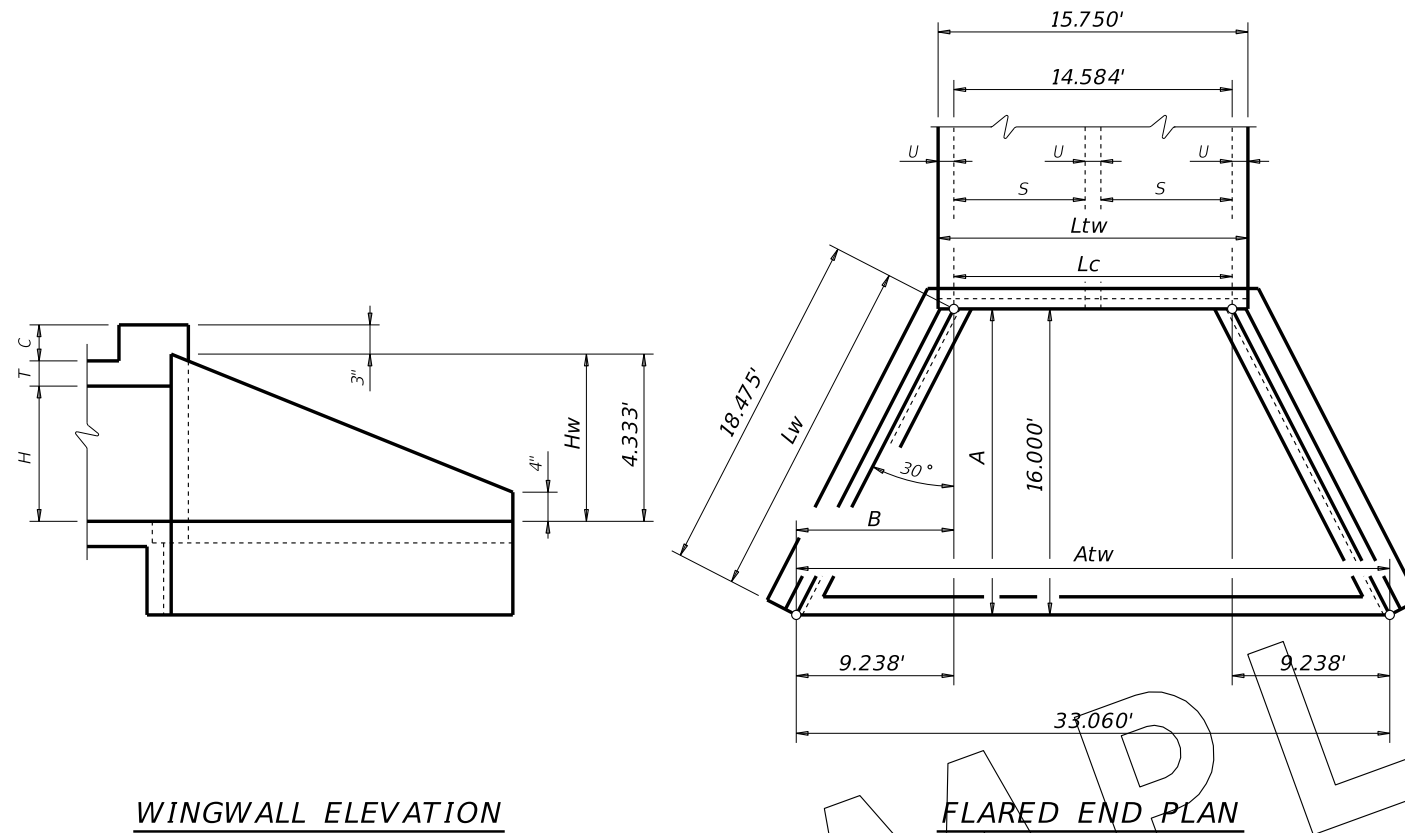


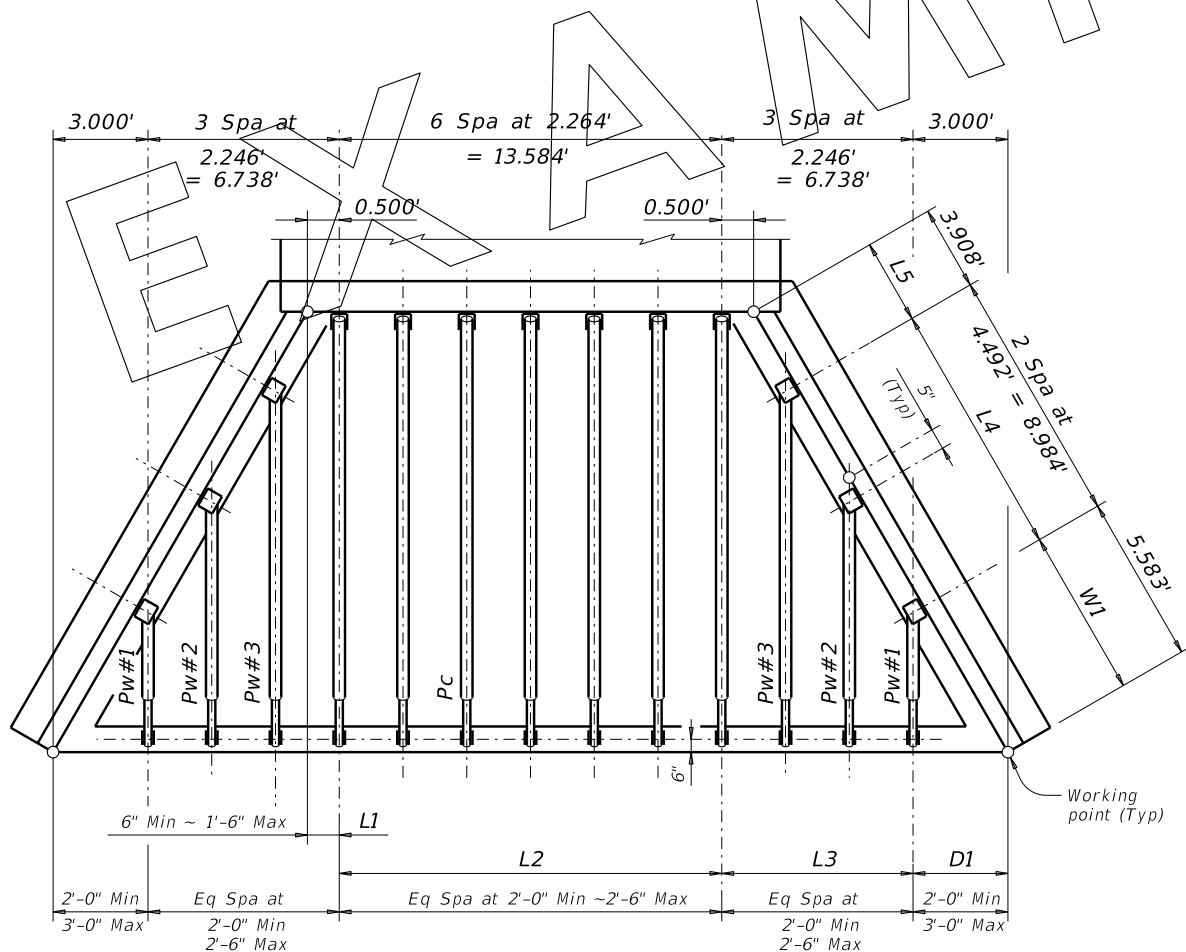
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DATE:
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WINGWALL ELEVATION

FLARED END PLAN



PIPE RUNNER PLAN

CONCRETE DIMENSIONS:

$$\begin{aligned}
 Hw &= H + T + C - 0.250' \\
 &= (3.000') + (0.583') + (1.000') - (0.250') \\
 &= 4.333' \\
 A &= (Hw - 0.333') (SL) \\
 &= (4.333' - 0.333') (4) \\
 &= 16.000' \\
 B &= (A) (\tan 30^\circ) \\
 &= (16.000') (\tan 30^\circ) \\
 &= 9.238' \\
 Lw &= (A) \div (\cos 30^\circ) \\
 &= (16.000') \div (\cos 30^\circ) \\
 &= 18.475' \\
 Ltw &= (N) (S) + (N + 1) (U) \\
 &= (2) (7.000') + (2 + 1) (0.583') \\
 &= 15.750' \\
 Lc &= (Ltw) - (2U) \\
 &= (15.750') - (2) (0.583') \\
 &= 14.584' \\
 Atw &= (Lc) + (2B) \\
 &= (14.584') + (2) (9.238') \\
 &= 33.060' \\
 \text{Wingwall Area} &= (Hw + 0.333') (Lw) \\
 &= (4.333' + 0.333') (18.475') \\
 &= 86.2' \text{ SF (Two wings)}
 \end{aligned}$$

PIPE LOCATIONS AND DIMENSIONS:

Establish Pipe Runner Spacing
 Determine curb pipe spacing - Try:
 $(L) \div (2) (0.500' \text{ min}) = 13.584'$
 $(13.584') \div (2.500' \text{ max}) = 5.4 \sim 6 \text{ spaces}$
 Try 6 spaces:
 $(13.584') \div (6 \text{ spaces}) = 2.264'$
 Test: $(2.500') > (2.264') > (0.500')$
 = yes
 Determine wingwall pipe spacing - Try:
 $(B) \div (0.500') - (3.000' \text{ max outside space at toewall}) = (9.238') \div (0.500') - (3.000') = 6.738'$
 $(6.738') \div (2.500' \text{ max}) = 2.7 \sim 3 \text{ spaces}$
 $(6.738') \div (3 \text{ spaces}) = 2.246'$
 Test: $(2.500') > (2.246') > (2.000')$
 = yes
 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 2.264' = 13.584'
 W1 = $(D1) (1 + \sin 30^\circ) - (0.417' \text{ bracket offset}) = (3.000') (1 + \sin 30^\circ) - (0.417') = (3.000') (2.000') - (0.417') = 5.583'$
 L4 = $(L3 - \text{one space}) \div (\sin 30^\circ) = (6.738' - 2.246') \div 0.500' = 8.984'$
 Determine spacing:
 $= (L4) \div \text{number of L3 spaces} - \text{one space} = (8.984') \div (3 - 1) = 2 \text{ Spa at } 4.492'$
 L5 = $(Lw) - (W1) - (L4) = (18.475') - (5.583') - (8.984') = 3.908'$
 Establish Pipe Runner Lengths
 Pw#1 shortest wing pipe runner = $(D1) (K2) - (2.063' \text{ end of pipe clearance}) = (3.000') (1.785) - (2.063') = 3.292'$
 Test: $(1.750' \text{ min sliding runner}) < (3.292')$
 = yes, use normal sliding runner for Pw#1
 Pw#3 longest wing pipe runner = $(D1 + L3 - \text{one L3 space}) (K2) - (2.063') = (3.000' + 6.738' - 2.246') (1.785) - (2.063') = 11.310'$
 = round to nearest 1/4", use 11.313'
 Pc = $(A) (K1) - (1.688' \text{ end of pipe clearance}) = (16.000') (1.031) - (1.688') = 14.808'$
 = round to nearest 1/4", use 14.813'
 Test: $(Pc) > (9.333' \text{ max length } 3" \text{ pipe runner}) = (14.813') > (9.333')$
 = yes, do not use 3" pipe runner
 Test: $(Pc) > (19.000' \text{ max length } 4" \text{ pipe runner}) = (14.813') > (19.000')$
 = no, use 4" pipe runner and 3" anchor pipe

BOX CULVERT PARAMETERS:

2 ~ 7' x 3' multi-box culvert with 8" fill, 4:1 slope, and 1.000' curb (C). From MC-7-10 Std: H = 3.000', T = 0.583', and U = 0.583'.

DEFINITIONS:

Hw = Wingwall height (at tallest point) (feet)
 H = Interior height of culvert/box (feet)
 T = Culvert slab thickness (feet)
 C = Height of curb above top of top slab (feet)
 A = Horizontal distance between face of anchor toewall and face of culvert curb (feet)
 SL:1 = Side slope ratio (horizontal : 1 vertical)
 SL:1 Slope Angle
 3:1 = 18.4349°
 4:1 = 14.0362°
 6:1 = 9.4623°
 K = Constant values for use in formulas
 SL:1 K1 K2
 3:1 1.054 ~ 1.826
 4:1 ~ 1.031 ~ 1.785
 6:1 ~ 1.014 ~ 1.756
 Note: K1 = $(1) \div \cos(\text{slope angle})$
 K2 = $(K1) \div \tan(30^\circ)$
 B = Horizontal offset of tip of wing from perpendicular (feet)
 Lw = Length of wingwall (along bottom inside face of wing) (feet)
 Atw = Anchor toewall length (along outside face of toewall) (feet)
 N = Number of culvert spans
 S = Interior width of culvert span (feet)
 U = Thickness of culvert wall (feet)
 Ltw = Length of culvert toewall (feet)
 Lc = Length of culvert curb between wings (feet)
 Pw = Length of pipe runner on wingwall (feet)
 Pc = Length of pipe runner on curb (feet)

EXAMPLE



EXAMPLE CALCULATIONS FOR SETB-FW-0 STANDARD

NOT A STANDARD
 NOT FOR INCLUSION
 IN THE PLANS

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