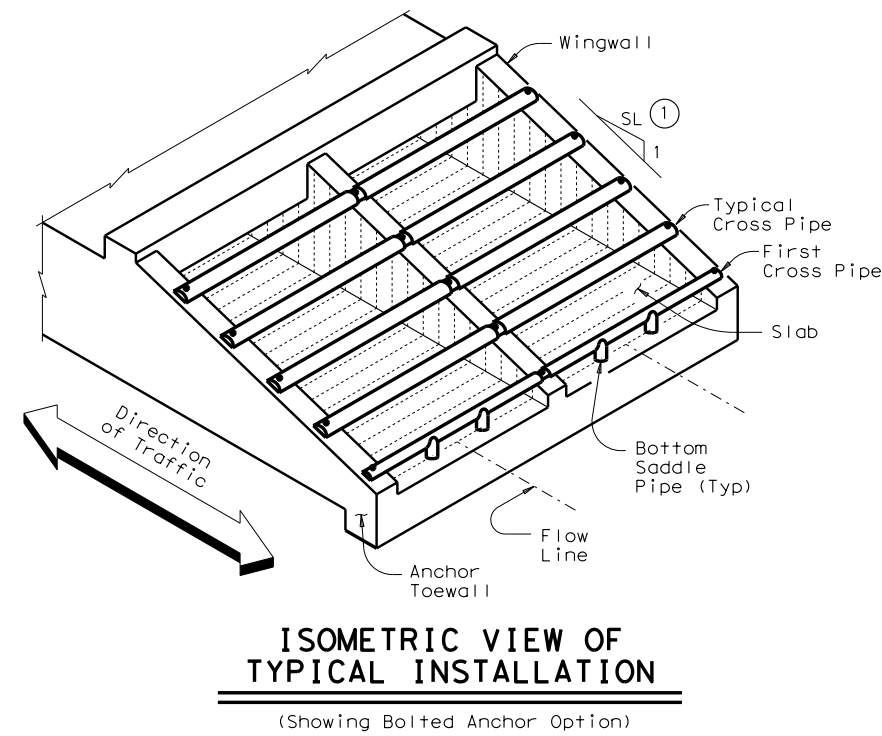
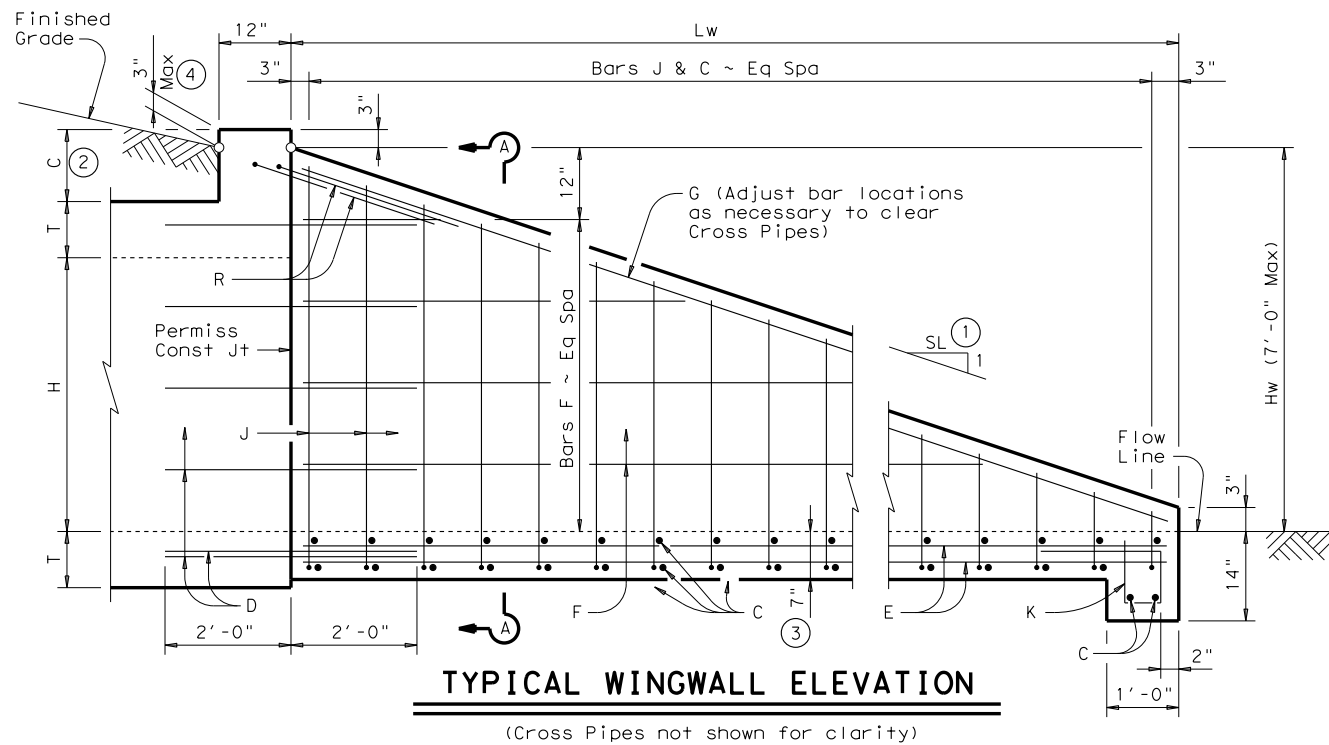


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Formulas: (All values are in Feet)
 $H_w = H + T + C - 0.250'$
 $L_w = (H_w - 0.250') (SL)$

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.)
 $= (0.5) (H_w + 0.250') (L_w) (N+1)$

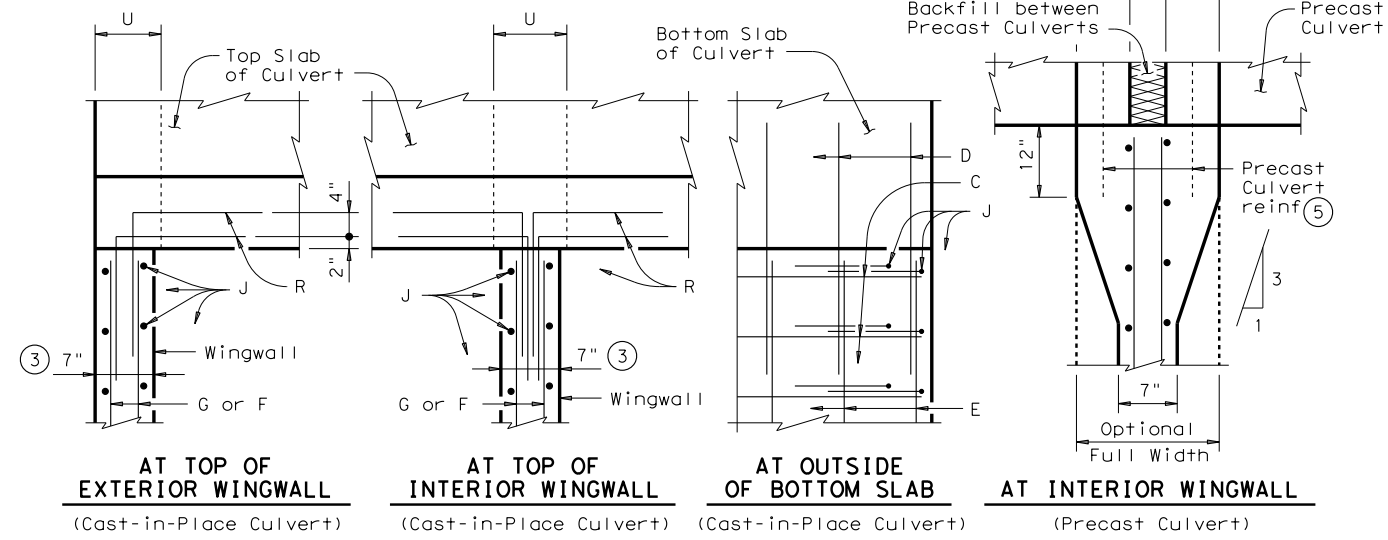
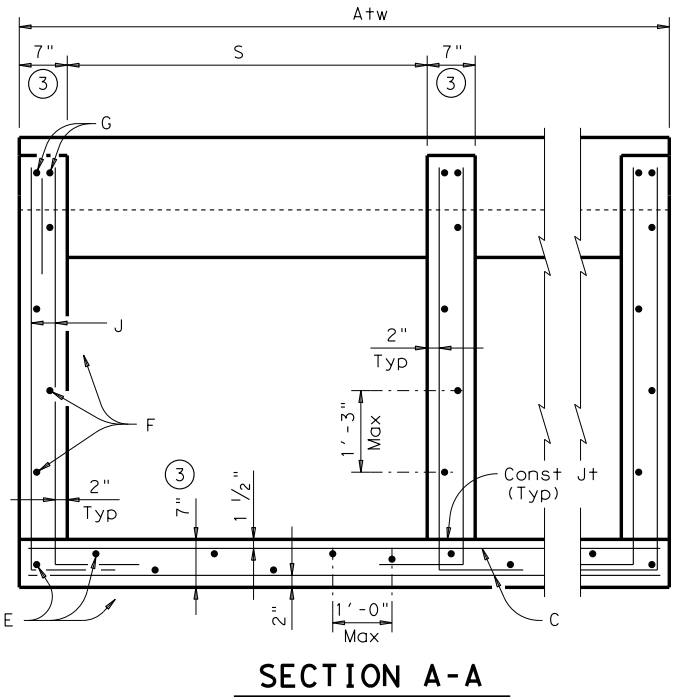
Total Concrete Volume (C.Y.)
 $= [(Wingwall Area) (0.583') + (L_w) (Atw) (0.583') + (Atw) (1.000') (1.167' - 0.583')] \div (27)$

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

C = Height of Curb above top of Top Slab
H_w = Height of Wingwall
K = Constant Value for use in formulas
Slope SL:1 = $\frac{K}{6:1} \sim 10.41$
Atw = Anchor Toewall Length
L_w = Length of Wingwall
N = Number of Culvert Barrels
S = Clear Span of each Barrel
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 Cross Pipes.
Cross Pipes are designed for a traversing load of 10,000 pounds at yield as recommended by Research Report 280-2F, "Safety Treatment of Roadside Parallel-Drainage Structures", Texas Transportation Institute, March 1981.
All concrete shall be Class "C" and shall have a minimum compressive strength of 3600 psi.
All reinforcing steel shall be Grade 60. All reinforcing shall be adjusted as necessary to provide a minimum clear cover of 1 1/4".
The quantities for concrete, reinforcing steel, and Cross Pipes resulting from the formulas given herein are for Contractor's information only.
Cross Pipes, Sleeve Pipes, and Saddle 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.



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

- ① Slope will be 6:1 or flatter.
- ② 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.
- ③ 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.
- ④ 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.
- ⑤ 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.

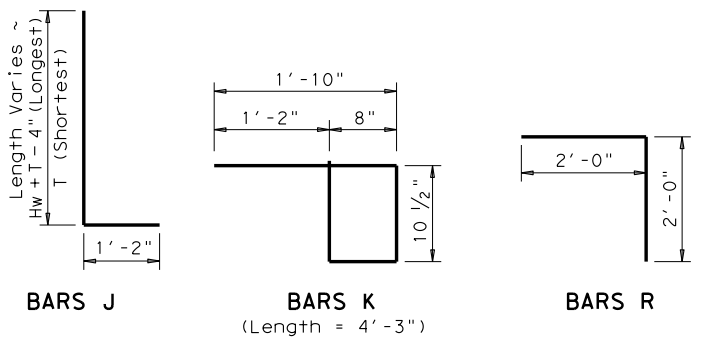
Texas Department of Transportation

SAFETY END TREATMENT FOR BOX CULVERTS (MAXIMUM H_w = 7'-0") TYPE I ~ PARALLEL DRAINAGE

SETB-PD

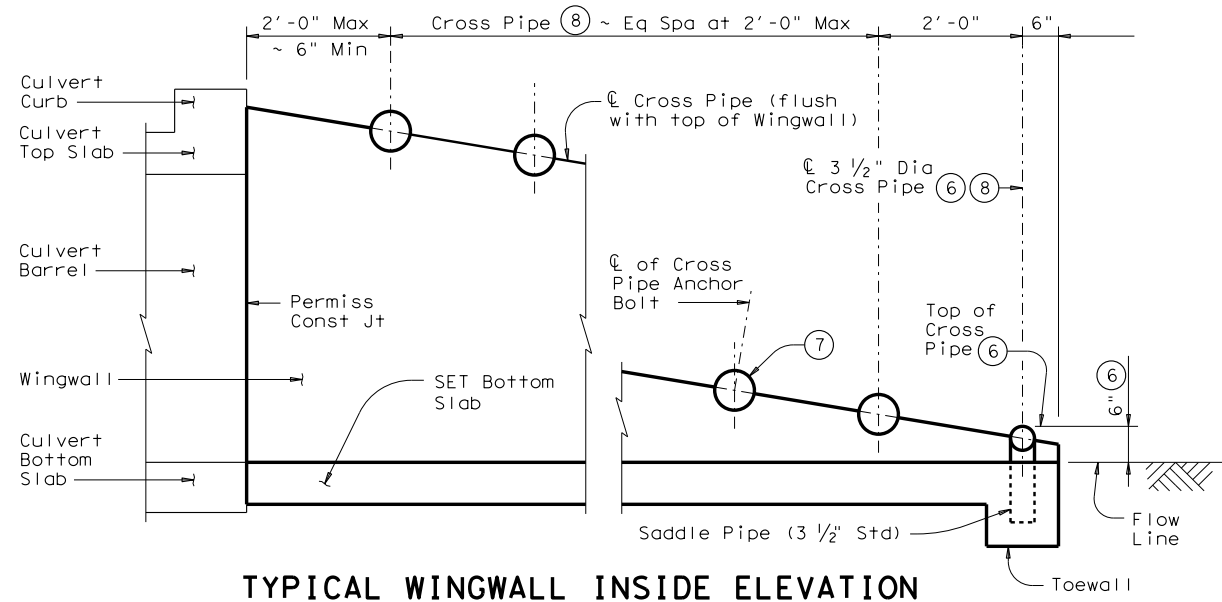
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Bridge Division Standard



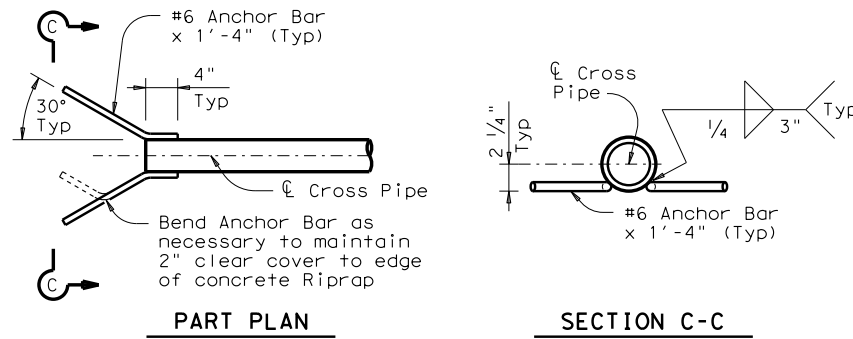
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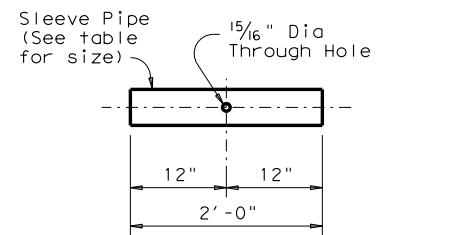


TYPICAL WINGWALL INSIDE ELEVATION

(Showing installation of Cross Pipes)



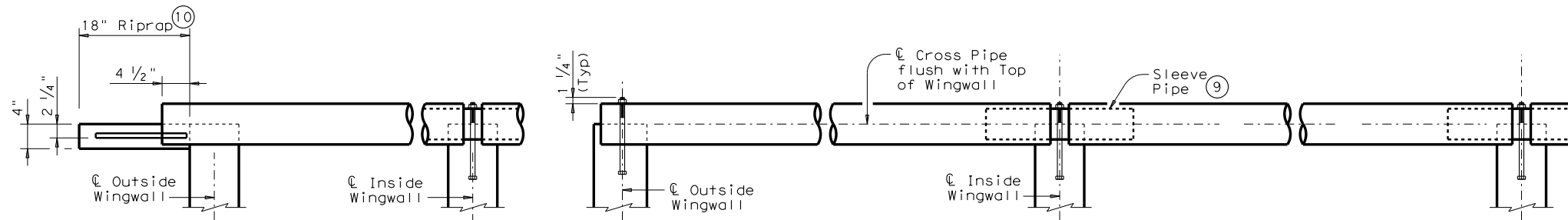
OPTIONAL ANCHOR BAR DETAILS



SLEEVE PIPE DETAILS

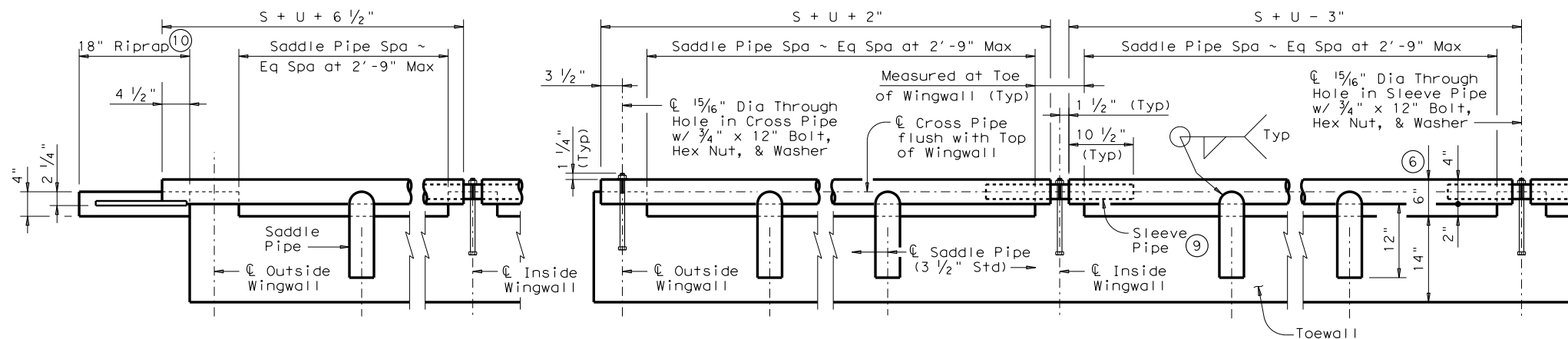
REQUIRED PIPE SIZES ^⑧			STANDARD PIPE SIZES		
Culvert Span Sizes	Cross Pipe Size	Sleeve Pipe Size ^⑨	Pipe Size	Pipe O.D.	Pipe I.D.
First Pipe	3 1/2" STD	2 1/2" STD	2 1/2" STD	2.875"	2.469"
30" to 42"	4" STD	3" STD	3" STD	3.500"	3.068"
48" to 72"	5" STD	4" STD	3 1/2" STD	4.000"	3.548"
78" to 120"	6" STD	5" STD	4" STD	4.500"	4.026"
			5" STD	5.563"	5.047"
			6" STD	6.625"	6.065"

- ⑥ The proper installation of the first Cross Pipe is critical for vehicle safety. The top of the first Cross Pipe must be placed at no more than 6" above the flow line.
- ⑦ The third Cross Pipe from the bottom of the Culvert shall always be installed using a bolted connection. Care shall be taken to ensure that concrete does not flow into this Cross Pipe so as to permit disassembly of the bolted connection to allow cleanout access.
- ⑧ Cross Pipes and Sleeve Pipes (if required) shall be as shown in the REQUIRED PIPE SIZES table. Saddle Pipes for the 3 1/2" first Cross Pipe shall also be 3 1/2".
- ⑨ At Contractor's option, the Cross Pipe may be continuous across the Inside Wingwalls. If such option is selected the Sleeve Pipe shall be omitted and a 15/16" diameter through hole made in the Cross Pipe to accept the anchor bolt at the centerline of each Interior Wingwall.
- ⑩ Riprap will be required when using the optional Anchor Bar details and shall be included in the Price Bid for Safety End Treatment. Such Riprap shall be concrete Riprap in accordance with Item 432, "Riprap".



SECTION THROUGH INSTALLATION OF TYPICAL FULL CROSS PIPE

(Anchor details and dimensions are similar to those shown below in SECTION THROUGH INSTALLATION OF 3 1/2" FIRST CROSS PIPE detail.)



CROSS PIPE INSTALLATION DETAILS

SHEET 2 OF 2



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

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