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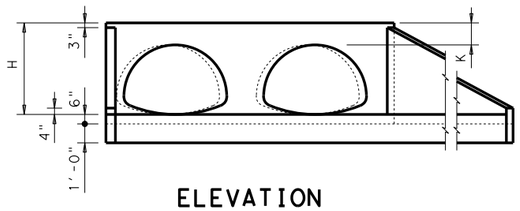
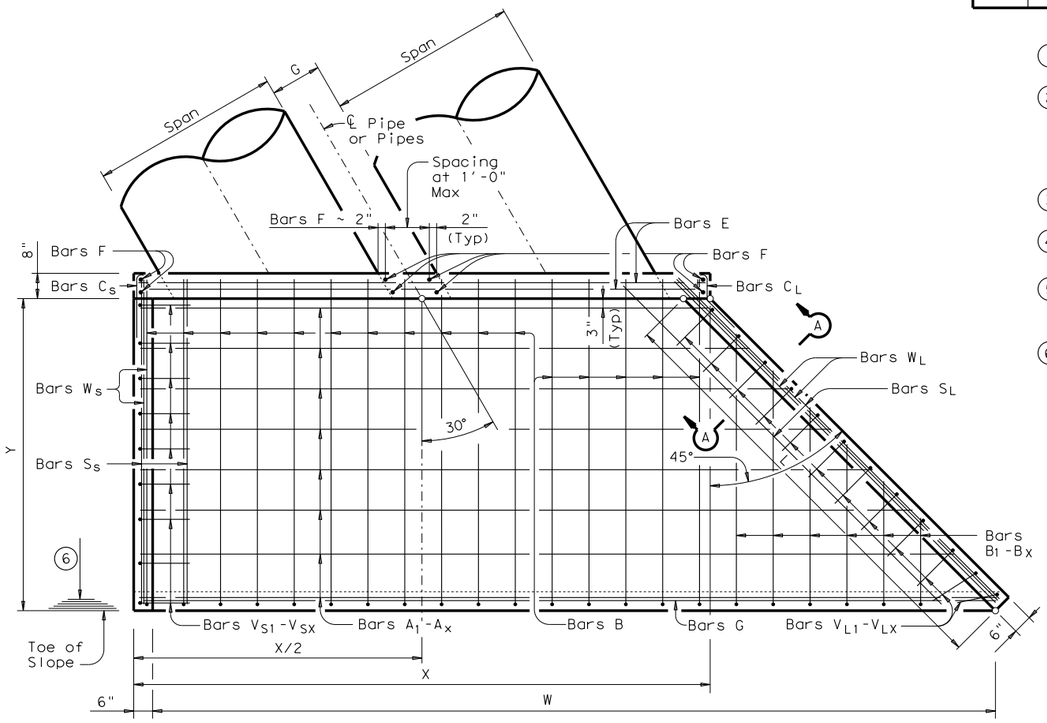
TABLE OF VARIABLE DIMENSIONS AND QUANTITIES FOR ONE HEADWALL (4)

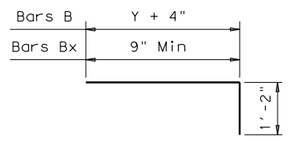
SLOPE	DESIGN	SIZE OF PIPE ARCH		Values for one Pipe						Values to be added for each addt'l Pipe		
		Span	Rise	W	X	Y	L	Reinf (Lbs)	Conc (CY) (1)	X and W	Reinf (Lbs)	Conc (CY) (1)
3:1	3	28"	20"	9'- 8 ½"	4'- 8"	6'- 3"	8'-10"	207	1.8	4'-4"	72	0.8
	4	35"	24"	11'- 4 ½"	5'- 4"	7'- 3"	10'- 3"	251	2.3	5'- 3 ½"	98	1.1
	5	42"	29"	13'- 3 ½"	6'- 0"	8'- 6"	12'- 0 ¼"	309	2.9	6'- 3"	126	1.5
	6	49"	33"	14'-11 ¾"	6'- 8 ¼"	9'- 6"	13'- 5 ¼"	355	3.6	7'- 2 ½"	145	1.9
	7	57"	38"	16'-12"	7'- 5 ½"	10'- 9"	15'- 2 ½"	423	4.4	8'- 3 ¼"	178	2.4
	8	64"	43"	18'-11"	8'- 1 ½"	12'- 0"	16'-11 ¾"	492	5.4	9'- 5 ¼"	221	3.0
	9	71"	47"	20'- 7"	8'- 9 ½"	13'- 0"	18'- 4 ¾"	549	6.2	10'- 5 ¾"	255	3.6
4:1	3	28"	20"	11'- 9 ½"	4'- 8"	8'- 4"	11'- 9 ½"	266	2.4	4'- 4"	81	1.0
	4	35"	24"	13'- 9 ½"	5'- 4"	9'- 8"	13'- 8"	328	3.1	5'- 3 ½"	112	1.4
	5	42"	29"	16'- 1 ½"	6'- 0"	11'- 4"	16'- 0 ¼"	390	4.1	6'- 3"	139	1.8
	6	49"	33"	18'- 1 ¾"	6'- 8 ¼"	12'- 8"	17'-11"	469	4.9	7'- 2 ½"	170	2.3
	7	57"	38"	20'- 7"	7'- 5 ½"	14'- 4"	20'- 3 ¼"	547	6.2	8'- 3 ¼"	204	3.0
	8	64"	43"	22'-11"	8'- 1 ½"	16'- 0"	22'- 7 ½"	650	7.5	9'- 5 ¼"	256	3.7
	9	71"	47"	24'-11"	8'- 9 ½"	17'- 4"	24'- 6 ¼"	723	8.7	10'- 5 ¾"	295	4.4
6:1	3	28"	20"	15'-11 ½"	4'- 8"	12'- 6"	17'- 8 ¼"	397	3.9	4'- 4"	100	1.3
	4	35"	24"	18'- 7 ½"	5'- 4"	14'- 6"	20'- 6"	480	5.1	5'- 3 ½"	132	1.8
	5	42"	29"	21'- 9 ½"	6'- 0"	17'- 0"	24'- 0 ½"	596	6.7	6'- 3"	172	2.5
	6	49"	33"	24'- 5 ¾"	6'- 8 ¼"	19'- 0"	26'-10 ½"	717	8.2	7'- 2 ½"	212	3.2
	7	57"	38"	27'- 9"	7'- 5 ½"	21'- 6"	30'- 5"	853	10.4	8'- 3 ¼"	264	4.1
	8	64"	43"	30'-11"	8'- 1 ½"	24'- 0"	33'-11 ¼"	1009	12.6	9'- 5 ¼"	325	5.1
	9	71"	47"	33'- 7"	8'- 9 ½"	26'- 0"	36'- 9 ¼"	1139	14.7	10'- 5 ¾"	382	6.1



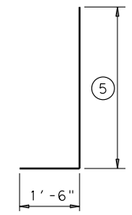
ELEVATION
Showing dimensions



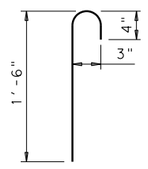
PLAN



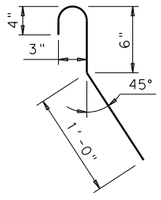
BARS B & B_1-B_x



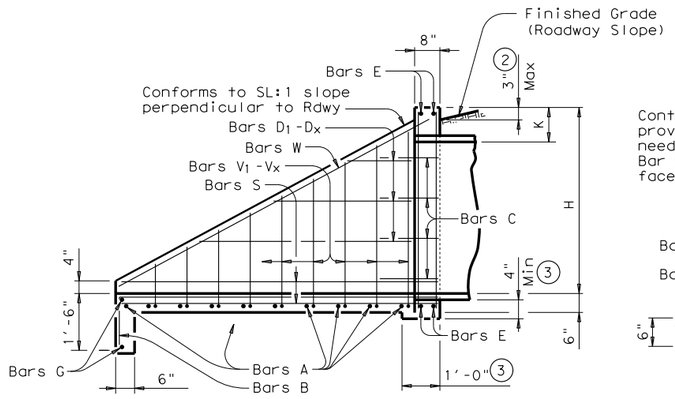
BARS V_S & V_L



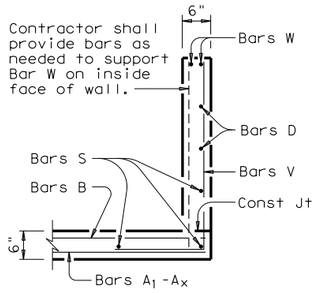
BARS C_S
(2'-0" long)



BARS C_L
(2'-0" long)



TYPICAL WING ELEVATION



SECTION A-A

TABLE OF (4) REINFORCING STEEL

Bar	Size	Spa	No.
A	# 4	1'-0"	~
B	# 3	1'-6"	~
C	# 4	1'-0"	~
D	# 3	1'-0"	~
E	# 5	~	4
F	# 5	~	~
G	# 3	~	2
S	# 4	~	6
V	# 4	1'-0"	~
W	# 5	~	4

TABLE OF DIMENSIONS NOT VARIED WITH SLOPE

DESIGN	SIZE OF PIPE ARCH		G	K	H
	Span	Rise			
3	28"	20"	1'- 5"	1'- 0"	2'- 8"
4	35"	24"	1'- 8"	1'- 0"	3'- 0"
5	42"	29"	1'-11"	1'- 0"	3'- 5"
6	49"	33"	2'- 2"	1'- 0"	3'- 9"
7	57"	38"	2'- 5"	1'- 0"	4'- 2"
8	64"	43"	2'-10"	1'- 0"	4'- 7"
9	71"	47"	3'- 2"	1'- 0"	4'-11"

(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.

(3) Provide a 1'-0" footing as shown where required to maintain 4" Min cover for pipes.

(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 = $12 \times H - 3" \times \left(\frac{12 \times H - 7}{12 \times L}\right) - 1"$

(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.

Texas Department of Transportation

Bridge Division Standard

SAFETY END TREATMENT WITH FLARED WINGS

FOR 30° SKEW ARCH PIPE CULVERTS
TYPE I ~ CROSS DRAINAGE

SETP-FW-A-30

FILE: stpa30se.dgn	DN: GAF	CK: CAT	DW: BWH	CK: GAF
©TxDOT February 2010	CONT	SECT	JOB	HIGHWAY
REVISIONS				
11-10: Removed Bars T.	DIST	COUNTY		SHEET NO.

DATE:
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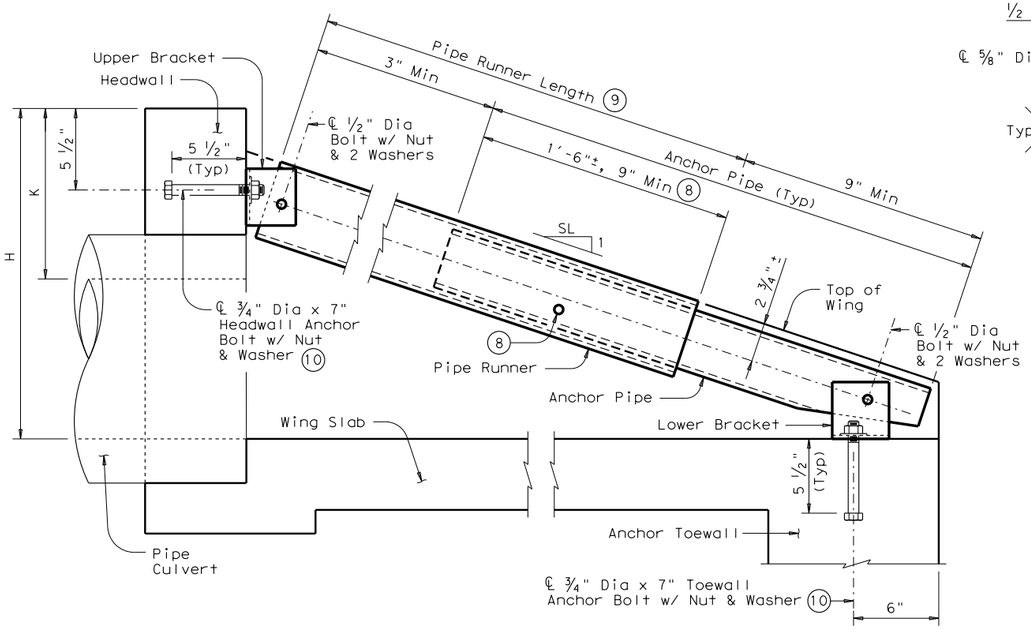
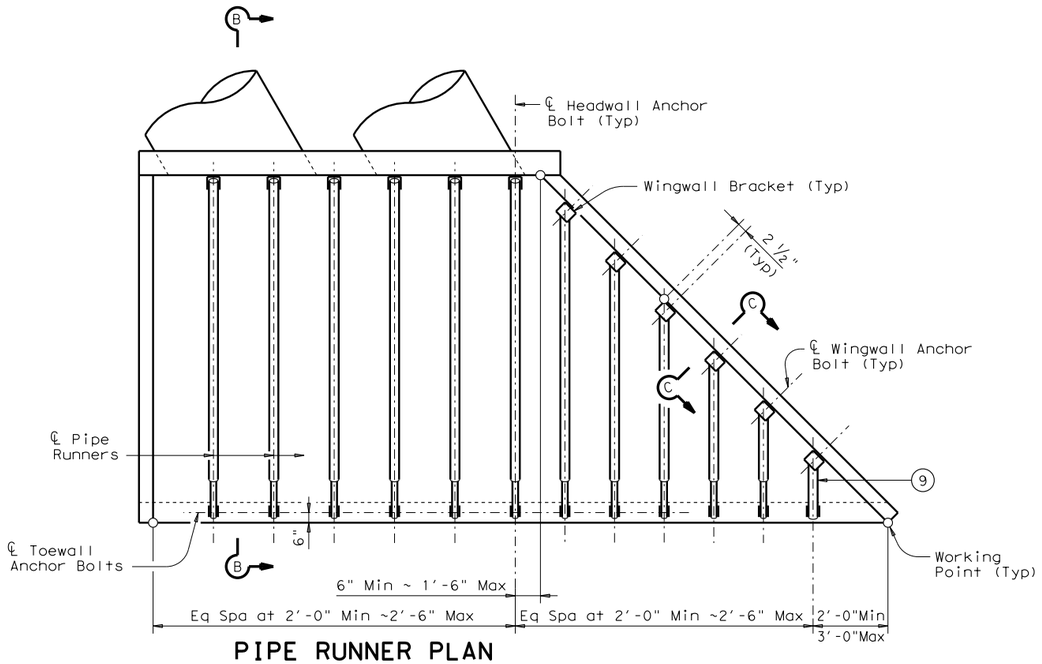
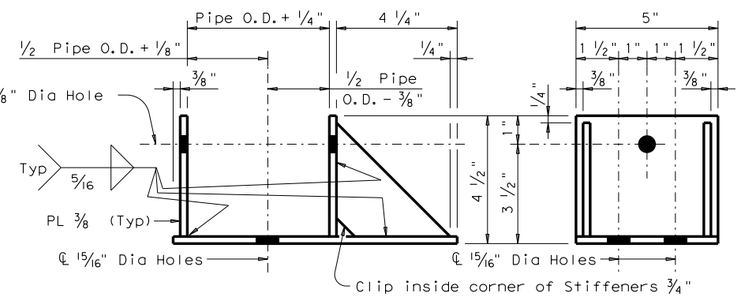


SECTION B-B

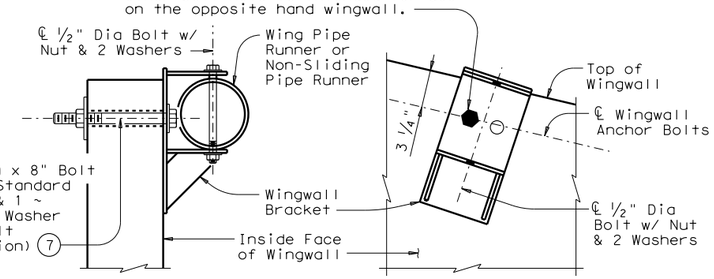
(Showing Headwall Pipe Runner. Except for upper bracket, Wingwall Pipe Runners are similar.)



PIPE RUNNER PLAN



ELEVATION SIDE VIEW

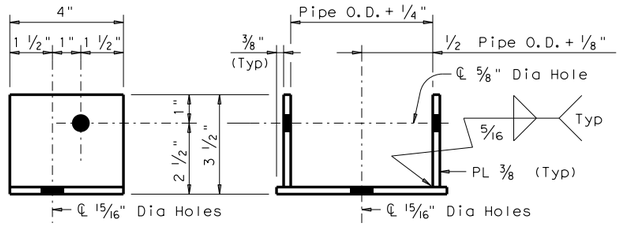


SECTION C-C (Showing installed bracket.)

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

NOTE: Wingwall Bracket shall match the Upper Bracket size.

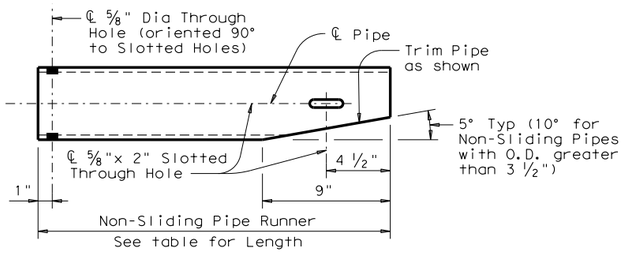
WINGWALL BRACKET DETAILS



SIDE VIEW ELEVATION

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.

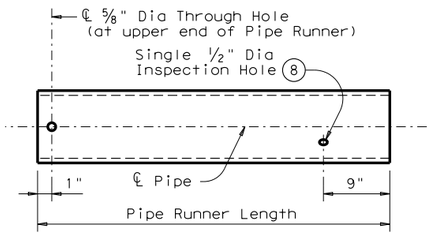
NON-SLIDING PIPE RUNNER DETAILS (9)

(7) At Contractor's option, ⅞" 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 ½" inspection hole shall be utilized to ensure that the lap of the Anchor Pipe with the Pipe Runner is adequate.

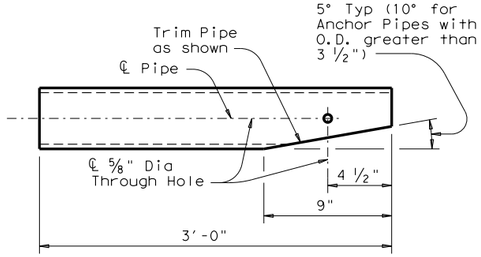
(9) Non-Sliding Pipe Runners are used for those installations that would require Pipe Runner lengths of 1'-9" or less. The Non-Sliding Pipe Runner, when required, replaces the outermost Pipe Runner and Anchor Pipe. See table on Sheet 3 of 3 to determine if the Non-Sliding Pipe Runner is required.

(10) 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 ¾". 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

Texas Department of Transportation

Bridge Division Standard

SAFETY END TREATMENT WITH FLARED WINGS

FOR 30° SKEW ARCH PIPE CULVERTS
TYPE I ~ CROSS DRAINAGE

SETP-FW-A-30

FILE: stpa30se.dgn	DN: GAF	CK: CAT	DW: TxDOT	CK: GAF
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REVISIONS 11-10: Removed Bars T.	DIST	COUNTY		SHEET NO.

Arch Pipe Culvert Design	Number of Pipe Culverts	No. of L2 Spaces	L2 Overall Dimension (Ft-In)	Number of Headwall Pipes
3	1	1	2′- 5 ½"	1
	2	3	6′- 9 ½"	3
	3	5	11′- 1 ½"	5
	4	7	15′- 5 ½"	7
	5	8	19′- 9 ½"	8
	6	10	24′- 1 ½"	10
4	1	2	3′- 7 ½"	2
	2	4	8′-11"	4
	3	6	14′- 2 ½"	6
	4	8	19′- 6"	8
	5	10	24′- 9 ½"	10
	6	12	30′- 1"	12
5	1	2	4′- 3 ½"	2
	2	5	10′- 6 ½"	5
	3	7	16′- 9 ½"	7
	4	10	23′- 0 ½"	10
	5	12	29′- 3 ½"	12
	6	15	35′- 6 ½"	15
6	1	2	4′-10 ¼"	2
	2	5	12′- 0 ¾"	5
	3	8	19′- 3 ¼"	8
	4	11	26′- 5 ¾"	11
	5	14	33′- 8 ¼"	14
	6	17	40′-10 ¾"	17
7	1	2	5′- 0"	2
	2	6	13′- 3 ¼"	6
	3	9	21′- 6 ½"	9
	4	12	29′- 9 ¾"	12
	5	16	38′- 1"	16
	6	19	46′- 4 ¼"	19
8	1	3	6′- 5"	3
	2	7	15′-10 ¼"	7
	3	11	25′- 3 ½"	11
	4	14	34′- 8 ¾"	14
	5	18	44′- 2"	18
	6	22	53′- 7 ¼"	22
9	1	3	7′- 1"	3
	2	7	17′- 6 ¾"	7
	3	12	28′- 0 ½"	12
	4	16	38′- 6 ¼"	16
	5	20	49′- 0"	20
	6	24	59′- 5 ¾"	24

Side Slope	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 (12)	Longest Wingwall Pipe Runner Length (Ft-In)	Shortest Wingwall Pipe Runner Length (Ft-In)	Non-Sliding Pipe Length (Ft-In)	Pipe Runner Size (13)	Total Length of Wingwall Pipe Runners (Ft-In) (12)
3:1	3	1′- 0"	2′- 3"	2	5′- 0"	2′-11 ¾"	1	3′- 6 ½"	4′-10 ¾"	2	2′-11 ¼"	2′-11 ¼"	1′- 9 ¾"	3" STD	4′- 9"
	4	6"	2′- 9"	2	5′- 0"	3′- 8 ¼"	1	3′- 6 ½"	5′-11 ½"	2	3′- 5 ¾"	3′- 5 ¾"	2′- 4"	3" STD	5′- 9 ¾"
	5	6"	2′- 0"	3	7′- 0"	2′- 7 ½"	2	6′- 7 ¼"	7′- 3 ¼"	3	4′-11 ½"	2′- 6"	1′- 6 ½"	3" STD	9′- 0"
	6	7 ½"	2′- 9"	3	7′- 4 ½"	3′- 8 ¼"	2	6′-11 ½"	8′- 4"	3	6′- 0 ¼"	3′- 5"	2′- 4"	3" STD	11′- 9 ¼"
	7	1′- 3"	2′- 0"	4	10′- 0"	2′- 7 ½"	3	10′- 7 ¼"	9′- 7 ¾"	4	7′-11 ½"	2′- 8 ¼"	1′- 6 ½"	3" STD	17′- 6 ¼"
	8	6"	2′- 6"	4	10′- 0"	3′- 4"	3	10′- 7 ¼"	10′-11 ½"	4	8′- 5 ¾"	3′- 2 ½"	2′- 0 ¾"	4" STD	19′- 7 ¼"
	9	6"	2′- 0"	5	11′- 6"	2′- 7 ½"	4	13′- 0"	12′- 0 ¼"	5	9′- 9"	2′- 5 ¾"	1′- 6 ½"	4" STD	26′- 0"
4:1	3	1′- 0"	2′- 0"	3	7′- 4"	2′- 7 ½"	2	6′-11"	6′-10 ¾"	3	5′- 0 ½"	2′- 6 ¼"	1′- 6"	3" STD	9′- 0 ¾"
	4	6"	2′- 9"	3	7′- 5"	3′- 8 ¼"	2	7′- 0"	8′- 3 ¼"	3	5′-10 ½"	3′- 3 ¾"	2′- 3 ¼"	3" STD	11′- 5 ½"
	5	6"	2′- 0"	4	9′-10"	2′- 7 ½"	3	10′- 5 ¼"	10′- 0"	4	7′- 7 ¼"	2′- 6 ½"	1′- 6"	4" STD	16′- 8 ¾"
	6	7 ½"	2′- 0"	5	11′- 3 ½"	2′- 7 ½"	4	12′- 9 ¼"	11′- 4 ½"	5	9′- 3 ¾"	2′- 4"	1′- 6"	4" STD	24′- 9 ½"
	7	1′- 3"	2′- 0"	6	13′- 7"	2′- 7 ½"	5	16′- 0"	13′- 1"	6	11′- 8"	2′- 4"	1′- 6"	4" STD	36′- 6"
	8	6"	2′- 0"	6	14′- 6"	2′- 7 ½"	5	17′- 1"	14′- 9 ¾"	6	12′- 5 ½"	2′- 6"	1′- 6"	4" STD	38′-10 ¾"
	9	6"	3′- 0"	6	14′-10"	4′- 0 ½"	5	17′- 5 ¾"	16′- 2 ¼"	6	13′- 9 ¼"	3′- 7"	2′- 6 ¼"	4" STD	45′-11"
6:1	3	1′- 0"	2′- 0"	5	11′- 6"	2′- 7 ½"	4	13′- 0"	10′-11 ¾"	5	9′- 3 ½"	2′- 3 ½"	1′- 5 ½"	4" STD	24′- 7 ½"
	4	6"	3′- 0"	5	12′- 0"	4′- 0 ½"	4	13′- 7"	13′- 0 ¼"	5	10′- 8 ½"	3′- 5"	2′- 5 ¾"	4" STD	30′- 8 ¾"
	5	6"	2′- 6"	6	15′- 0"	3′- 4"	5	17′- 8"	15′- 6 ½"	6	13′- 1 ¾"	3′- 0"	1′-11 ¾"	4" STD	42′- 4 ¼"
	6	7 ½"	2′- 3"	7	17′- 4 ½"	2′-11 ¾"	6	21′- 0 ¾"	17′- 7"	7	15′- 3 ¾"	2′- 8 ¾"	1′- 8 ½"	4" STD	55′-10"
	7	1′- 3"	2′- 9"	8	20′- 0"	3′- 8 ¼"	7	24′- 9"	20′- 1 ¼"	8	18′- 5 ¾"	3′- 3 ¼"	2′- 2 ¾"	4" STD	78′- 4 ¼"
	8	6"	2′- 0"	9	22′- 6"	2′- 7 ½"	8	28′- 3 ¼"	22′- 7 ¾"	9	20′- 3"	2′- 6"	1′- 5 ½"	5" STD	92′- 5 ½"
	9	6"	2′- 0"	10	24′- 6"	2′- 7 ½"	9	31′- 2 ¼"	24′- 8"	10	22′- 4"	2′- 5 ½"	1′- 5 ½"	5" STD	113′- 0 ¼"

(11) If the outermost Wing Pipe Runner is a Non-Sliding Pipe Runner, the next outermost Wing Pipe Runner shall be considered the Shortest.

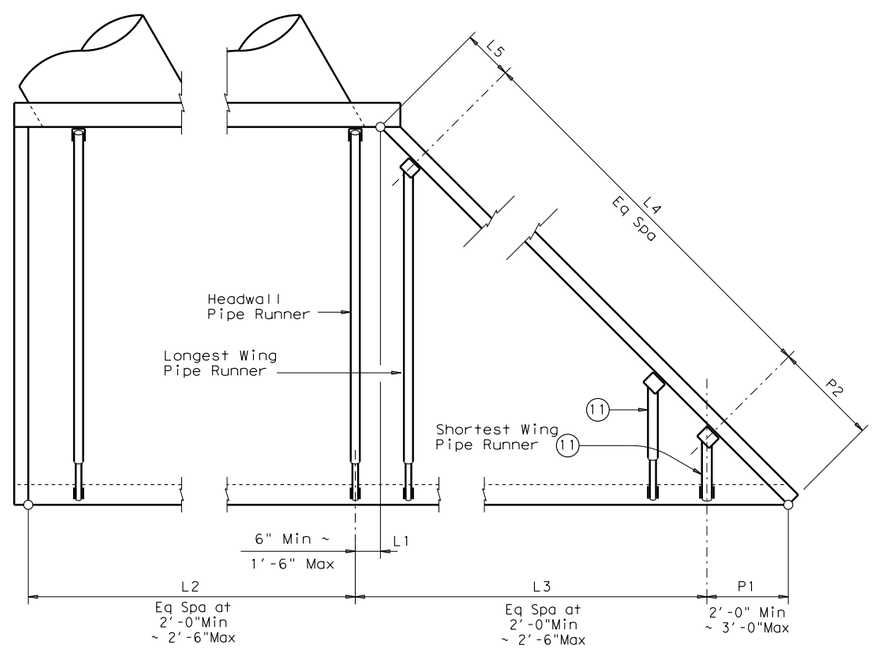
(12) Quantities shown include, if present, the Non-Sliding Pipes.

(13) Anchor Pipe size shall be the next smaller size than the Pipe Runner size.

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.

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"



PIPE RUNNER LAYOUT

Note: Left forward culvert skew shown, actual culvert skew may be opposite hand.

TOTAL PIPE LENGTHS FORMULAS:

$$\text{Total Length of All Pipe Runners} = \text{Total Length of Wingwall Pipe Runners} + \left(\text{No. of Headwall Pipe Runners}\right)\left(\text{Headwall Pipe Runner Length}\right)$$

$$\text{Total Length of All Anchor Pipes} = \left(3.000'\right)\left(\text{No. of Wing Pipe Runners} + \text{No. of Headwall Pipe Runners} - \text{No. of Non-Sliding Pipe Runners}\right)$$

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SAFETY END TREATMENT WITH FLARED WINGS

FOR 30° SKEW ARCH PIPE CULVERTS
TYPE I ~ CROSS DRAINAGE

SETP-FW-A-30

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