29" 23' - 3 1/2" 4' - 9 3/4" 17' - 0" 19' - 7 1/2"

9 71" 47" 36' - 1 1/4" 7' - 2 3/4" 26' - 0" 30' - 0 1/4" 1119 14.7 9' - 1"

6 49" 33" 26' - 2 1/4" 5' - 4 3/4" 19' - 0" 21' -11 1/4"

7 57" 38" 29'- 9" 6'- 0 ¾" 21'- 6" 24'-10"

8 64" 43" 33'- 2 1/2" 6'- 7 3/4" 24'- 0" 27'- 8 1/2"

464 5.0 4'- 7"

705 8.2 6' - 3"

846 10.3 7' - 2"

990 12.6 8' - 2"

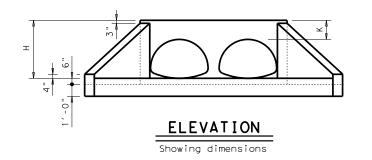
6.6 5'- 5"

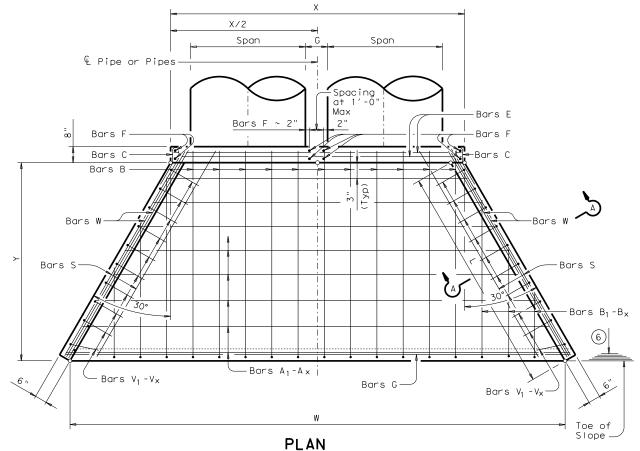
581

112 1.6

233 3.5

289 4.4





Contractor shall provide bars as

needed to suppor-

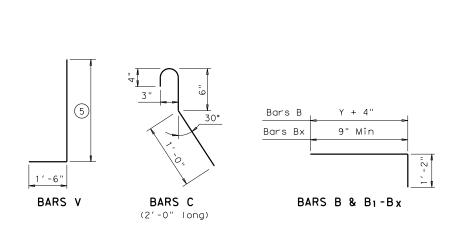
-Const Jt

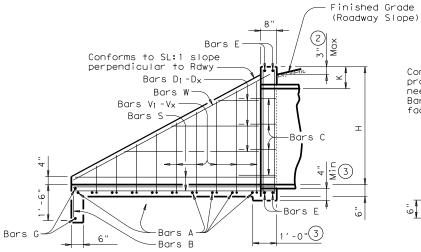
Bar W on inside

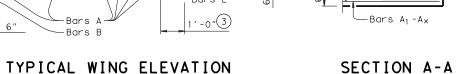
face of wall.

Bars S

Bars B







REIN		LE OF (CING S	4) TEEL		TABLE OF DIMENSIONS NOT VARIED WITH SLOP							
Bar	Size	Spa	No.	N)	E OF						
Α	# 4	1'-0"	~	V) <u> </u>	ARCH	G	K	Н			
В	# 3	1′-6"	~	7		Rise						
С	# 4	1′-0"	٠	4	35"	24"	1'-8"	1'-0"	3'- 0"			
D	# 3	1′-0"	~	5	42"	29"	1'-11"	1'- 0"	3'- 5"			
E	# 5	~	4	6	49"	33"	2'- 2"	1'-0"	3'- 9"			
F	# 5	~	~	7	57"	38"	2'-5"	1'-0"	4'- 2"			
G	# 3	~	2	8	64"	43"	2'-10"	1'-0"	4'- 7"			
S	# 4	~	6	9	71"	47"	3' - 2"	1'-0"	4'-11"			
V	# 4	1′-0"	~									
W	# 5	~	4									

- 1) Quantities shown are for metal pipe and will decrease slightly for concrete pipe installations.
- (2) 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.
- $\begin{picture}(60,0)\put(0,0){\line(0,0){10}}\put(0,0){\line(0,0){10}$
- (4) Quantities shown are for one structure end only (one headwall).
- (5) Min Length = 6" + 3" $\times \left(\frac{12 \times H 7}{12 \times L}\right)$ Max Length = 12 x H - 3" x $\left(\frac{12 \times H - 7}{12 \times L}\right)$ - 1"
- 6 Lengths of wings based on SL:1 Slope along this line.

GENERAL NOTES:

Designed according to AASHTO LRFD Specifications.

The Safety End Treatment 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.

The Safety 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.

Reinforcing steel shall be placed with the center of the outside layer of bars 2" from the surface of the concrete.

All reinforcing steel shall be Grade 60.
All concrete shall be Class "C" and shall have
a minimum compressive strength of 3600 psi.
All bolts, nuts, washers, brackets, angles and pipe runners are considered parts of the Safety

End Treatment for payment.
Pipe Runners 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. Steel plates shall conform to ASTM A36. All steel components, except reinforcing, shall be galvanized. Galvanizing damaged during transport or construction shall be repaired in accordance with the specifications.

SHEET 1 OF 3

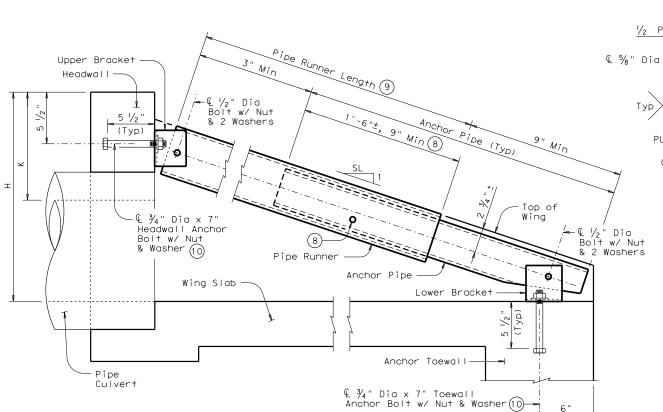


SAFETY END TREATMENT WITH FLARED WINGS

FOR 0° SKEW ARCH PIPE CULVERTS TYPE I ~ CROSS DRAINAGE

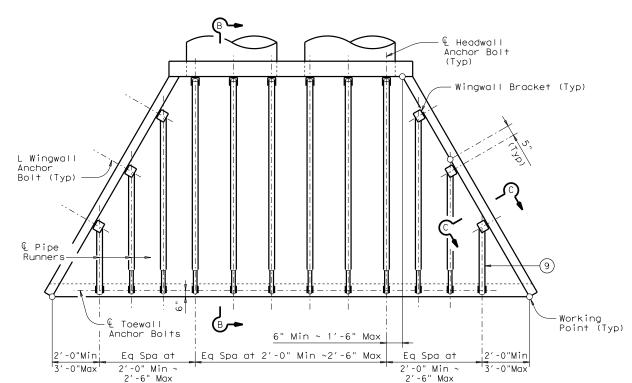
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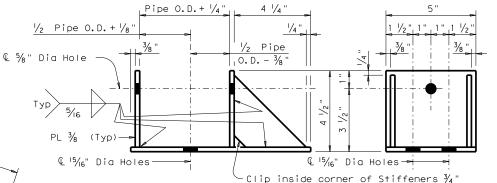


SECTION B-B

(Showing Headwall Pipe Runner. Except for upper bracket, Wingwall Pipe Runners are similar.)



PIPE RUNNER PLAN



ELEVATION

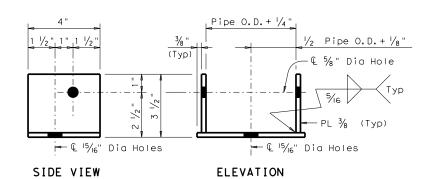
SIDE VIEW

 $\frac{3}{4}$ " Anchor Bolt shall be installed in hole nearest to the headwall. Other bolt hole is intended for use on the opposite hand wingwall. € ½" Dia Bolt w/ Nut & 2 Washers → Wing Pipe Runner or Non-Sliding Top of Pipe Runner Wingwall € Wingwall - · - оно <u>ни - / - : :</u> Anchor Bolts € ¾" Dia x 8" Bolt
w/ Nut, Standard
Washer, & 1 ~ Winawall -€ ½" Dia Bolt w/ Nut Bračket Plate Washer Inside Face & 2 Washers orientation) (7) of Wingwall SECTION C-C ELEVATION

(Showing installed bracket.) (Showing installed bracket normal to Wall. Pipe not shown for clarity.)

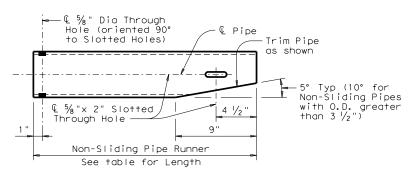
NOTE: Wingwall Bracket shall match the Upper Bracket size.

WINGWALL BRACKET DETAILS



NOTE: Upper and Lower Brackets shall, except for the Brackets used with Non-Sliding Pipe Runners, match the required pipe diameters as shown in the table.

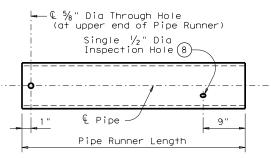
UPPER & LOWER BRACKET DETAILS



Note: Pipe size shall be same as required for headwall pipe runner. Adjust the corresponding Lower Bracket accordingly.

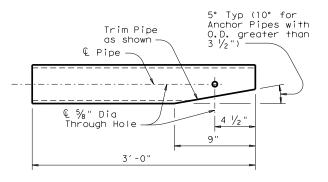
NON-SLIDING PIPE RUNNER DETAILS 9

- 7 At Contractor's option, 7/8" diameter hole may be formed or cored drilled. Percussion drilling is not permitted. Adjust placement of reinforcing steel as necessary to avoid bolt holes.
- (8) After installation of the Pipe Runner, the 1/2" inspection hole shall be utilized to ensure that the lap of the Anchor Pipe with the Pipe Runner is adequate.
- 9 Non-Sliding Pipe Runners are used for those installations that would require Pipe Runner lengths of 1'-9" or less. The Non-Sliding Pipe Runner, when required, replaces the outermost Pipe Runner and Anchor Pipe. See table on Sheet 3 of 3 to determine if the Non-Sliding Pipe Runner is required.
- At Contractor's option, an epoxy anchorage system may be used. Anchorage system chosen must be able to achieve an ultimate tensile resistance of 20 kips. Anchor diameter shall be 3/4". 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 recommendations.



Note: Pipe diameter required for Headwall pipe runner shall also be used for wingwall pipe runner.

PIPE RUNNER DETAILS



ANCHOR PIPE DETAILS

SHEET 2 OF 3



FOR 0° SKEW ARCH PIPE CULVERTS
TYPE I ~ CROSS DRAINAGE

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	to warranty of any	kind is made by TxDOT for any purpose whatsoever. TxDOT assumes no responsibility for the conversion	m its use.	
	The use of this standard is governed by the "Texas Engineering Practice Act". No warranty of any	ssumes no responsibil.	of this standard to other formats or for incorrect results or damages resulting from its use.	
	by the "Texas Engine	rhatsoever. TxDOT as	incorrect results or (
	standard is governed	OT for any purpose w	other formats or for	
DISCLAIMER:	The use of this s	kind is made by TxD(of this standard to c	

Side	Arch Pipe Culvert Design	L1 (Ft-In)	P1 (Ft-In)	Number of Spaces in L3	L3 Overall Dimension (Ft-In)	P2 (Ft-In)	Number of Spaces in L4	L4 Overall Dimension (Ft-In)	Headwall Pipe Runner Length (Ft-In)	No. of Wing Pipes	Longest Wingwall Pipe Runner Length (Ft-In)	Shortest Wingwall Pipe Runner Length (Ft-In)	Non- Sliding Pipe Length (Ft-In)	Pipe Runner Size	Total Length of Wingwall Pipe Runners (Ft-In)
	4	6"	2'- 3"	1	2'-5 1/4"	4'-1"	0	N/A	5′-11 ½"	2	2'-0 1/2"	2'-0 1/2"	N/A	3" STD	4′- 1"
	5	7"	3'-0"	1	2' - 6"	5' - 7"	0	N/A	7' - 3 1/4"	2	3′ - 5"	3′ - 5"	N/A	3" STD	6′-10"
-	6	1'- 0"	2'- 0"	2	4' - 5 3/4"	3' - 7"	1	4' - 5 3/4"	8'- 4"	4	5′- 8 1/4"	5'-8 1/4"	3' - 1"	4" STD	17'- 6 1/2"
ω.	7	1'- 3"	2'-6"	2	4'-11 1/2"	4' - 7"	1	4'-11 1/2"	9'-7 3/4"	4	7′- 0 1/4"	2'-6"	N/A	4" STD	19'- 0 1/2"
	8	6"	2'-6"	2	4'-11 1/4"	4' - 7"	1	4'-11 1/4"	10'-11 1/2"	4	7′- 0"	2'-6"	N/A	4" STD	19'- 0"
	9	9"	2'-0"	3	6'- 3"	3' - 7"	2	8'- 4"	12' - 0 1/4"	6	9' - 2 1/2"	5'- 4 3/4"	3' - 1"	4" STD	35′- 4 ½"
	4	6"	2'-0"	2	4'-1"	3' - 7"	1	4′- 1"	8' - 3 1/4"	4	5'-1 3/4"	5'-1 3/4"	3'-0"	4" STD	16'- 3 1/2"
	5	7"	2'-2"	2	4'-11 1/2"	3′-11"	1	4'-11 1/2"	10'- 0"	4	6' - 2 3/4"	1'- 9 3/4"	N/A	4" STD	16' - 1"
 L	6	1'- 0"	2'-0"	3	6' - 3 3/4"	3' - 7"	2	8′-5"	11'- 4 1/2"	6	9'-0 1/4"	5'- 3 1/4"	3'-0"	4" STD	34' - 7"
	7	1'- 3"	2'-0"	3	7' - 6 1/4"	3' - 7"	2	10'- 0 1/2"	13′- 1"	6	10' - 5 1/2"	5′-11 ¾"	3'-0"	4" STD	38′-10 1/2"
	8	6"	2'- 3"	3	7'-5 3/4"	4'-1"	2	9'-11 3/4"	14'- 9 3/4"	6	10'-10 1/4"	1'-11 1/2"	N/A	5" STD	38' - 5 1/4"
	9	9"	2'-0"	4	8'-9"	3' - 7"	3	13' - 1 3/4"	16' - 2 1/4"	8	13' - 2 3/4"	5'- 5"	3'-0"	5" STD	61′-11 1/4"
	4	6"	2'-0"	3	6'-10 1/2"	3' - 7"	2	9'- 2"	13' - 0 1/4"	6	9′-6"	5'-5 3/4"	2'-11 1/2"	4" STD	35′-10 ½"
	5	7"	3'-0"	3	7' - 4 3/4"	5' - 7"	2	9'-10 1/4"	15' - 6 1/2"	6	11'-10 1/2"	3' - 2 1/2"	N/A	5" STD	45' - 3"
	6	1'- 0"	2'-0"	4	9'-11 3/4"	3' - 7"	3	14'-11 1/2"	17'- 7"	8	14' - 7"		2'-11 1/2"		67'- 2"
9	7	1'- 3"	2'-0"	5	11'- 8"	3' - 7"	4	18' - 8"	20' - 1 1/4"	10	17′-10"	- , , ,	2'-11 1/2"		99′- 5"
	8	6"	2'-0"	5	12' - 4 1/4"	3' - 7"	4	19' - 9 1/4"	22′ - 7 ¾"	10	18' - 9 3/4"		2'-11 1/2"		104' - 4"
`	9	9"	2'-0"	6	13' - 9 1/4"	3' - 7"	5	22'-11 1/4"	24' - 8"	12	21'- 7"	5' - 5 3/4"	2'-11 1/2"	5" STD	141' - 2 3/4"

- (1) If the outermost Wing Pipe Runner is a Non-Sliding Pipe Runner, the next outermost Wing Pipe Runner shall be considered the
- $\widehat{\mbox{\sc 12}}$ Quantities shown include, if present, the Non-Sliding Pipes.
- (13) Anchor Pipe size shall be the next smaller size than the Pipe Runner size.

STANDARD PIPE RUNNER AND ANCHOR PIPE SIZES (13)

Pipe Size	Pipe O.D.	Pipe I.D.
2" STD	2.375"	2.067"
3" STD	3.500"	3.068"
4" STD	4.500"	4.026"
5" STD	5.563"	5.047"

Headwall Pipe Runner Longest Wing Pipe Runner Shortest Wing L 1 6" Min ~ 1'-6" Max 6" Min ~ 1'-6" Max Р1 Р1 L3 Eq Spa at 2'-0"Min ~ 2'-6"Max 2'-0" Min Eq Spa at 2′-0"Min Eq Spa at 2′-0"Min 2'-0" Min ~ 3'-0"Max ~ 3'-0"Max

PIPE RUNNER LAYOUT

~ 2′-6"Max

~ 2'-6"Max

TOTAL PIPE LENGTHS FORMULAS:

Total Length of All = Total Length + (No. of Headwall Pipe Runners + Pipe Runners Headwall Pipe Runner Length

Total Length of All \equiv (3.000') (No. of Wing + Headwall - No. of Non-Sliding Anchor Pipes \equiv (3.000') (Pipe Runners + Pipe Runners +

SPECIAL NOTE:

Note that the tabular quantities are given for estimating purposes only. It is likely that these quantities will change due to field conditions. Therefore, all dimensions shall be verified by the Contractor in the field prior to fabrication of the Safety End Treatment components.

Texas Department of Transportation

Arch

Pipe

Culvert

Number

Ωf

Pipe

6

4

6

2

4

4

Design Culverts

of L2

Spaces

5

9

10

8

10

12

4

6

1.1

14

10

13

16

2

6

9

12

15

19

2

6

10

13

17

20

Number

of

Headwal

Pipes

4

6

8 10

1.1

5

11

13

10 12

15

5

8

11

14 17

3

7

10

13

16

20

1.1

14

18

21

Overall

Dimension

2'-1'

6' - 8"

11'- 3"

15'-10"

20' - 5"

25' - 0"

7′-11"

13' - 4"

18' - 9" 24' - 2"

29' - 7"

2'- 3"

8'-6"

14' - 9"

21'- 0"

27' - 3"

33' - 6"

9'- 7"

16' - 9'

23′-11′

31'- 1'

38' - 3"

4'-6"

12' - 8"

20'-10"

29' - 0"

37' - 2"

45' - 4"

4'- 7"

13' - 8"

22' - 9"

31′-10"

40'-11'

50'- 0"

SAFETY END TREATMENT WITH FLARED WINGS

FOR 0° SKEW ARCH PIPE CULVERTS TYPE I ~ CROSS DRAINAGE

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SHEET 3 OF 3