



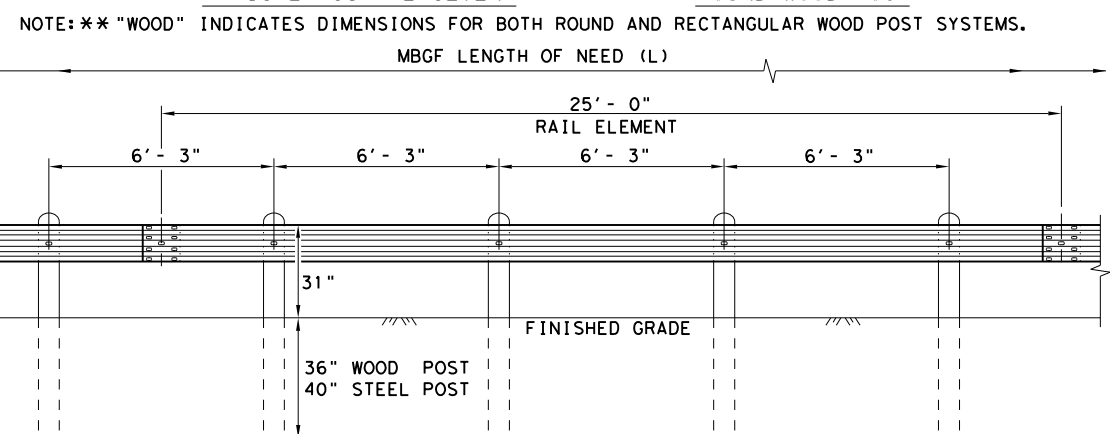
**WOOD BLOCK TO RECTANGULAR WOOD POST**



**ROUTED WOOD BLOCK TO I-BEAM STEEL POST**

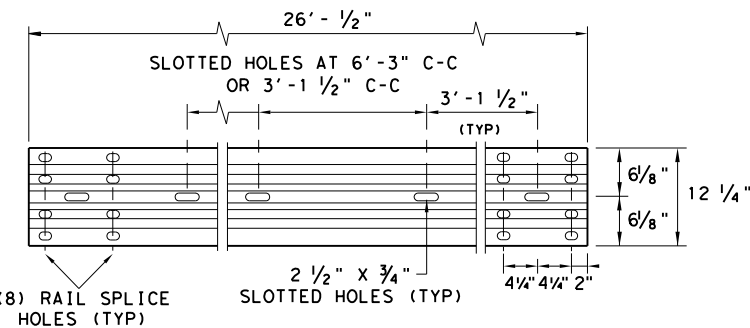
**GENERAL NOTES**

1. THE TYPE OF POST (ROUND WOOD POST, RECTANGULAR WOOD POST, OR STEEL POST) WILL BE AS SHOWN IN THE PLANS. THE EXACT POSITION OF MBGF SHALL BE SHOWN IN THE PLANS OR AS DIRECTED BY THE ENGINEER. STEEL POSTS TO BE GALVANIZED IN ACCORDANCE WITH ITEM 445, "GALVANIZING."
2. RAIL ELEMENTS SHALL MEET THE REQUIREMENTS OF ITEM 540, "METAL BEAM GUARD FENCE" EXCEPT AS MODIFIED IN THE PLANS. THE CONTRACTOR MAY FURNISH RAIL ELEMENTS OF 25'-0", OR 12'-6" (NOM.) LENGTHS. RAIL ELEMENTS MAY HAVE SLOTTED HOLES AT 3'-1 1/2" C-C OR 6'-3" C-C. A SPECIAL LENGTH OF RAIL MAY BE MANUFACTURED TO ACCOMMODATE THE DOWNSTREAM ANCHOR TERMINAL (DAT) AND THE TRANSITION SECTIONS OF GUARDRAIL.
3. BUTTON HEAD "POST BOLTS & NUTS" SHALL MEET THE REQUIREMENTS OF (ASTM A307), AND SHALL BE OF SUFFICIENT LENGTH TO EXTEND THROUGH THE FULL THICKNESS OF THE NUT AND 3/8" WASHER (FWC16G) AND NOT MORE THAN 1" BEYOND IT. TRIM REMAINING BOLT LENGTH TO MEET REQUIRED LENGTH.
4. FITTINGS (BOLTS, NUTS, AND WASHERS) SHALL BE GALVANIZED IN ACCORDANCE WITH ITEM 445, "GALVANIZING." FITTINGS SHALL BE SUBSIDIARY TO THE BID ITEM.
5. CROWN SHALL BE WIDENED TO ACCOMMODATE THE METAL BEAM GUARD FENCE.
6. THE LATERAL APPROACH TO THE GUARD FENCE, SHALL HAVE A MAXIMUM SLOPE OF 1V:10H.
7. IF SHOWN ELSEWHERE IN THE PLANS OR AS DIRECTED BY THE ENGINEER, THE GUARD FENCE MAY BE FLARED AT A RATE OF 25:1 OR FLATTER.
8. UNLESS OTHERWISE SHOWN IN THE PLANS, GUARD FENCE PLACED IN THE VICINITY OF CURBS SHALL BE POSITIONED SO THAT THE FACE OF CURB IS LOCATED DIRECTLY BELOW OR BEHIND THE FACE OF THE RAIL. RAIL PLACED OVER CURBS SHALL BE INSTALLED SO THAT THE POST BOLT IS LOCATED APPROXIMATELY 25 INCHES ABOVE THE GUTTER PAN OR EDGE OF SHOULDER.
9. APPLICATIONS IN SOLID ROCK ARE ONLY ALLOWED WITH STEEL POSTS. IF SOLID ROCK IS ENCOUNTERED WITHIN 0 TO 18" OF THE FINISHED GRADE, DRILL A 24" DIA. HOLE, 24" INTO THE ROCK. IF SOLID ROCK IS ENCOUNTERED BELOW 18", DRILL A 12" DIA. HOLE, 12" INTO THE ROCK OR TO THE STANDARD EMBEDMENT DEPTH, WHICHEVER MAYBE LESS. ANY EXCESS POST LENGTH, AFTER MEETING THESE DEPTHS, MAY BE FIELD CUT TO ENSURE PROPER GUARDRAIL MOUNTING HEIGHT. BACKFILL WITH COARSE AGGREGATE MATERIAL.
10. POSTS SHALL NOT BE SET IN CONCRETE, OF ANY DEPTH.
11. SPECIAL FABRICATION WILL BE REQUIRED AT INSTALLATION LOCATIONS HAVING A CURVATURE OF LESS THAN 150 FT. RADIUS.
12. UNLESS OTHERWISE SHOWN IN THE PLANS, A COMPOSITE MATERIAL BLOCK THAT MEETS THE REQUIREMENTS OF DMS-7210, "COMPOSITE MATERIAL POSTS AND BLOCKS FOR METAL BEAM GUARD FENCE" MAY BE SUBSTITUTED FOR BLOCKS OF SIMILAR DIMENSIONS. THE CONSTRUCTION DIVISION, TXDOT MAINTAINS A MATERIAL PRODUCER LIST (MPL) FOR PRODUCERS OF MATERIALS CONFORMING TO DMS-7210 ONLY PRODUCERS ON THE MPL MAY FURNISH COMPOSITE MATERIAL BLOCKS.
13. FOR THE LOW FILL CULVERT OPTION, POSTS LOCATED PARTIALLY OR WHOLLY BETWEEN PRECAST BOX CULVERT UNITS, THE USE OF A CAST-IN-PLACE CONCRETE CLOSURE BETWEEN BOXES IS REQUIRED. THE LENGTH OF THE CAST-IN-PLACE CONCRETE CLOSURE SHALL ACCOMMODATE THE PLACEMENT OF THE LOW FILL CULVERT OPTION. SEE CONCRETE CLOSURE DETAILS ON BRIDGE STANDARD SCP-MD.
14. GUARDRAIL HEIGHT MEASUREMENT: WHEN THE GUARDRAIL IS LOCATED ABOVE PAVEMENT, MEASURE THE HEIGHT FROM THE PAVEMENT TO THE TOP OF THE W-BEAM RAIL. WHEN THE GUARDRAIL IS LOCATED UP TO 2 FT. OFF OF THE EDGE OF PAVEMENT OR FOR A PAVEMENT OVERLAY, USE A 10-FOOT STRAIGHTEDGE TO EXTEND THE PAVEMENT/SHOULDER SLOPE TO THE BACK OF RAIL, MEASURE FROM THE BOTTOM OF STRAIGHTEDGE TO THE TOP OF RAIL. FOR GUARDRAIL LOCATED DOWN A 10:1 SLOPE, MEASURE FROM THE NOMINAL TERRAIN.



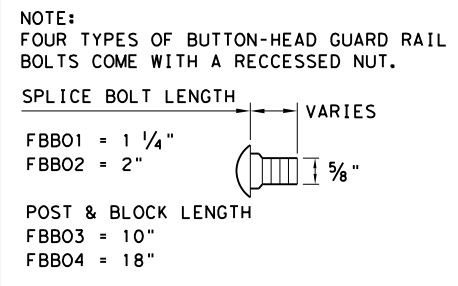
**ELEVATION MID-SPAN RAIL SPLICE**

SHOWING A 25'-0" SECTION OF W-BEAM RAIL. (SEE GENERAL NOTE 2)



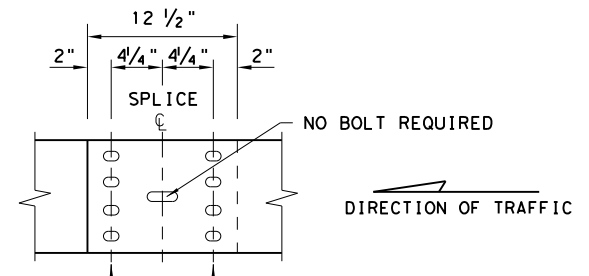
**ELEVATION 25'-0" (NOM.) W-BEAM SECTION**

NOTES: SEE GENERAL NOTE 2 FOR ALLOWABLE RAIL TYPES. SEE RAIL SPLICE DETAIL FOR REQUIRED HARDWARE.



**BUTTON HEAD BOLT**

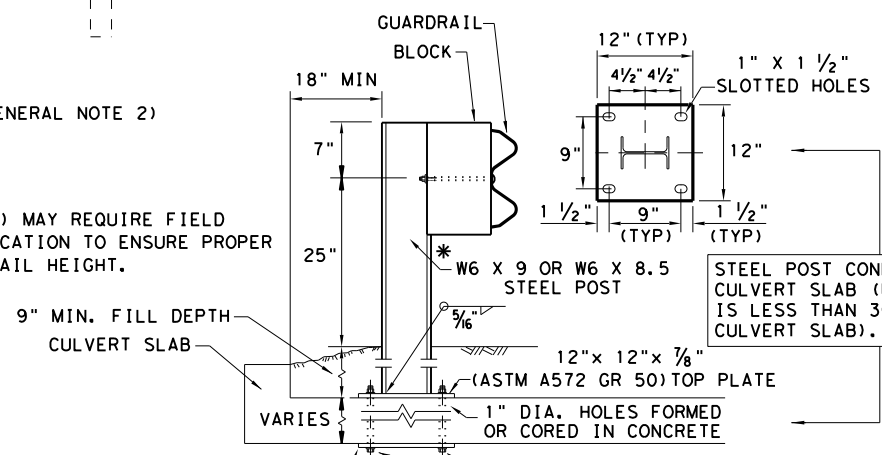
NOTE: SEE GENERAL NOTE 3 FOR SPLICE & POST BOLT DETAILS.



**MID-SPAN RAIL SPLICE DETAIL**

NOTE: GF(31), MID-SPAN RAIL SPLICES ARE REQUIRED WITH 6'-3" POST SPACINGS.

\* POST(S) MAY REQUIRE FIELD MODIFICATION TO ENSURE PROPER GUARDRAIL HEIGHT.



**LOW FILL CULVERT POST**

12" x 12" x 1/4" (ASTM A36) STEEL BOTTOM PLATE WITH 1" DIA. HOLES REQUIRED WITH BOLT-THROUGH INSTALLATION.

NOTE: TWO INSTALLATION OPTIONS.

1. **BOLT-THROUGH OPTION:** REQUIRES A 6" MIN. SLAB THICKNESS. 7/8" DIA (ASTM A449) HEAVY HEX BOLTS WITH TWO HARDENED WASHER EACH AND HEAVY HEX NUTS. NOTE: BOLT LENGTH = SLAB PLUS 2 1/4" MIN.
2. **EPOXY ANCHOR OPTION:** THIS OPTION MAY ONLY BE USED IF THE CULVERT SLAB IS 9" MIN. THICK. THREADED ANCHOR RODS MUST BE 7/8" DIA. ASTM A449 OR A193 GRADE B7 WITH HEAVY HEX NUT, AND ONE HARDENED WASHER EACH. EMBED ANCHOR RODS 6" WITH HILTI HIT RE 500 EPOXY ADHESIVE. OTHER TYPE III CLASS C EPOXY ADHESIVES MEETING THE REQUIREMENTS OF DMS-6100, "EPOXIES AND ADHESIVES", MAY BE USED IF IT CAN BE DEMONSTRATED THAT THEY MEET OR EXCEED THE STRENGTH OF HILTI HIT RE 500 WITH THE SAME EMBEDMENT DEPTH AND THREADED ROD DIA. FOLLOW THE MANUFACTURER'S REQUIREMENTS FOR INSTALLING EPOXIED THREADED RODS. EXTEND RODS 1/4" MIN. BEYOND NUT.

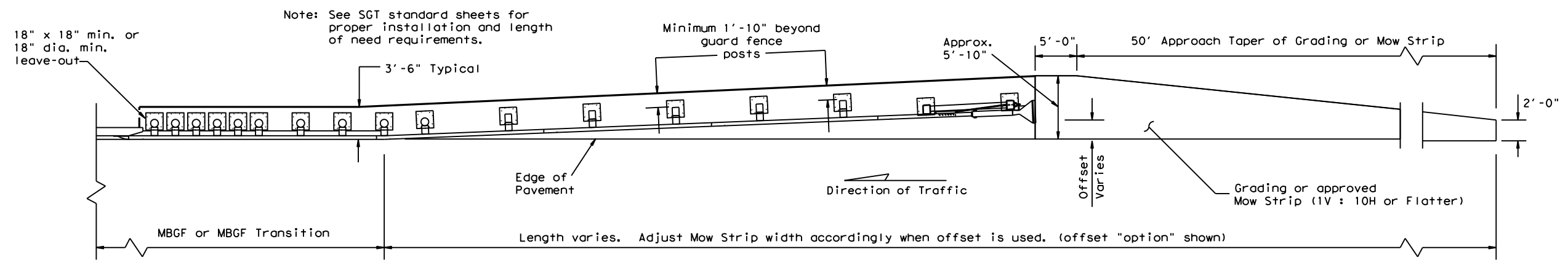
NOTE: CULVERTS OF 25 FT. OR LESS, SEE GF(31)LS STANDARD FOR "LONG SPAN" OPTION.

NOTE: TRANSITIONS TO BRIDGE RAILS OR TRAFFIC BARRIERS. SEE GF(31)TL3 TR STANDARD FOR HIGH-SPEED TL-3 TRANSITIONS. SEE GF(31)TL2 TR STANDARD FOR LOW-SPEED TL-2 TRANSITIONS.

				Design Division Standard	
<b>METAL BEAM GUARD FENCE</b> <b>TL-3 MASH COMPLIANT</b> <b>GF(31)-19</b>					
FILE: gf3119.dgn	DN: TXDOT	CK: KM	DW: VP	CK: CGL/AG	
© TXDOT: NOVEMBER 2019	CONT	SECT	JOB	HIGHWAY	
REVISIONS	6385	38	001	IH 30	
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	PAR	HUNT, ETC			28

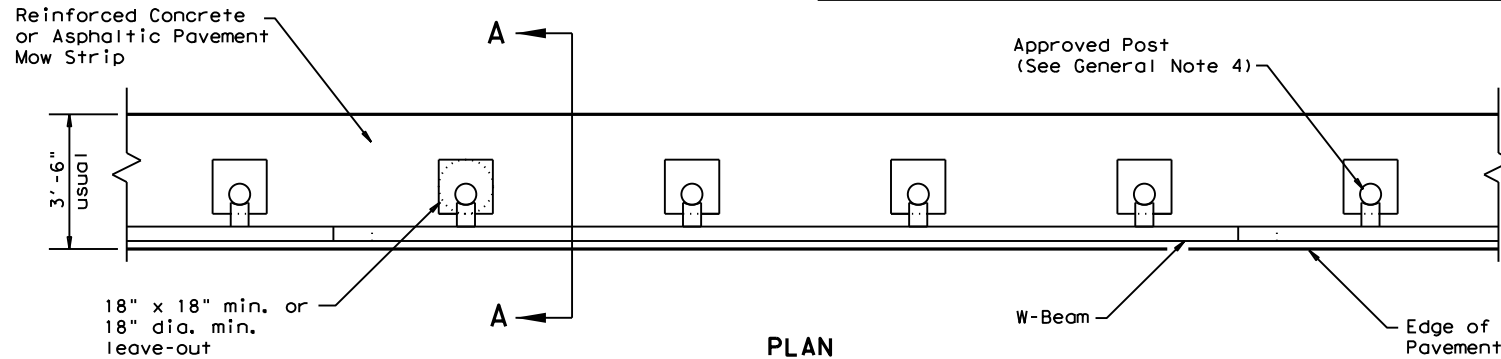
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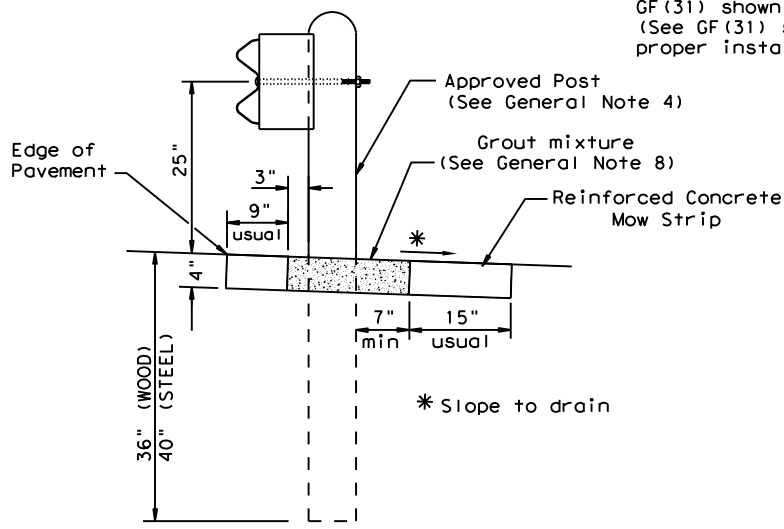
**GRADING AND MOW STRIP AT GUARDRAIL END TREATMENTS**

Note: Site Condition(s)  
 Site conditions may exist where grading is required for the proper installation of metal guard fence and end treatments.  
 Approach grading or mow strip may be decreased or eliminated, as directed by the Engineer.



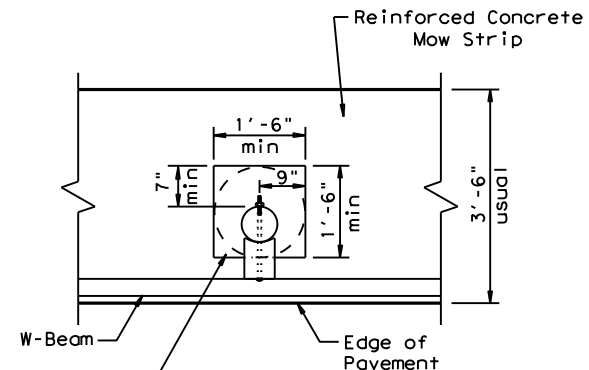
**PLAN**

GF(31) shown with Mow Strip  
 (See GF(31) standard sheet for proper installation)



**SECTION A-A**

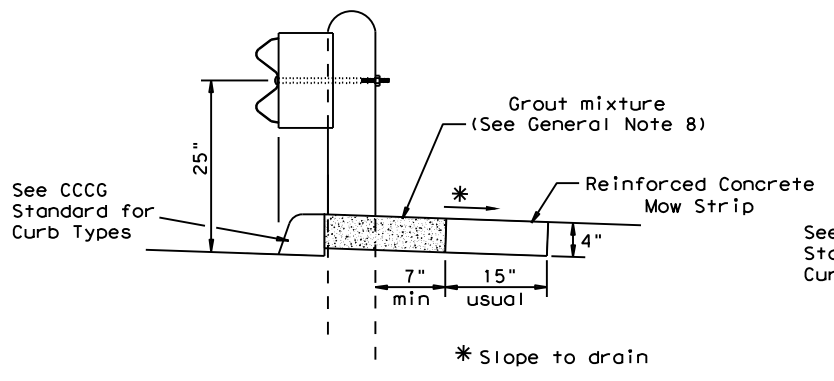
Typical



**MOW STRIP DETAIL**

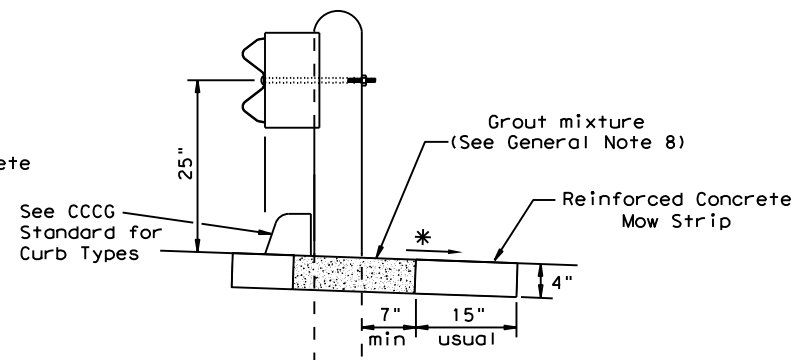
Reinforced Concrete Mow Strip with 18" x 18" Square or 18" Dia. minimum leave-out.

- GENERAL NOTES**
1. This mow strip design is for use with metal beam guard fence, guard fence transitions, and guard fence end treatments. See applicable GF(31) MBGF or GF(31) Transition Standard sheet for additional information.
  2. Mow strips shall be reinforced concrete with (wire mesh or synthetic fiber), as shown on the plans and will be paid for under the pertinent bid item. Reinforced concrete shall be placed in accordance with Item 432, "Riprap." The use of the synthetic fiber in lieu of steel reinforcing is acceptable, provided the fiber producer is on the Department Material Producer List (MPL), maintained by TxDOT, Construction Division.
  3. The leave-out behind the post shall be a minimum of 7".
  4. Only steel (W6 x 8.5 or W6 x 9.0), or 7 1/2" Dia. round wood posts are acceptable for use in the mow strip. See GF(31) Standard for additional details.
  5. Other curb placement options may be used. Curbs are not considered part of the mow strip and will be paid for under other pertinent bid item.
  6. Thickness of the mow strip will be 4".
  7. The limits of payment for reinforced concrete will include leave-outs for the posts.
  8. The leave-outs shall be filled with a Grout mixture consisting of: 2719 pounds sand, 188 pounds Type 1 or II cement, and 550 pounds of water per cubic yard, with a 28-day compressive strength of approximately 230 psi or less. Provide grout with a consistency that will flow into and completely fill all voids. Due to auger size, larger leave-out dimensions are acceptable from both an impact performance and maintenance repair standpoint (Suggested Maximum leave-out of 20"). Payment for furnishing and placing the grout mixture will be subsidiary to the pay item of riprap mow strip.



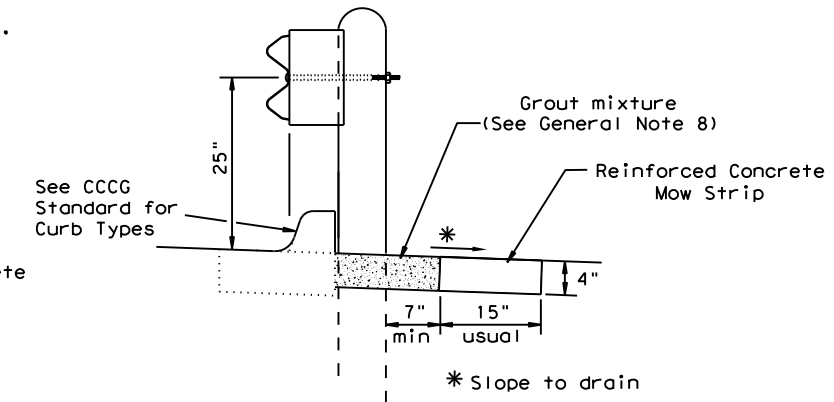
**CURB OPTION (1)**

This option will increase the post embedment throughout the system.



**CURB OPTION (2)**

Curb shown on top of mow strip

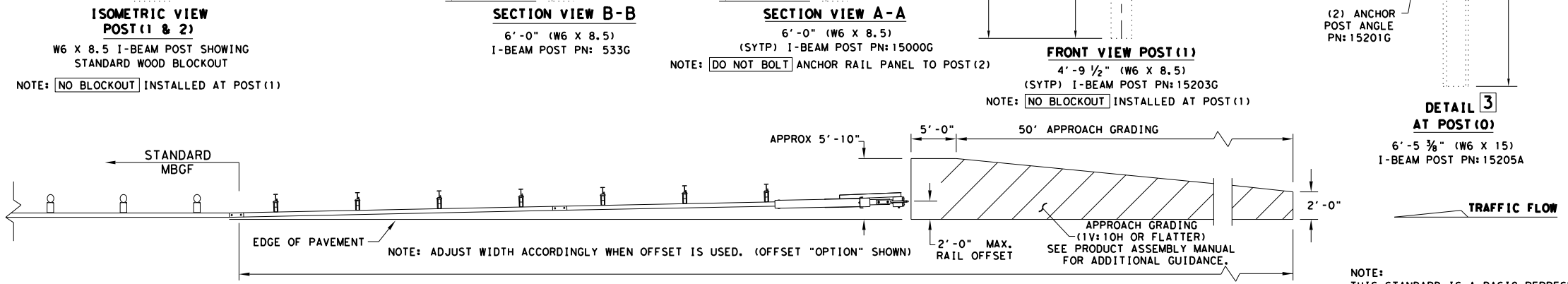
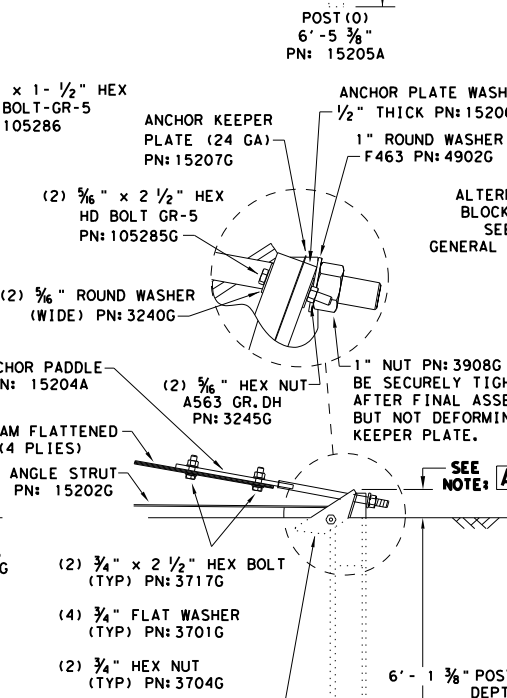
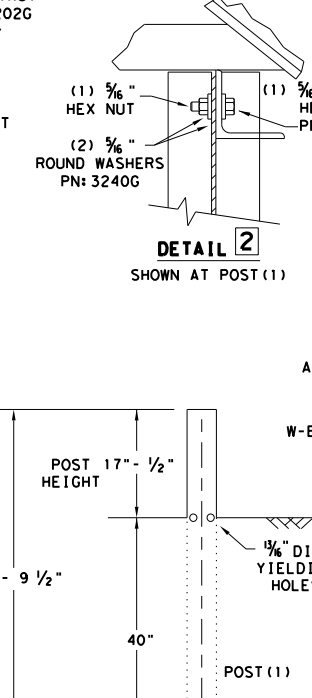
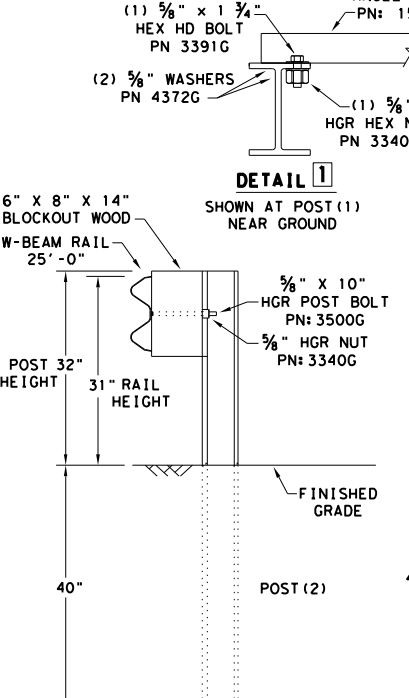
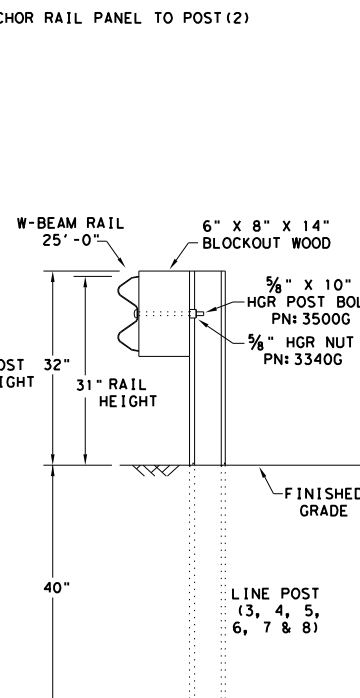
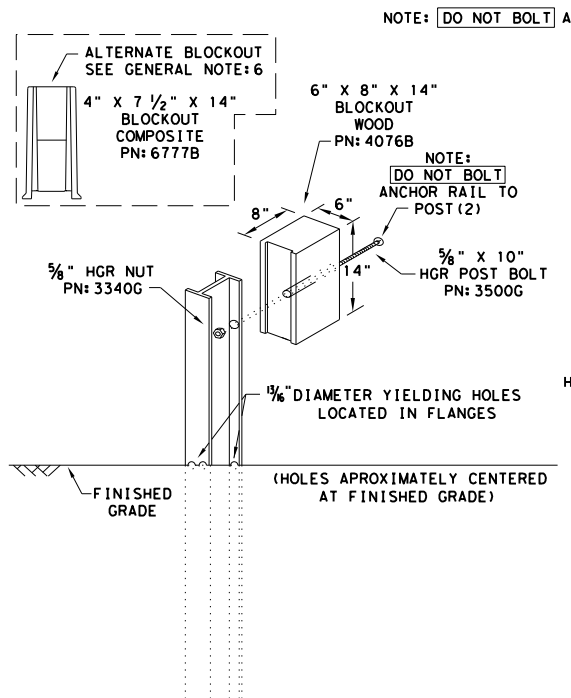
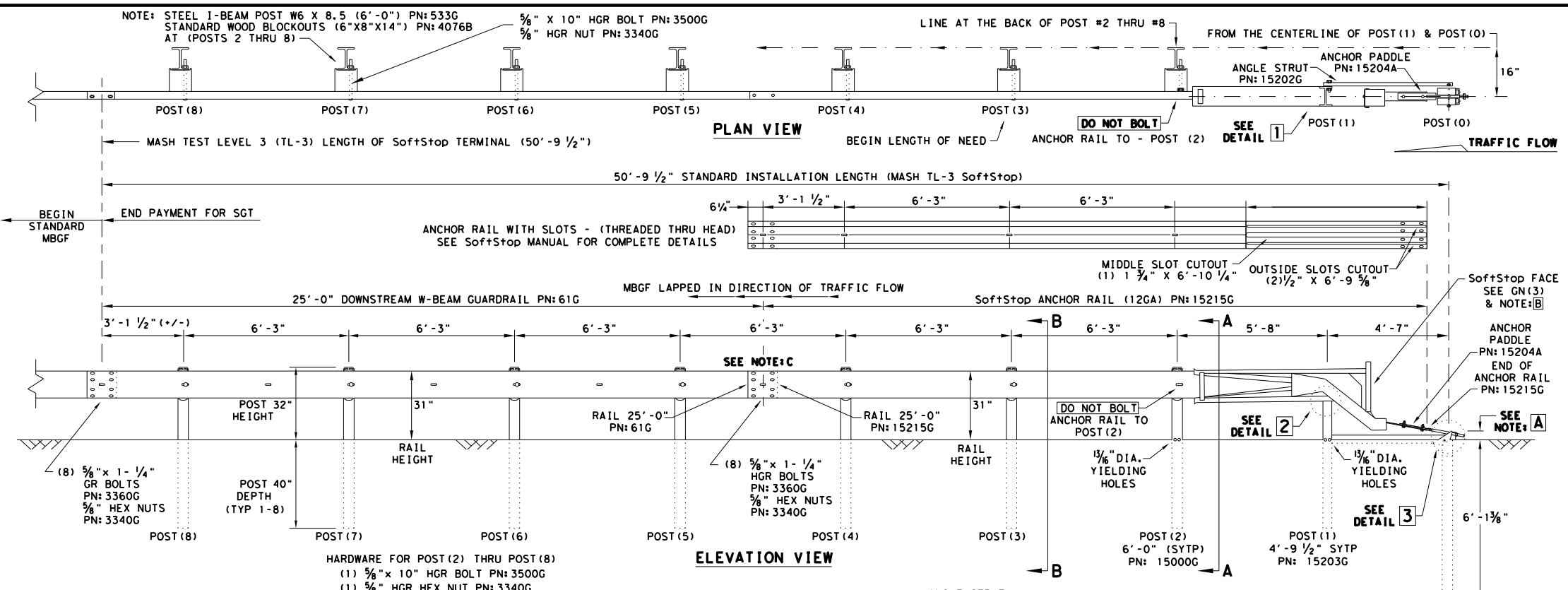


**CURB OPTION (3)**

		Design Division Standard	
<b>METAL BEAM GUARD FENCE (MOW STRIP)</b> <b>TL-3 MASH COMPLIANT</b> <b>GF(31)MS-19</b>			
FILE: gf31ms19.dgn	DN: TxDOT	CK: KM	DW: VP
©TXDOT: NOVEMBER 2019	CONT SECT	JOB	HIGHWAY
REVISIONS	6385 38	001	IH 30
DIST	COUNTY	SHEET NO.	
PAR	HUNT, ETC	29	

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- GENERAL NOTES**
- FOR SPECIFIC INFORMATION REGARDING INSTALLATION AND TECHNICAL GUIDANCE OF THE SYSTEM, CONTACT: TRINITY HIGHWAY AT 1(888)323-6374, 2525 N. STEMMONS FREEWAY, DALLAS, TX 75207
  - FOR INSTALLATION, REPAIR AND MAINTENANCE REFER TO THE SoftStop END TERMINAL, PRODUCT DESCRIPTION ASSEMBLY MANUAL. PN:620237B
  - APPLY HIGH INTENSITY REFLECTIVE SHEETING, "OBJECT MARKER" ON THE FRONT FACE OF THE DEVICE PER MANUFACTURER'S RECOMMENDATIONS. OBJECT MARKER SHALL CONFORM TO THE STANDARDS REQUIRED IN TEXAS MUTCD.
  - FOR POST (LEAVE-OUT) INSTALLATION AND GUIDANCE SEE TxDOT'S LATEST ROADWAY MOW STRIP STANDARD.
  - HARDWARE (BOLTS, NUTS, & WASHERS) SHALL BE GALVANIZED IN ACCORDANCE WITH ITEM 445, "GALVANIZING". FITTINGS SHALL BE SUBSIDIARY TO THE BID ITEM.
  - A COMPOSITE MATERIAL BLOCKOUT THAT MEETS THE REQUIREMENTS OF DMS-7210, MAY BE SUBSTITUTED FOR BLOCKOUTS OF SIMILAR DIMENSIONS. SEE CONSTRUCTION DIVISION MATERIAL PRODUCER LIST (MPL) FOR CERTIFIED PRODUCERS.
  - IF SOLID ROCK IS ENCOUNTERED SEE THE MANUFACTURER'S INSTALLATION MANUAL AND REFER TO THE LATEST ROADWAY MOW STRIP STANDARD FOR INSTALLATION GUIDANCE.
  - POSTS SHALL NOT BE SET IN CONCRETE.
  - IT IS ACCEPTABLE TO INSTALL THE SoftStop IMPACT HEAD PARALLEL TO THE GRADE LINE OR WITH AN UPWARD TILT.
  - DO NOT ATTACH THE SoftStop SYSTEM DIRECTLY TO A RIGID BARRIER.
  - UNDER NO CIRCUMSTANCES SHALL THE GUARDRAIL WITHIN THE SoftStop SYSTEM BE CURVED.
  - A FLARE RATE OF UP TO 25:1 MAY BE USED TO PREVENT THE TERMINAL HEAD FROM ENCRoaching ON THE SHOULDER. THE FLARE MAY BE DECREASED OR ELIMINATED FOR SPECIFIC INSTALLATIONS, IF DIRECTED BY THE ENGINEER.

**NOTE: A** THE INSTALLATION HEIGHT OF FULLY ASSEMBLED ANCHOR POST WILL VARY FROM 3'-3/4" MIN. TO 4" MAX. ABOVE FINISHED GRADE.

**NOTE: B** PART PN:5852B RIGHT-SIDE (HIGH INTENSITY REFLECTIVE SHEETING) PART PN:5851B LEFT-SIDE (HIGH INTENSITY REFLECTIVE SHEETING)

**NOTE: C** W-BEAM SPLICE LOCATED BETWEEN LINE POST (4) AND LINE POST (5) GUARDRAIL PANEL 25'-0" PN:61G ANCHOR RAIL 25'-0" PN:15215G LAP GUARDRAIL IN DIRECTION OF TRAFFIC FLOW.

PART	QTY	MAIN SYSTEM COMPONENTS
620237B	1	PRODUCT DESCRIPTION ASSEMBLY MANUAL (LATEST REV.)
15208A	1	SoftStop HEAD (SEE MANUAL FOR RIGHT-LEFT APPROACH)
15215G	1	SoftStop ANCHOR RAIL (12GA) WITH CUTOUT SLOTS
61G	1	SoftStop DOWNSTREAM W-BEAM RAIL (12GA) (25' - 0")
15205A	1	POST #0 - ANCHOR POST (6' - 5 3/8")
15203G	1	POST #1 - (SYTP) (4' - 9 1/2")
15000G	1	POST #2 - (SYTP) (6' - 0")
533G	6	POST #3 THRU #8 - I-BEAM (W6 X 8.5) (6' - 0")
4076B	7	BLOCKOUT - WOOD (ROUTED) (6" X 8" X 14")
6777B	7	BLOCKOUT - COMPOSITE (4" X 7 1/2" X 14")
15204A	1	ANCHOR PADDLE
15207G	1	ANCHOR KEEPER PLATE (24 GA)
15206G	1	ANCHOR PLATE WASHER (1/2" THICK)
15201G	2	ANCHOR POST ANGLE (10" LONG)
15202G	1	ANGLE STRUT

HARDWARE		
4902G	1	1" ROUND WASHER F436
3908G	1	1" HEAVY HEX NUT A563 GR.DH
3717G	2	3/4" X 2 1/2" HEX BOLT A325
3701G	4	3/4" ROUND WASHER F436
3704G	2	3/4" HEAVY HEX NUT A563 GR.DH
3360G	16	5/8" X 1 1/4" W-BEAM RAIL SPLICE BOLTS HGR
3340G	25	5/8" W-BEAM RAIL SPLICE NUTS HGR
3500G	7	5/8" X 10" HGR POST BOLT A307
3391G	1	5/8" X 1 3/4" HEX HD BOLT A325
4489G	1	5/8" X 9" HEX HD BOLT A325
4372G	4	5/8" WASHER F436
105285G	2	5/8" X 2 1/2" HEX HD BOLT GR-5
105286G	1	5/8" X 1 1/2" HEX HD BOLT GR-5
3240G	6	5/8" ROUND WASHER (WIDE)
3245G	3	5/8" HEX NUT A563 GR.DH
5852B	1	HIGH INTENSITY REFLECTIVE SHEETING - SEE NOTE: B

Texas Department of Transportation  
 Design Division Standard

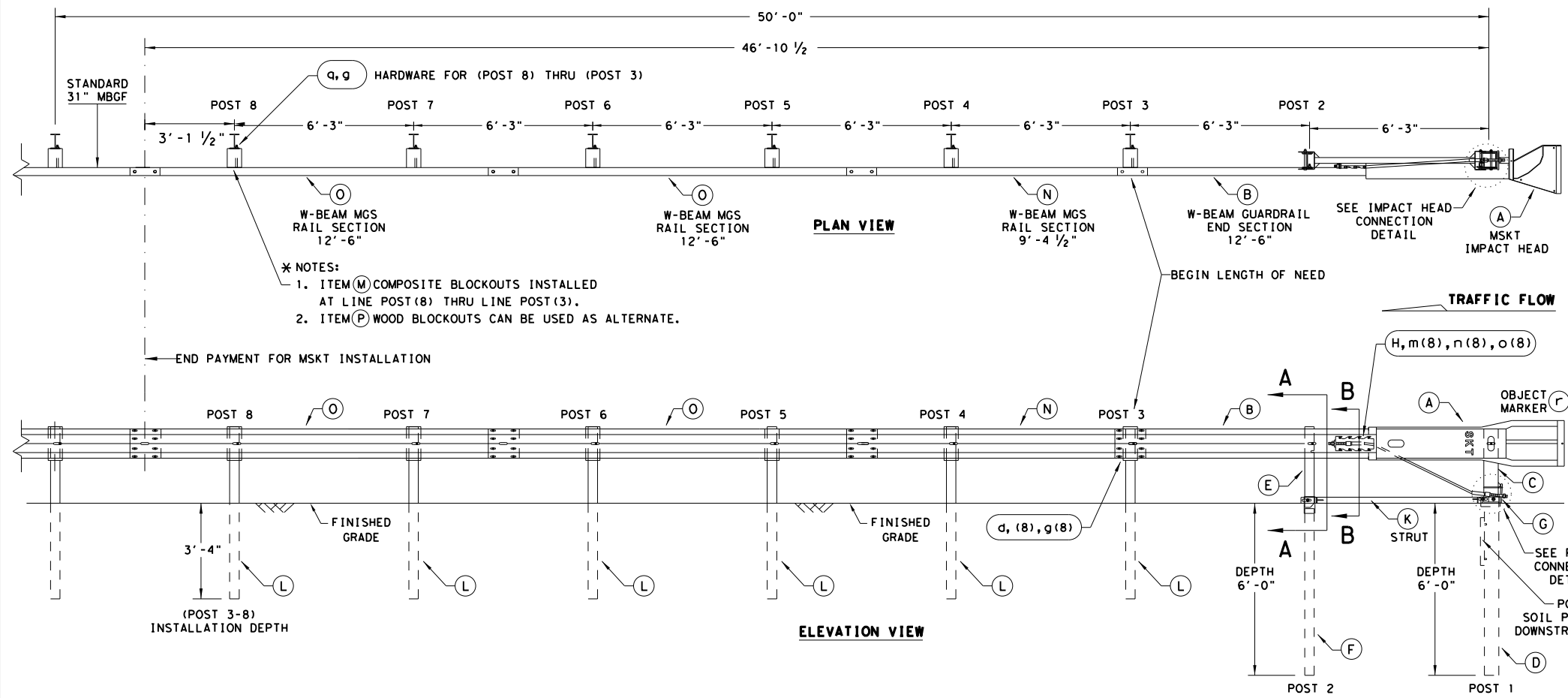
**TRINITY HIGHWAY  
 SOFTSTOP END TERMINAL  
 MASH - TL-3  
 SGT (10S) 31-16**

FILE: sgt10s3116	DN: TxDOT	CK: KM	DW: VP	CK: MB/VP
©TxDOT: JULY 2016	CONT	SECT	JOB	HIGHWAY
REVISIONS	6385	38	001	IH 30
	DIST	COUNTY	SHEET NO.	
	PAR	HUNT, ETC	30	

NOTE: THIS STANDARD IS A BASIC REPRESENTATION OF THE SoftStop END TERMINAL, IT IS NOT INTENDED TO REPLACE THE PRODUCT DESCRIPTION ASSEMBLY MANUAL.

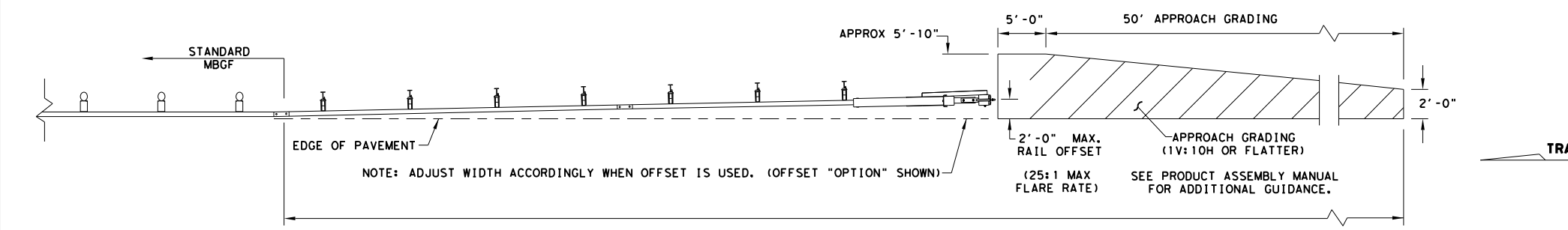
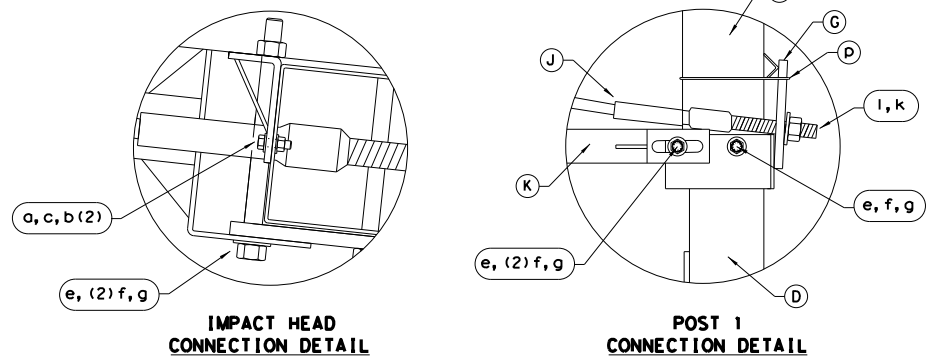
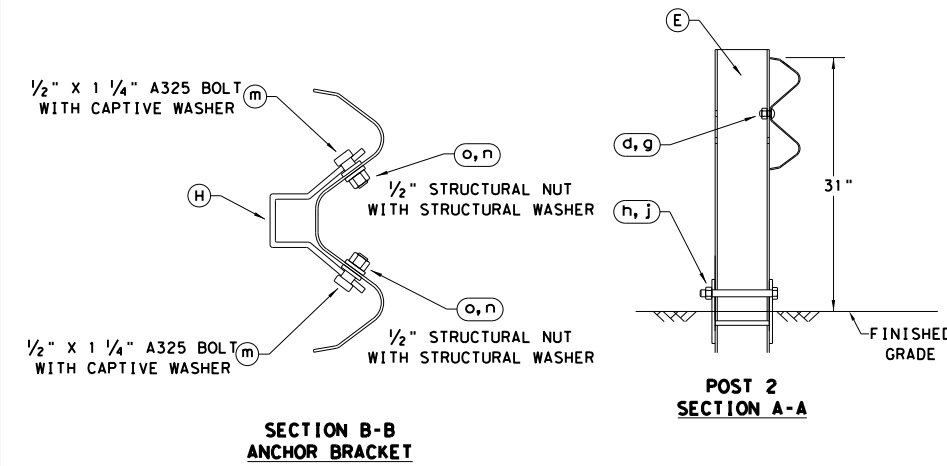


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- GENERAL NOTES**
- FOR SPECIFIC INFORMATION REGARDING INSTALLATION AND TECHNICAL GUIDANCE OF THE SYSTEM, CONTACT: ROAD SYSTEMS, INC. (432)263-2435. 3616 OLD HOWARD COUNTY AIRPORT, BIG SPRING, TX 79720
  - FOR INSTALLATION, REPAIR AND MAINTENANCE REFER TO THE: MSKT END TERMINAL, PRODUCT DESCRIPTION ASSEMBLY MANUAL (PUBLICATION-062717).
  - APPLY HIGH INTENSITY REFLECTIVE SHEETING, "OBJECT MARKER" ON THE FRONT FACE OF THE DEVICE PER MANUFACTURER'S RECOMMENDATIONS. OBJECT MARKER SHALL CONFORM TO THE STANDARDS REQUIRED IN TEXAS MUTCD.
  - FOR POST (LEAVE-OUT) INSTALLATION AND GUIDANCE SEE TXDOT'S LATEST ROADWAY MOW STRIP STANDARD.
  - HARDWARE (BOLTS, NUTS, & WASHERS) SHALL BE GALVANIZED IN ACCORDANCE WITH ITEM 445, "GALVANIZING". FITTINGS SHALL BE SUBSIDIARY TO THE BID ITEM.
  - SYSTEM SHOWN USING STEEL WIDE FLANGE POSTS WITH COMPOSITE BLOCKOUTS.
  - A COMPOSITE MATERIAL BLOCKOUTS THAT MEETS THE REQUIREMENTS OF DMS-7210, MAY BE SUBSTITUTED FOR BLOCKOUTS OF SIMILAR DIMENSIONS. SEE CONSTRUCTION DIVISION MATERIAL PRODUCER LIST (MPL) FOR CERTIFIED PRODUCERS.
  - IF SOLID ROCK IS ENCOUNTERED IN THE AREA OF (POST 1) AND / OR (POST 2) CONTACT THE MANUFACTURER, & REFER TO THE LATEST ROADWAY MOW STRIP STANDARD FOR INSTALLATION GUIDANCE.
  - POSTS SHALL NOT BE SET IN CONCRETE.
  - SYSTEM MUST BE ATTACHED TO STANDARD 31" MBGF.
  - UNDER NO CIRCUMSTANCES SHALL THE GUARDRAIL WITHIN THE MSKT SYSTEM BE CURVED.
  - A FLARE RATE OF UP TO 25:1 MAY BE USED TO PREVENT THE TERMINAL HEAD FROM ENCRANCHING ON THE SHOULDER. THE FLARE MAY BE DECREASED OR ELIMINATED FOR SPECIFIC INSTALLATIONS, IF DIRECTED BY THE ENGINEER.
  - THE SYSTEM IS SHOWN WITH TWO 12'-6" MBGF PANELS, ONE 25'-0" MBGF PANEL IS ALSO ALLOWED IN ITS PLACE.
  - A DRIVING CAP WITH A TIMBER OR PLASTIC INSERT SHALL BE USED WHEN DRIVING POSTS 3-8 TO PREVENT DAMAGE TO THE GALVANIZING ON TOP OF THE POST. SPECIAL DRIVING CAP TO BE USED ON LOWER POSTS 1 & 2 TO PREVENT DAMAGE TO THE WELDED PLATES.

ITEM	QTY	MAIN SYSTEM COMPONENTS	ITEM NUMBERS
A	1	MSKT IMPACT HEAD	MS3000
B	1	W-BEAM GUARDRAIL END SECTION, 12 Go.	SF1303
C	1	POST 1 - TOP (6" X 6" X 1/8" TUBE)	MTPHP1A
D	1	POST 1 - BOTTOM (6' W6X15)	MTPHP1B
E	1	POST 2 - ASSEMBLY TOP	UHP2A
F	1	POST 2 - ASSEMBLY BOTTOM (6' W6X9)	HP2B
G	1	BEARING PLATE	E750
H	1	CABLE ANCHOR BOX	S760
J	1	BCT CABLE ANCHOR ASSEMBLY	E770
K	1	GROUND STRUT	MS785
L	6	W6X9 OR W6X8.5 STEEL POST	P621
M	6	COMPOSITE BLOCKOUTS	CBSP-14
N	1	W-BEAM MGS RAIL SECTION (9'-4 1/2")	G12025
O	2	W-BEAM MGS RAIL SECTION (12'-6")	G1203A
P	6	WOOD BLOCKOUT 6" X 8" X 14"	P675
Q	1	W-BEAM MGS RAIL SECTION (25'-0")	G1209
SMALL HARDWARE			
o	2	5/8" x 1" HEX BOLT (GRD 5)	B5160104A
b	4	5/8" WASHER	W0516
c	2	5/8" HEX NUT	N0516
d	25	5/8" Dia. x 1 1/4" SPLICE BOLT (POST 2)	B580122
e	2	5/8" Dia. x 9" HEX BOLT (GRD A449)	B580904A
f	3	5/8" WASHER	W050
g	33	5/8" Dia. H.G.R NUT	N050
h	1	3/4" Dia. x 8 1/2" HEX BOLT (GRD A449)	B340854A
j	1	3/4" Dia. HEX NUT	N030
k	2	1 ANCHOR CABLE HEX NUT	N100
i	2	1 ANCHOR CABLE WASHER	W100
m	8	1/2" x 1 1/4" A325 BOLT WITH CAPTIVE WASHER	SB12A
n	8	1/2" STRUCTURAL NUTS	N012A
o	8	1 1/8" O.D. x 3/8" I.D. STRUCTURAL WASHERS	W012A
p	1	BEARING PLATE RETAINER TIE	CT-100ST
q	6	5/8" x 10" H.G.R. BOLT	B581002
r	1	OBJECT MARKER 18" X 18"	E3151



NOTE: TXDOT GENERIC APPROACH GRADING LAYOUT USED FOR ALL TANGENT TYPE END TREATMENTS.

NOTE: THIS STANDARD IS A BASIC REPRESENTATION OF THE MSKT END TERMINAL, IT IS NOT INTENDED TO REPLACE THE PRODUCT DESCRIPTION ASSEMBLY MANUAL.

**Design Division Standard**

## SINGLE GUARDRAIL TERMINAL

### MSKT-MASH-TL-3

### SGT (12S) 31-18

FILE: sgt12s3118.dgn	DN: TXDOT	CK: KM	DW: VP	CK: CL
© TXDOT: APRIL 2018	CONT	SECT	JOB	HIGHWAY
REVISIONS	6385	38	001	IH 30
DIST	COUNTY		SHEET NO.	
PAR	HUNT, ETC		32	



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APPLICABLE STANDARDS SHEETS

OVERHEAD SIGN BRIDGE STANDARDS:

- OSB-SE
- OSB-Z#
- OSB-Z#1
- HOSB-Z#
- HOSB-Z1L
- HOSB-Z#1
- OSBT
- OSBC
- OSBC-SC-Z#
- OSBS-SC
- OSB-FD
- OSB-FD-SC

CANTILEVER OVERHEAD SIGN SUPPORT STANDARDS:

- COSS-SE
- COSS-Z#-10
- HCOSS-Z#-10
- COSS-Z21-10
- COSS-Z#&Z#1-10
- COSSD
- COSSF
- COSS-FD

Note: # = Wind Zone number 1, 2, 3 or 4

HIGH MAST ILLUMINATION POLE STANDARDS:

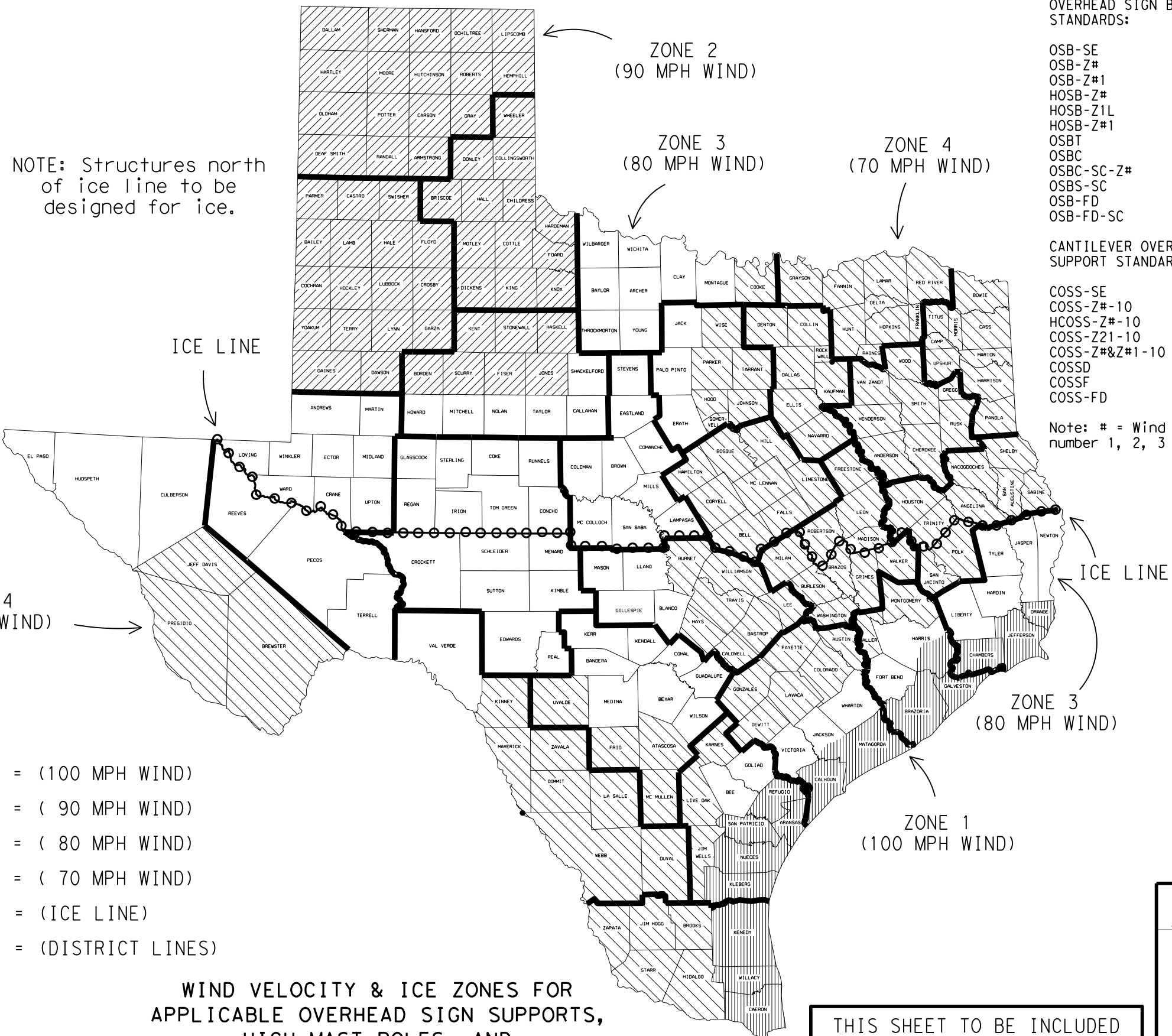
- HMIP-98
- HMIF-98

WALKWAYS AND BRACKETS STANDARDS:

- SWW
- SB(SWL-1)

TRAFFIC SIGNAL POLE STANDARDS:

- SP-80
- SP-100
- SMA-80
- SMA-100
- DMA-80
- DMA-100
- MA-C
- MAC (ILSN)
- MAD-D
- TS-FD
- LUM-A
- CFA
- LMA
- TS-C
- MA-DPD



NOTE: Structures north of ice line to be designed for ice.

LEGEND

- ZONE 1 - [diagonal lines] = (100 MPH WIND)
- ZONE 2 - [diagonal lines] = ( 90 MPH WIND)
- ZONE 3 - [white box] = ( 80 MPH WIND)
- ZONE 4 - [diagonal lines] = ( 70 MPH WIND)
- [dashed line with circles] = (ICE LINE)
- [solid black line] = (DISTRICT LINES)

WIND VELOCITY & ICE ZONES FOR APPLICABLE OVERHEAD SIGN SUPPORTS, HIGH MAST POLES, AND TRAFFIC SIGNAL POLES

Based on 50 Year Mean Recurrence Interval of Fastest Mile Wind Velocity at 33 feet height.

THIS SHEET TO BE INCLUDED IN ALL P.S.&E. PACKAGES CONTAINING ONE OR MORE OF THE APPLICABLE STANDARD SHEETS LISTED HEREON

FOR HARRIS CO. ONLY  
 Zone line is just North of US 90, around on the North, West and South sides of IH 610 and down the West side of SH 288.

FOR JACKSON CO. ONLY  
 Zone line is just North of SH 616.

		Traffic Operations Division Standard	
<h3>WIND VELOCITY AND ICE ZONES</h3> <h3>WV &amp; IZ-14</h3>			
FILE:	windice.dgn	DN: TxDOT	CK: TxDOT
© TxDOT	April 1996	CONT	SECT
REVISIONS	6385	38	001
8-14-Added list of applicable standards, restricting use to structures designed for Fastest Mile wind speeds.	DIST	COUNTY	SHEET NO.
	PAR	HUNT, ETC	33

**ZONE 3 WITH AND WITHOUT ICE 80 MPH WIND**

TOWER HEIGHT (ft)	10' SPAN										15' SPAN										20' SPAN										25' SPAN										TOWER HEIGHT (ft)							
	TOWER PIPE		ANCHOR BOLTS		BASE PLATE	TRUSS	DESIGN LOADS				TOWER PIPE		ANCHOR BOLTS		BASE PLATE	TRUSS	DESIGN LOADS				TOWER PIPE		ANCHOR BOLTS		BASE PLATE	TRUSS	DESIGN LOADS				TOWER PIPE		ANCHOR BOLTS		BASE PLATE	TRUSS	DESIGN LOADS											
	O.D. (in)	WALL THICK (in)	DEFL ΔH (in)	SIZE DIA (in)	NO.		BOLT CIR DIA	SIZE (in)	DEFL ΔV (in)	SHEAR V (Kips)	TORSION T (K-ft)	MOMENT M (K-ft)	O.D. (in)	WALL THICK (in)	DEFL ΔH (in)		SIZE DIA (in)	NO.	BOLT CIR DIA	SIZE (in)	DEFL ΔV (in)	SHEAR V (Kips)	TORSION T (K-ft)	MOMENT M (K-ft)	O.D. (in)		WALL THICK (in)	DEFL ΔH (in)	SIZE DIA (in)	NO.	BOLT CIR DIA	SIZE (in)	DEFL ΔV (in)	SHEAR V (Kips)	TORSION T (K-ft)		MOMENT M (K-ft)	O.D. (in)	WALL THICK (in)	DEFL ΔH (in)		SIZE DIA (in)	NO.	BOLT CIR DIA	SIZE (in)	DEFL ΔV (in)	SHEAR V (Kips)	TORSION T (K-ft)
14'	16	0.250	0.105	1 1/4	6	20 1/2"	24 x 1 1/4	0.2	3.59	16.19	49.87	16	0.250	0.235	1 3/8	8	20 3/4"	24 1/2 x 1 3/8	0.5	5.40	37.56	76.63	20	0.250	0.213	1 1/4	8	24 1/2"	28 x 1 1/4	0.7	7.43	69.08	107.16	20	0.281	0.308	1 1/2	8	25"	29 x 1 1/2	1.3	9.14	107.68	135.49	14'			
15'			0.120						3.61		53.42			0.270					0.6	5.41		81.91			0.244	1 1/4		24 1/2"	28 x 1 1/4	0.7	7.43		113.96			0.281	0.354				1.4	9.17		144.13	15'			
16'			0.137						3.62		57.00			0.308					0.6	5.43		87.23			0.278	1 3/8		24 3/4"	28 1/2 x 1 3/8	0.8	7.45		121.17			0.281	0.403				1.4	9.19		152.86	16'			
17'			0.154						3.64		60.59			0.347					0.7	5.45		92.57			0.314						0.8	7.47		128.42			0.281	0.455	1 1/2		25"	29 x 1 1/2	1.5	9.21		161.65	17'	
18'			0.173						3.66		64.21			0.389					0.7	5.46		97.94			0.352						0.9	7.49		135.72			0.312	0.460	1 3/4	25 3/8"	29 3/4 x 1 5/8	1.5	9.23		170.51	18'		
19'			0.193						3.67		67.85			0.434					0.7	5.48		103.33			0.392	1 3/8		24 3/4"	28 1/2 x 1 3/8	0.9	7.51		143.06			0.312	0.513					1.5	9.25		179.43	19'		
20'			0.214						3.69		71.51			0.481					0.8	5.50		108.75			0.435	1 1/2		25"	29 x 1 1/2	1.0	7.53		150.43			0.312	0.568					1.6	9.27		188.39	20'		
21'			0.235						3.71		75.18		0.250	0.530							5.51		114.19			0.479					1.0	7.55		157.84			0.312	0.627					1.6	9.29		197.41	21'	
22'			0.258					0.2	3.73		78.88		0.281	0.521	1 3/8		20 3/4"	24 1/2 x 1 1/2			5.53		119.66			0.526				1.1	7.57		165.28			0.344	0.628					1.6	9.31		206.47	22'		
23'			0.282					0.3	3.74		82.59		0.281	0.569	1 1/2		21"	25 x 1 5/8			5.55		125.14		0.250	0.575				29 x 1 1/2		7.60		172.75			0.344	0.686					1.7	9.34		215.57	23'	
24'			0.308						3.76		86.33		0.281	0.620							5.56		130.65		0.281	0.560				29 x 1 1/8		7.62		180.26			0.344	0.747					1.8	9.36		224.71	24'	
25'			0.334				24 x 1 1/4		3.78		90.08		0.312	0.610							5.58		136.18		0.281	0.607	1 1/2		25"	29 x 1 5/8		7.64		187.79			0.375	0.748					1.8	9.38		233.89	25'	
26'			0.361				24 x 1 3/8		3.79		93.85		0.312	0.660				25 x 1 5/8			5.60		141.73		0.281	0.657	1 3/4		25 3/8"	29 3/4 x 1 5/8		7.66		195.35			0.375	0.809	1 3/4		25 3/8"	29 3/4 x 1 5/8	1.7	9.40		243.10	26'	
27'			0.389						3.81		97.64		0.312	0.711				25 x 1 3/4			5.62		147.30		0.310	0.640				29 3/4 x 1 3/4		7.68		202.94			0.375	0.872	2		25 3/4"	30 1/2 x 2	1.8	9.42		252.34	27'	
28'			0.419						3.83		101.44		0.344	0.699							5.63		152.89		0.310	0.688					7.70		210.55			0.406	0.870						1.8	9.44		261.62	28'	
29'			0.449						3.84		105.26		0.344	0.750							5.65		158.50		0.310	0.738					7.72		218.20			0.406	0.933						1.8	9.46		270.93	29'	
30'			0.481						3.86		109.11		0.344	0.802	1 1/2		21"	25 x 1 3/4			5.67		164.12		0.340	0.721				29 3/4 x 1 3/4		7.74		225.86			0.406	0.999						1.8	9.48		280.27	30'
31'			0.513				24 x 1 3/8		3.88		112.96		0.375	0.791	1 3/4		21 1/2"	26 x 1 7/8			5.68		169.77		0.340	0.770				29 3/4 x 1 7/8		7.77		233.56			0.441	0.992						1.8	9.50		289.64	31'
32'	16	0.250	0.547	1 1/4	8	20 1/2"	24 x 1 1/2	0.3	3.89	16.19	116.84	16	0.375	0.843	1 3/4	8	21 1/2"	26 x 1 7/8	0.8	5.70	37.56	175.43	20	0.340	0.821	1 3/4	8	25 3/8"	29 3/4 x 1 7/8	1.1	7.79	69.08	241.27	20	0.441	1.057	2	8	25 3/4"	30 1/2 x 2 1/4	1.8	9.53	107.68	299.04	32'			

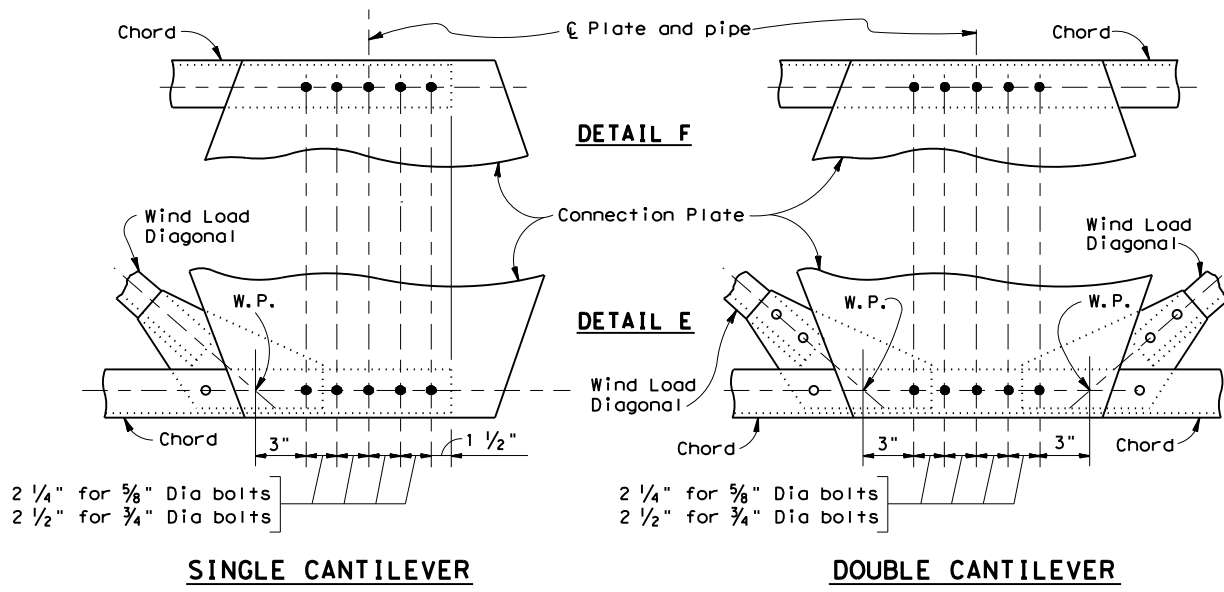
**ZONE 3 WITH AND WITHOUT ICE 80 MPH WIND**

TOWER HEIGHT (ft)	30' SPAN										35' SPAN										40' SPAN										TOWER HEIGHT (ft)												
	TOWER PIPE		ANCHOR BOLTS		BASE PLATE	TRUSS	DESIGN LOADS				TOWER PIPE		ANCHOR BOLTS		BASE PLATE	TRUSS	DESIGN LOADS				TOWER PIPE		ANCHOR BOLTS		BASE PLATE	TRUSS	DESIGN LOADS																
	O.D. (in)	WALL THICK (in)	DEFL ΔH (in)	SIZE DIA (in)	NO.		BOLT CIR DIA	SIZE (in)	DEFL ΔV (in)	SHEAR V (Kips)	TORSION T (K-ft)	MOMENT M (K-ft)	O.D. (in)	WALL THICK (in)	DEFL ΔH (in)		SIZE DIA (in)	NO.	BOLT CIR DIA	SIZE (in)	DEFL ΔV (in)	SHEAR V (Kips)	TORSION T (K-ft)	MOMENT M (K-ft)	O.D. (in)		WALL THICK (in)	DEFL ΔH (in)	SIZE DIA (in)	NO.		BOLT CIR DIA	SIZE (in)	DEFL ΔV (in)	SHEAR V (Kips)	TORSION T (K-ft)	MOMENT M (K-ft)	O.D. (in)	WALL THICK (in)	DEFL ΔH (in)	SIZE DIA (in)	NO.	BOLT CIR DIA
14'	24	0.250	0.289	1 1/2	8	29"	33 x 1 1/2	1.6	11.00	155.44	167.11	30	0.250	0.210	1 3/4	8	35 3/8"	39 3/4 x 1 1/2	1.5	12.87	211.58	202.48	30	0.280	0.260	1 3/4	8	35 3/8"	39 3/8 x 1 1/2	2.1	14.65	276.72	242.20	14'									
15'		0.250	0.331	1 1/2		29"	33 x 1 1/2	1.6	11.03		177.27			0.241						1.6	12.90		213.97			0.298	1 3/4		35 3/8"	39 3/8 x 1 1/2	2.2	14.68		254.69	15'								
16'		0.281	0.338	1 3/4		29 3/8"	33 3/4 x 1 1/2	1.6	11.05		187.54			0.275						1.6	12.93		225.63			0.339	1 3/4		35 3/8"	39 3/8 x 1 1/2	2.3	14.71		267.44	16'								
17'		0.381					33 3/4 x 1 1/2	1.7	11.08		197.93		0.250	0.310						1.7	12.97		237.46			0.383	2		35 3/4"	40 1/2 x 1 1/2	2.4	14.75		280.40	17'								
18'		0.428					33 3/4 x 1 1/2	1.8	11.10		208.40		0.281	0.310						1.7	13.00		249.43			0.429			40 1/2 x 1 5/8		2.5	14.78		293.56	18'								
19'		0.281	0.477				33 3/4 x 1 5/8		11.13		218.97			0.346						1.7	13.03		261.52		0.280	0.478				2.6	14.81		306.90	19'									
20'		0.312	0.477				33 3/4 x 1 5/8		11.15		229.60			0.383						1.8	13.06		273.72		0.312	0.478				2.6	14.84		320.39	20'									
21'		0.526					33 3/4 x 1 5/8	1.8	11.18		240.31			0.422						1.8	13.09		286.04			0.527			40 1/2 x 1 5/8		2.6	14.87		334.02	21'								
22'		0.577					33 3/4 x 1 3/4	1.9	11.20		251.08			0.463						1.9	13.12		298.44			0.578			40 1/2 x 1 3/4		2.7	14.90		347.79	22'								
23'		0.631					33 3/4 x 1 3/4	2.0	11.23		261.91		0.507	1 3/4		35 3/8"	39 3/4 x 1 1/2			2.0	13.16		310.94			0.632				2.8	14.94		361.67	23'									
24'		0.312	0.687	1 3/4		29 3/8"	33 3/4 x 1 3/4		11.25		272.80			0.552	2		35 3/4"	40 1/2 x 1 5/8			2.0	13.19		323.51			0.688			2.9	14.97		375.66	24'									
25'		0.344	0.679	2		29 3/4"	34 1/2 x 1 3/4		11.28		283.74			0.598						2.1	13.22		336.16		0.312	0.747				3.0	15.00		389.75	25'									
26'		0.735					34 1/2 x 2	2.0	11.30		294.73			0.647						2.2	13.25		348.89		0.340	0.736				40 1/2 x 2		3.0	15.03		403.94	26'							
27'		0.792						2.1	11.33		305.77			0.698						2.2	13.28		361.68			0.794	2		35 3/4"	40 1/2 x 2	3.0	15.06		418.22	27'								
28'		0.852						2.2	11.36		316.85		0.281	0.751						2.3	13.31		374.53			0.854	2 1/4		36"	41 x 2	3.1	15.09		432.57	28'								
29'		0.344	0.914						11.38		327.97		0.310	0.726						2.2	13.35		387.45			0.916				3.2	15.13		447.01	29'									
30'		0.375	0.901						11.41		339.13			0.777						2.2	13.38																						



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DATE: 1/5/2022 4:12:26 PM  
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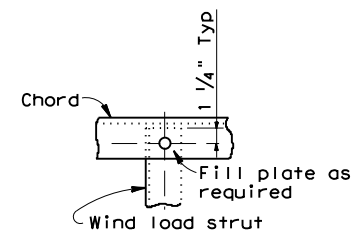


2 1/4" for 5/8" Dia bolts  
 2 1/2" for 3/4" Dia bolts

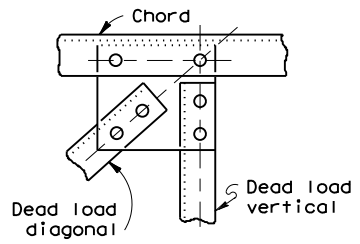
**SINGLE CANTILEVER**

**DOUBLE CANTILEVER**

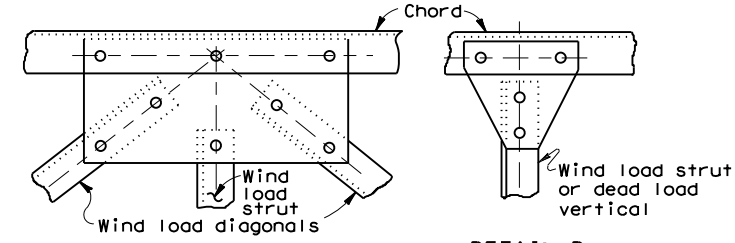
**CONNECTION DETAILS**



**DETAIL B**

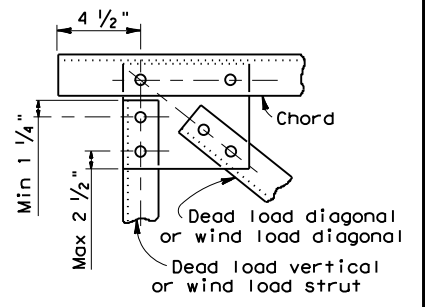


**DETAIL C**



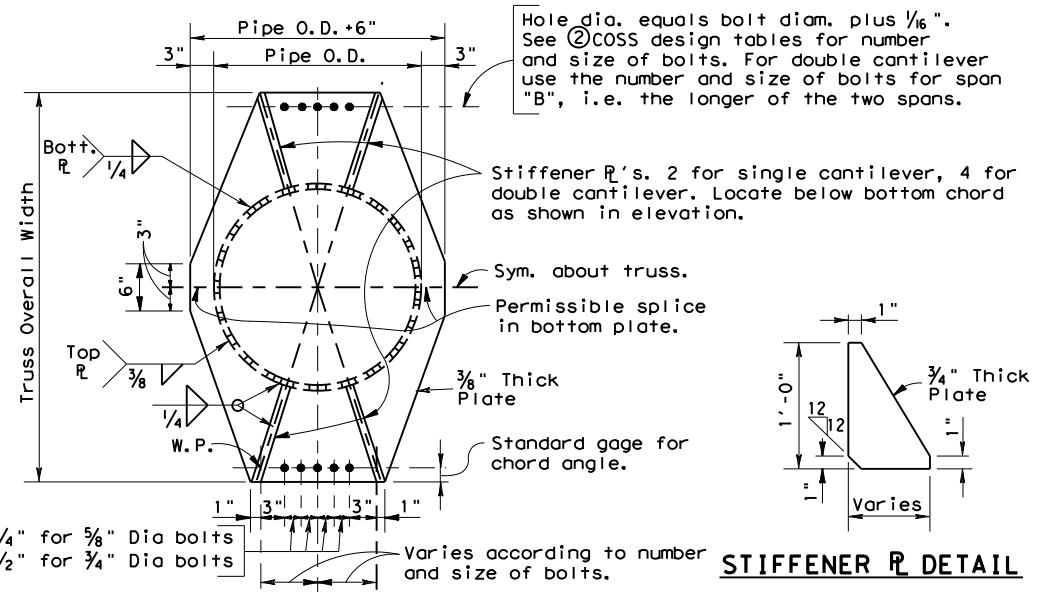
**DETAIL A**

**DETAIL D**



**DETAIL G**

TOTAL NO. OF BOLTS IN DIAG'S. IN JOINT	NUMBER OF BOLTS REQ'D. IN GUSSET PL. TO CHORD CONNECTION
0	2
2	2
3	3
4	3
5	4
6	4
8	5
10	6



Hole dia. equals bolt diam. plus 1/16". See ② COSS design tables for number and size of bolts. For double cantilever use the number and size of bolts for span "B", i.e. the longer of the two spans.

Stiffener P's. 2 for single cantilever, 4 for double cantilever. Locate below bottom chord as shown in elevation.

Sym. about truss.  
 Permissible splice in bottom plate.

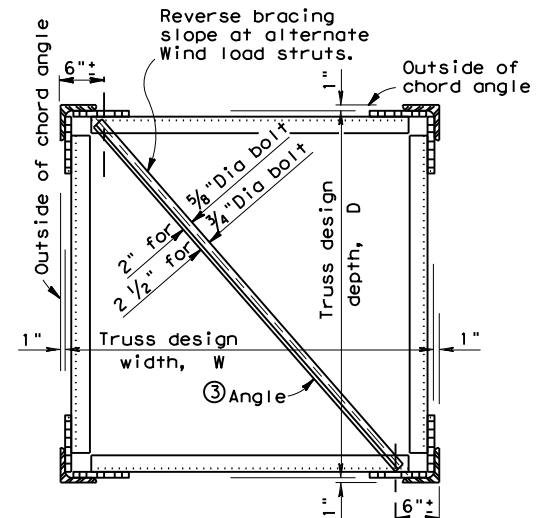
3/8" Thick Plate

Standard gage for chord angle.

2 1/4" for 5/8" Dia bolts  
 2 1/2" for 3/4" Dia bolts

Varies according to number and size of bolts.

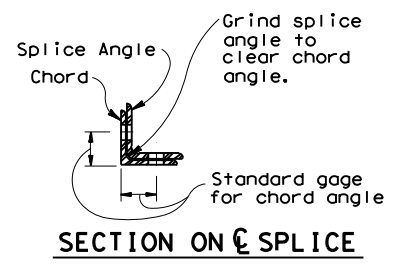
**STIFFENER PLATE DETAIL**



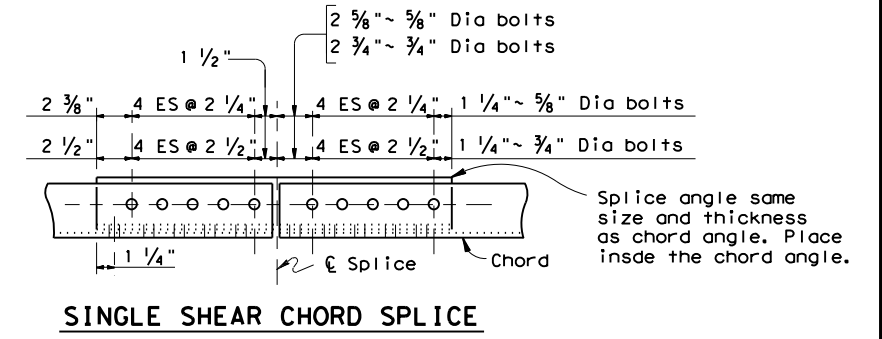
③ 2" x 2" x 3/16" angle for 5/8" Dia bolts [1]  
 2 1/2" x 2" x 3/16" angle for 3/4" Dia bolts [1]

**TRUSS SECTION**

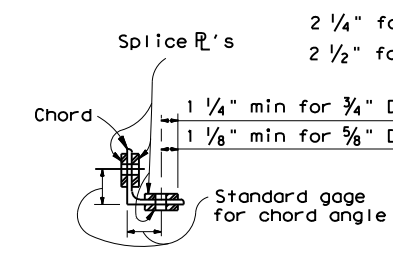
(DIAGONALS NOT SHOWN)



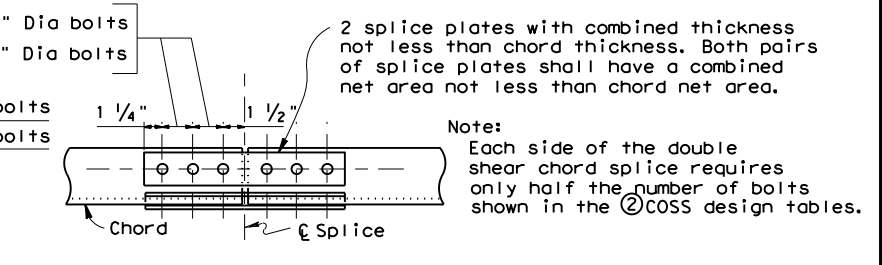
**SECTION ON C SPLICE**



**SINGLE SHEAR CHORD SPLICE**



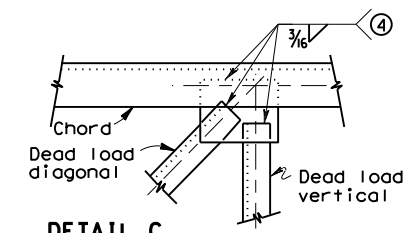
**SECTION ON C SPLICE**



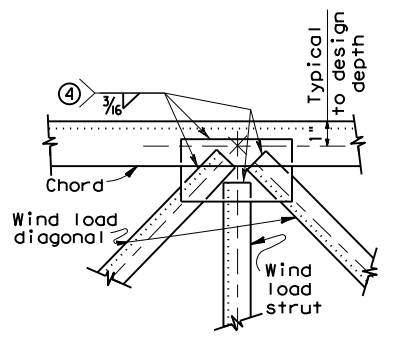
**DOUBLE SHEAR CHORD SPLICE**

**SPLICE DETAILS**

**CONNECTION PLATE DETAIL**



**DETAIL C**  
 (Gusset plates in other details to be similar)



**DETAIL A**

**ALTERNATE WELDED CONNECTION DETAILS**

④ MINIMUM LENGTH OF 3/16" FILLET WELD REQUIRED		
NUMBER OF BOLTS	TO REPLACE 5/8" DIA BOLTS	TO REPLACE 3/4" DIA BOLTS
1	2"	3"
2	4"	6"
3	6"	9"
4	8"	11 1/2"
5	10"	14 1/2"
6	12"	17 1/2"
7	14"	20"

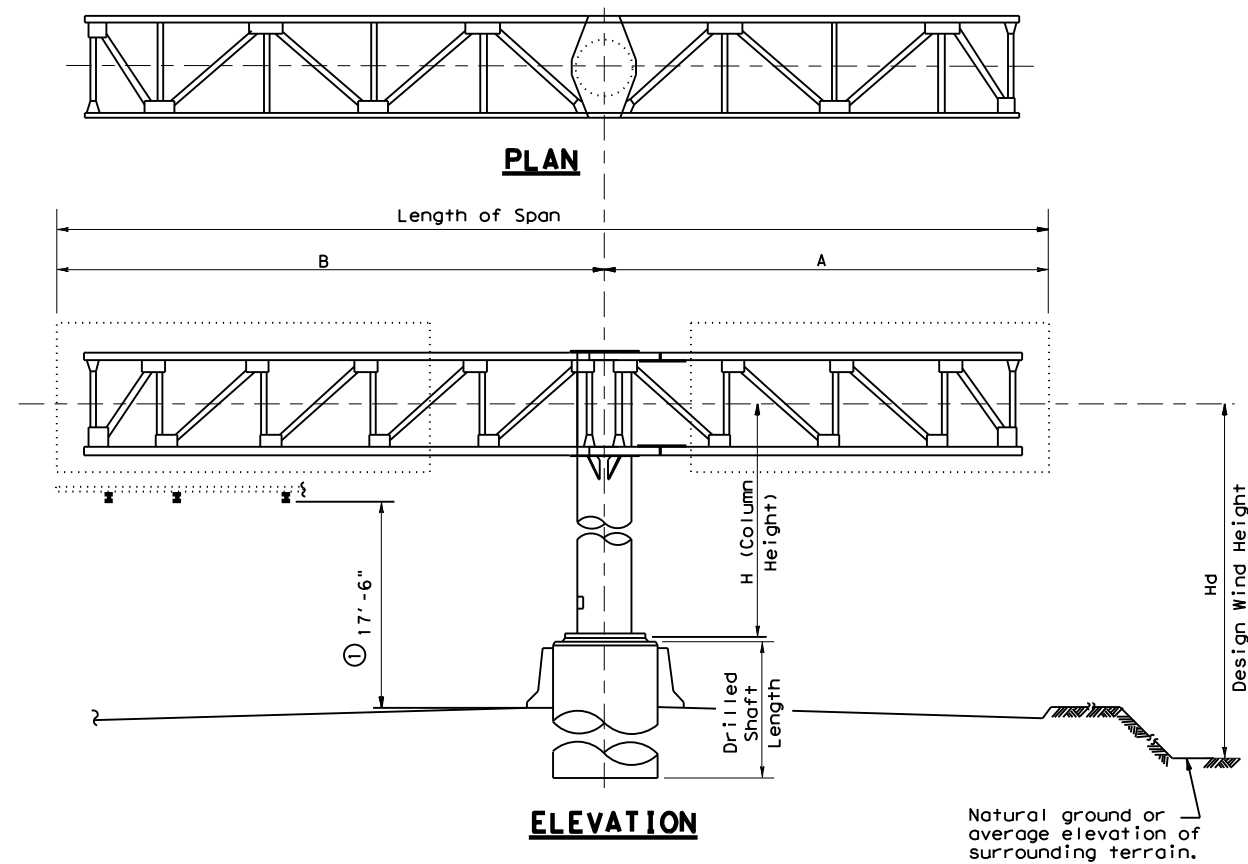
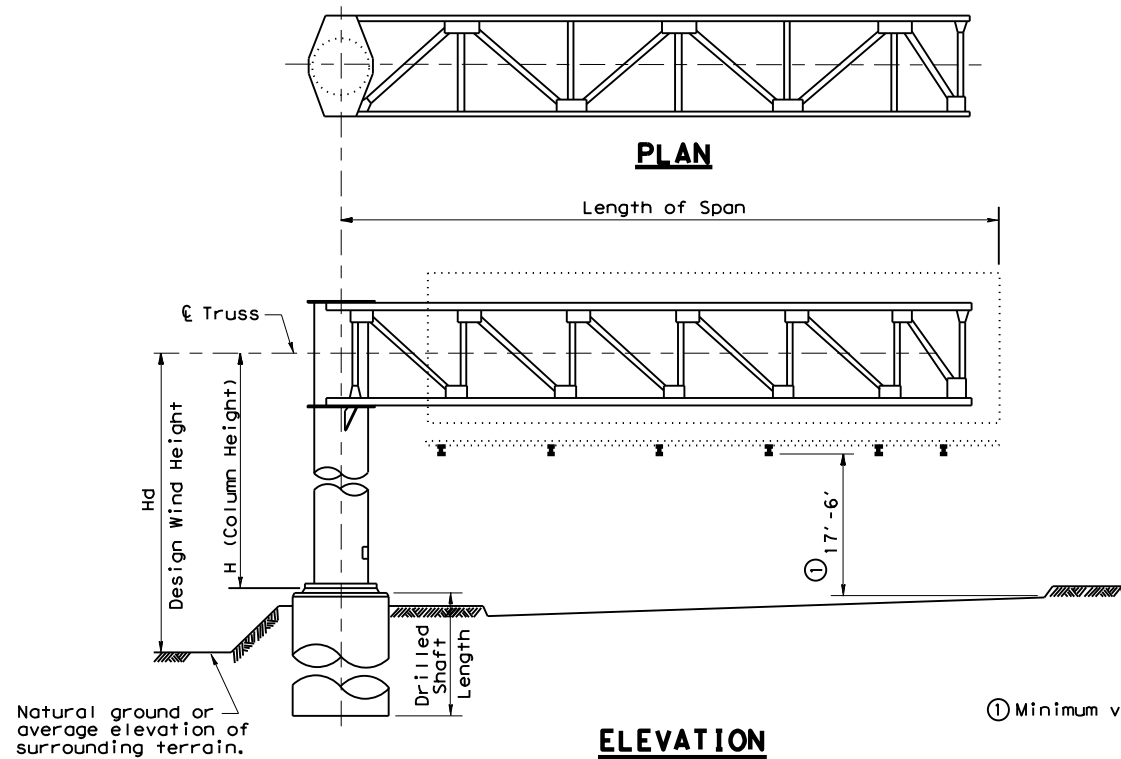
**CANTILEVER OVERHEAD  
 SIGN SUPPORT DETAILS**

**COSSD**

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REVISIONS					
CONTRACT NO.	SECTION	JOB	HIGHWAY		
6385	38	001	IH 30		
DISTRICT	COUNTY	SHEET NO.			
PAR	HUNT, ETC	36			

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**SELECTION EXAMPLE CANTILEVER SPAN**

Given: Cantilever Span = 33'; Column Height, H = 23.3'; Design Wind Height, Hd = 27'; Avg. Penetrometer Value, N = 15 (clay type soil); Hill County

- Step 1: Select applicable COSS standard. From Wind Velocity and Ice Zone sheet (WV & IZ-96) determine that Hill County is in Zone 4 (70 mph) and is above the ice line. Since Design Wind Height is less than 30', use standard COSS-Z4 & Z4I. If Design Wind Height is more than 30', use COSS-Z3 & Z3I. NOTE: In Zone 1 if Design Wind Height is greater than 30' use HCOSS-Z1.
- Step 2: Determine tower details from COSS-Z4 & Z4I. Use column height to nearest tabulated value, i.e., 23'. Round span length up to the nearest tabulated value, i.e., 35'. Tower details are:  
 Tower pipe 24" Dia with min. wall thickness = 0.312"  
 Base plate 33 3/4" Dia x 1 3/4"  
 Anchor bolts 8-1 3/4" Dia on 29 3/8" bolt circle  
 Horizontal deflection of tower at  $\bar{C}$  truss = 0.889". During installation, double nuts at base plate may be used to plumb tower to compensate for horizontal deflection.  
 Design Moment = 244 Kip-ft  
 Design Torsion = 162 Kip-ft
- Step 3: Determine truss details from COSS-Z4 & Z4I. Read from small table at bottom of sheet for span = 35'. Truss design width, W and depth, D = 4.0' x 4.0'.  
 Chord L 3 x 3 x 3/8 (HYC) with 6 bolt connection at tower  
 D.L. Diag. L 2 x 2 x 3/8 (HYC) with 2 bolt connection  
 W. L. Diag. L 3 x 3 x 3/8 (HYC) with 2 bolt connection  
 D. L. Vert. L 2 x 2 x 3/8 (HYC) with 2 bolt connection  
 W. L. Strut. L 2 x 2 x 3/8 (HYC) with 1 bolt connection  
 Bolts are 3/8" Dia high strength with 5-3/4" Dia bolt alternate for chord connection at tower.  
 D.L. of truss = 50 lb/ft  
 Truss deflection at free end = 3.2". The fabricator shall compensate for this deflection by offsetting bolt holes between the upper and lower chords at the truss-to-tower connection.
- Step 4: Determine foundation details. Use standard COSSF. From COSSF with 24" Dia pipe and 1 3/4" Dia anchor bolts:  
 Anchor Bolts 1 3/4" Dia x 3'-10"  
 Drilled Shaft Dia 42"  
 Vertical Reinforcing 12 ~ #10 bars  
 Spiral C = #4 at 6" pitch Grade 60.  
 Misc. handhole, base plate, anchor bolt, and foundation details are shown on COSSF.
- Step 5: Determine drilled shaft length from COSS-FD. Enter the appropriate graph (for 42" Dia drilled shaft in clay soil) from the bottom with N = 15. Proceed upward interpolating moment curves (solid lines) to locate 244 Kip-ft. Project to the left side of the graph to determine the required embedment length, i.e., 12'. Repeat the procedure for torsion curves (dashed lines) to locate 162 Kip-ft. The embedment length required to satisfy torsion is 14'. Add 3'-0" to the longer length to obtain a required drilled shaft length of 17'.

**SELECTION EXAMPLE DOUBLE CANTILEVER SPAN**

Given: Short span, A = 9'; Long Span, B = 25'; Total Cantilever Span = 34'; Column Height, H = 24'; Design Wind Height, Hd = 26'; Avg. Penetrometer Value, N = 20 (clay type soil); Wheeler County.

- Step 1: Select applicable COSS standard. From Wind Velocity and Ice Zone sheet determine that Wheeler County is in Zone 2 (90 mph) and is above the ice line. Since Design Wind Height is less than 30' use standard COSS-Z2I. If Design Wind Height is more than 30', use HCOSS-Z1.
- Step 2: Determine tower details from COSS-Z2I. Use column height = 24'. Round total span length up to the next longer tabulated length span, i.e., 35'. If total span length is greater than 40', a special design would be required. Tower details are:  
 Tower pipe 30" Dia with min. wall thickness = 0.310"  
 Base Plate 40 1/2" Dia x 1 3/4"  
 Anchor bolts 8 ~ 2" Dia on 35 3/4" bolt circle  
 Horizontal deflection of tower at  $\bar{C}$  truss = 0.574-0.316 = 0.26". During installation, double nuts at base plate may be used to plumb tower and compensate for horizontal deflection.  
 Design Moment = 403 Kip-ft (use total span = 35')  
 Design Torsion = 136 Kip-ft (use long span = 25')
- Step 3: Determine truss details from COSS-Z2I. Read from small table at bottom of sheet 2 of 2 for Span A = 9' (use 10'):  
 Chord L 3 x 3 x 3/8 (HYC) with 3 bolt connection at splice  
 D.L. Diag. L 2 x 2 x 3/8 (HYC) with 2 bolt connection  
 W.L. Diag. L 3 x 3 x 3/8 (HYC) with 2 bolt connection  
 D.L. Vert. L 2 x 2 x 3/8 (HYC) with 2 bolt connection  
 W.L. Strut. L 2 x 2 x 3/8 (HYC) with 1 bolt connection  
 Bolts are 3/8" Dia high strength.  
 D.L. of truss = 42 lb/ft.  
 Span B = 25':  
 Chord L 3 x 3 x 1/4 (HYC) with 4 bolt connection at tower  
 D.L. Diag. L 2 x 2 x 3/8 (HYC) with 2 bolt connection  
 W.L. Diag. L 3 x 3 x 3/8 (HYC) with 2 bolt connection  
 D.L. Vert. L 2 x 2 x 3/8 (HYC) with 2 bolt connection  
 W.L. Strut. L 2 x 2 x 3/8 (HYC) with 1 bolt connection  
 Bolts are 3/8" Dia high strength with 3 ~ 3/4" Dia bolt alternate for chord connection at tower.  
 D.L. of truss = 47 lb/ft.  
 Truss defl. at free end = 0.2" for Span A, = 1.3" for Span B. The fabricator shall compensate for deflections by offsetting bolt holes between upper and lower chords at splice and at truss-to-tower connection. Top chord shall be shortened between the tower and the splice to achieve the required offset.

- Step 4: Determine foundation details. Use standard COSSF. From COSSF with 30" Dia pipe and 2" Dia anchor bolts:  
 Anchor bolts 2" Dia x 4'-3"  
 Drilled shaft Dia 54"  
 Vertical Reinforcing 18 ~ #10 bars  
 Spiral C = #4 at 6" pitch Grade 60  
 Misc. handhole, base plate, anchor bolt, and foundation details are shown on COSSF.
- Step 5: Determine drilled shaft length from COSS-FD. Enter the appropriate graph (for 54" Dia drilled shaft in clay type soil) from the bottom with N = 20. Proceed upward interpolating moment curves (solid lines) to locate 403 Kip-ft. Project to the left side of graph to determine required embedment length, i.e., 13'. Repeat the procedure for the torsion curves (dashed lines) to locate 136 Kip-ft. Embedment length required to satisfy torsion is 9'. Add 3' to the longer length to obtain required drilled shaft length of 16'.

**CANTILEVER  
 OVERHEAD SIGN SUPPORTS  
 SELECTION EXAMPLES**

**COSSE-SE**

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REVISIONS					
CONT	SECT	JOB	HIGHWAY		
6385	38	001	IH 30		
DIST	COUNTY		SHEET NO.		
PAR	HUNT, ETC		37		

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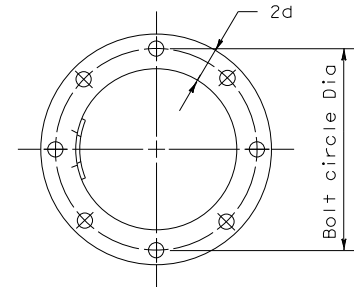
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Washers shall conform to ASTM F436.

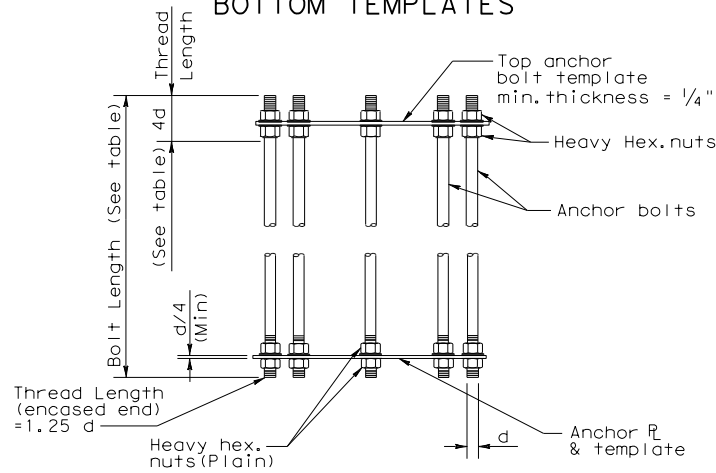
ANCHOR BOLT DIA.	WASHER DIMENSIONS			HOLE IN BASE PLATE	
	OUTSIDE DIAMETER	HOLE DIAMETER	THICKNESS		
			MIN.		MAX.
d	2d	d + 1/8"	0.136"	0.177"	d + 1/4"
1 1/2" or less	2d	d + 1/8"	0.136"	0.177"	d + 1/4"
1 3/4"	2d - 1/8"	d + 1/8"	0.178"	0.280"	d + 5/16"
2"	2d - 1/4"	d + 1/8"	0.178"	0.280"	d + 5/16"
Over 2"	2d - 1/2"	d + 1/8"	0.240"	0.340"	d + 5/16"

ANCHOR BOLT SIZE				
DIA	BOLT LENGTH	THREAD LENGTH	PROJECTION LENGTH	GALVAN. LENGTH
1 1/4"	2'-11"	5"	5 1/4"	11 1/4"
1 3/8"	3'-1"	5 1/2"	5 3/4"	11 3/4"
1 1/2"	3'-4"	6"	6 1/4"	1'-0 1/4"
1 3/4"	3'-10"	7"	7 1/4"	1'-1 1/4"
2"	4'-3"	8"	8 1/4"	1'-2 1/4"
2 1/4"	4'-9"	9"	9 1/4"	1'-3 1/4"
2 1/2"	5'-2"	10"	10 1/4"	1'-4 1/4"
2 3/4"	5'-8"	11"	11 1/4"	1'-5 1/4"
3"	6'-1"	1'-0"	1'-0 1/4"	1'-6 1/4"

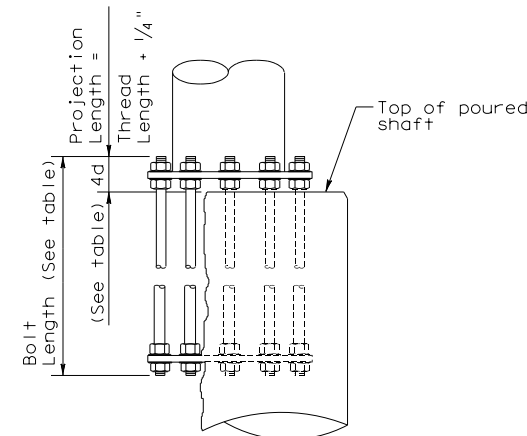
- ① Anchor Bolt Fabrication Tolerances:  
 Bolt Length ~ ±1/2"  
 Thread Length ~ ±1/2"  
 Galvanized Length ~ -1/4"
- ② Thread length applies to upper and lower threads



TOP VIEW OF TOP & BOTTOM TEMPLATES

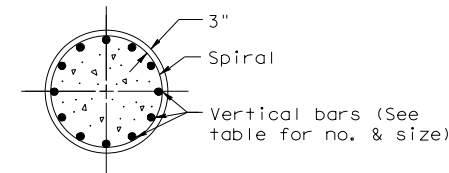


ANCHOR BOLT ASSEMBLY (PRIOR TO INSTALLATION)

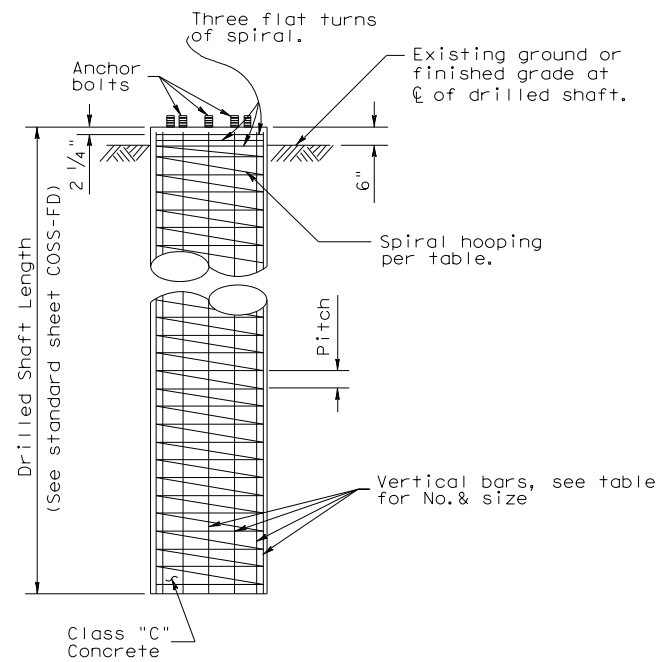


BEARING SEAT ELEVATION

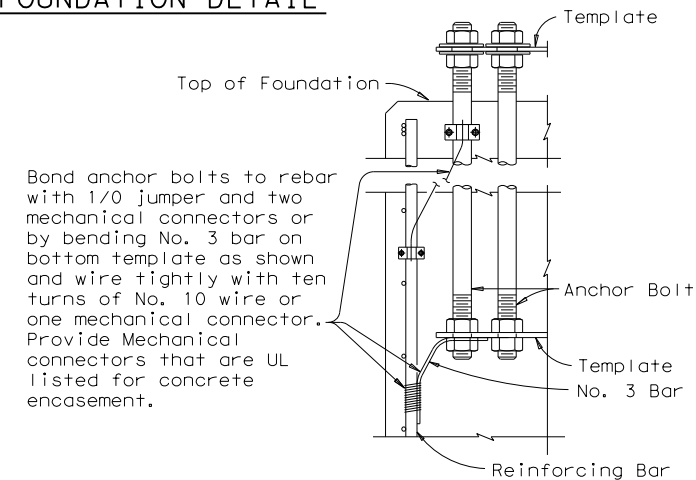
ANCHOR BOLT SIZE	PIPE OUTSIDE DIAMETER											
	16"			20"			24"			30"		
	BOLT CIRCLE DIA	DRILLED SHAFT SIZE	DRILLED SHAFT REINF	BOLT CIRCLE DIA	DRILLED SHAFT SIZE	DRILLED SHAFT REINF	BOLT CIRCLE DIA	DRILLED SHAFT SIZE	DRILLED SHAFT REINF	BOLT CIRCLE DIA	DRILLED SHAFT SIZE	DRILLED SHAFT REINF
1 1/4" Dia x 2'-11"	20 1/2"	36" Dia	14-#8 (A)	24 1/2"	36" Dia	14-#8 (A)						
1 3/8" Dia x 3'-1"	20 3/4"	36" Dia	12-#9 (A)	24 3/4"	42" Dia	14-#9 (A)						
1 1/2" Dia x 3'-4"	21"	36" Dia	12-#9 (A)	25"	42" Dia	14-#9 (A)	29"	42" Dia	14-#9 (C)			
1 3/4" Dia x 3'-10"	21 1/2"	36" Dia	10-#10 (A)	25 3/8"	42" Dia	12-#10 (B)	29 3/8"	48" Dia	16-#10 (C)	35 3/8"	54" Dia	18-#10 (C)
2" Dia x 4'-3"	22"	36" Dia	12-#10 (A)	25 3/4"	42" Dia	12-#10 (B)	29 3/4"	48" Dia	16-#10 (C)	35 3/4"	54" Dia	18-#10 (C)
2 1/4" Dia x 4'-9"	22 1/2"	42" Dia	12-#11 (A)	26"	42" Dia	10-#11 (B)	30"	48" Dia	14-#11 (C)	36"	54" Dia	14-#11 (D)
2 1/2" Dia x 5'-2"				26 1/2"	42" Dia	12-#11 (B)	30 1/2"	48" Dia	16-#11 (C)	36 1/2"	54" Dia	16-#11 (D)
2 3/4" Dia x 5'-8"							31 1/2"	48" Dia	18-#11 (D)	37"	54" Dia	20-#11 (D)
3" Dia x 6'-1"										37 1/2"	54" Dia	24-#11 (D)



SECTION



FOUNDATION DETAIL

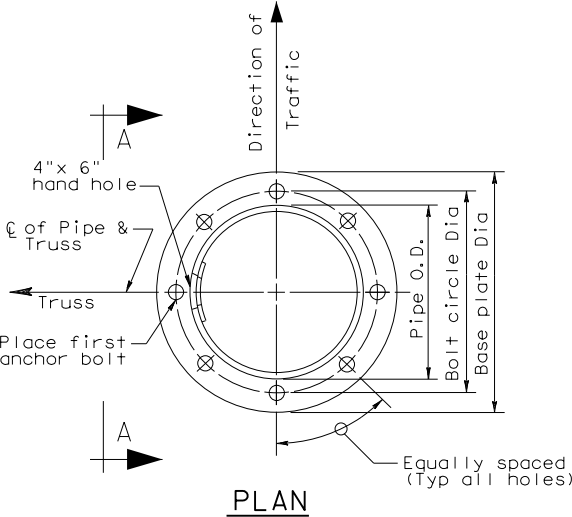


LIGHTNING PROTECTION SYSTEM

- A = #3 Plain spiral at 6" pitch (Grade 40)
- B = #4 Plain spiral at 6" pitch (Grade 40)
- C = #4 Plain spiral at 6" pitch (Grade 60)
- D = #4 Plain spiral at 3 1/2" pitch (Grade 60)

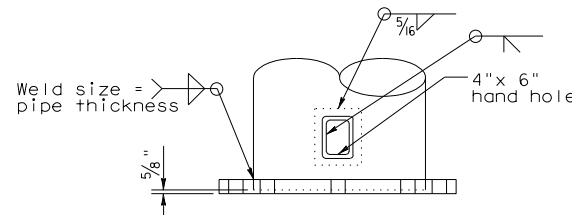
GENERAL NOTES

- Concrete shall be Class "C".
- Reinforcing shall conform to Item 440, "Reinforcing Steel".
- Anchor bolts and nuts for anchor bolts shall be "Alloy Steel" per Item 449, "Anchor Bolts".
- Anchor bolts shall be rigidly held in position during concrete placement using steel templates at the top and bottom. The top templates shall be removed after the concrete has set.
- Lubricate and tighten anchor bolts when erecting the structure per Item 449, "Anchor Bolts". After the structure has been aligned in its final position and the anchor bolts have been properly tightened, tack weld anchor bolt nuts to washer, and tack weld washers to base plate. Galvanizing in tack welded areas shall be repaired in accordance with Item 445, "Galvanizing".
- All vertical reinforcing shall be carried to the bottom of the Drilled Shaft.



PLAN

- ② See "Cantilever Overhead Sign Support" or "High Lever Cantilever Overhead Sign Support" sheets for number and size.



VIEW A-A

③ BASE PLATE & HANDHOLE DETAILS

- ③ See "Cantilever Overhead Sign Support" or "High Level Cantilever Overhead Sign Support" sheets for Diameter and thickness of base plate.

Cut 5" x 7" hole in pipe. Center 4" x 6" hand hole in 3/8" x 8" x 10" back up plate. Provide attachable cover made from section cut from pipe.

<h2>CANTILEVER OVERHEAD SIGN SUPPORT FOUNDATION</h2> <h3>COSSE-21</h3>			
FILE: cossef-21.dgn	DN:	CK:	DW:
© TxDOT November 2007	CONT: 6385	SECT: 38	JOB: 001
8-21	REVISIONS		HWSO
DIST: B&R	COUNTY: HUNTCO	SHEET NO. 38	

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**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.

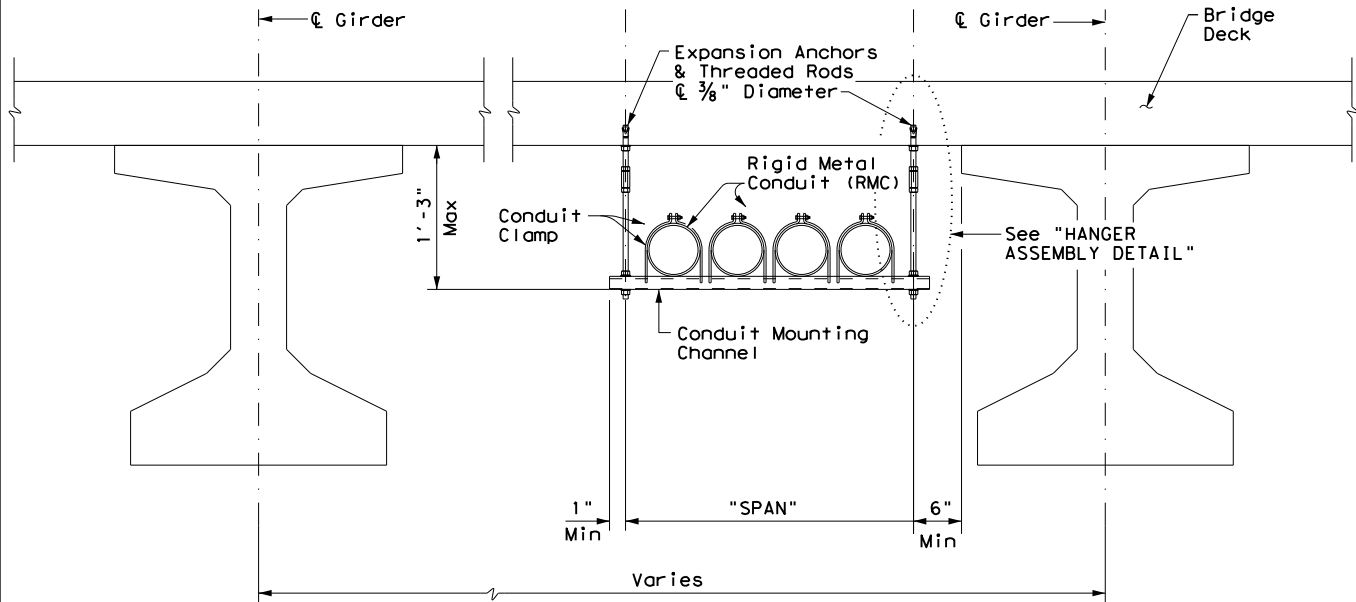
**B. CONSTRUCTION METHODS**

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.

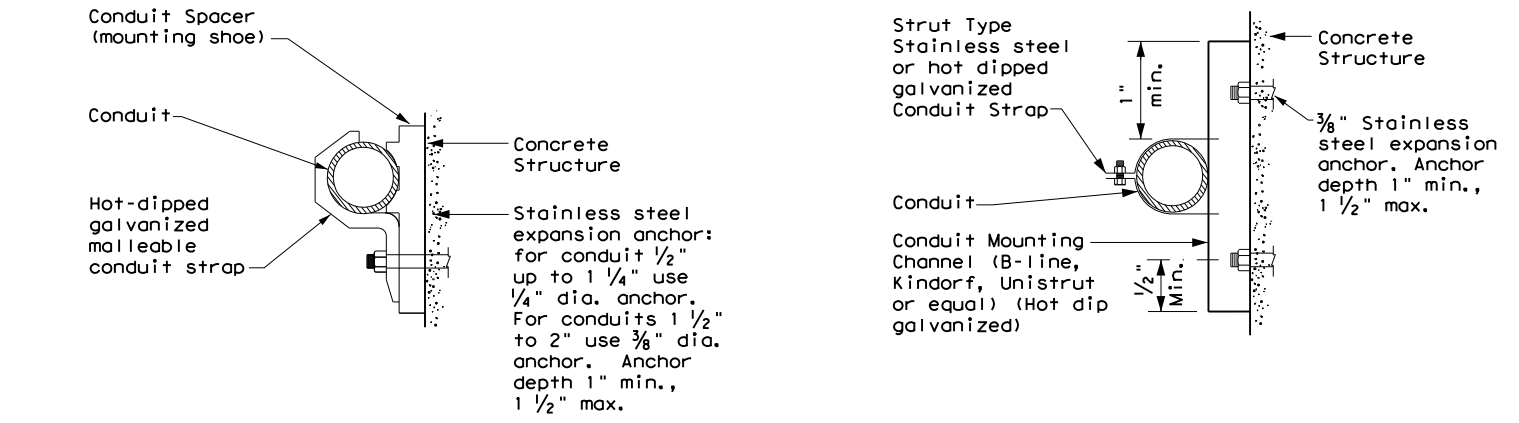
			
<h1>ELECTRICAL DETAILS CONDUITS &amp; NOTES</h1>			
<h2>ED(1) - 14</h2>			
FILE:	ed1-14.dgn	DWG:	CK:
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REVISIONS	6385	38	001
	DIST	COUNTY	SHEET NO.
	PAR	HUNT, ETC	39

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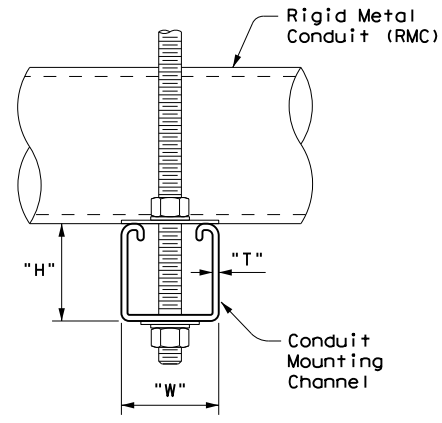
CONDUIT HANGING DETAIL



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

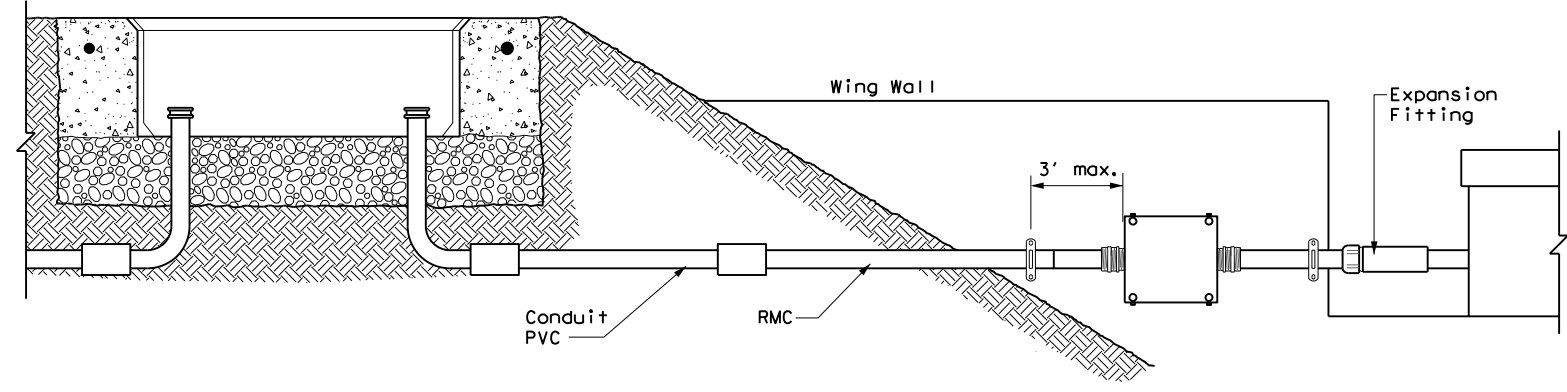
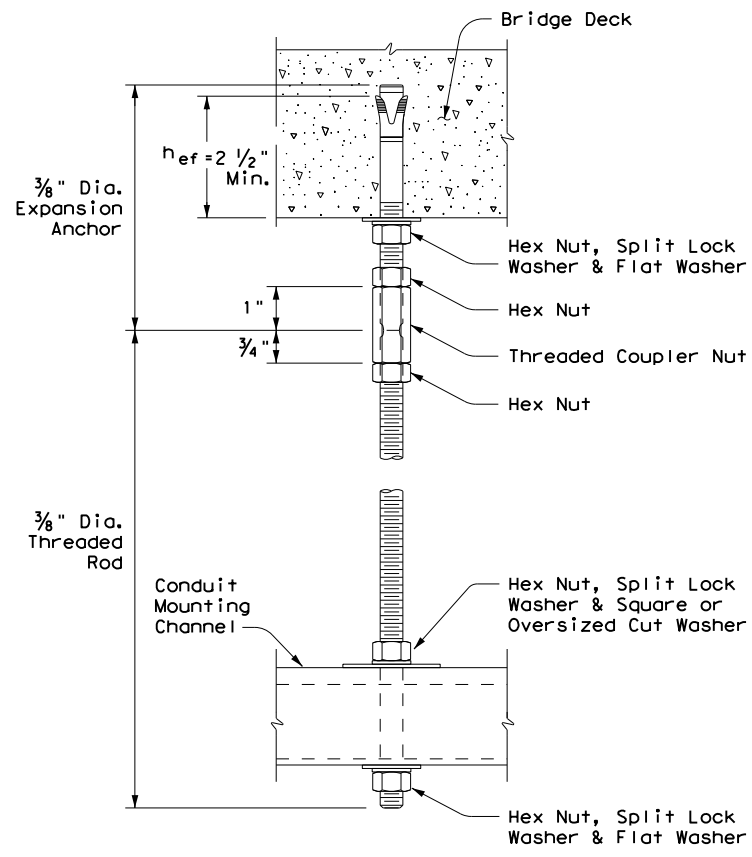
"SPAN"	"W" x "H"	"T"
less than 2'	1 5/8" x 1 3/8"	12 Ga.
2'-0" to 2'-6"	1 5/8" x 1 5/8"	12 Ga.
>2'-6" to 3'-0"	1 5/8" x 2 7/16"	12 Ga.

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



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<sub>ef</sub>), as shown. Increase (h<sub>ef</sub>) 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<sub>ef</sub>). No lateral loads shall be introduced after conduit installation.

		Traffic Operations Division Standard	
<h2>ELECTRICAL DETAILS CONDUIT SUPPORTS</h2>			
<h3>ED(2) - 14</h3>			
FILE: ed2-14.dgn	DW: TxDOT	CK: TxDOT	DW: TxDOT
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REVISIONS	6385	38	IH 30
DIST: PAR	COUNTY: HUNT, ETC	SHEET NO. 40	



# 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.

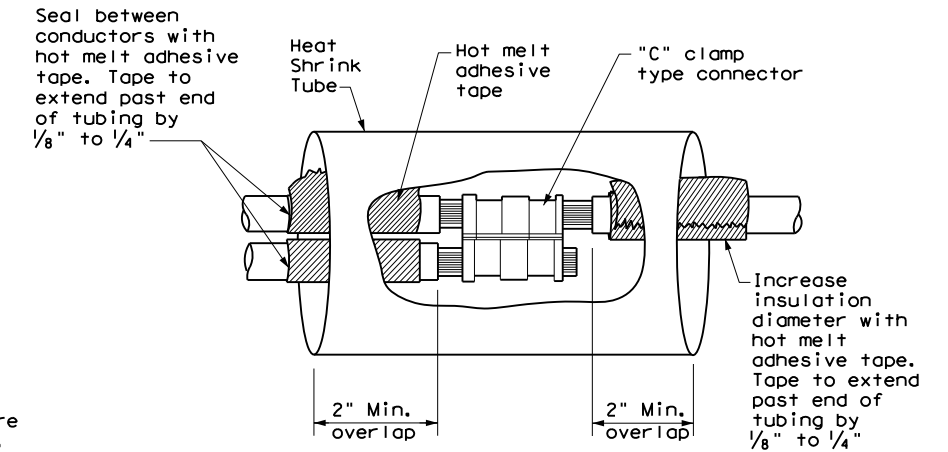
## B. CONSTRUCTION METHODS

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.



**SPLICE OPTION 1  
Compression Type**

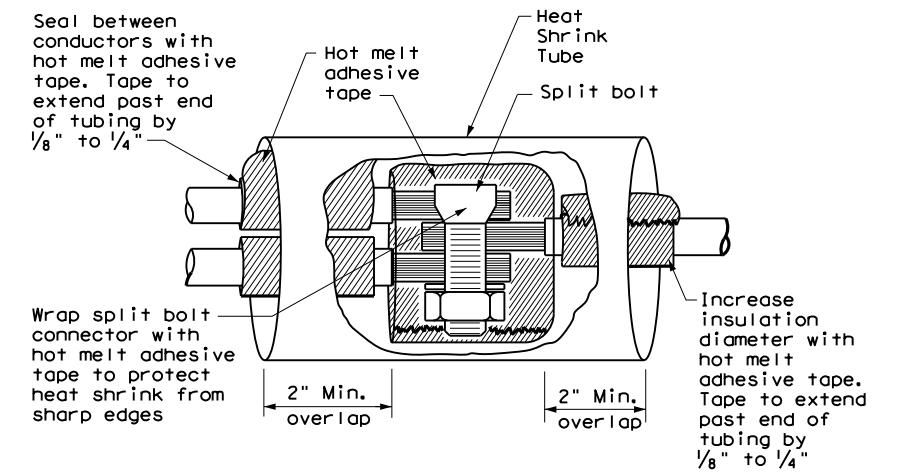
## GROUND RODS & GROUNDING ELECTRODES

### A. MATERIAL INFORMATION

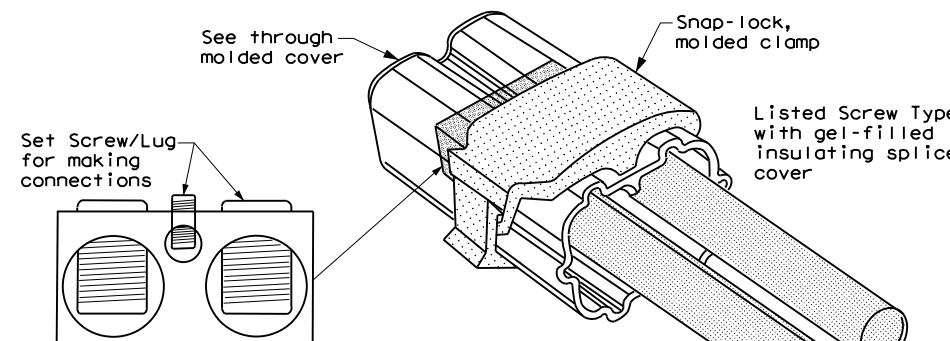
1. Provide and install a grounding electrode at electrical services. Provide ground rods according to DMS 11040 and the plans. Larger diameter or longer length rods may be called for in some specific locations, see the individual plans sheets. Concrete encased grounding electrodes may be called for in 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 2  
Split Bolt Type**



**SPLICE OPTION 3  
Listed Screw Type**

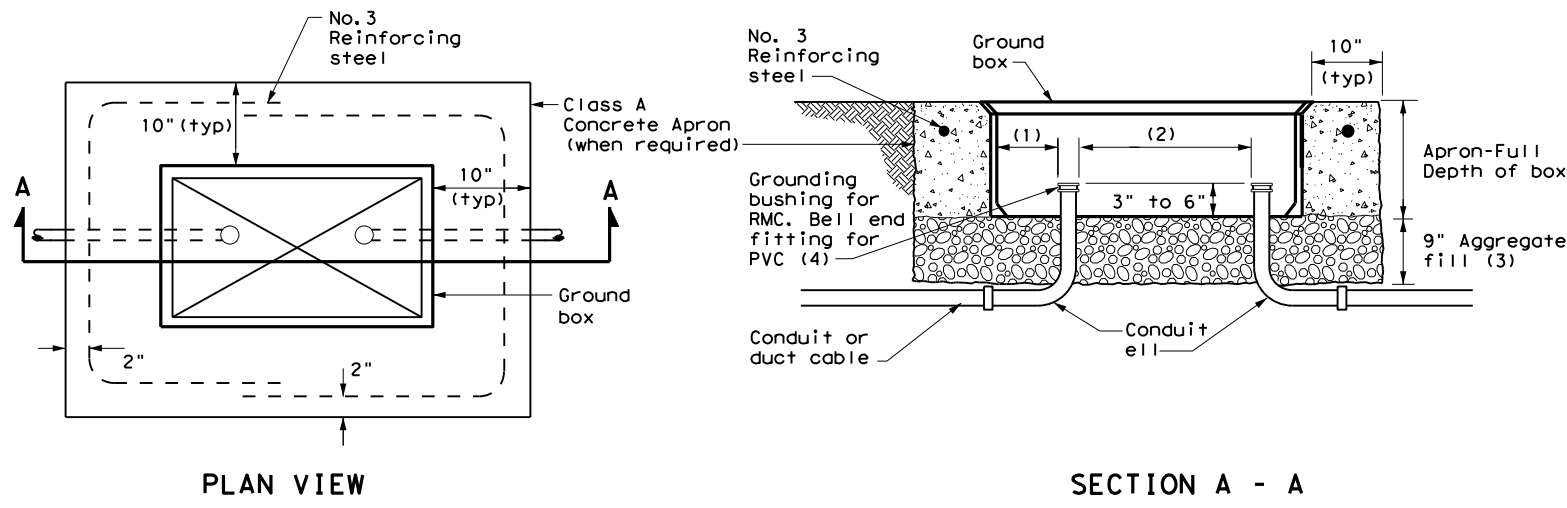
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		Traffic Operations Division Standard	
<h1>ELECTRICAL DETAILS CONDUCTORS</h1>			
<h2>ED(3) - 14</h2>			
FILE: ed3-14.dgn	DW: TxDOT	CK: TxDOT	DW: TxDOT
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REVISIONS	6385	38	001
	DIST	COUNTY	SHEET NO.
	PAR	HUNT, ETC	41

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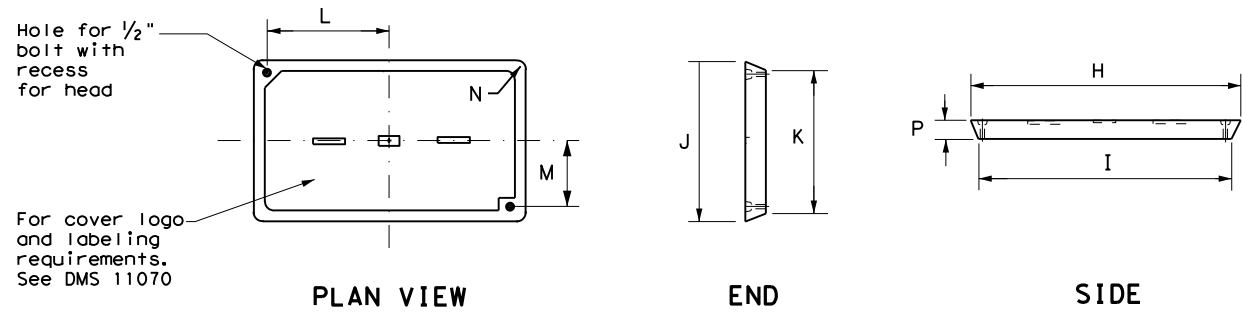


**APRON FOR GROUND BOX**

- (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 x Length X Depth)
A	12 X 23 X 11
B	12 X 23 X 22
C	16 X 29 X 11
D	16 X 29 X 22
E	12 X 23 X 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 on 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	
<h2>ELECTRICAL DETAILS</h2> <h3>GROUND BOXES</h3> <h4>ED(4) - 14</h4>					
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				SHEET NO.:	42

**ELECTRICAL SERVICES NOTES**

- 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.
- 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.
- Provide all work, materials, services, and any incidentals needed to install a complete electrical service as specified in the plans.
- 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.
- 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.
- 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.
- When galvanized is specified for nuts, screws, bolts or miscellaneous hardware, stainless steel may be used.
- 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.
- 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.
- 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.
- 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.
- Ensure all mounting hardware and installation details of services conform to utility company specifications.
- 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.
- 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.
- 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**

- Provide threaded hub for all conduit entries into the top of enclosure.
- 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 photoceII or lighting contactor. Provide GS enclosures in accordance with DMS 11080, 11082, 11083, and 11084.
- 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.
- 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**

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

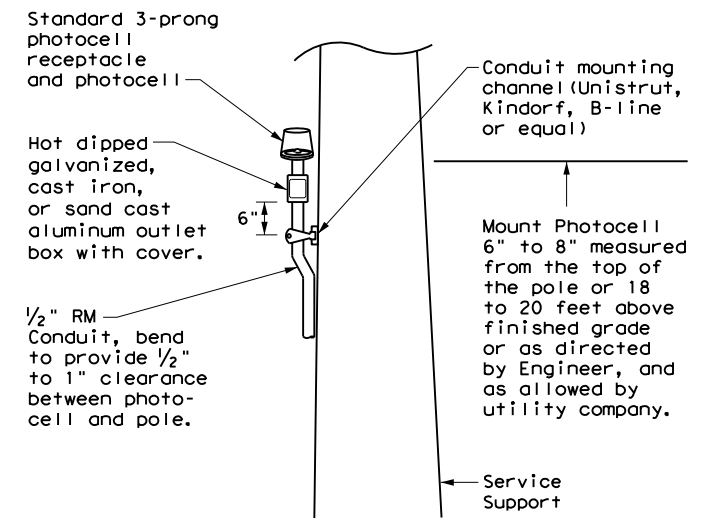
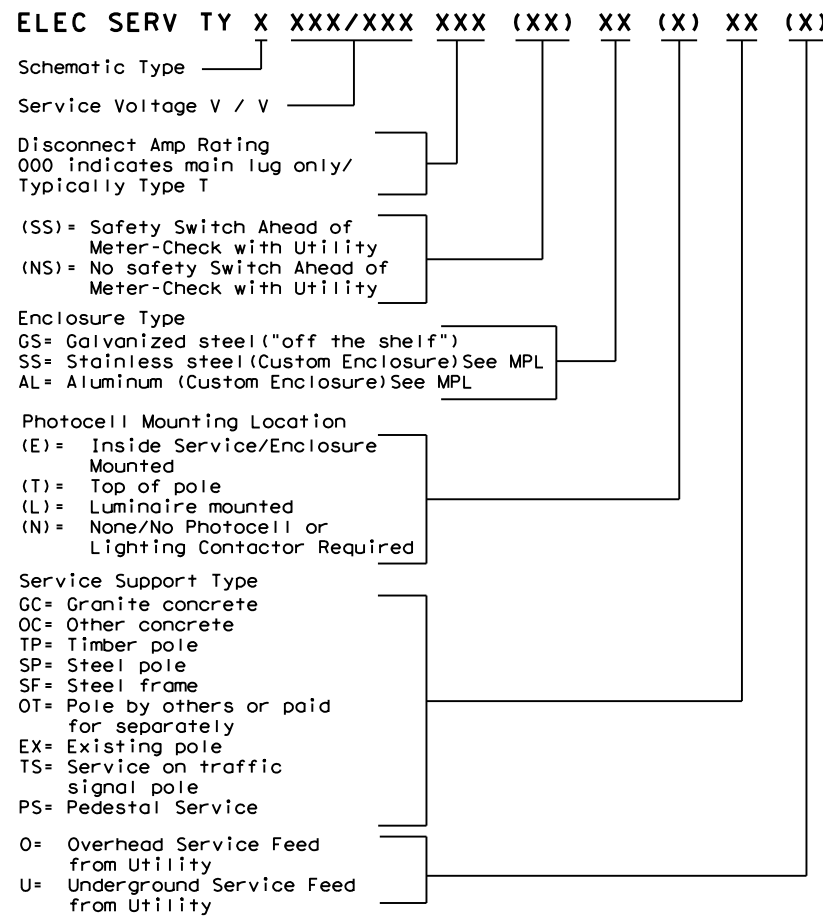
**PHOTOELECTRIC CONTROL**

- 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 *xSize	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**



**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**

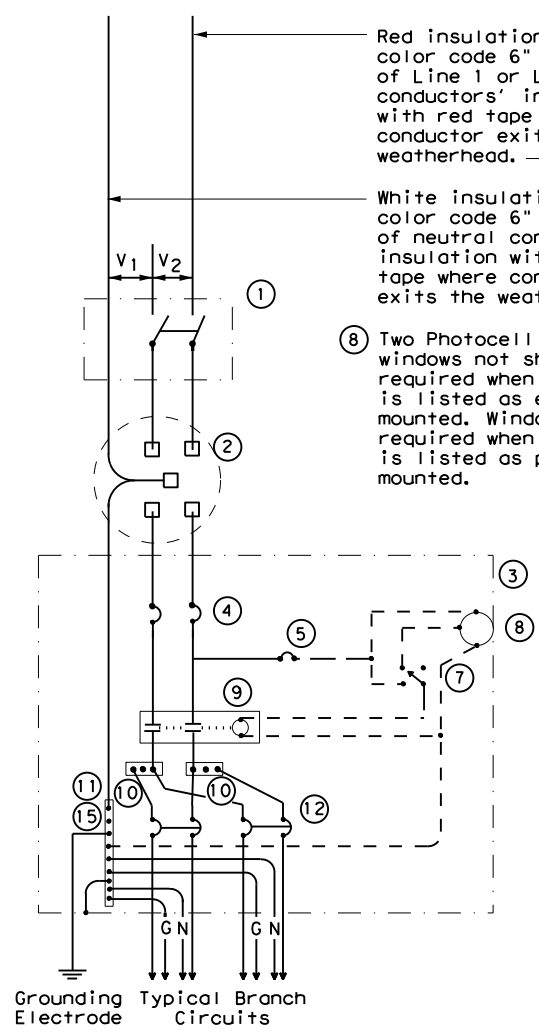
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© TxDOT October 2014	CONT	SECT	JOB	HIGHWAY
REVISIONS	6385	38	001	IH 30
DIST	COUNTY		SHEET NO.	
PAR	HUNT, ETC		43	

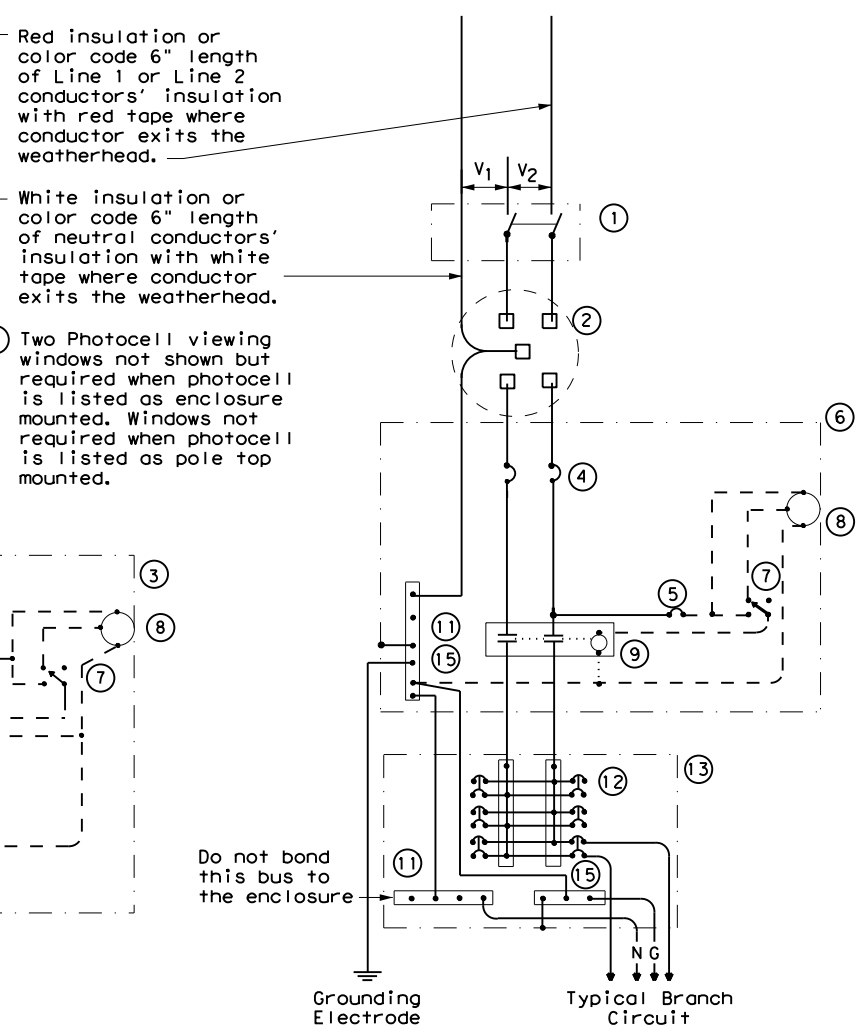
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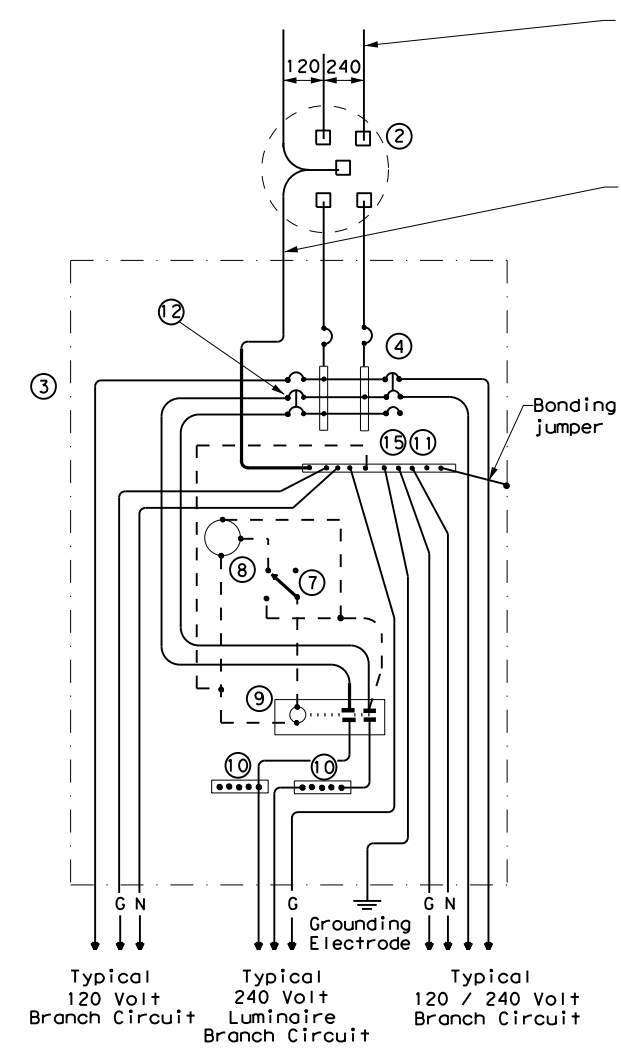
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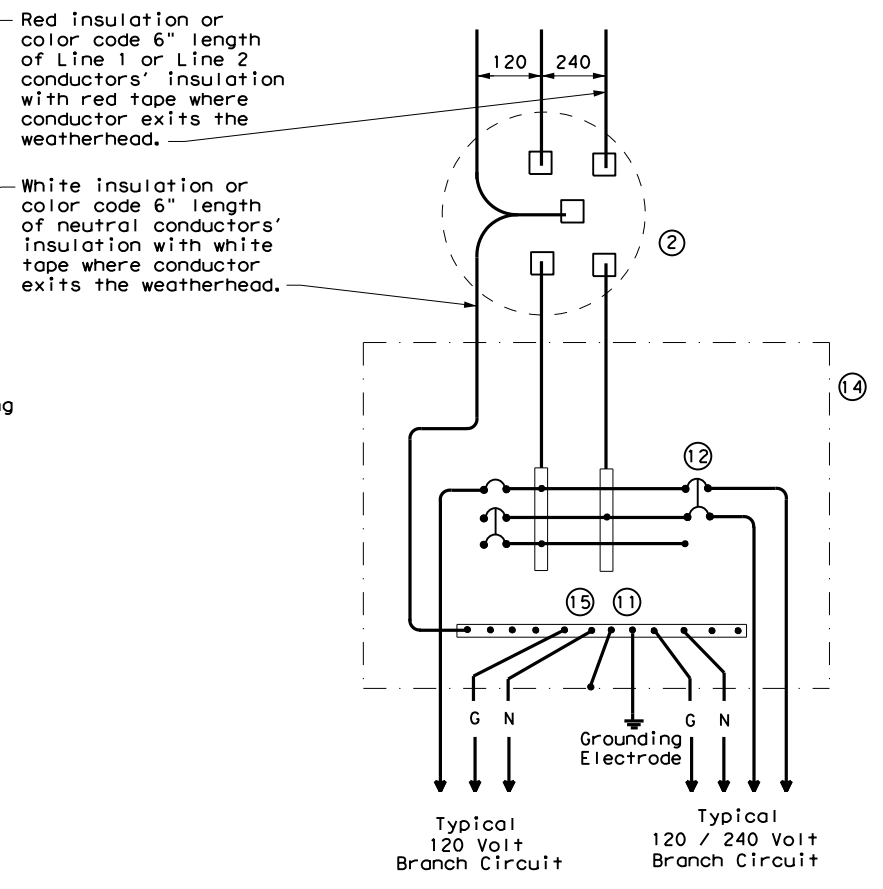
**SCHEMATIC TYPE A  
THREE WIRE**



**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 photo cell 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	
<b>ELECTRICAL DETAILS SERVICE ENCLOSURE AND NOTES</b>					
<b>ED(6) - 14</b>					
FILE:	ed6-14.dgn	DN:	TxDOT	CK:	TxDOT
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REVISIONS		JOB:	001	HIGHWAY:	IH 30
DIST:	PAR	COUNTY:	HUNT, ETC	SHEET NO.:	44

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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 3/8 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 ellis 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 tapped 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 A

Inset B

60" TYP.

2"

Class "C" concrete

RMC

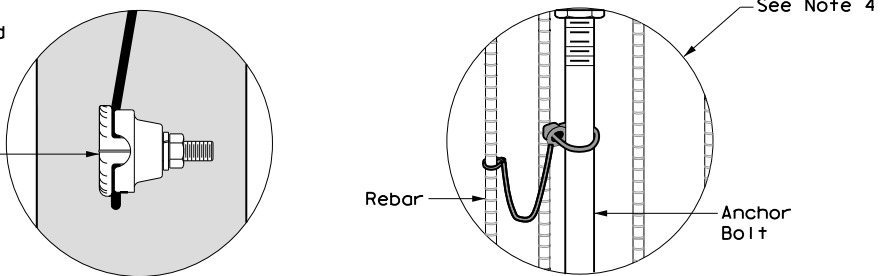
PVC

18" Min.

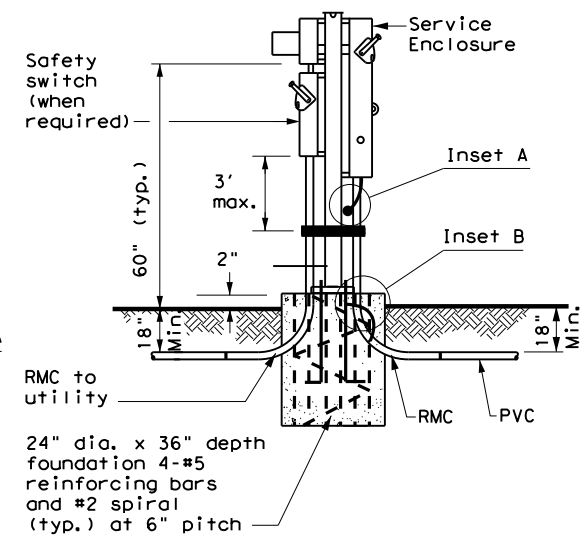
24 Dia. x 60" depth foundation 4-#5 reinforcing bars and #2 spiral (typ.) at 6" pitch

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

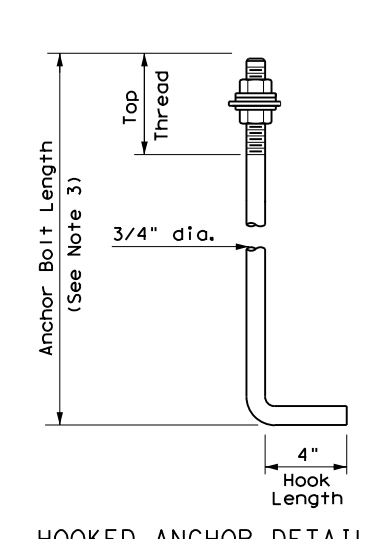
Drill, tap, and thread 1/2" X 13 UNC. Install tank ground fitting, connect electrical service grounding electrode conductor. See Note 7.



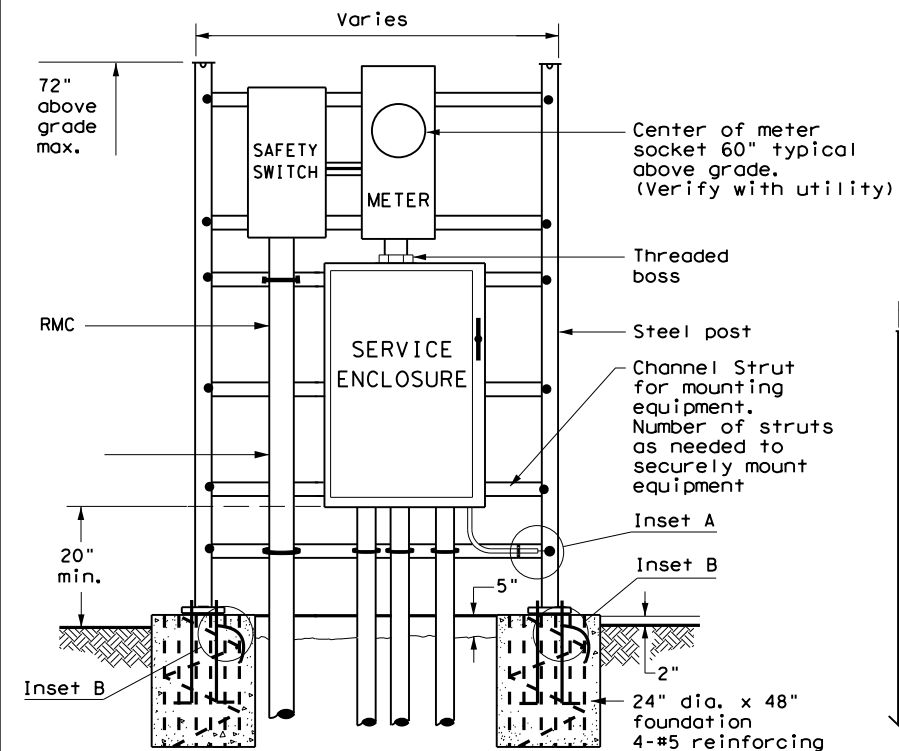
FRONT VIEW  
INSET A  
INSET B



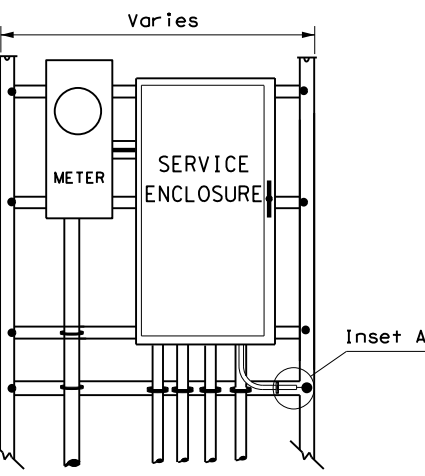
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**SERVICE SUPPORT TYPE SP(U) - UNDERGROUND SERVICE**



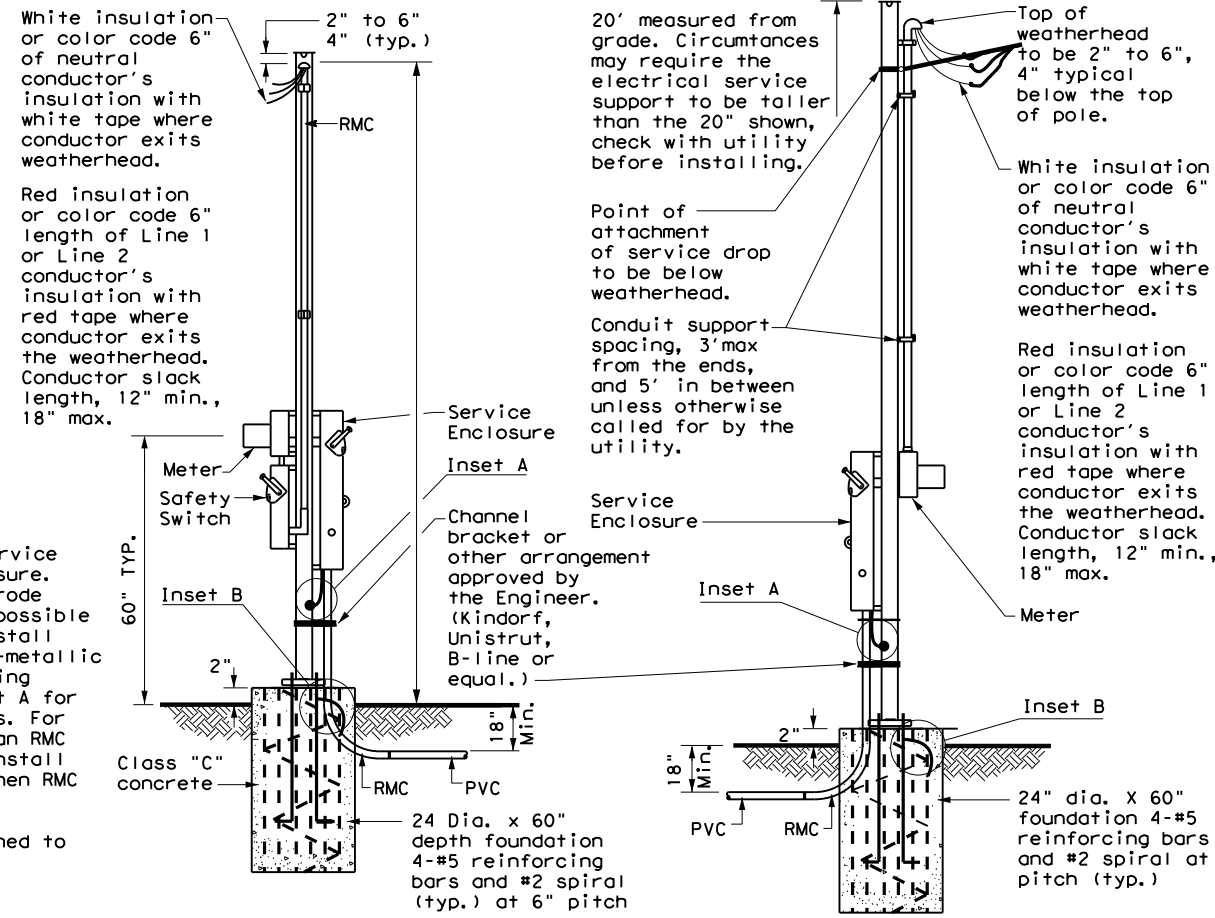
**HOOKED ANCHOR DETAIL**



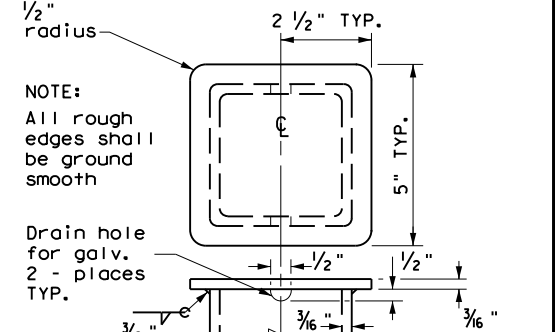
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**SERVICE SUPPORT TYPE SF (U) - UNDERGROUND SERVICE**



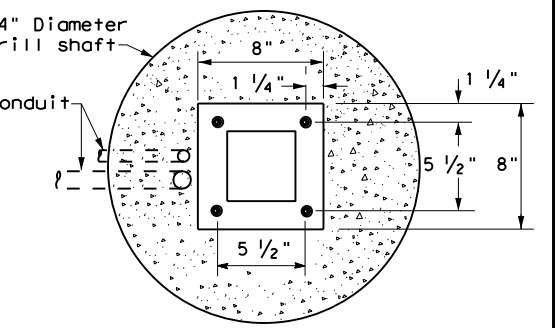
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**SERVICE SUPPORT TYPE SF (O) - OVERHEAD SERVICE**



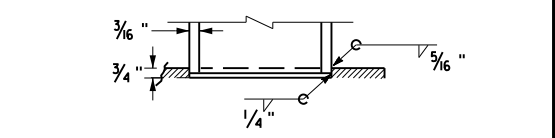
WITH SAFETY SWITCH  
WITHOUT SAFETY SWITCH  
**SERVICE SUPPORT TYPE SP (O) - OVERHEAD SERVICE**



**POLE TOP PLATE**

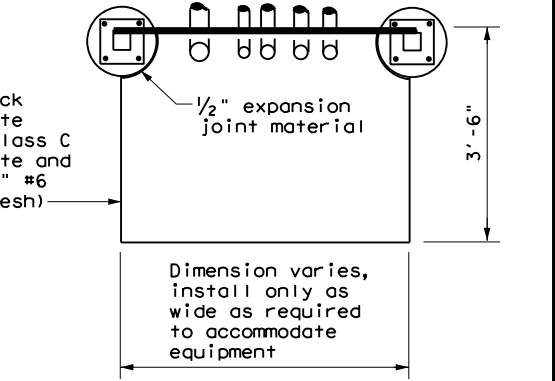


**BASE PLATE DETAIL**



**BOTTOM OF POLE**

**SERVICE SUPPORT TYPE SF & SP**



**TOP VIEW**

**SERVICE SUPPORT TY SF (O) & SF (U)**

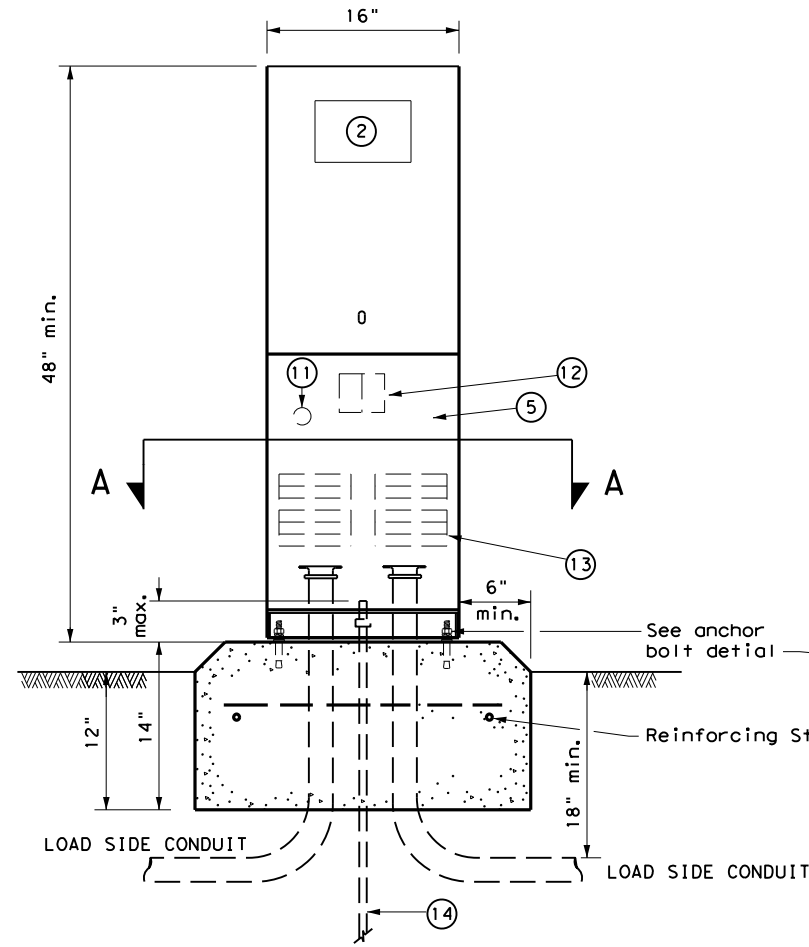
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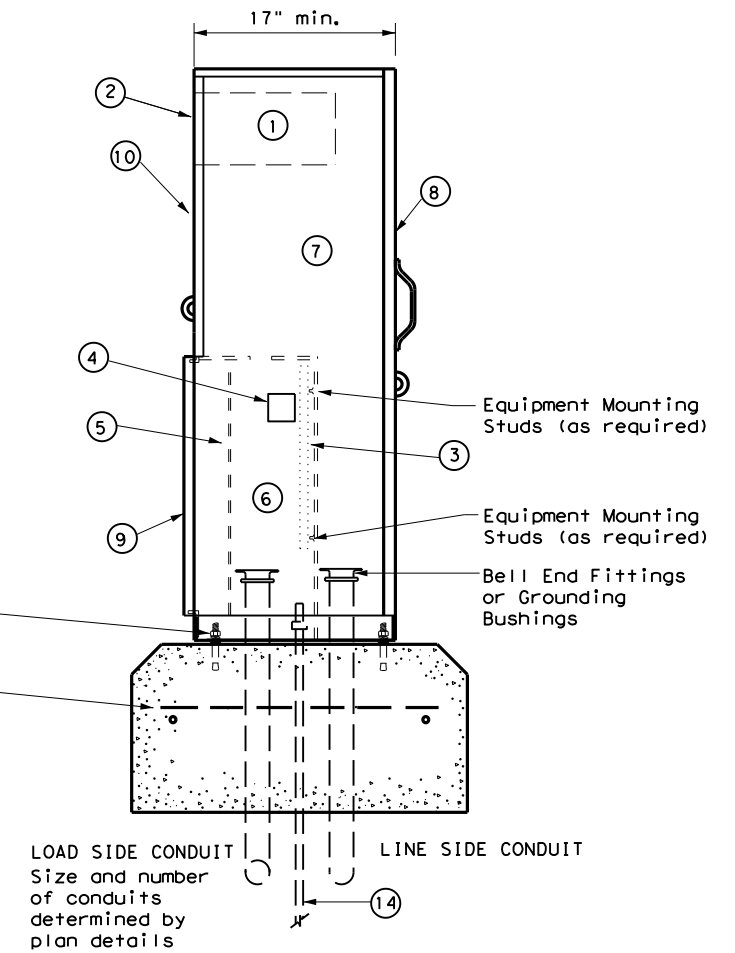
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**PEDESTAL SERVICE NOTES**

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.

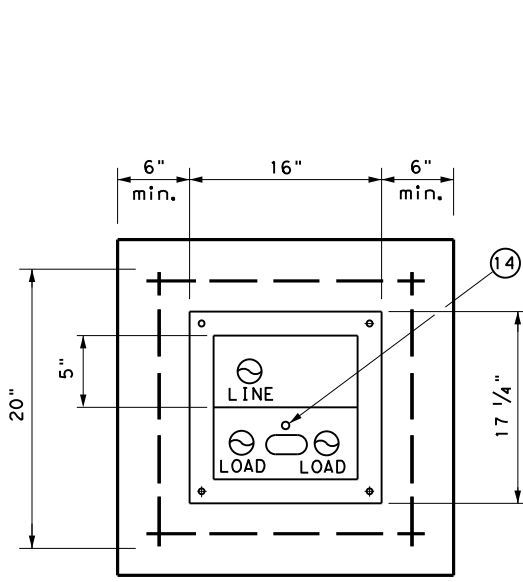


**FRONT VIEW**

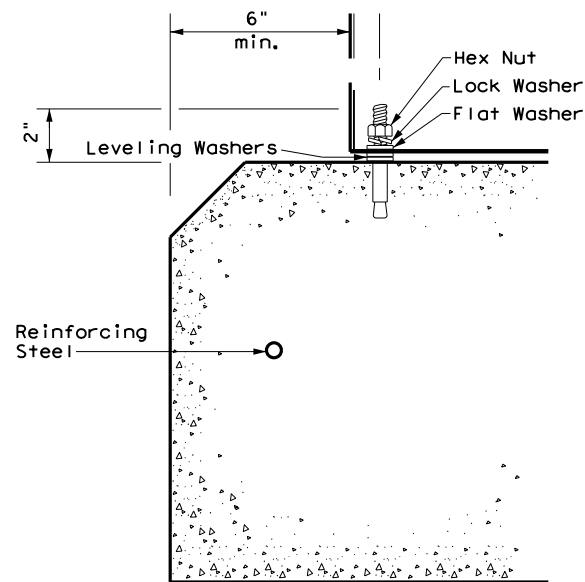


**SIDE VIEW**

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.



**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'

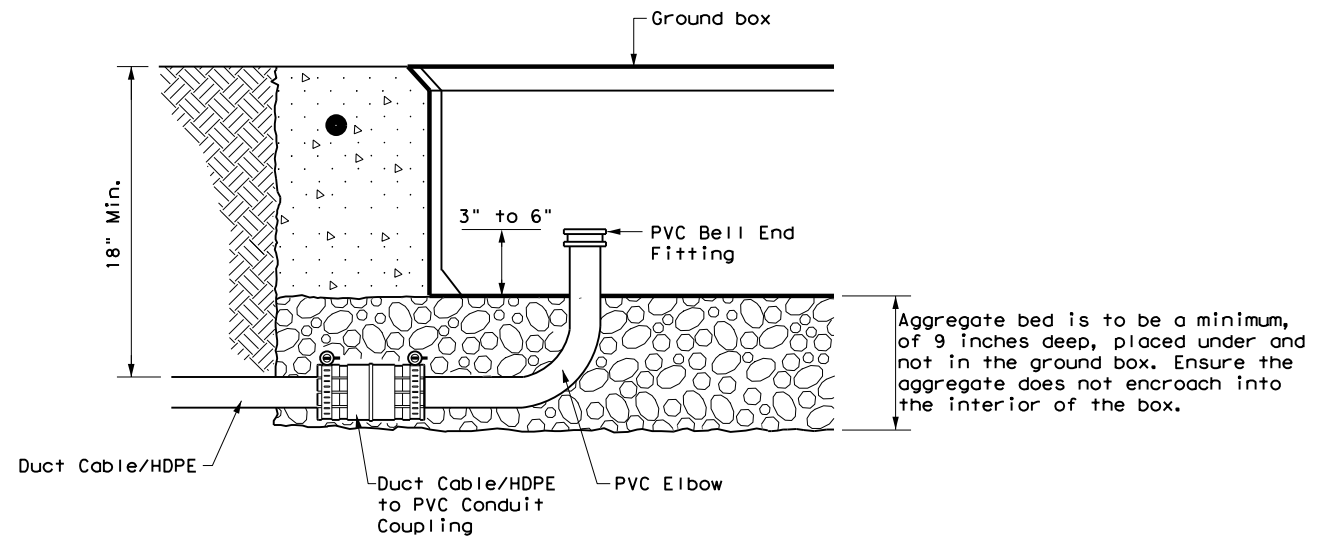
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<b>ED(9) - 14</b>			
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PAR	HUNT, ETC	46	

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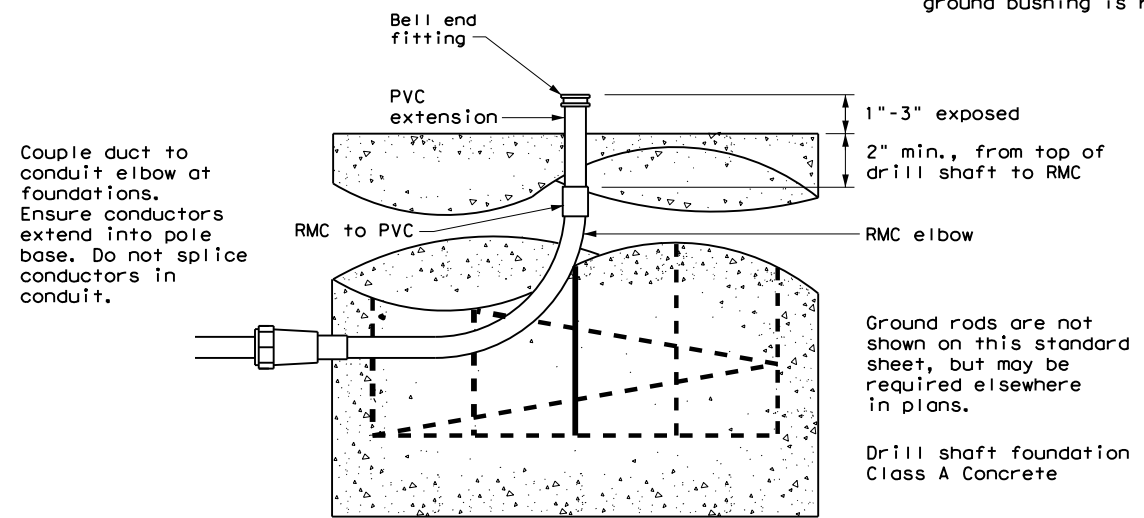
**DUCT CABLE & HDPE CONDUIT NOTES**

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.

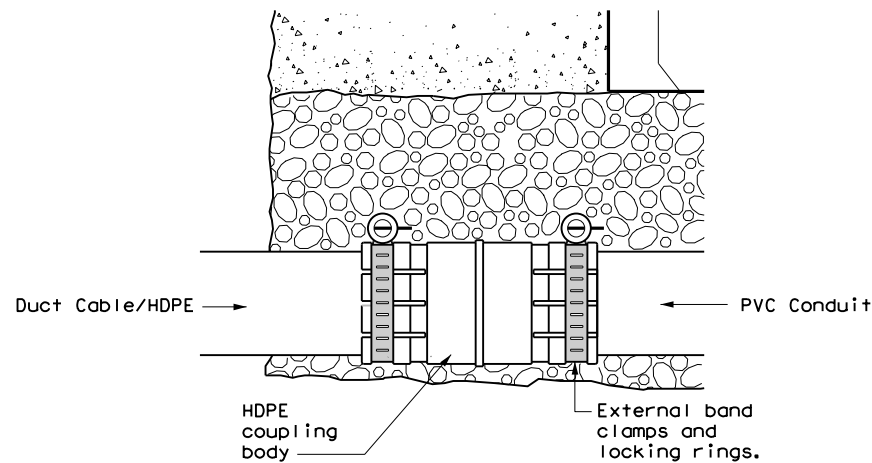


**DUCT CABLE/HDPE AT GROUND BOX**

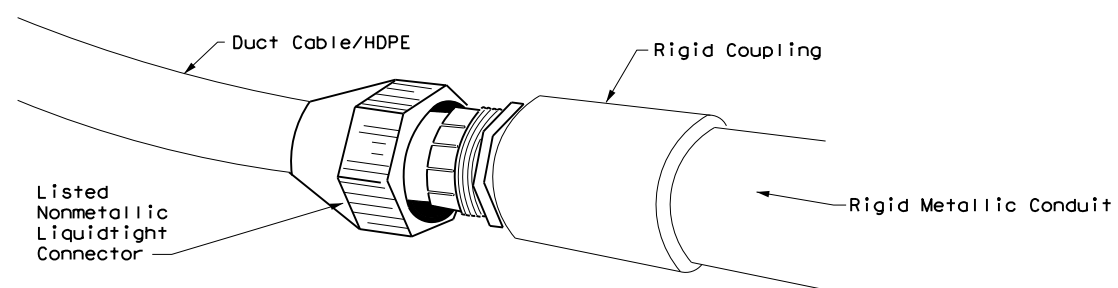
When the upper end of an RMC EII does not enter the ground box, it may be extended with a SCH-40 PVC conduit nipple and bell end, provided there is a minimum of 18" of cover over all parts of the elbow. If not, a rigid extension and ground bushing is required.



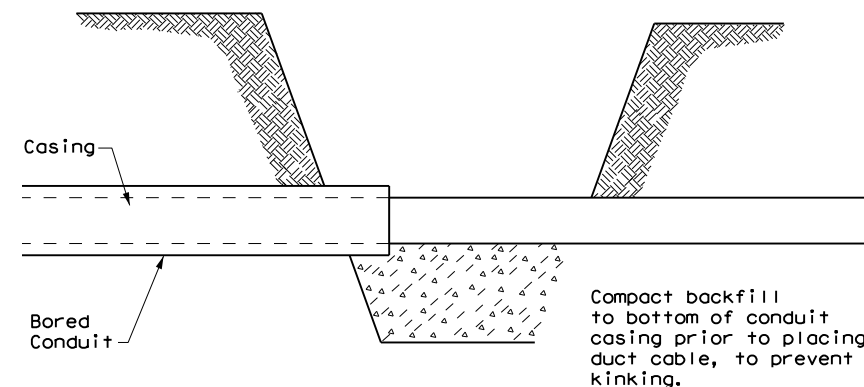
**DUCT CABLE / HDPE AT FOUNDATION**



**DUCT CABLE/HDPE TO PVC**



**DUCT CABLE/HDPE TO RMC**



**BORE PIT DETAIL**

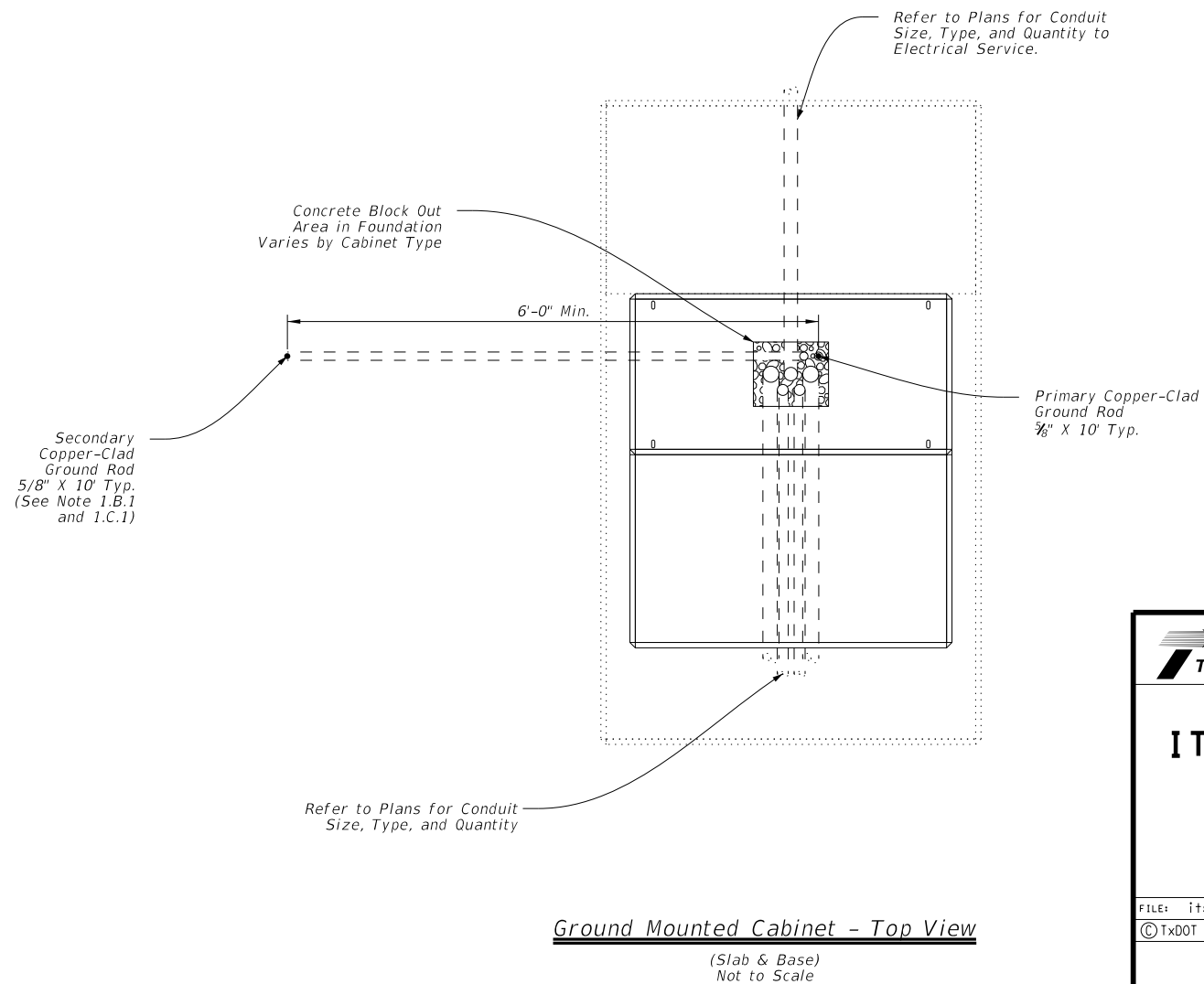
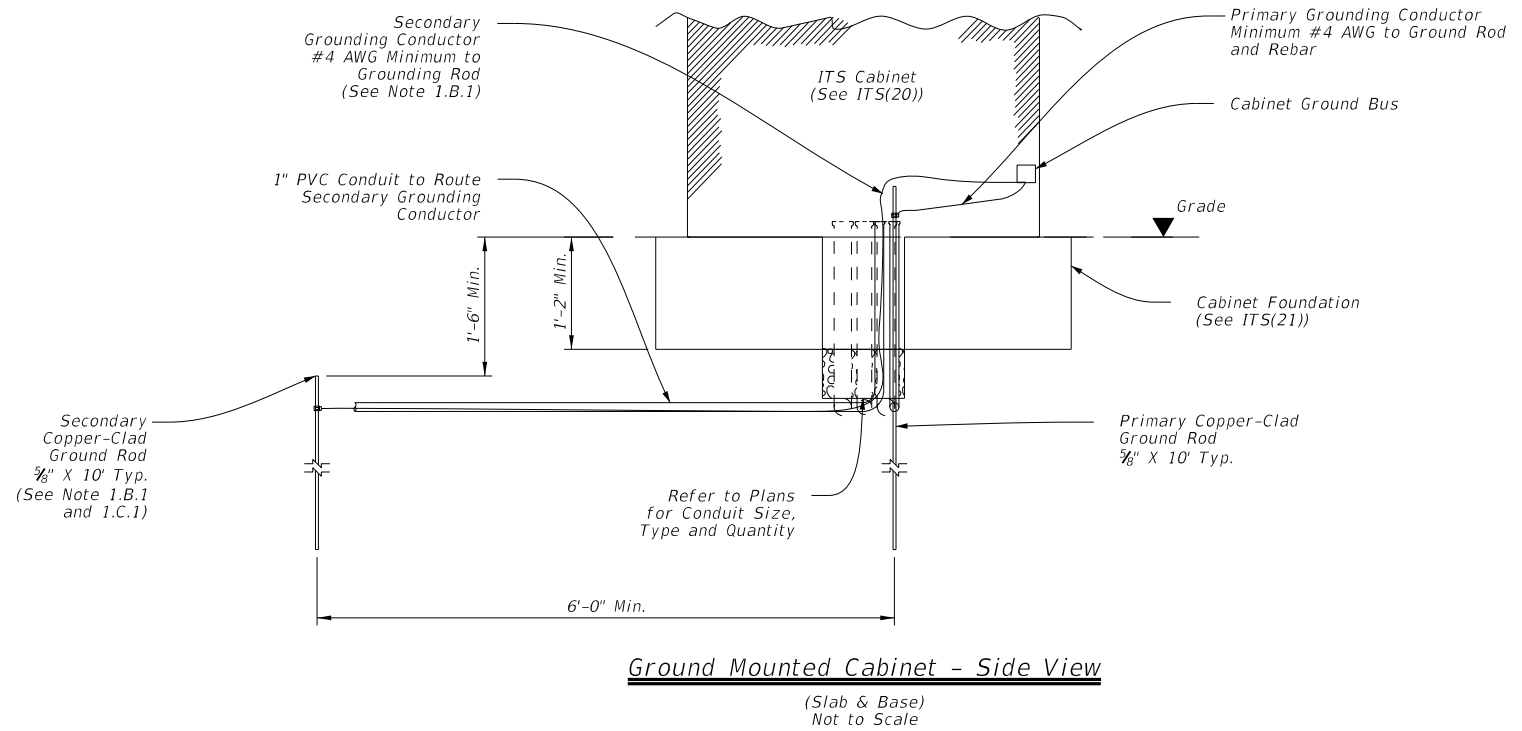
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<b>ED(11)-14</b>					
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	PAR	HUNT, ETC			47

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**General Notes:**

1. Grounding System:
  - A. Description:
    1. Provide ground system consisting of copper wires, ground rods, and concrete-encased grounding electrodes (Ufers), of the configuration shown to minimize potential gradient irregularities, drain leakage, and fault currents to earth.
  - B. Performance:
    1. Provide a grounding system, consisting of a minimum one ground rod, having a resistance not greater than 5 Ohms to ground. Additional ground rods may be added to the system to achieve less than 5 Ohms resistance.
  - C. Design Criteria:
    1. The combined ground resistance of separate systems bonded together below grade may be used to meet the specified ground resistance, but the minimum number of rods indicated shall still be provided.
    2. Measure the resistance of systems requiring separate ground resistance separately before bonding below grade.
    3. Only provide UL-approved materials listed for grounding systems.
    4. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture, unless moisture is permanently excluded from the junction of such materials.
    5. Submit product data for the materials and products used to perform the work of this section.
  - D. Materials:
    1. Conductors:
      - a. Bare Ground Conductor:
        - 1) For No. 8 AWG or larger bare ground wire sizes, provide soft drawn copper, Class A or Class B, stranded wire meeting the requirements of ASTM B 8.
      2. Ground Compression Connectors:
        - a. Provide molds, thermite packages, and other material for ground compression connectors that are full-rated to carry 100% of the cable rating and which meet IEEE 837.
          - 1) Provide the compression materials from a single manufacturer throughout the project.
          - 2) Provide the items necessary for connecting cable to ground rods.
      3. Ground Rods:
        - a. Provide copper-clad steel ground rods conforming to the requirements specified in UL 467.
          - 1) Diameter: 5/8 in.
          - 2) Length: 10 Ft.
2. Installation:
  - A. Install grounding components and systems in accordance with the requirements specified in UL 467, IEEE 81, and IEEE 142.
  - B. System Grounding:
    1. Ground Rods:
      - a. Drive ground rods into the ground until the tops of the rods are approximately 18 in. below finished grade.
      - b. If multiple ground rods are needed to meet the minimum resistance of 5 Ohms, space ground rods as evenly as possible, at least 6 feet apart, and so conductors will be connected below grade.
    2. Conductors:
      - a. Provide minimum No. 4 AWG ground wire for system and equipment grounding.
      - b. Using suitable fasteners, securely attach exposed ground wires to structural supports at not more than 2 ft. intervals, where applicable.
      - c. Bends in ground wires greater than 45 degrees are unacceptable.
    3. Cable Connections:
      - a. Use approved exothermic-welded connections for conductor splices and connections between conductors and other components.
3. Testing:
  - A. Resistance Test:
    1. Test Procedure:
      - a. The ground-resistance measurements of each ground Rod shall be taken.
        - 1) The resistance to ground shall be measured in accordance with the fall-of-potential method specified in IEEE 81 and IEEE 142.
        - 2) Ground-resistance measurements shall be made in normally dry weather, not less than 48 hours after rainfall, and with the ground under test isolated from other grounds.
      - b. Test reports shall be prepared that indicate the location of the ground rod, the grounding system, and the resistance and soil conditions at the time the test was performed.
    2. Acceptance Criteria:
      - a. The grounding system must have a resistance not greater than 5 Ohms.
      - b. Do not energize any part of the electrical distribution system prior to the resistance testing of that system's ground rods and grounding system, and submission of the test results for approval.
    3. Inspections:
      - a. Prepare and submit as-built record drawings of the grounding system as installed and test reports for approval.

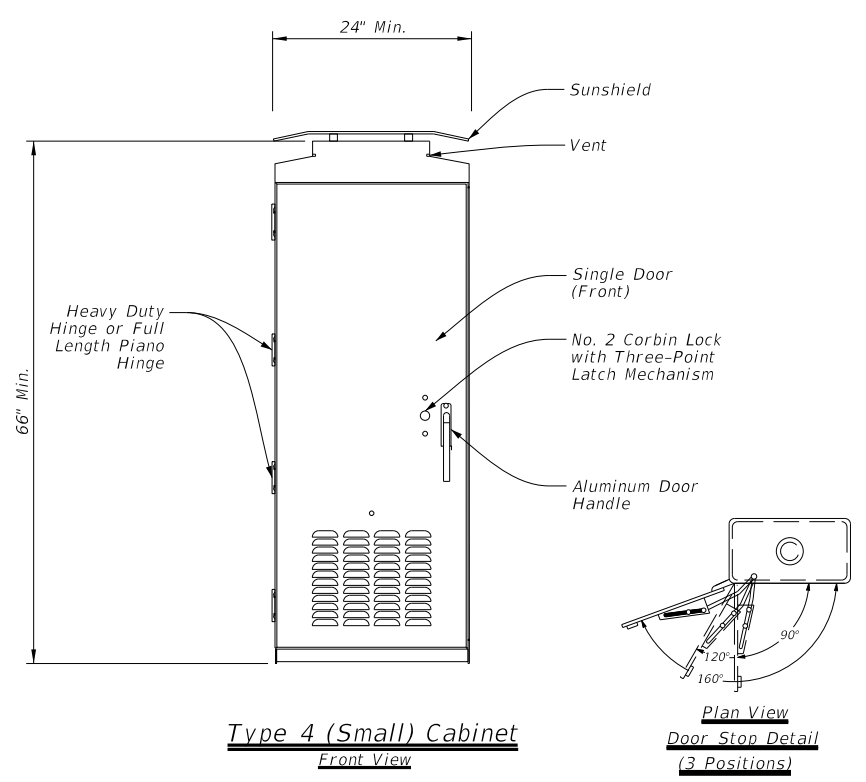


				<b>Traffic Operations Division Standard</b>	
<h2>ITS CABINET GROUNDING DETAILS</h2>					
<h3>ITS(18)-15</h3>					
FILE: its(18)-15.dgn	DN: TxDOT	CK: TxDOT	DW: TxDOT	CR: TxDOT	
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REVISIONS	6385	38	001	IH	30
	DIST	COUNTY	SHEET NO.		
	PAR	HUNT, ETC			48

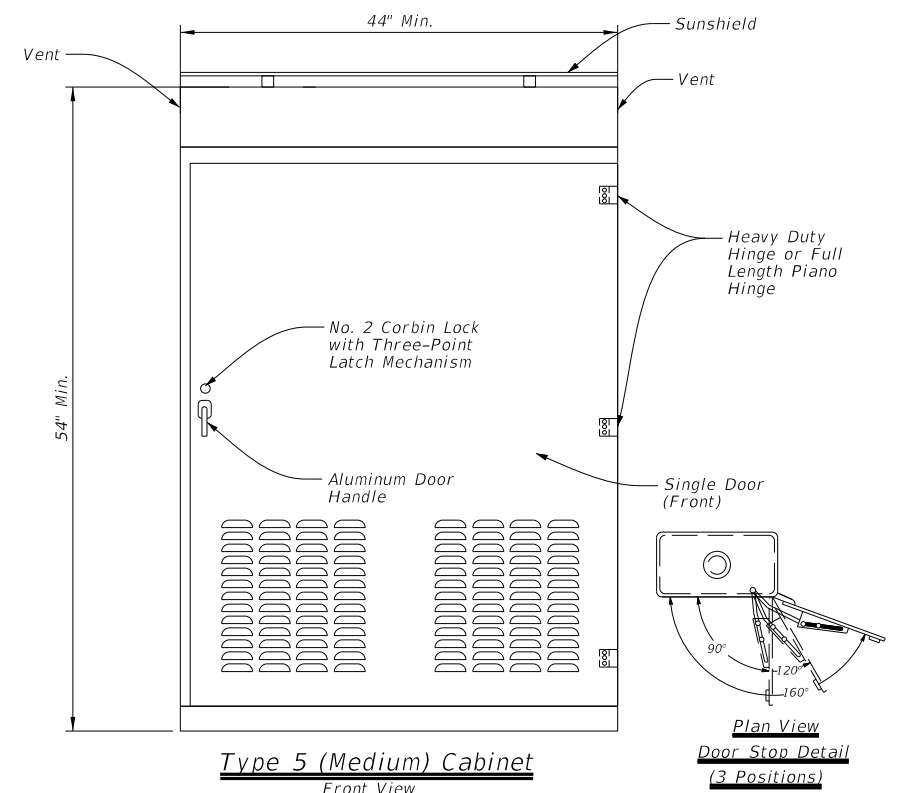
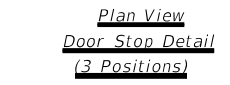


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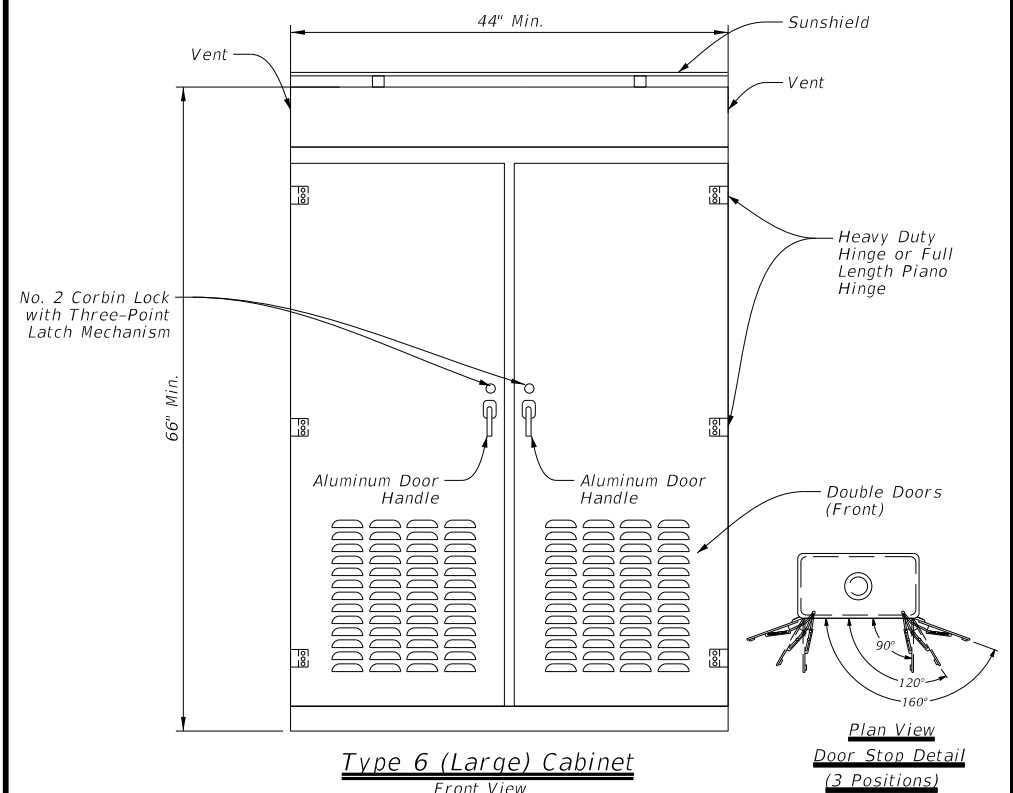
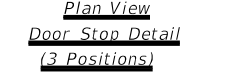
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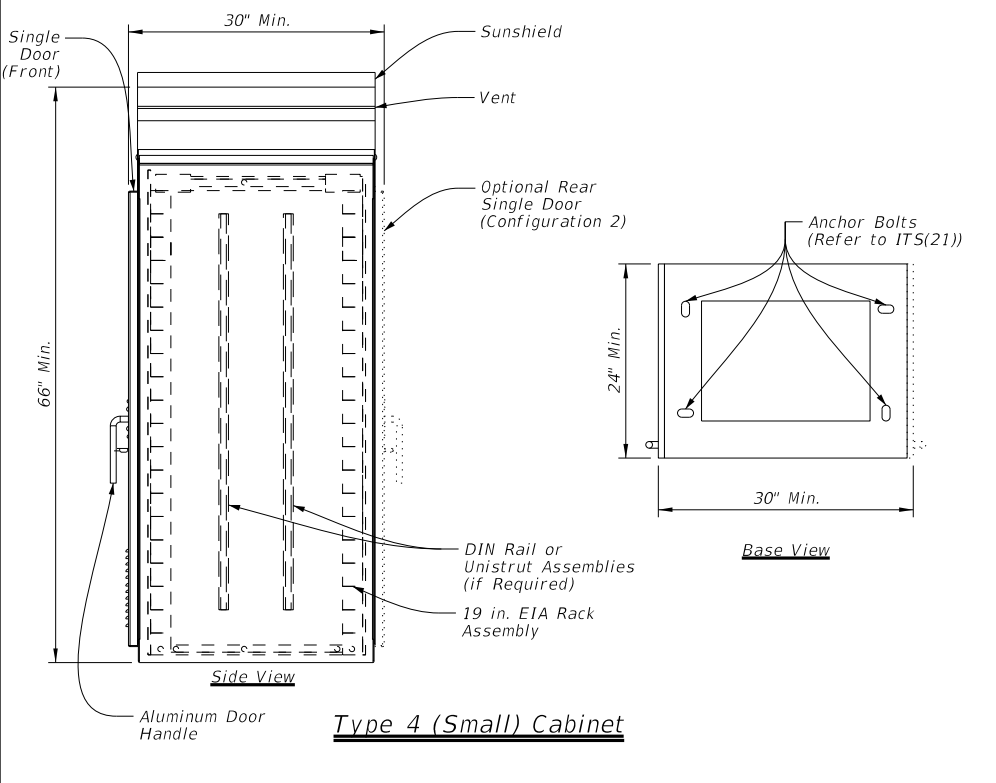
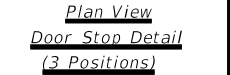
**Type 4 (Small) Cabinet**  
 Front View



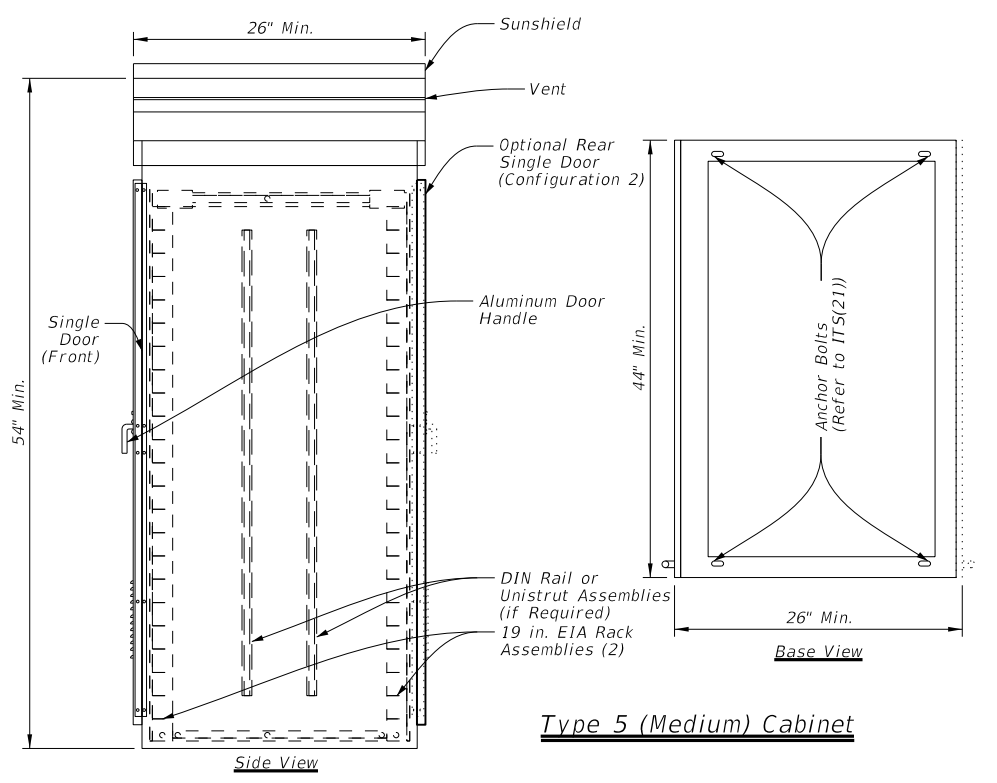
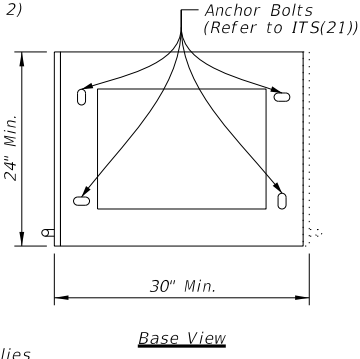
**Type 5 (Medium) Cabinet**  
 Front View



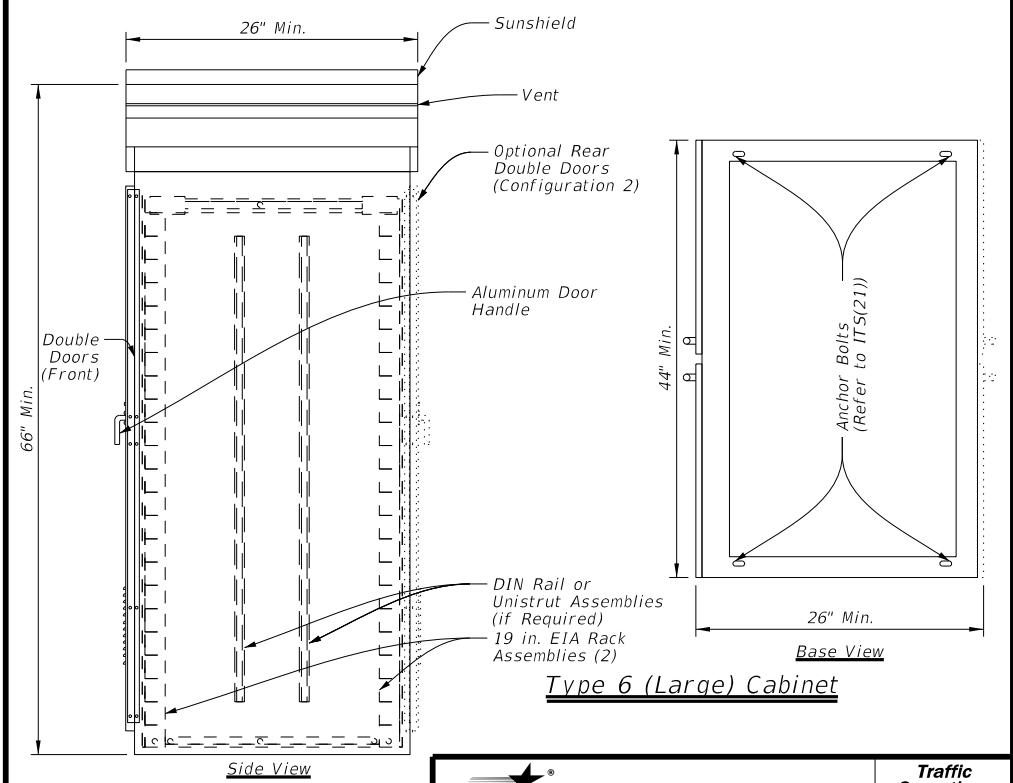
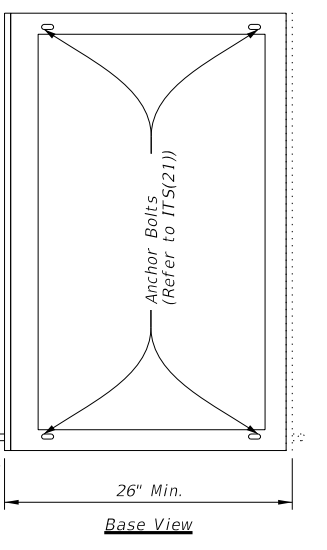
**Type 6 (Large) Cabinet**  
 Front View



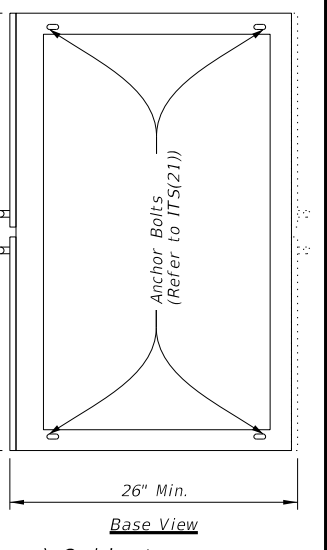
**Type 4 (Small) Cabinet**  
 Side View



**Type 5 (Medium) Cabinet**  
 Side View



**Type 6 (Large) Cabinet**  
 Side View



**General Notes:**

1. Cabinet hardware equipment and door configuration shown is diagrammatic in nature and intended to represent a preferred ground mounted cabinet setup. Door orientation may vary and will be noted in the plans. The contractor will be responsible for configuring cabinets with all appropriate ITS hardware and power supplies in accordance with the plans and specifications. The contractor may alter the cabinet configuration shown to maximize space and ensure easy access for maintenance.
2. All dimensions are approximate and represent minimum dimensions.
3. Provide conduit entrances at the bottom of the cabinet.
4. Paid under Special Specification "ITS Ground Mounted Cabinet" (Configuration 1) with single door. Paid under Special Specification "ITS Ground Mounted Cabinet" (Configuration 2) for rear door option.
5. Sunshield to be mounted to cabinet using nuts, bolts, and spacers. Water proof sealant to be used at cabinet surface/bolt contact points.



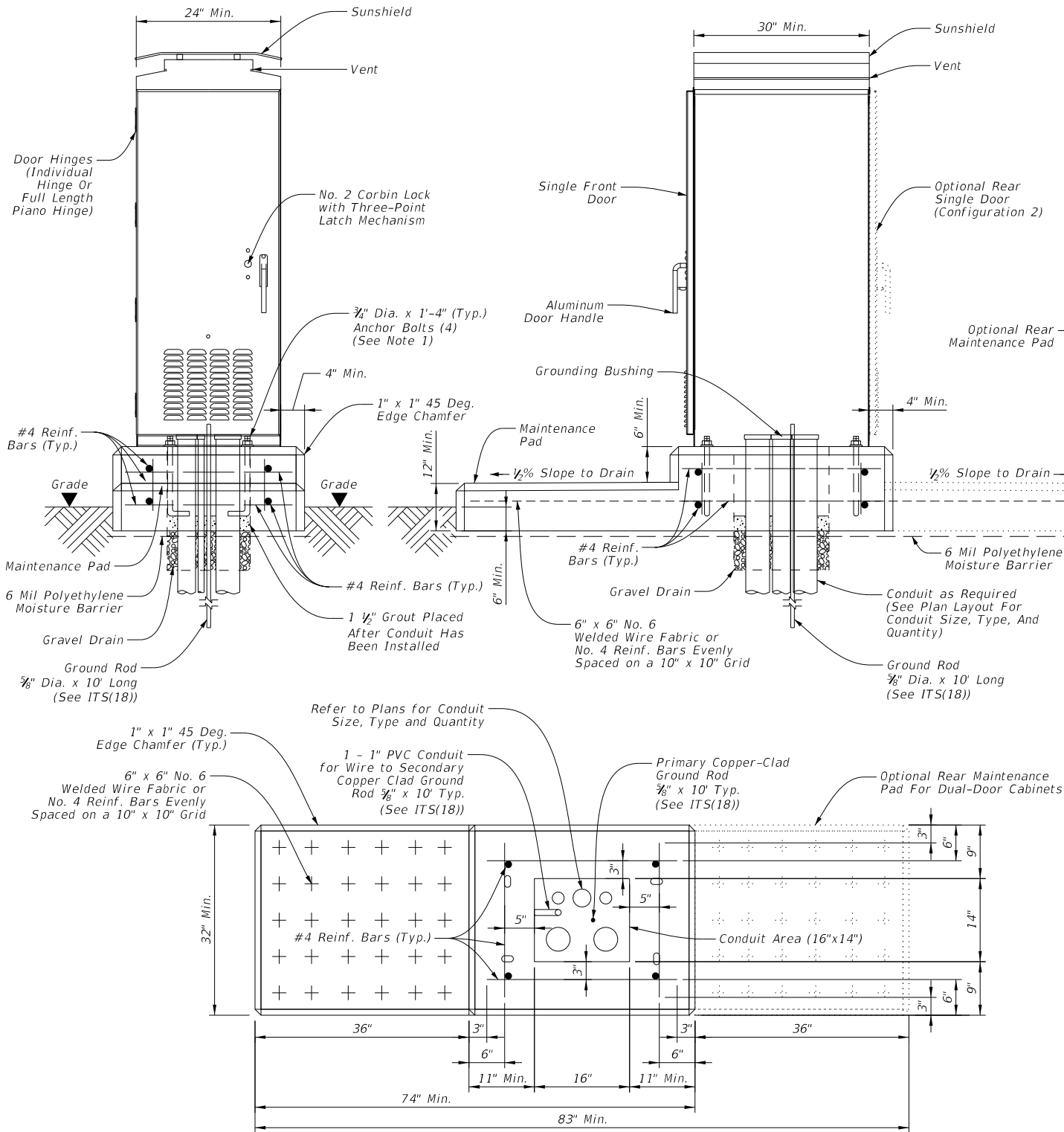
**ITS GROUND MOUNTED CABINET ELEVATION DETAILS**

**ITS(20)-15**

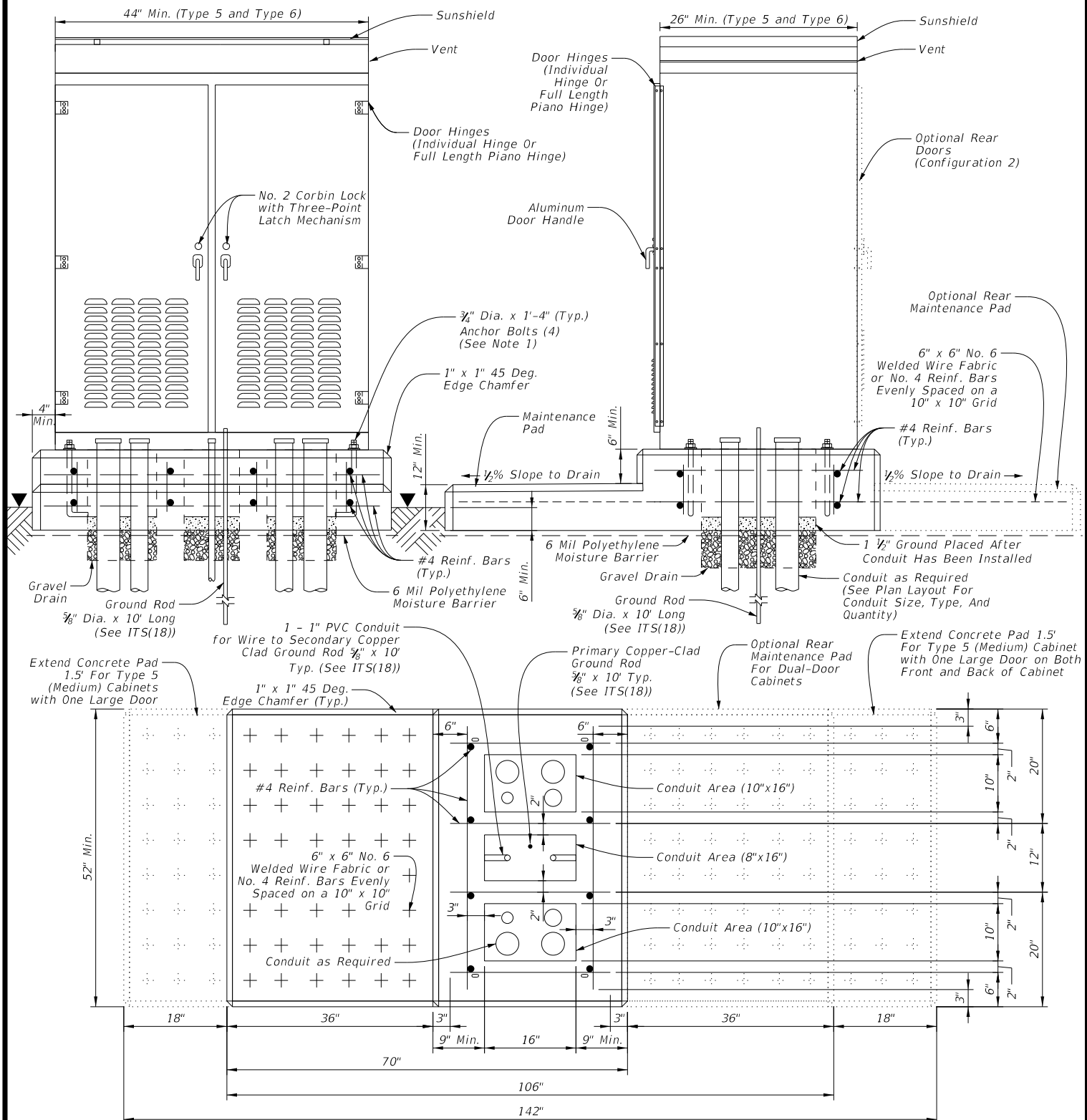
FILE: its(20)-15.dgn	DN: TxDOT	CK: TxDOT	DW: TxDOT	CR: TxDOT
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PAR	HUNT, ETC		49	

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**Type 4 (Small) Cabinet**



**Type 5 (Medium) & Type 6 (Large) Cabinet**

**General Notes:**

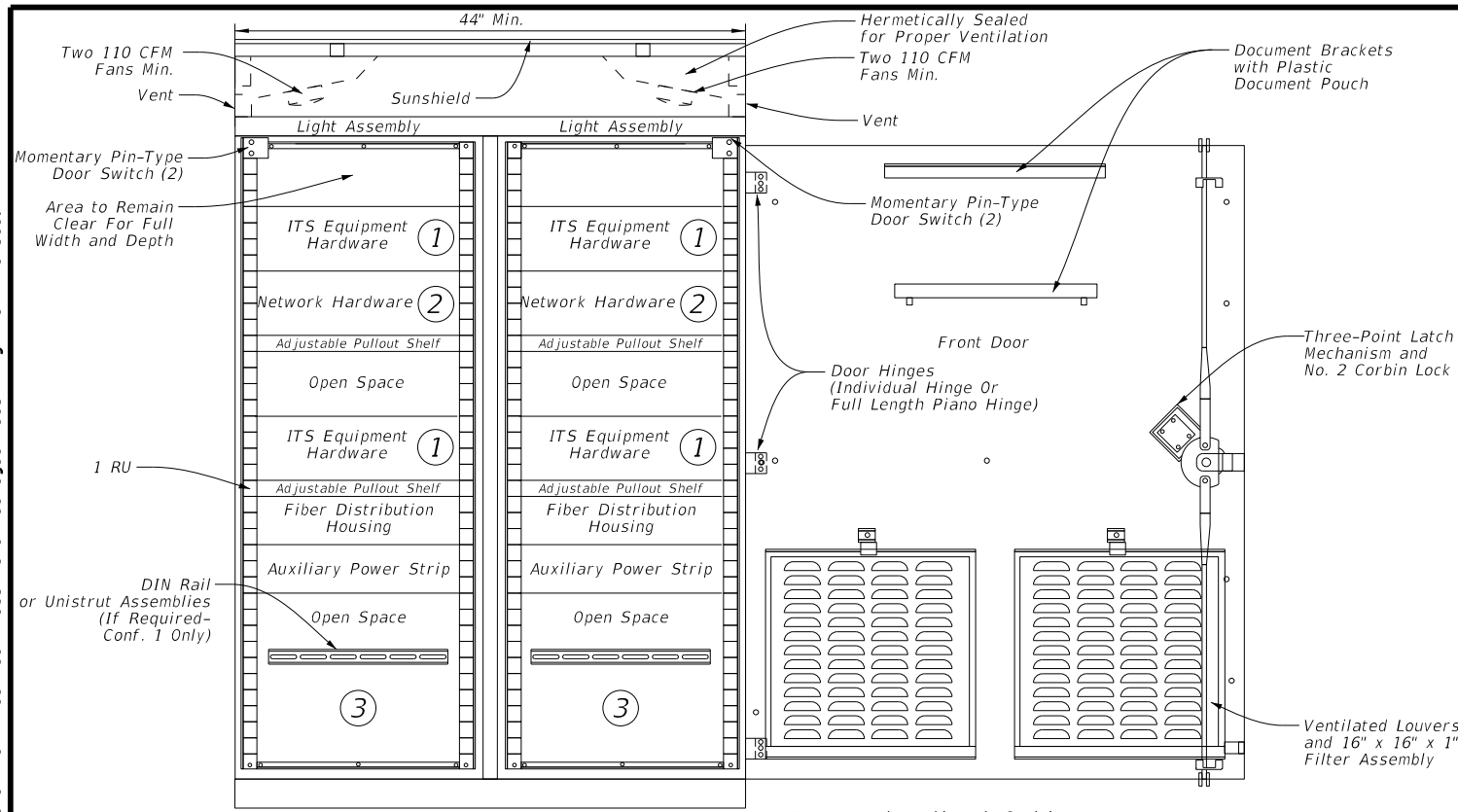
1. Details of anchor bolt location to be furnished by the cabinet manufacturer. Size and length of anchor bolts shown in details may vary by manufacturer.
2. Modify concrete base dimensions to fit required cabinet type.
3. Ensure conduit area has gravel drain, 12" depth, coarse aggregate, grade No. 1.
4. All concrete to be Class "A" in accordance with Item 421.
5. Set the cabinet foundation level with the pavement surface, in unpaved area. The foundation shall be a minimum of 4" above surrounding grade, or as approved by the Engineer.
6. Furnish any additional concrete which may be necessary to stabilize foundation at unusual locations.
7. Foundation will be subsidiary to Special Specification "ITS Ground Mounted Cabinet."
8. Ground cabinet as required in cabinet specifications and as detailed on ITS(18) in accordance with the National Electric Code (NEC).
9. Treat cabinet foundation with moisture sealant.
10. Type 5 cabinet foundation will have a slightly larger foundation than Type 6. See foundation notes on details.
11. Drain pipe shall be screened for drainage portion below foundation in gravel.

		<b>Traffic Operations Division Standard</b>	
<h2>ITS GROUND MOUNTED CABINET FOUNDATION DETAILS</h2>			
<h3>ITS(21)-15</h3>			
FILE: its(21)-15.dgn	DW: TxDOT	CK: TxDOT	DW: TxDOT
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REVISIONS			HIGHWAY: IH 30
	DIST: PAR	COUNTY: HUNT, ETC	SHEET NO.: 50



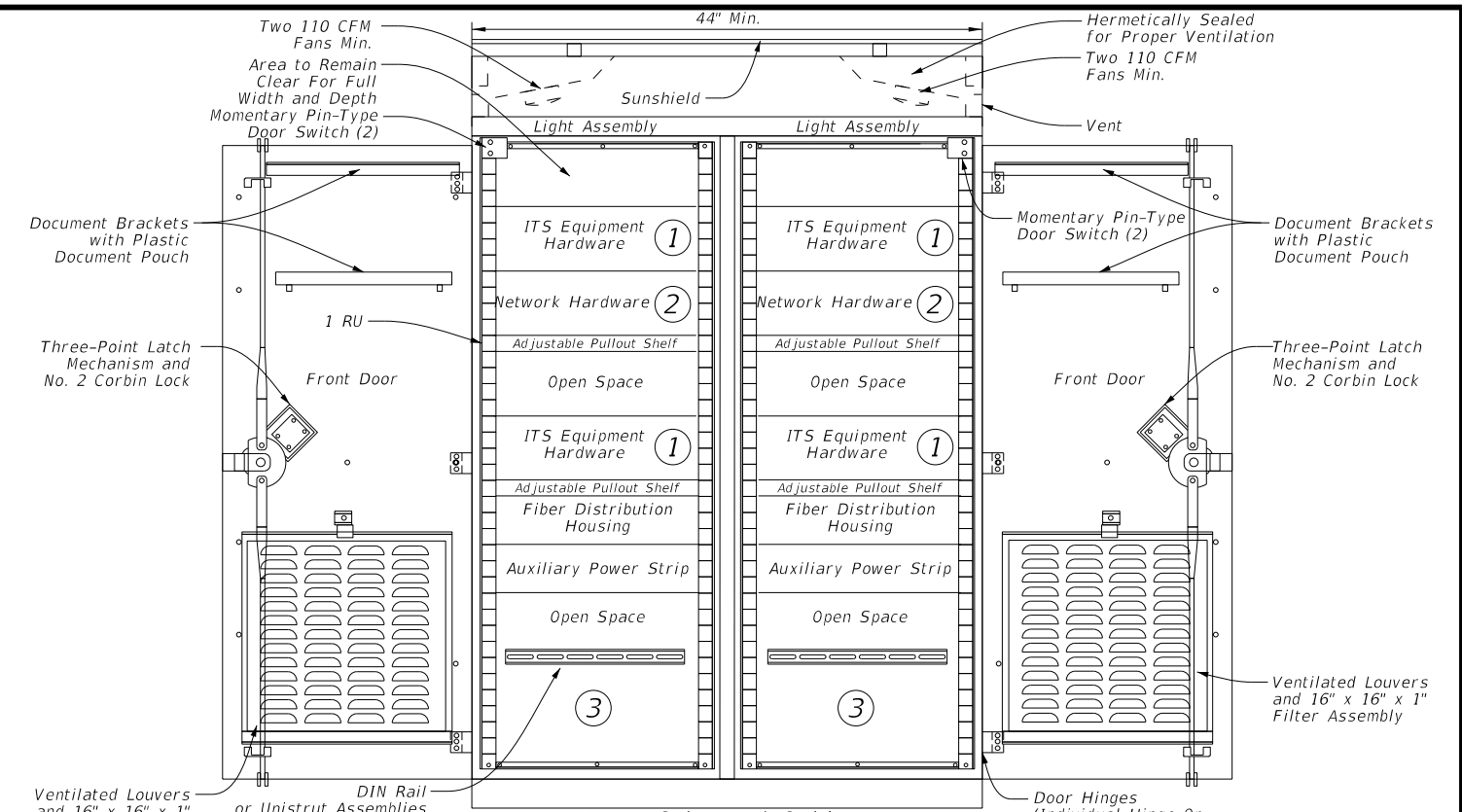
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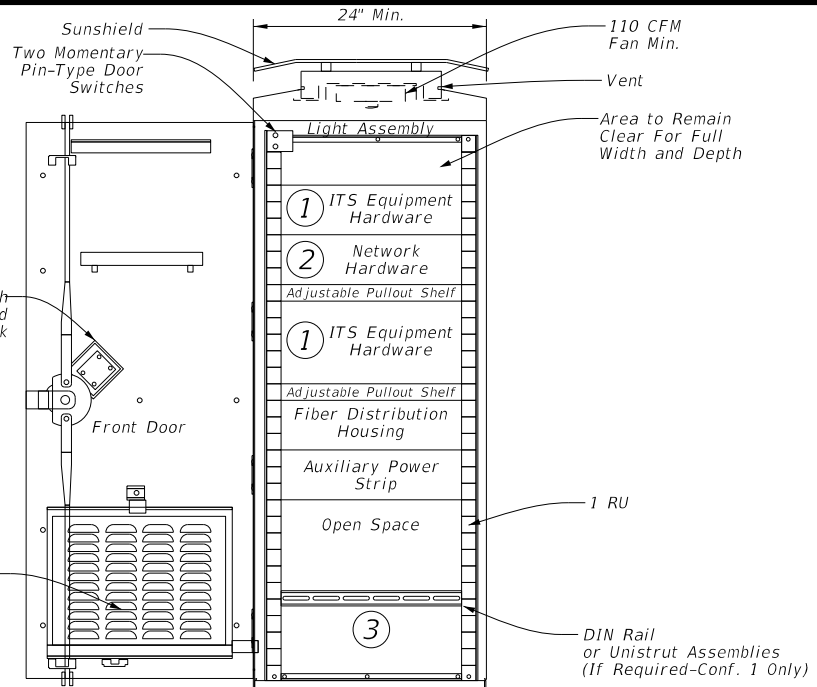
**Type 5 (Medium) Cabinet**

Configuration 1 = Doors in Front Only  
 Configuration 2 = Doors in Front and Rear



**Type 6 (Large) Cabinet**

Configuration 1 = Doors in Front Only  
 Configuration 2 = Doors in Front and Rear



**Type 4 (Small) Cabinet**

Configuration 1 = Doors in Front Only  
 Configuration 2 = Doors in Front and Rear

Typical Equipment Layout Legend	
Example Equipment	
①	CCTV Interface Panel, Radar Vehicle Sensing Device (RVSD) Equipment, DMS/LCS Controller, Environmental Sensor Station (ESS) Equipment, Bluetooth Equipment, Highway Advisory Radio (HAR), Ramp Meter or Inductive Loop Card Rack, Automatic Vehicle Identification (AVI) Equipment, or ITS Radio Equipment (See General Note 1)
②	Ethernet Switch, Video Encoder, Terminal Server, Fiber Optic Transceivers, or Media Conversion Equipment (See General Note 1)
③	Power Distribution Assembly, Service Entrance Breakers, Primary AC Power, Auxiliary Power Strip, Ground Bus Bar, Surge Protection Equipment, Solar Power System (If Required)

**General Notes:**

- Layout of hardware equipment and configuration shown is diagrammatic in nature and intended to represent a preferred ground mounted cabinet setup. Hardware needed for each cabinet varies and not all cabinet equipment may be shown. The contractor will be responsible for configuring cabinets with all appropriate ITS hardware and power supplies in accordance with the plans and specifications. The contractor may alter the cabinet configuration shown to maximize space and ensure easy access for maintenance.
- All dimensions are approximate and represent minimum dimensions.
- Provide conduit entrances at the bottom of the cabinet.
- Paid under Special Specification "ITS Ground Mounted Cabinet" (Configuration 1) with single door.  
 Paid under Special Specification "ITS Ground Mounted Cabinet" (Configuration 2) for rear door option.
- RU = rack unit.
- Contractor to remove the cabinet removable center support, which ensures cabinet rigidity during shipping, during installation.

Texas Department of Transportation Traffic Operations Division Standard

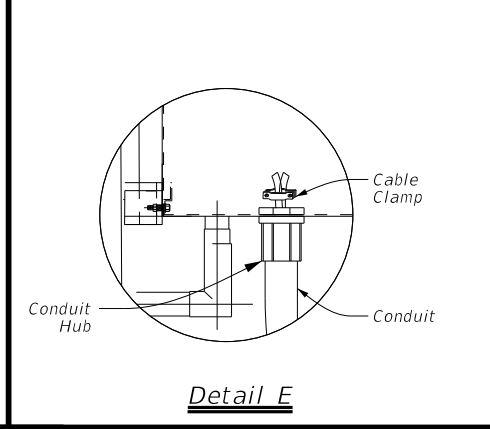
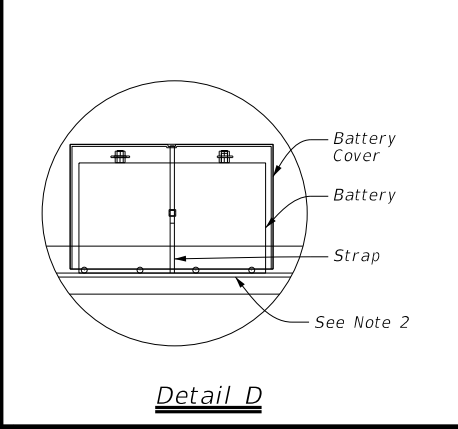
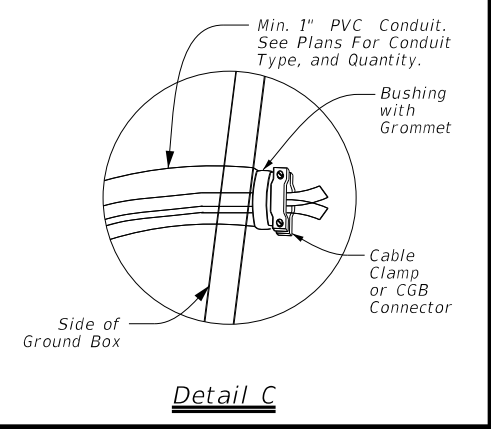
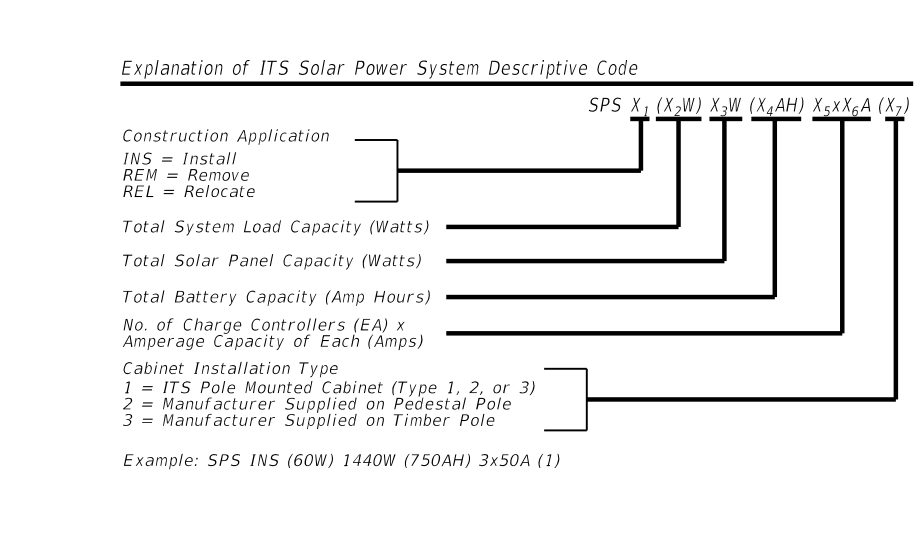
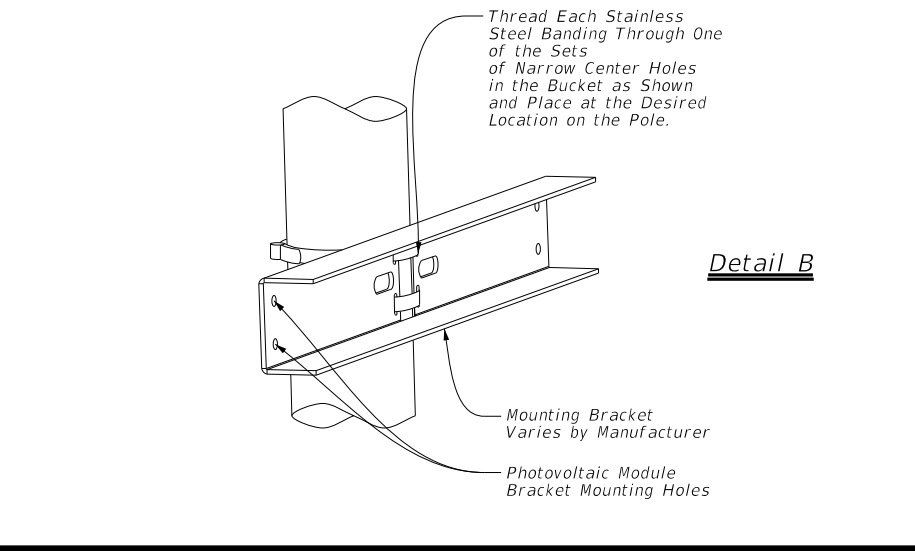
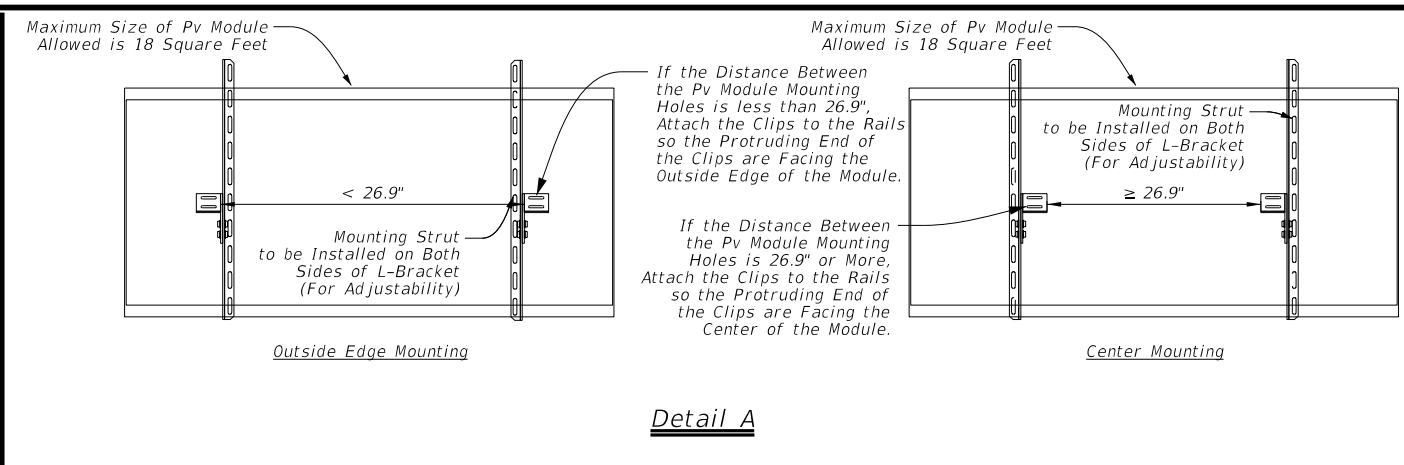
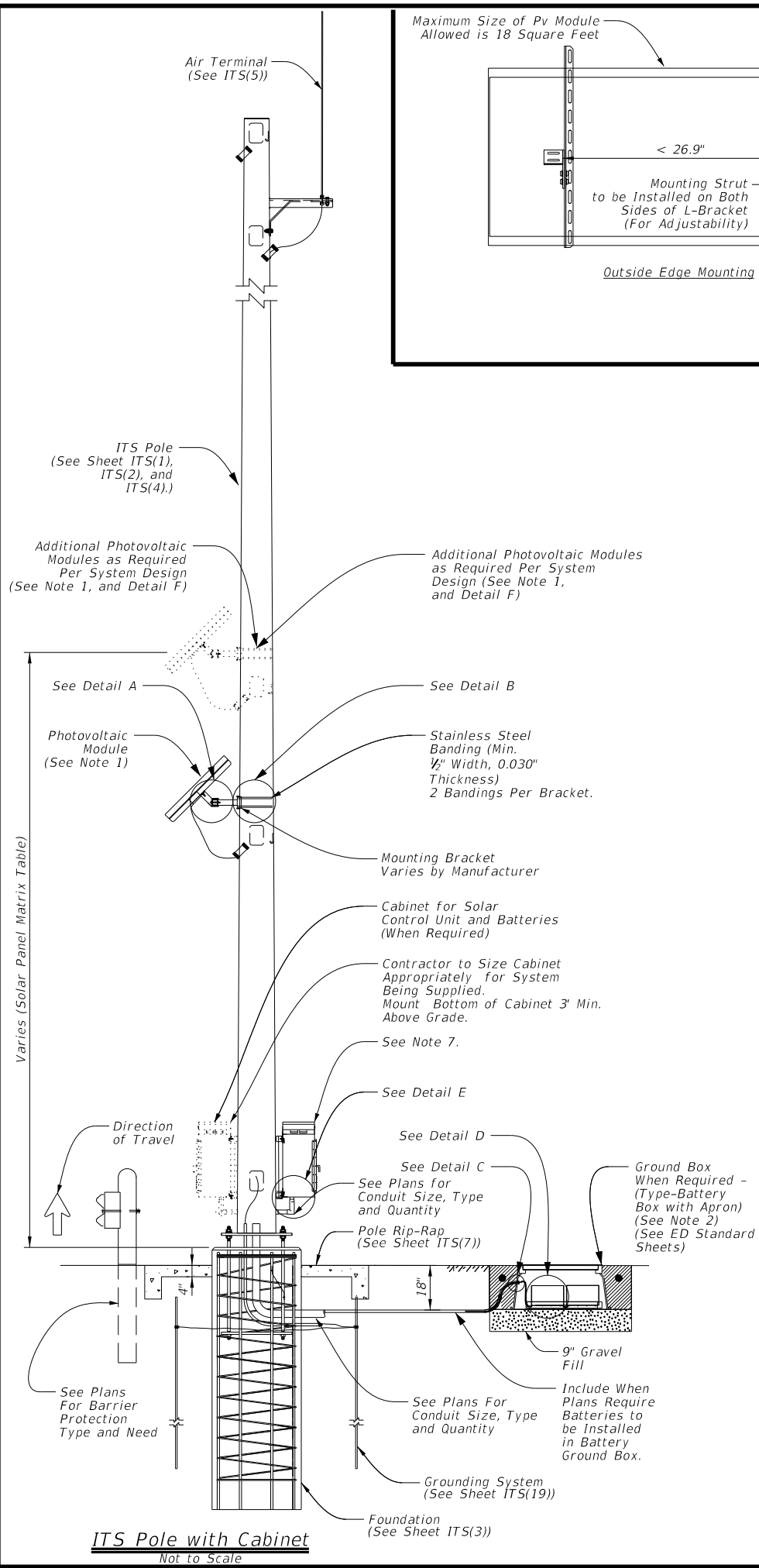
## ITS GROUND MOUNTED CABINET INTERIOR DETAILS

### ITS(23)-15

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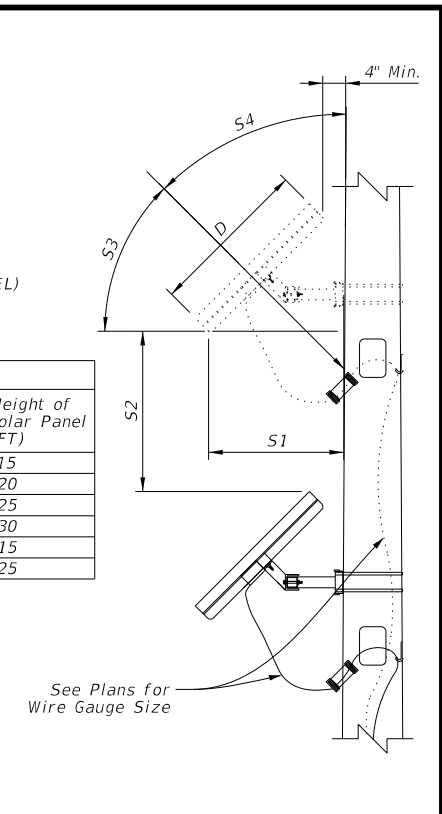


Dimension	Distance/Angle
S1	= $D \times (\sin(S3)) + 4$ (in.)
S2	= $D \times (\sin(S3)) \times (\tan(S3))$ (in.)
S3	= 90 deg. - S4 (zenith angle)
S4	Variable

S1 = Panel offset  
 S2 = Optimum vertical clearance between panels (in.)  
 S3 = Tilt angle (degrees), also sun elevation from horizon  
 S4 = Sun zenith angle (degrees) oriented for maximum exposure per National Renewable Energy Laboratory (NREL)  
 D = Depth of panel (in.)

Wind Zone (MPH)	Pole Height (FT)	Stiffeners	Max. No. of Solar Panels	Max. Height of Upper Solar Panel (FT)
90 or 110	20	Not Included	1	15
90 or 110	30-60	Not Included	2	20
90 or 110	30	Included	3	25
90 or 110	40-60	Included	4	30
130	20-60	Not Included	1	15
130	30-60	Included	3	25

\* - ITS pole height less than 20 ft. have not been designed to support solar panels



**General Notes:**

- Orient photovoltaic module (Pv) for optimum exposure to sunlight (face to the south) per National Renewable Energy Laboratory (NREL) guidelines. Prior to installation, check the location to ensure there is no overhead obstruction that would block the Photovoltaic Module from receiving full sunlight. Unless specified elsewhere, mount a minimum of 14' above grade.
- When required for batteries to be installed in a battery ground box, place the batteries on a 3/16" thick plastic sheet and connect batteries together. Place a plastic cover (battery bell jar) over the top of each battery and secure the battery bell jar to the battery with a strap. The batteries, bell jars, straps and 3/16" thick plastic sheet will be subsidiary to special specification "ITS Solar Power System."
- When required for batteries to be installed in an pole mounted cabinet, wire batteries according to manufacturer's recommendations. Provide the number of batteries as required by the manufacturer. Stack the batteries in the cabinet on shelves with 1" vertical separation.
- See Electrical Details (ED) standard sheets for additional requirements regarding the installation of ground boxes/battery boxes, and conduit.
- Use materials specifically designed for attaching cabinets, photovoltaic modules, etc., to poles.
- See special specification "ITS Solar Power System" for further requirements.
- When provisioned in the plans, solar controller and batteries are permitted to be installed along with ITS equipment inside ITS pole mounted cabinet for new installations. For existing conditions, solar controller and batteries are permitted if spare capacity exists. Engineer to verify existing cabinet type and spare capacity before sizing solar power system.
- Pv = Photovoltaic
- See sheets ITS(1), ITS(2), and ITS(4) "ITS Pole Details" for further information regarding the ITS pole assembly.
- Use hardware specifically designed for attaching equipment (i.e., cabinet, photovoltaic module, etc.) to pole as recommended by equipment manufacturer. Provide mounting details for approval.

Texas Department of Transportation  
 Traffic Operations Division Standard

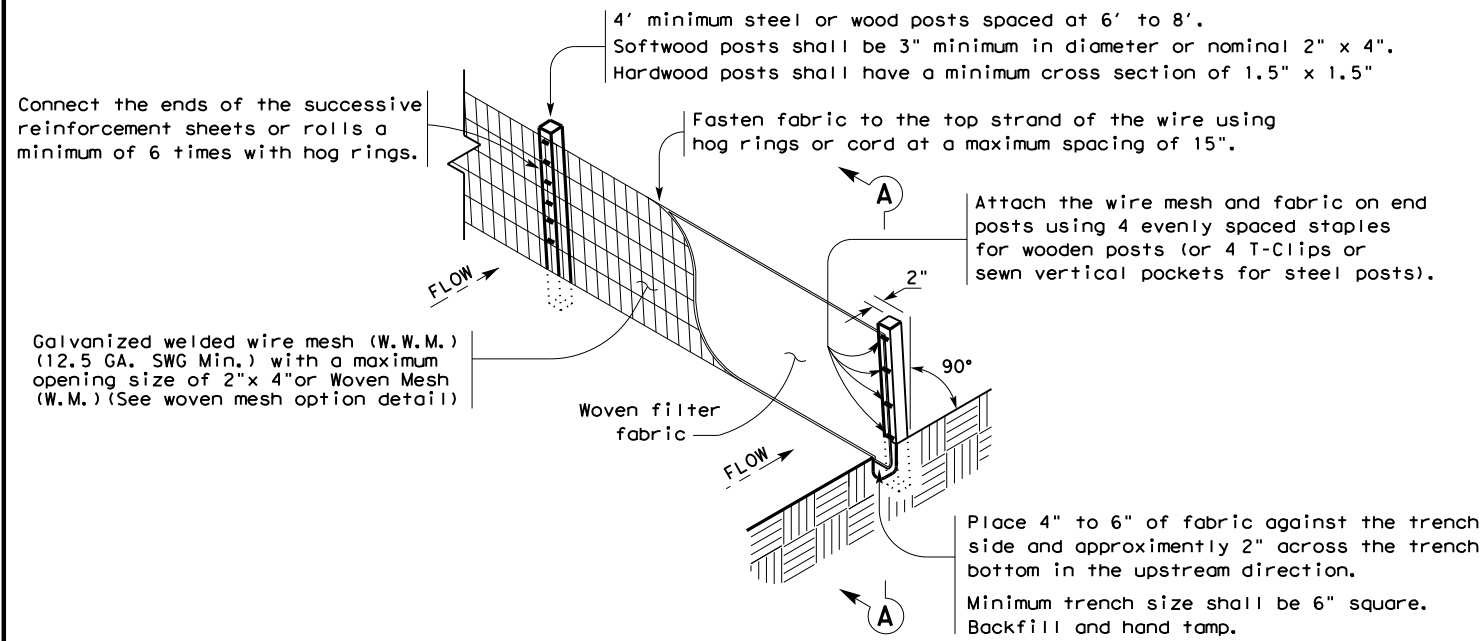
## ITS SOLAR POWER SYSTEM POLE MOUNTING DETAILS

### ITS(24)-15

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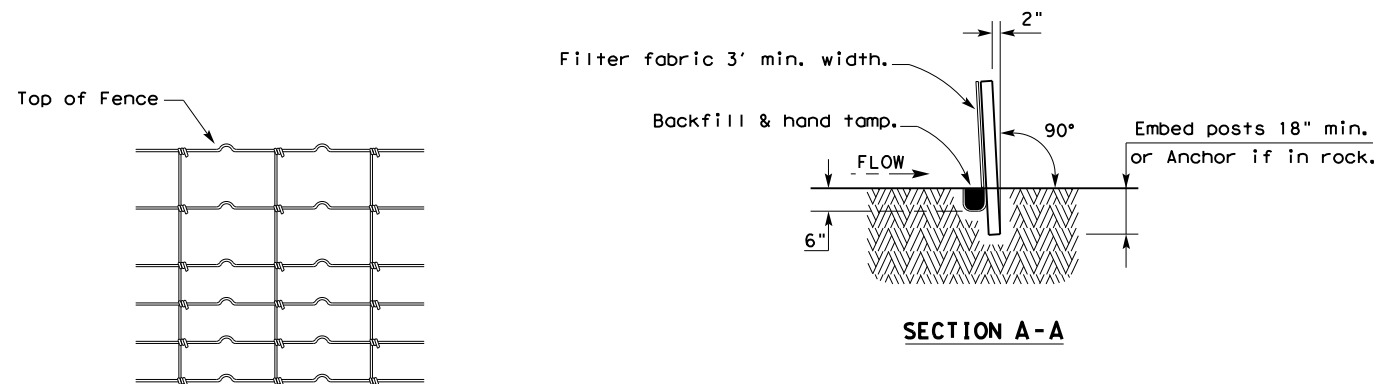
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**TEMPORARY SEDIMENT CONTROL FENCE**

SCF



**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/FT<sup>2</sup>. Sediment control fence is not recommended to control erosion from a drainage area larger than 2 acres.

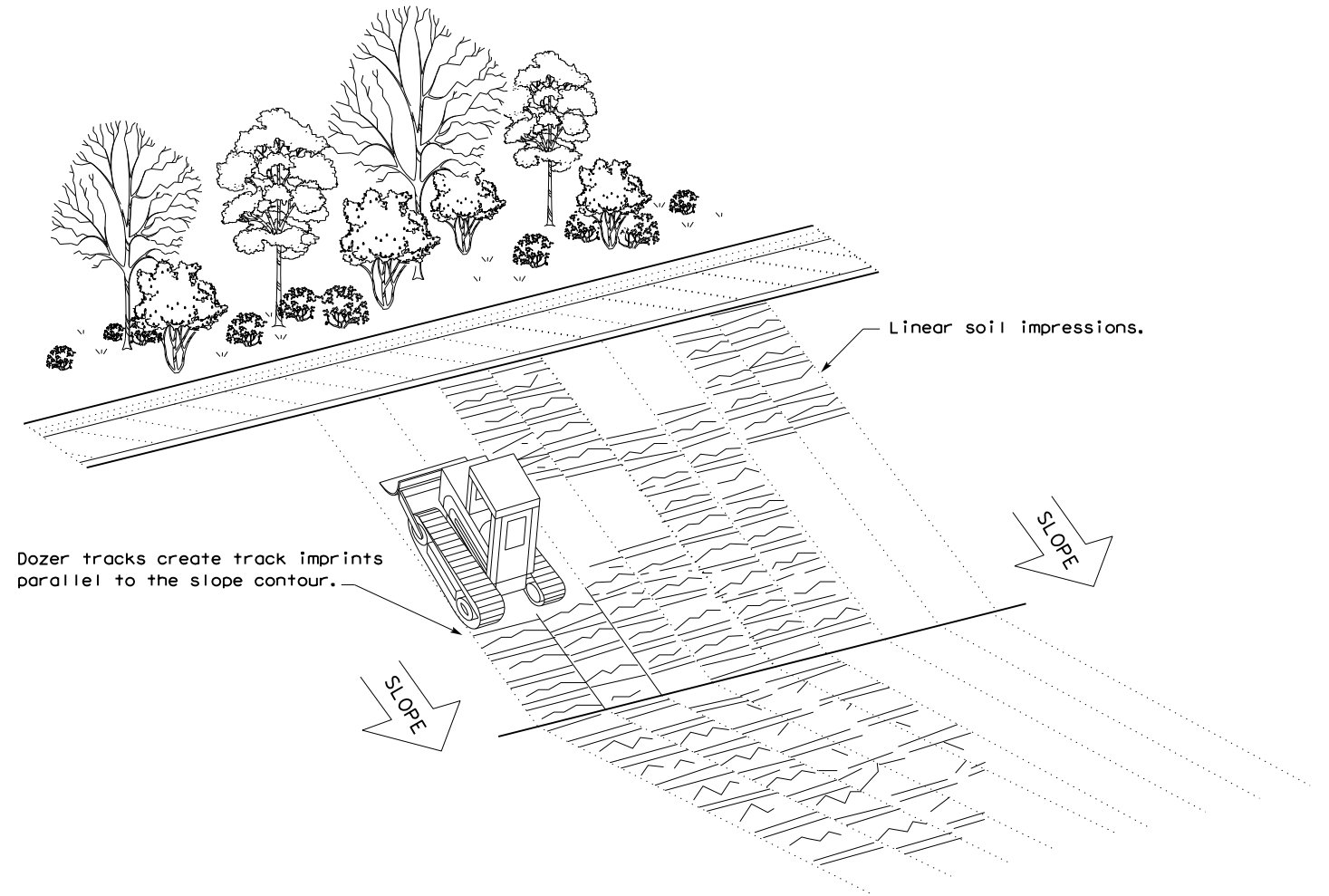
**LEGEND**

Sediment Control Fence

SCF

**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.



**VERTICAL TRACKING**

				Design Division Standard	
<b>TEMPORARY EROSION, SEDIMENT AND WATER POLLUTION CONTROL MEASURES FENCE &amp; VERTICAL TRACKING</b> <b>EC(1) - 16</b>					
FILE: ec116	DN: TxDOT	CK: KM	DW: VP	DN/CK: LS	
© TxDOT: JULY 2016	CONT	SECT	JOB	HIGHWAY	
REVISIONS	6385	38	001	IH 30	
	DIST	COUNTY	SHEET NO.		
	PAR	HUNT, ETC	54		