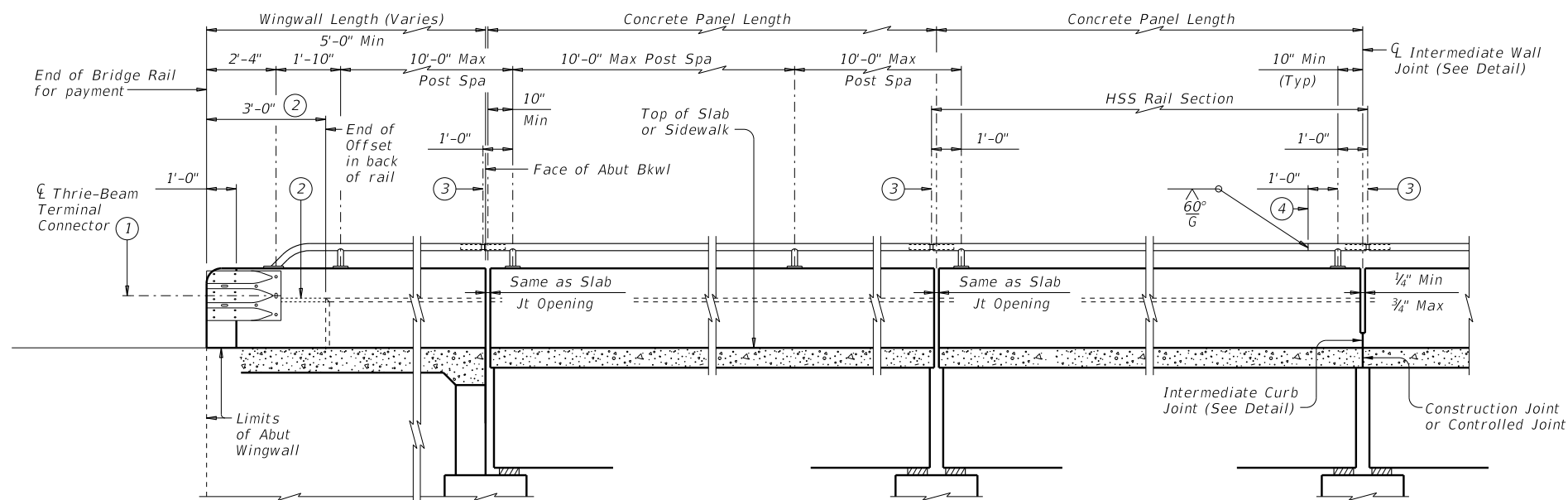


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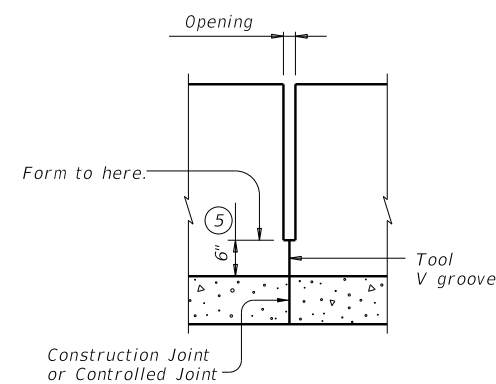


## AT ABUTMENTS

### AT BENTS WITH SLAB EXP JOINTS

AT BENTS WITHOUT SLAB EXP JOINTS

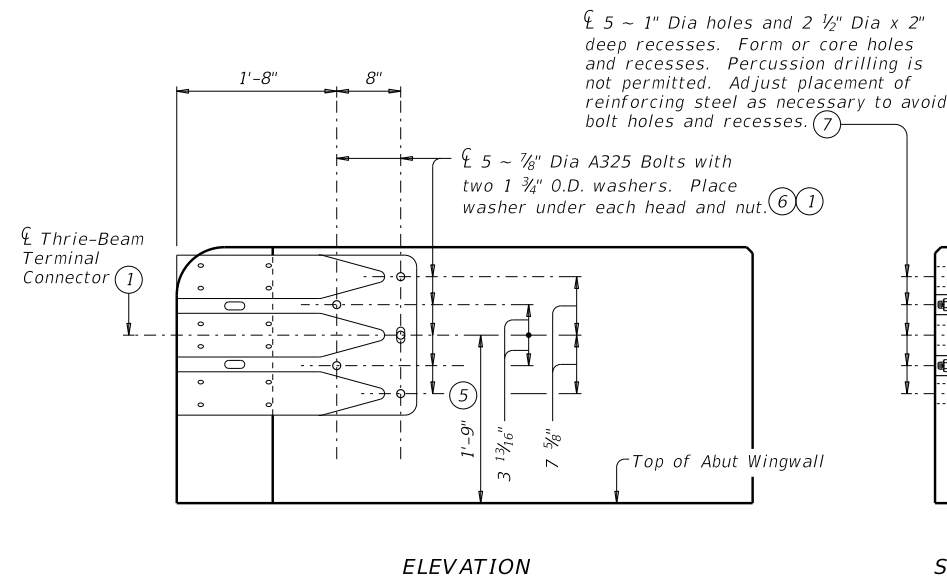
## ROADWAY ELEVATION OF RAIL



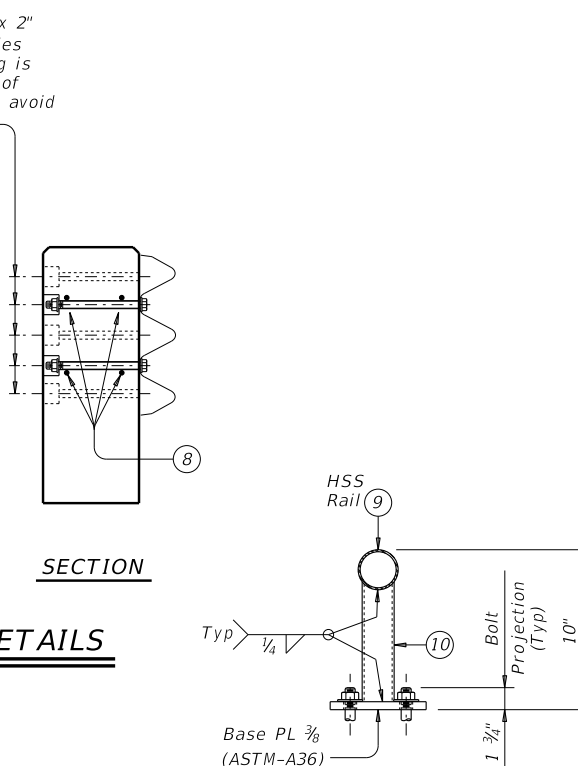
*INTERMEDIATE  
WALL JOINT DETAIL*

*Provide at all interior bents without slab expansion joints. Location independent of HSS rail splices.*

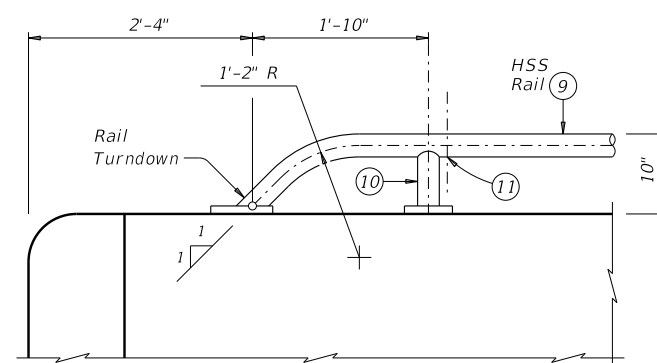
- ① Terminal Connectors and associated hardware are to be paid for under the Item "Metal Beam Guard Fence". Attach Metal Beam Guard Fence Transitions to the bridge rail and extend along the embankment unless otherwise shown in the plans.
- ② Back of rail offset may, with Engineer's approval, be continued to the end of the railing.
- ③ Exp Joint or Splice Joint as required.
- ④ One shop splice per HSS rail section is permitted with minimum 85 percent penetration. The weld may be square groove, or single vee groove. Grind smooth.
- ⑤ Increase 2" for structures with overlay.
- ⑥ Provide bolts of sufficient length to extend  $\frac{1}{2}$ " to  $\frac{3}{4}$ " beyond nut.
- ⑦ Bolt recesses are only required when pedestrian sidewalks are adjacent to back of rail.
- ⑧ Place 4 additional Bars R(#4) 3'-8" in length in fourth Bars S(#4) and centered 2'-0" from end of rail when Terminal Connections are required. Field bend as needed.
- ⑨ HSS 2.875 x 0.203
- ⑩ HSS 2.375 x 0.154
- ⑪  $\frac{3}{8}$ " Dia Hole in bottom of HSS rail (Minimum 1 hole between posts ~ Typ)



### TERMINAL CONNECTION DETAILS

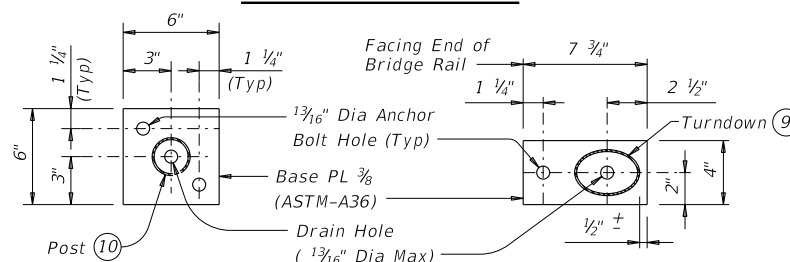


TRANSVERSE SECTION



Note that at least two anchor points (as shown) are required for the Bridge Rail on the Abutment Wingwall. Longer Wingwalls may require more than two Rail anchorages.

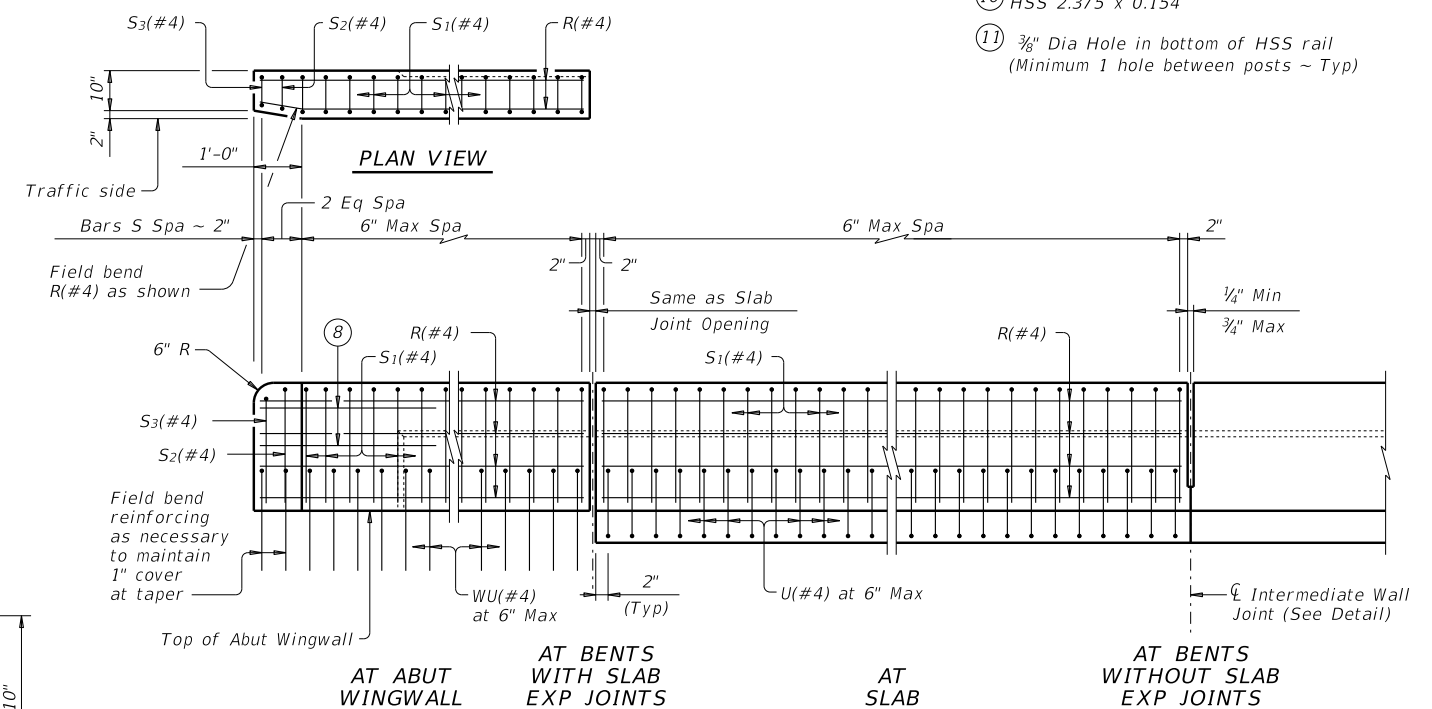
*HSS RAIL TERMINAL DETAIL*



POST BASE PLATE PLAN

RAIL TURNDOWN  
BASE PLATE PLAN

## HSS RAIL DETAILS



ELEVATION SHOWING TYPICAL REINFORCING PLACEMENT

(Showing without raised sidewalk)

*SHEET 1 OF 3*




Texas Department of Transportation

**Bridge  
Division  
Standard**

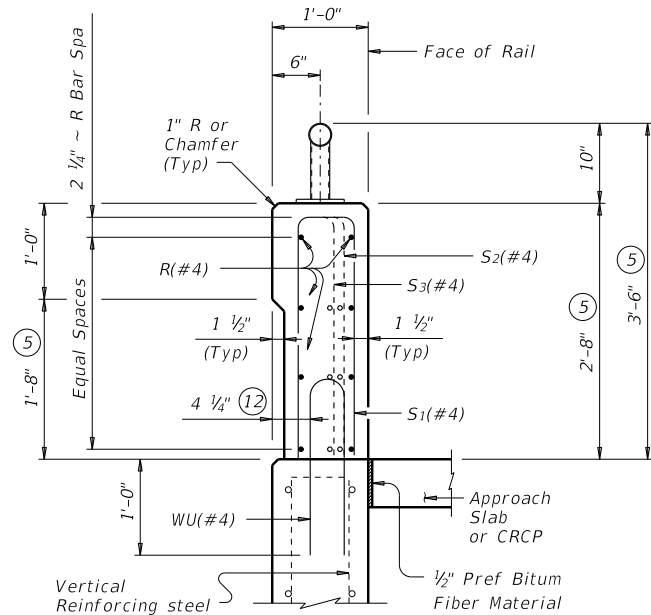
### COMBINATION RAIL

*TYPE C221*

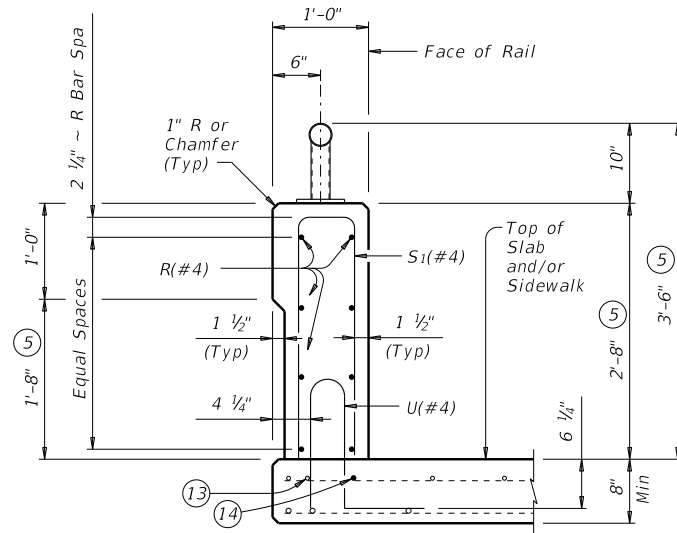
FILE:	rlstd018.dgn	DN:	TxDOT	CK:	TxDOT	DW:	JTR	CK:	JMH
 <b>TxDOT</b> July 2014		CONT	SECT	JOB			HIGHWAY		
REVISIONS 03-16: Removed shop drawing note. Added WASH TL-3 in General Notes. Added additional epyr classes.									
		DIST	COUNTY				SHEET NO.		

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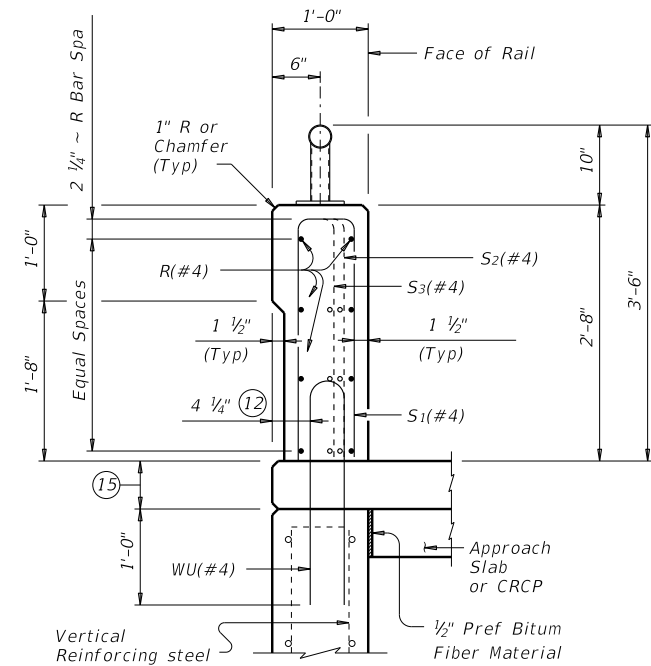


ON ABUTMENT WINGWALLS  
OR CIP RETAINING WALLS

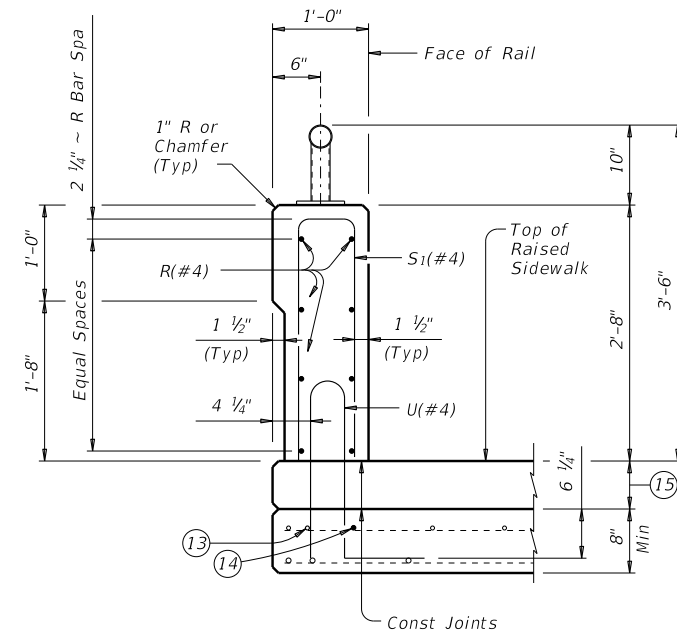


ON BRIDGE SLAB

SECTIONS THRU RAIL WITHOUT RAISED SIDEWALK

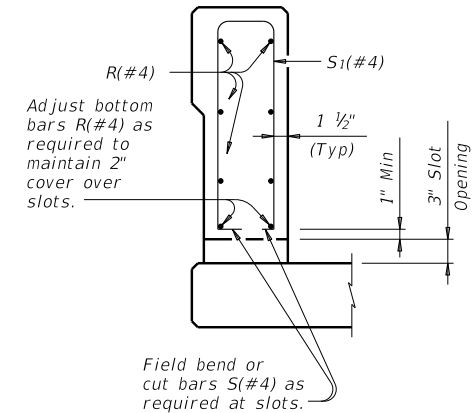


ON ABUTMENT WINGWALLS  
OR CIP RETAINING WALLS

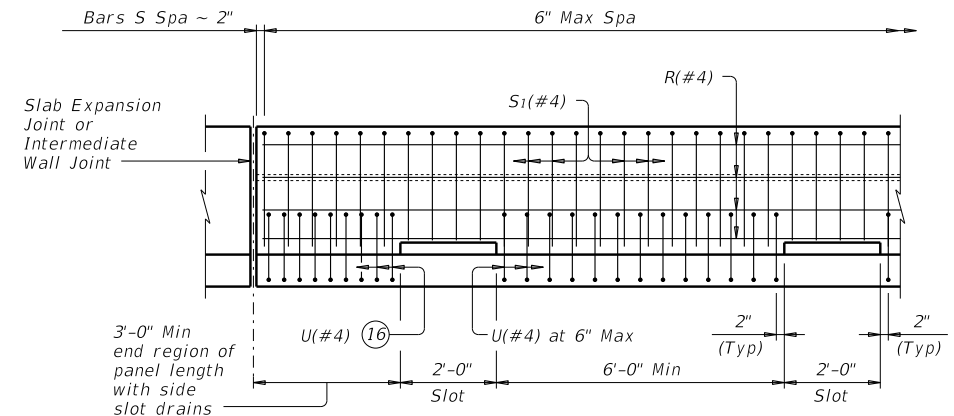


ON BRIDGE SLAB

SECTIONS THRU RAIL WITH RAISED SIDEWALK



SECTION THRU  
OPTIONAL SIDE SLOT DRAIN




OPTIONAL SIDE SLOT DRAIN DETAIL

Note: Side Slot Drains may be used where shown elsewhere on the plans or as directed by the Engineer. Drains should not be placed over railroad tracks, lower roadways, or sidewalks. When this rail is used as a separator between a roadway surface and a sidewalk surface, side drain slots will not be permitted.

- (5) Increase 2" for structures with overlay.
- (12) 5 1/4" when vertical reinforcing has closer clear cover over horizontal reinforcing in abutment wingwalls or retaining walls on traffic side of wall.
- (13) As an aid in supporting reinforcement, additional longitudinal bars may be used in the slab with the approval of the Engineer. Such bars must be furnished at the Contractors expense.
- (14) Top longitudinal slab bar may be adjusted laterally 3" plus or minus to tie reinforcing.
- (15) Raised Sidewalk
- (16) Space U(#4) bars at 4" Max when end region of panel length is less than 6'-0" to side slot drain. Space U(#4) bars at 6" Max when end region of panel length is 6'-0" and greater to side slot drain.

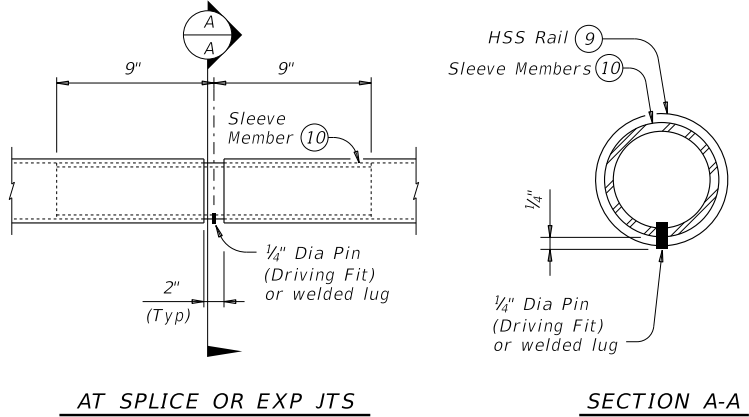
SHEET 2 OF 3

 <b>Texas Department of Transportation</b>				<b>Bridge Division Standard</b>	
<div>COMBINATION RAIL</div> <div>TYPE C221</div>					
FILE: r1st018.dgn	DN: TxDOT	CK: TxDOT	DW: JTR	CK: JMH	
©TxDOT July 2014	CONT	SECT	JOB	HIGHWAY	
REVISIONS					
03-16: Removed shop drawing note. Added WASH TL-3 in General Notes. Added additional epoxy classes.					
DIST	COUNTY			SHEET NO.	

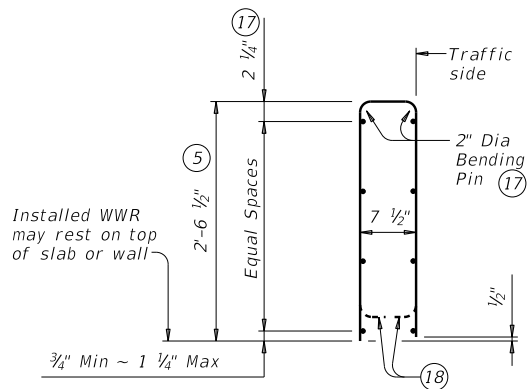
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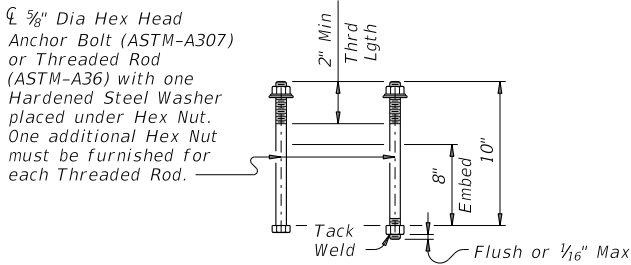
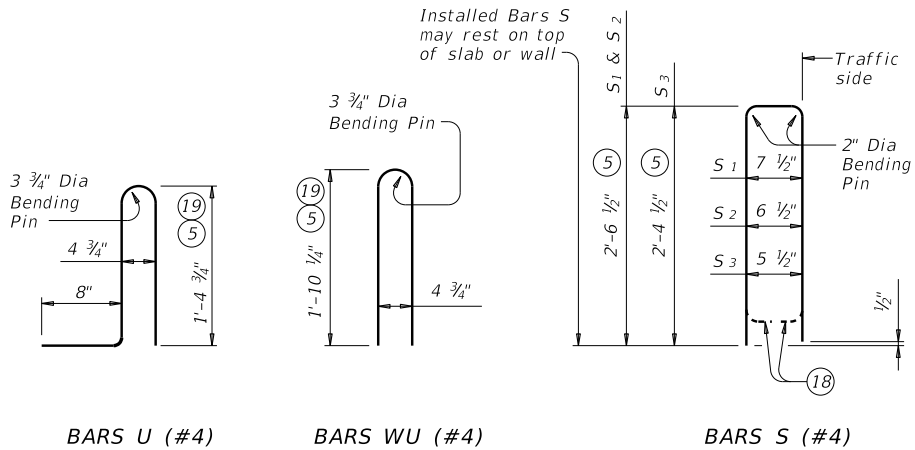
RAIL DATA FOR HORIZONTAL CURVES			
	RADIUS TO FACE OF RAIL	MAX CHORD LENGTH	CONSTRUCT OR FABRICATE
HSS Rail	Over 2800'	29'-0"	Straight rail panels
	Over 1400' thru 2800'	14'-6"	To required radius or to chords shown
	Over 700' thru 1400'	7'-3"	
	Thru 700'	Zero	To required radius



### PIPE SPLICE DETAILS



DESCRIPTION	LONGITUDINAL WIRES	VERTICAL WIRES
Minimum (Cumulative Total) Wire Area	1.067 Sq In.	0.267 Sq In. per Ft
Minimum	No. of Wires 8	Spacing 4"
Maximum	10	8"
Maximum Wire Size Differential	The smaller wire must have an area of 40% or more of the larger wire.	




- (5) Increase 2" for structures with overlay.  
(9) HSS 2.875 x 0.203  
(10) HSS 2.375 x 0.154  
(17) No longitudinal wires may be in top center of cage.  
(18) Bend or cut as required to clear drain slots.  
(19) For raised sidewalks, add sidewalk height to total bar height. Use sidewalk height at rail's location.  
(20) See "Material Notes" for anchor bolt information.

**CONSTRUCTION NOTES:**  
This railing may be constructed with slip-forms when approved by the Engineer, with equipment approved by the Engineer and when epoxy adhesive anchor bolts are used. Slip-forming parapet is not allowed if anchor bolts are cast with parapet wall. Provide sensor control for both line and grade. Tack welding to provide bracing for slip-form operations is acceptable. Welding can be performed at a minimum spacing of 3 ft between the cage and the anchorage. It is permissible to weld to U, WU and S bars at any location on the cage. If increased bracing is needed, additional anchorage devices must be added and welding must be performed in the upper two thirds of the cage.  
Face of rail, parapet must be plumb unless otherwise approved by the Engineer. HSS rail posts must be square to the top of parapet. Use epoxy mortar under post base plates if gaps larger than 1/16" exist.  
Round or chamfer exposed edges of HSS rail and HSS rail posts to approximately 1/16" by grinding.  
At the contractor's option anchor bolts may be cast with the parapet (See Cast-in-Place Anchor Bolt Options).  
HSS rail sections must not include less than two posts, and no more than four (except at Abutments).  
Chamfer all parapet exposed corners.

**MATERIAL NOTES:**  
Galvanize all steel components except reinforcing steel unless otherwise shown on plans.  
Provide Class "C" concrete. Provide Class "C" (HPC) if required elsewhere.  
Provide Grade 60 reinforcing steel.  
Epoxy coat all rail reinforcement if slab bars are epoxy coated.  
Deformed Welded Wire Reinforcement (WWR) (ASTM A1064) of equal size and spacing may be substituted for Bars U and WU unless noted otherwise. Deformed WWR (ASTM 1064) may be substituted for Bars R and S, as shown. Combinations of reinforcing steel and WWR or configurations of WWR other than shown are permitted if conditions in the table are satisfied. Provide the same laps as required for reinforcing bars.  
Provide ASTM-A1085 or A500 Grade B or A53 Grade B for all HSS.  
Anchor bolts must be 3/8" Dia ASTM A36 fully threaded rods with one hex nut and one hardened steel washer at each bolt. Embed threaded rods into parapet wall with a Type III, Class C, D, E, or F epoxy anchorage system. Minimum embedment depth is 3". Anchorage system chosen must be able to achieve an ultimate tensile resistance of 8.4 kips per bolt. The Contractor must provide evidence to the Engineer that this can be achieved. Evidence of adequate tensile resistance can be based on the manufacturer's published values of ultimate tensile strength (anchor spacing and edge distance must be accounted for). Anchor installation, including hole size, drilling, and clean-out, must be in accordance with the manufacturer's instructions.  
Optional cast-in-place anchor bolts must be 3/8" Dia ASTM A307 Grade A bolts (or A36 threaded rods with one tack welded hex nut each) with one hex nut and one hardened steel washer at each bolt.  
Provide bar laps, where required, as follows:  
Uncoated ~ #4 = 1'-5"  
Epoxy coated ~ #4 = 2'-1"

**GENERAL NOTES:**  
This rail has been evaluated and accepted to be of equal strength to railings with like geometry, which have been crash tested to meet MASH TL-3 criteria. This rail can be used for speeds of 50 mph and greater when a TL-3 rated guard fence transition is used. When a TL-2 rated guard fence transition is used, this rail can only be used for speeds of 45 mph and less.  
Do not use this railing on bridges with expansion joints providing more than 5" movement.  
Rail anchorage details shown on this standard may require modification for select structure types. See appropriate details elsewhere in plans for these modifications.  
Submit erection drawings showing panel lengths, rail post spacing, and anchor bolt setting to the Engineer for approval.  
Average weight of railing with no overlay: 380 plf (total)  
370 plf (Conc)  
10 plf (Steel)

Cover dimensions are clear dimensions, unless noted otherwise.  
Reinforcing bar dimensions shown are out-to-out of bar.

SHEET 3 OF 3				
 <b>Texas Department of Transportation</b>			<b>Bridge Division Standard</b>	
COMBINATION RAIL				
TYPE C221				
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REVISIONS				
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