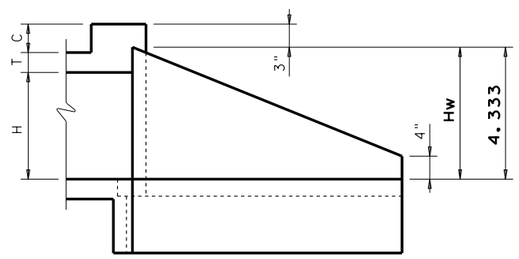
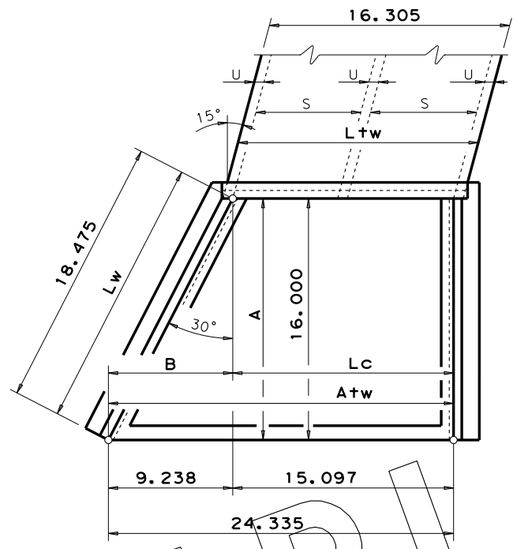
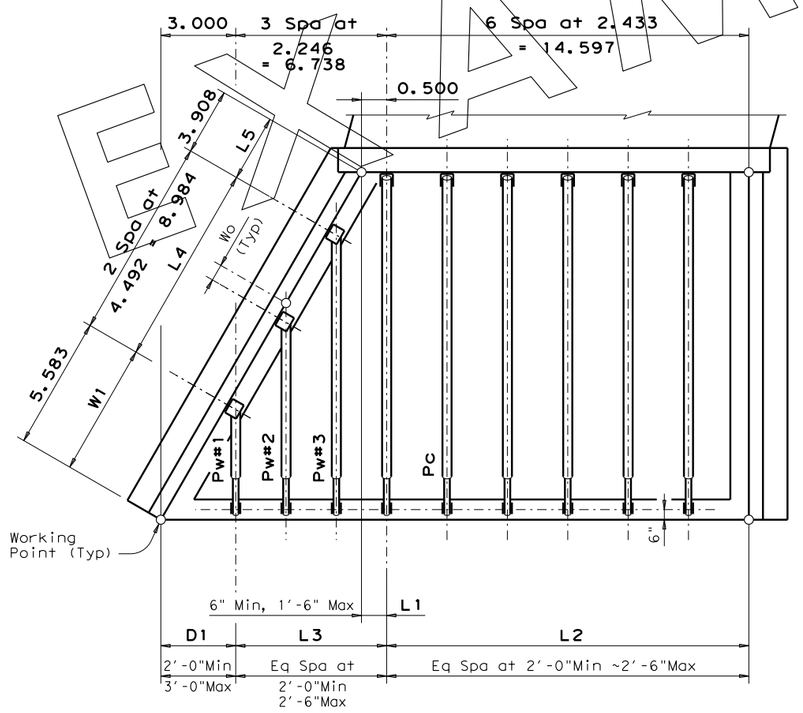
DATE:
FILE:



WINGWALL ELEVATION



FLARED END PLAN



PIPE RUNNER PLAN

CONCRETE DIMENSIONS:

Hw = H + T + C - 0.250
= (3.000) + (0.583) + (1.000) - (0.250)
= **4.333**
A = (Hw - 0.333) (SL)
= (4.333 - 0.333) (4)
= **16.000**
B = (A) [Tangent (15° + ~~θ~~)]
= (16.000) (Tan 30°)
= **9.238**
Lw = (A) ÷ [Cosine (15° + ~~θ~~)]
= (16.000) ÷ (Cosine 30°)
= **18.475**
Ltw = [(N) (S) + (N+1) (U)] ÷ (Cosine 15°)
= [(2) (7.000) + (2+1) (0.583)] ÷ (Cosine 15°)
= **16.305**
Lc = (Ltw) - (2U) ÷ (Cosine ~~θ~~)
= (16.305) - (2) (0.583) ÷ (Cosine 15°)
= **15.097**
Atw = (Lc) + (B)
= (15.097) + (9.238)
= **24.335**
Long Wing Area = (Lw) (Hw - 0.333) (0.5) + (Lw) (0.333)
= (18.475) (4.333 - 0.333) (0.5) + (18.475) (0.333)
= 43.102
Short Wing Area = (A) (Hw - 0.333) (0.5) + (A) (0.333)
= (16.000) (4.333 - 0.333) (0.5) + (16.000) (0.333)
= 37.328
Total Wing Area = (Long Wing Area) + (Short Wing Area)
= (43.102) + (37.328)
= **80.430** (S.F. ~ 2 Wings)

PIPE LOCATIONS & DIMENSIONS:

Establish Pipe Runner Spacing
Determine curb pipe spacing - Try:
(Lc) - (0.500 min)
= 14.597
(14.597) ÷ (2.500 max)
= 5.8 ~ 6 spaces
Try 5 spaces:
(2.500 spacing) (5 spaces)
= 12.500
(Lc) - (12.500)
= (15.097) - (12.500)
= 2.597
Test: (1.500) > (2.597) > (0.500)
= no, use 6 spaces & 0.500
(14.597) ÷ (6 spaces)
= 2.433 ÷ space
Determine wingwall pipe spacing - Try:
(B) + (0.500) - (3.000 max outside space at toewall)
= (9.238) + (0.500) - (3.000)
= 6.738
(6.738) ÷ (2.500 max)
= 2.7 ~ 3 spaces
(6.738) ÷ (3 spaces)
= 2.246 ÷ space
Use:
D1 = outside space at toewall = **3.000**
L3 = runner spacing at wingwall = **3 spa at 2.246 = 6.738**
L1 = outside space at curb = **0.500**
L2 = runner spacing at curb = **6 spa at 2.433 = 14.597**
W1 = (K3) (D1) - (Wo)
= (2.000) (3.000) - (0.417)
= **5.583**
L4 = (L3 - one space) (K3)
= (6.738 - 2.246) (2.000)
= **8.984**
Determine spacing:
= (L4) ÷ (number of L3 spaces - one space)
= (8.984) ÷ (3 - 1)
= **2 spa at 4.492**
L5 = (Lw) - (W1) - (L4)
= (18.475) - (5.583) - (8.984)
= **3.908**
Establish Pipe Runner Lengths and Sizes
Pw#1 shortest wing pipe runner = (D1) (K2) - (2.063 end of pipe clearance)
= (3.000) (1.785) - (2.063)
= **3.292**
Test: (1.750 min sliding runner) < (3.292)
= yes, use normal sliding runner for Pw#1
Pw#3 longest wing pipe runner = (D1 + L3 - one L3 space) (K2) - (2.063)
= (3.000 + 6.738 - 2.246) (1.785) - (2.063)
= **11.310**
Pc = (A) (K1) - (1.688 end of pipe clearance)
= (16.000) (1.031) - (1.688)
= **14.808**
Test: (Pc) > (9.333 max length 3" Pipe Runner)
= (14.808) > (9.333)
= yes, do not use 3" Pipe Runner
Test: (Pc) > (19.000 max length 4" Pipe Runner)
= (14.808) > (19.000)
= no, **use 4" Upper Pipe Runner & 3" Anchor Pipe**

BOX CULVERT PARAMETERS:

2 ~ 7' x 3' Multi-Box Culvert with 8' Fill, 4:1 Slope, 15° Skew, and 1.000' Curb (C). From MC-7-10 Std: H = 3.000', T = 0.583', and U = 0.583'.

DEFINITIONS:

~~θ~~ = Culvert Skew
Hw = Wingwall height (at tallest point)
H = Interior height of Culvert box
T = Culvert Slab thickness
C = Height of Curb above Top of top Slab
A = Horizontal distance between face of Anchor Toewall and face of Culvert Curb
SL:1 = Side Slope Ratio (Horizontal : 1 Vertical)

SL:1	Slope Angle
3:1	= 18.4349°
4:1	= 14.0362°
5:1	= 9.4623°

K = Constant values for use in formulas

SL:1	K1	K2~15° Skew	K2~30° Skew
3:1	~ 1.054	~ 1.826	~ 1.054
4:1	~ 1.031	~ 1.785	~ 1.031
6:1	~ 1.014	~ 1.756	~ 1.014

Note: K1 = (1 ÷ Cosine Slope Angle)
K2 = (K1) [Tangent (75° - 0)]
K3 = 15° Skew ~ 2.000'
30° Skew ~ 1.414'
Note: K3 = 1/[Sine(Skew + 15°)]
B = Horizontal offset of Tip of Wing from perpendicular
Lw = Length of Wingwall (along bottom inside face of Wing)
Atw = Anchor Toewall length (along outside face of toewall)
N = Number of Culvert Spans
S = Interior width of Culvert Span
U = Thickness of Culvert Wall
Ltw = Length of Culvert Curb
Lc = Length of Culvert Curb between wings
Wo = Wing Anchor Bracket Offset
Wo = (3 ½") ÷ [Tangent (Skew + 15°)] - (1")

Skew	Wo
15° ~	5"
30° ~	2 ½"

Pw = Length of Pipe Runner on Wingwall
Pc = Length of Pipe Runner on Curb

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SHEET 1 OF 2

Texas Department of Transportation | Bridge Division Standard

EXAMPLE CALCULATIONS FOR SETB-FW-S STANDARD

FILE: exstde04.dgn	DN: GAF	CK: CAT	DW: JRP	CK: GAF
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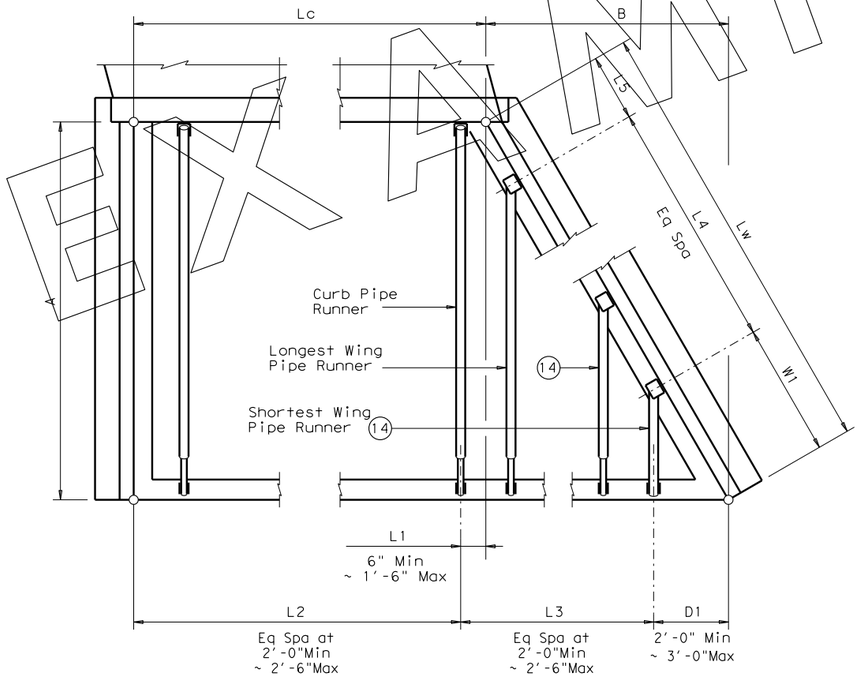
REVISIONS				
	DIST	COUNTY		SHEET NO.

Culvert Station and/or Creek name followed by applicable end (Lt, Rt or Both) (14)	Lc (Ft)	L1 (Ft)	L2 No. Spa	L2 Spa at (Ft)	L2 Overall Length (Ft)	D1 (Ft)	L3 No. Spa	L3 Spa at (Ft)	L3 Overall Length (Ft)	W1 (Ft)	L4 No. Spa	L4 Spa at (Ft)	L4 Overall Length (Ft)	L5 (Ft)	Curb Pipe Runner (Pc) No.	Curb Pipe Runner (Pc) Length (Ft)	Longest Wing Pipe Runner (Pw) (Ft)	Shortest Wing Pipe Runner (Pw) (Ft)	Non-Sliding Wing Pipe Runner (if applicable) (Ft)	Curb, Wing, and/or Non-Sliding Pipe Runners Size (3",4" or 5")	Curb, Wing, and/or Non-Sliding Pipe Runners Total (16) Length (Ft)	3'-0" Anchor Pipe Size (2",3" or 4")	3'-0" Anchor Pipe Total (16) Length (Ft)
Shaggy's Creek (Both)	15.098'	0.500'	6	2.433'	14.598'	3.000'	3	2.246'	6.738'	5.583'	2	4.492'	8.983'	3.908'	6	14.813'	11.313'	3.292'	N/A	4"	221.563'	3"	54.000'
Sta 152+00 (Rt)	18.283'	0.500'	8	2.223'	17.783'	3.000'	4	2.250'	9.000'	4.034'	3	3.182'	9.545'	2.685'	8	10.438'	8.208'	3.479'	2.604'	4"	103.635'	3"	33.000'



PIPE RUNNER LAYOUT

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

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

(15) Quantities shown are for one structure end if Lt or Rt. Quantities shown are for two structure ends if Both.

SPECIAL NOTE:

This tabular sheet is to be filled out by the culvert specifier and provides information for the construction details and quantities of Pipe Runners.

An Excel 97 spreadsheet to assist in completing this table can be downloaded from the Bridge Standards (English) web page on the TxDOT web site. The completed sheet shall be signed, sealed, and dated by a licensed Professional Engineer.

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.

NOT A STANDARD

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DATE:
FILE:

Texas Department of Transportation | Bridge Division Standard

EXAMPLE OF COMPLETED SHEET 3 OF 3 SETB-FW-S STANDARD

FILE: exstde04.dgn	DN: TxDOT	CK: TxDOT	DW: TxDOT	CK: GAF
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REVISIONS				
	DIST	COUNTY		SHEET NO.