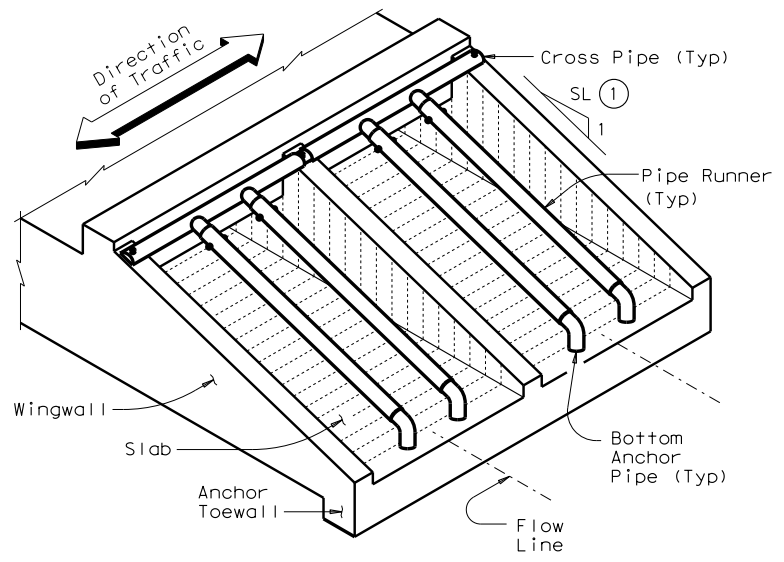
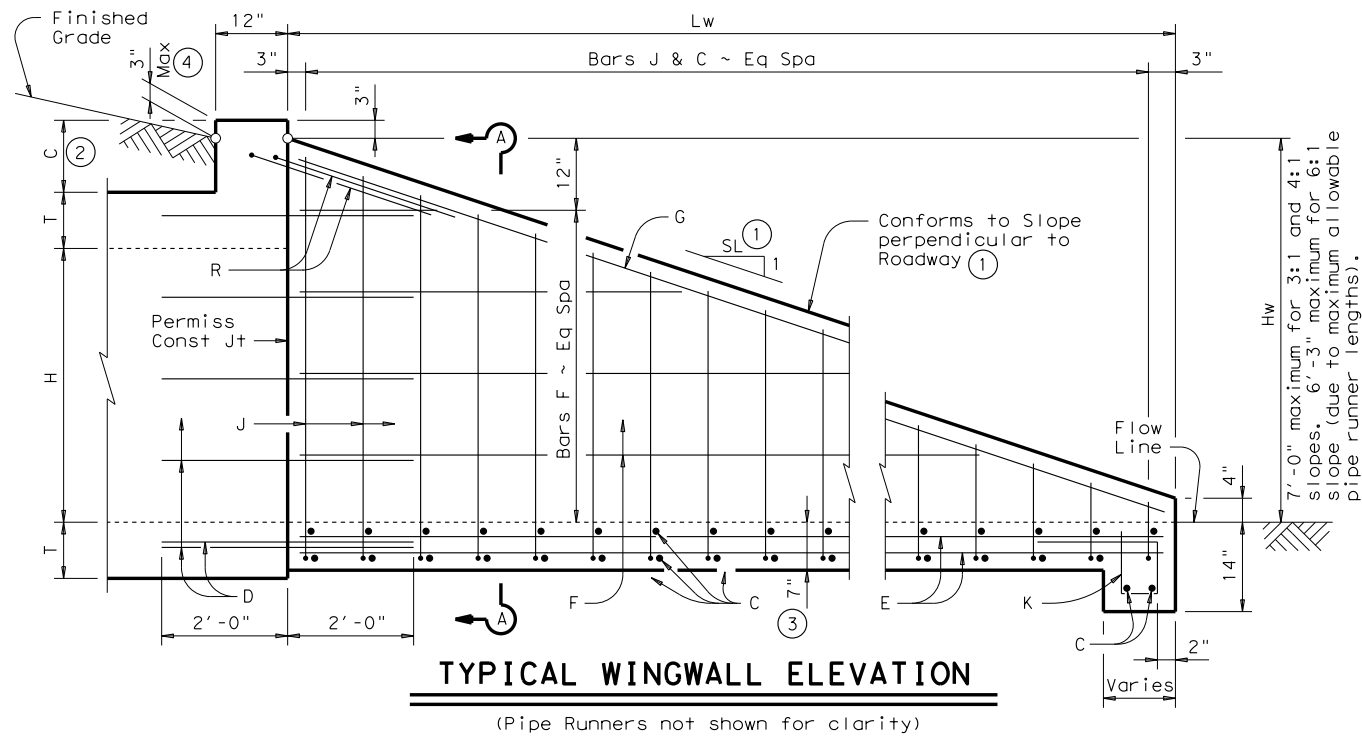


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DATE: FILE:



Formulas: (All values are in Feet)  
 $H_w = H + T + C - 0.250'$   
 $L_w = (H_w - 0.333') (SL)$

For Cast-in-place culverts:  
 $Atw = (N) (S) + (N+1) (U)$

For Precast culverts:  
 $Atw = (N) (2U+S) + (N-1) (0.500')$

Total Wingwall Area (S.F.)  
 $= (0.5) (H_w + 0.333') (L_w) (N+1)$

Total Concrete Volume (C.Y.)  
 $= [(Wingwall Area) (0.583') + (L_w) (Atw) (0.583') + (Atw) (1.167') (1.167' - 0.583')] \div (27)$

Pipe Runner Length  
 $= (L_w) (K1) - (1.917')$

Total Reinforcing (Lbs)  
 $= (1.55) (L_w) (Atw) + (4.43) (Atw) + (K2) (H_w) (N+1) (\sqrt{L_w})$

C = Height of Curb above top of Top Slab  
Hw = Height of Wingwall  
K = Constant Value for use in formulas

Slope SL:1	K1	K2
3:1	~ 1.054	~ 7.45
4:1	~ 1.031	~ 8.49
6:1	~ 1.014	~ 10.30

Atw = Anchor Toewall Length  
Lw = Length of Wingwall  
N = Number of Culvert Barrels  
SL:1 = Side Slope Ratio (Horizontal : 1 Vertical)

See applicable box culvert standard for H, S, T, and U values.

**GENERAL NOTES:**

Designed according to AASHTO LRFD Specifications.

The Safety End Treatments shown herein are intended for use in those installations where out of control vehicles are likely to traverse the openings approximately perpendicular to the Pipe Runners.

Pipe Runners are designed for a traversing load of 1,800 pounds at yield as recommended by Research Report 280-1, "Safety Treatment of Roadside Cross-Drainage Structures", Texas Transportation Institute, March 1981.

All reinforcing steel shall be Grade 60. All reinforcing shall be adjusted as necessary to provide a minimum clear cover of 1 1/4".

All concrete shall be Class "C" and shall have a minimum compressive strength of 3600 psi.

The quantities for Pipe Runners, reinforcing steel, and concrete, resulting from the formulas given herein are for Contractor's information only.

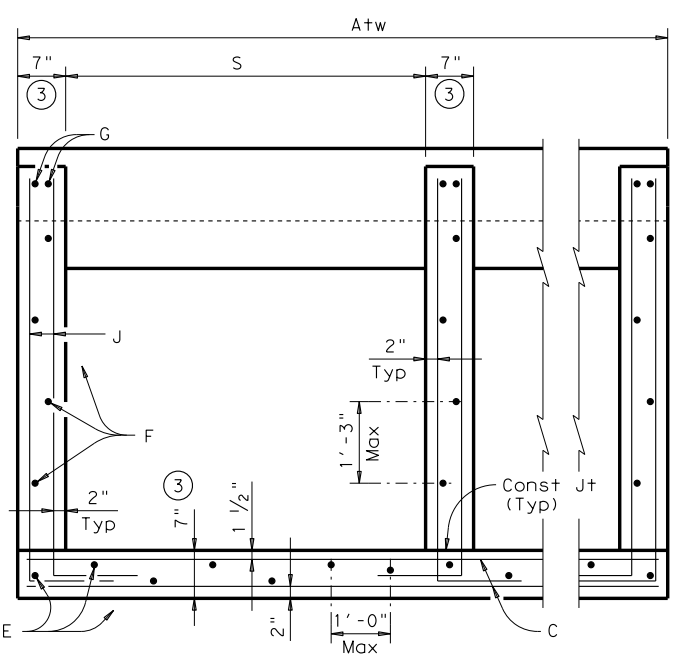
Pipe Runners, Cross Pipes, and Anchor Pipes shall conform to the requirements of ASTM A53 (Type E or S, Grade B), ASTM A500 (Grade B), or API 5LX52.

Bolts and nuts shall conform to ASTM A307.

All steel components, except the concrete reinforcing, shall be galvanized after fabrication. Galvanizing damaged during transport or construction shall be repaired in accordance with the specifications.

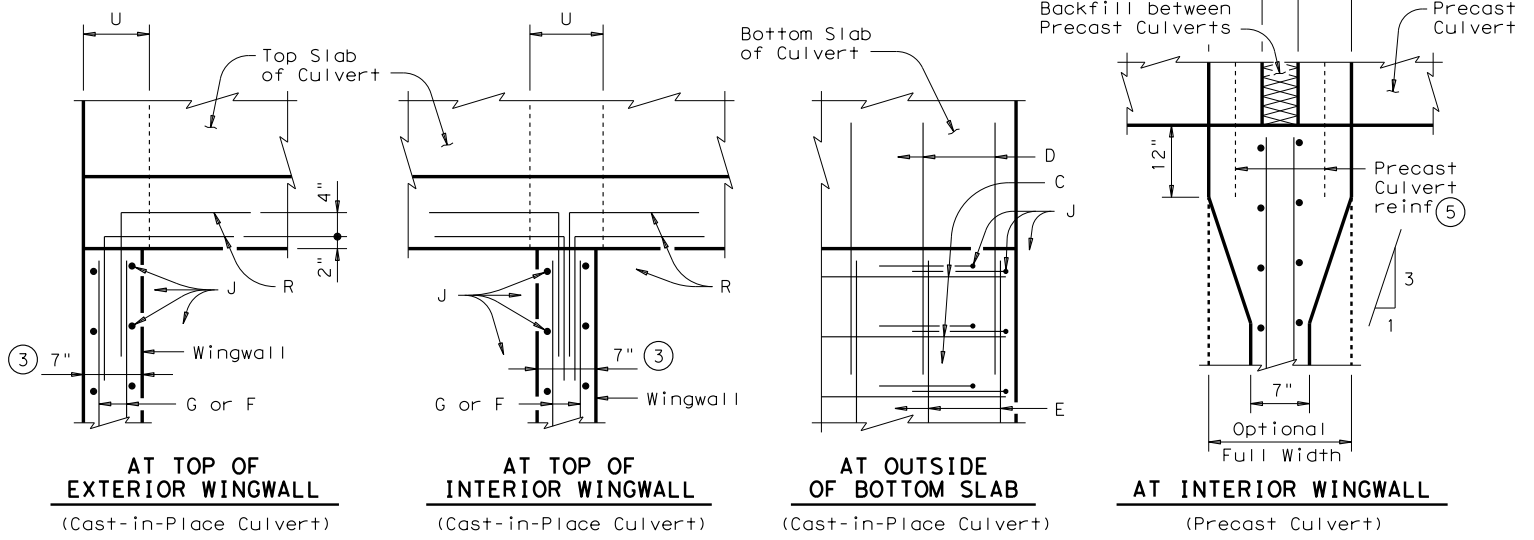
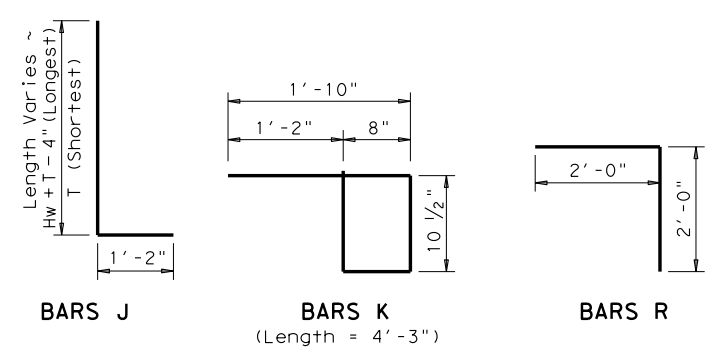
See BCS standard sheet for additional dimensions and information.

Alternate design drawings bearing the seal of a professional engineer will be acceptable for precast construction of the Safety End Treatments.



**SECTION A-A**

(Showing typical Wingwall and Wing Slab reinforcing)  
(Pipe Runners not shown for clarity)



**PLAN VIEWS OF CORNER DETAILS**

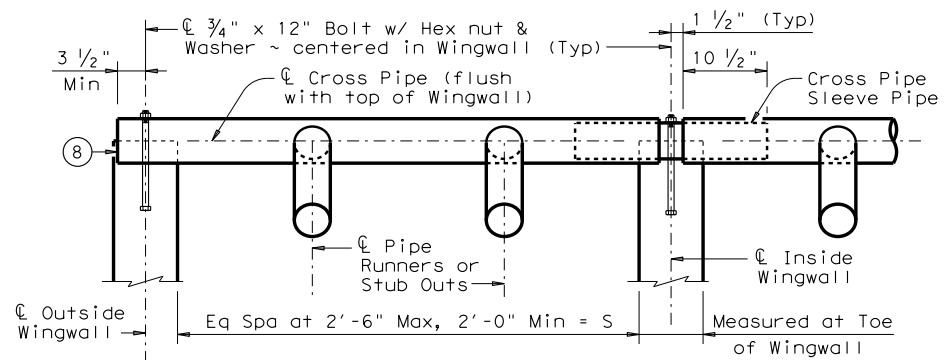
TABLE OF REINFORCING BAR SIZES & SPACING		
Bar	Size	Spacing
C	#4	10" Max
D	#4	match F & E
E	#4	1' - 0" Max
F	#4	1' - 3" Max
G	#6	Shown
J	#4	10" Max
K	#4	1' - 0" Max
R	#4	Shown

- Recommended values of slope are: 3:1, 4:1, & 6:1. Slope shall be 3:1 or flatter.
- 0" min to 5'-0" max. Estimated curb heights are shown elsewhere in the plans. For structures without railing and curbs taller than 1'-0", refer to ECD standard.
- Wingwall and slab thicknesses may be the same as the adjacent culvert wall and slab thicknesses (7" Minimum). If thicknesses greater than the minimum (7") are used, no changes will be made in quantities and no additional compensation will be allowed.
- For vehicle safety, curbs shall project no more than 3" above finished grade. Curb heights shall be reduced, if necessary, to meet these requirements. No changes will be made in quantities and no additional compensation will be allowed for this work.
- For Culverts with C = 0", the precast culvert reinforcing may extend 1'-0" minimum into Wingwall. Wingwall Bars D and R may be omitted. Otherwise, refer to the "Wingwall Connection Detail" on the SCP-MD standard.

		<b>Bridge Division Standard</b>	
<b>SAFETY END TREATMENT</b> <b>FOR 0° SKEW BOX CULVERTS</b> <b>(MAXIMUM Hw = 7'-0")</b> <b>TYPE I ~ CROSS DRAINAGE</b>			
<b>SETB-CD</b>			
FILE: setbcdse.dgn	DN: GAF	CK: CAT	DW: JRP
©TxDOT February 2010	CONT	SECT	JOB
REVISIONS			HIGHWAY
	DIST	COUNTY	SHEET NO.

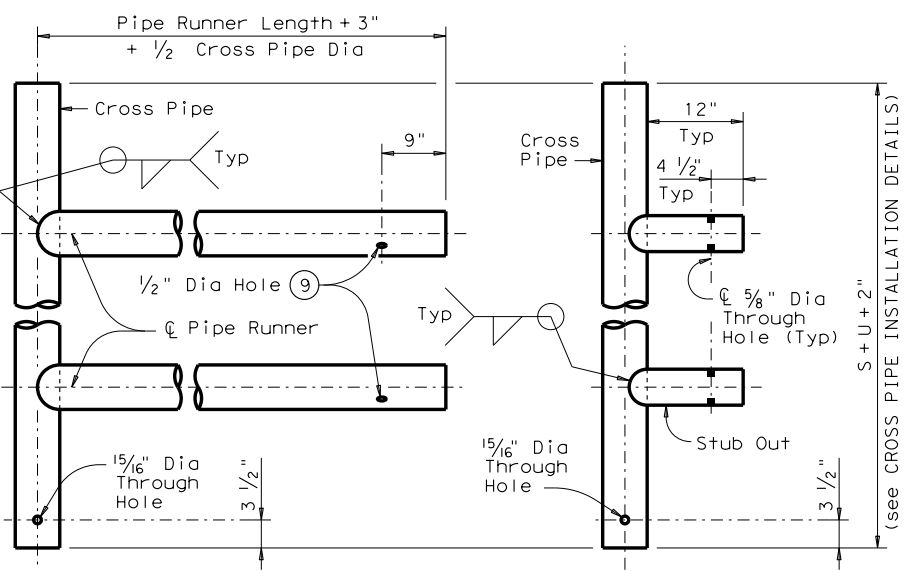
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DATE: FILE:

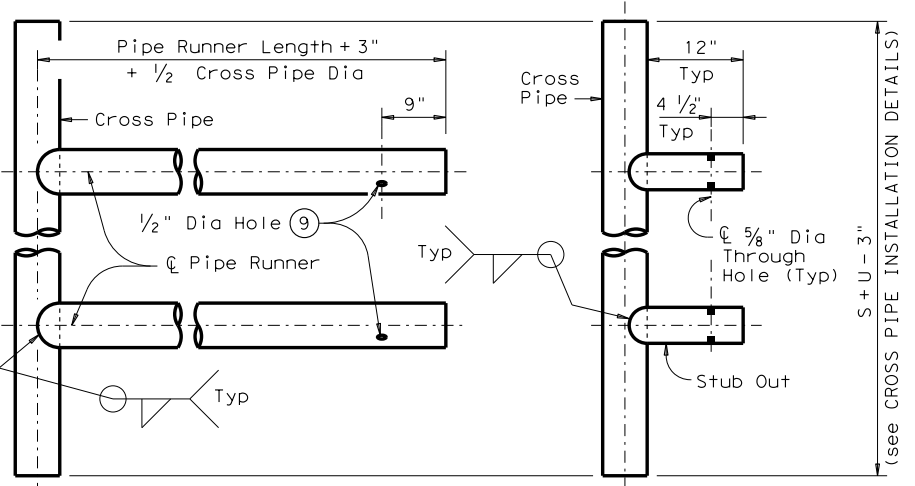


NOTE: At Contractor's option, the Cross Pipe may be made continuous across the Inside Wingwalls. If such option is selected, the Sleeve Pipe shall be omitted and a 1 5/16" diameter through hole be made in the Cross Pipe to accept the anchor bolt at the centerline of each Inside Wingwall.

**CROSS PIPE INSTALLATION DETAILS**

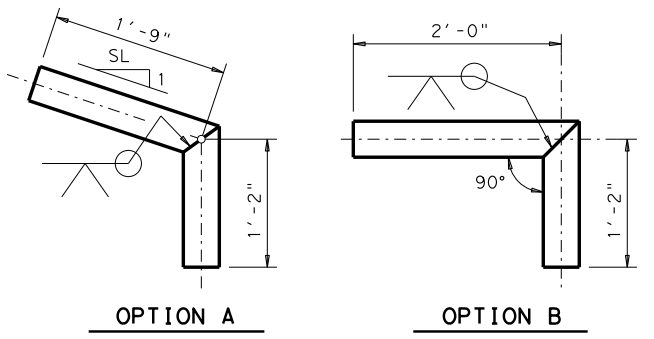


OPTION A2 FOR USE IN OUTSIDE CULVERT BAY



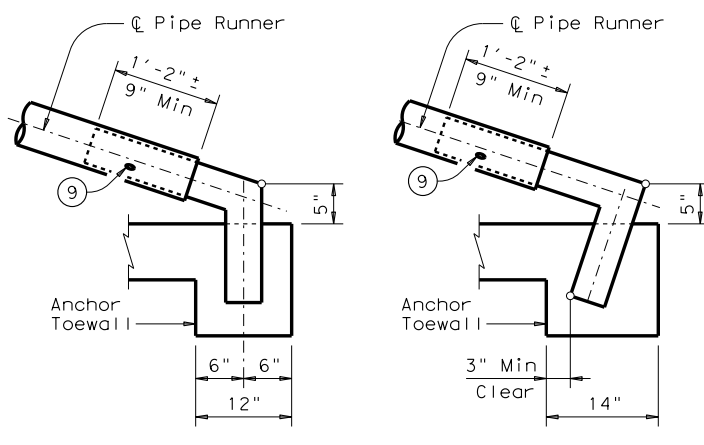
OPTION A2 FOR USE IN INSIDE CULVERT BAY

**CROSS PIPE AND CONNECTIONS DETAILS**



OPTION A OPTION B

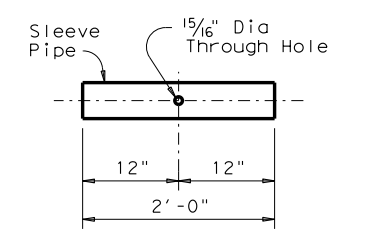
**BOTTOM ANCHOR PIPE DETAILS**



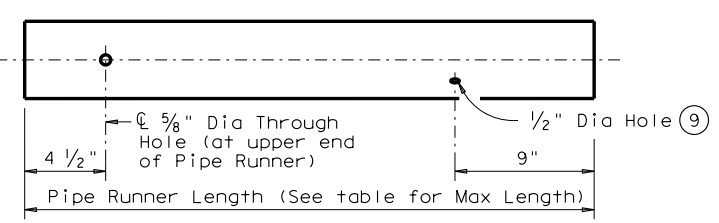
OPTION B1 OPTION B2

**BOTTOM ANCHOR TOEWALL DETAILS**

(Wingwall not shown for clarity)



**CROSS PIPE SLEEVE PIPE DETAILS**

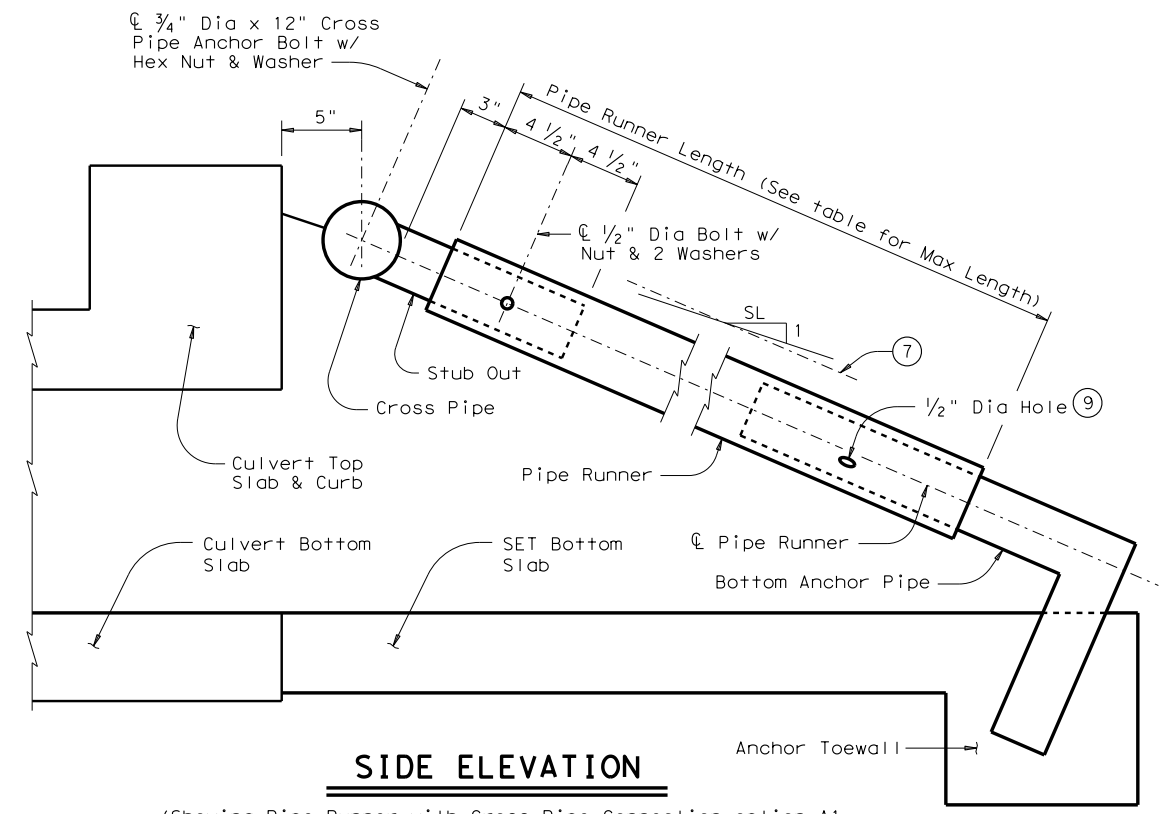


NOTE: The separate Pipe Runner shown is required when Cross Pipe Connection Option A1 is used.

**PIPE RUNNER DETAILS**

- ⑥ Cross Pipe shall be the same size as the Pipe Runner. Cross Pipe Stub Out shall be the same size as the Anchor Pipe.
- ⑦ Note that actual slope of Safety Pipe Runner may vary slightly from Side Slope.
- ⑧ Care shall be taken to ensure that Riprap concrete does not flow into the Cross Pipe so as to permit disassembly of the bolted connection to allow cleanout access.
- ⑨ After installation, the 1/2" hole shall be inspected to ensure that the lap of the Safety Pipe Runner with the Bottom Anchor Pipe is adequate.
- ⑩ At fabricator's option, a heat bend to a smooth 5" radius or a manufactured elbow (of the same material as the Runner) may be substituted for the mitered and welded joint in the Bottom Anchor Pipe.

Maximum Pipe Runner Length	Required Pipe Runner Size			Required Anchor Pipe Size		
	Pipe Size	Pipe O.D.	Pipe I.D.	Pipe Size	Pipe O.D.	Pipe I.D.
10' - 0"	3" STD	3.500"	3.068"	2" STD	2.375"	2.067"
19' - 8"	4" STD	4.500"	4.026"	3" STD	3.500"	3.068"
34' - 2"	5" STD	5.563"	5.047"	4" STD	4.500"	4.026"



**SIDE ELEVATION**

(Showing Pipe Runner with Cross Pipe Connection option A1 and anchor Pipe option B2. Wingwall not shown for clarity)

SHEET 2 OF 2

Texas Department of Transportation  
 Bridge Division Standard

**SAFETY END TREATMENT**  
 FOR 0° SKEW BOX CULVERTS  
 (MAXIMUM Hw = 7'-0")  
 TYPE I ~ CROSS DRAINAGE

**SETB-CD**

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REVISIONS				
DIST		COUNTY		SHEET NO.