



Triple Reinforced Concrete Box Culvert Standards - Flared Wing Headwalls

General Notes:

- The RCB culvert sections are designed for HL-93 live load and earth fills of varying heights.
- Vertical earth pressure, $EV=0.120$ kcf.
Horizontal earth pressure, $EH_{max} = 0.060$ kcf max, $EH_{min} = 0.030$ kcf.
- The RCB culvert sections are designed for Class 1 exposure conditions except: Class 2 exposure condition is utilized for the slab design in 0' fill instances.
- All slab and floor reinforcing steel is to be supported at intervals of not more than 3'-0" in either direction as outlined in the Standard Specifications.
- The clear distance from face of concrete to near edge or end of reinforcing bar to be 2" unless otherwise noted.
- Except for dowel bars 5r1 in slab, longitudinal reinforcing is not to extend thru the construction joints.
- Floor of barrel is to be finished smooth. Sides of footing are to be formed to ensure correct line and grade.
- The permissible construction joint at the top of the walls may be lowered at the Contractor's option with Engineer's approval.
- The reinforcement supplied for this structure shall be Grade 60 reinforcement in accordance with the Standard Specifications. The design stresses are based on ASTM A706 Grade 60 reinforcement.
- The vertical bars in the walls may be spliced above the footing at the Contractor's option as follows:

Bar Size Number	4	5	6	7	8	9
Minimum Splice Length	20"	24"	29"	34"	38"	47"

This splice, if used, will be at the Contractor's expense.

- Reinforcing bar clearances will be as follows:
 - Edge clearances: 2" except
 - Top of floor 2 1/4" to near transverse reinforcing bar
 - Bottom of floor 3 1/2" to near transverse reinforcing bar
 - End clearances:
 - Vertical top 2"
 - Vertical bottom 3" or 3 1/2" if overall height of the culvert is not to a full inch
 - Transverse 2"
- All construction joints shall be formed with a beveled keyway except at bell joints.
- All beveled keyways shall be centered.
- Keyway size shall be 2"x4" except as follows:
 - Keyway between the floor and wall shall be 2"x6" when the wall is greater than 10 inches wide.
- Keyway dimensions shown on the plans are based on nominal dimensions unless stated otherwise. In addition, the bevel used on the keyway shall be limited to a maximum of 10 degrees from vertical.
- If 0' of fill is specified, details for paving notch and reference to epoxy coating of slab reinforcing steel, if applicable, shall be included in the final plans.
- All dimensions are in feet and inches unless otherwise noted or shown.
- Dimensions with parenthesis () indicate a reference dimension.
- See current Standard Specifications regarding concrete form removal.
- These culvert standards label all reinforcing steel with English notation (5a1 is 5/8 inch diameter bar). English reinforcing steel received in the field may display the following "bar designation". The "bar designation" is the stamped impression on the reinforcing bars, and is equivalent to the bar diameter in millimeters.

English Size	4	5	6	7	8	9
Bar Designation	13	16	19	22	25	29

- In the event the slab thickness at the barrel end section exceeds 18 inches, the culvert parapet shall extend a minimum of 6 inches above the top of the culvert slab. Refer to the Culvert Design Manual for instructions. These details are to be included in the design plans to address these situations.
- For barrel details used in conjunction with these flared wing headwall standards, see the Triple Reinforced Concrete Box Culvert Standards (TRRCB).

Index for Triple Culvert Standards:

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TRFWH 0-2-21	Flared Wing Hdwls., 0° Skew, Apron Details
TRFWH 0-3-21	Flared Wing Hdwls., 0° Skew, Parapet & Curtain Wall Details
TRFWH 0-4-21	Flared Wing Hdwls., 0° Skew, Wingwall Details
TRFWH 0-5-21	Flared Wing Hdwls., 0° Skew, Quantity Tabulation, 12'-0" Span, Sheet 1 of 2
TRFWH 0-5-21	Flared Wing Hdwls., 0° Skew, Quantity Tabulation, 12'-0" Span, Sheet 2 of 2
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TRFWH 15-4-21	Flared Wing Hdwls., 15° Skew, Bottom Apron Detail
TRFWH 15-5-21	Flared Wing Hdwls., 15° Skew, Parapet & Curtain Wall Details
TRFWH 15-6-21	Flared Wing Hdwls., 15° Skew, Wingwall Details
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TRFWH 30-2-21	Flared Wing Hdwls., 30° Skew, Dimension Table
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Specifications:

Design:
AASHTO LRFD Bridge Design Specifications, 8th Ed., Series of 2017.

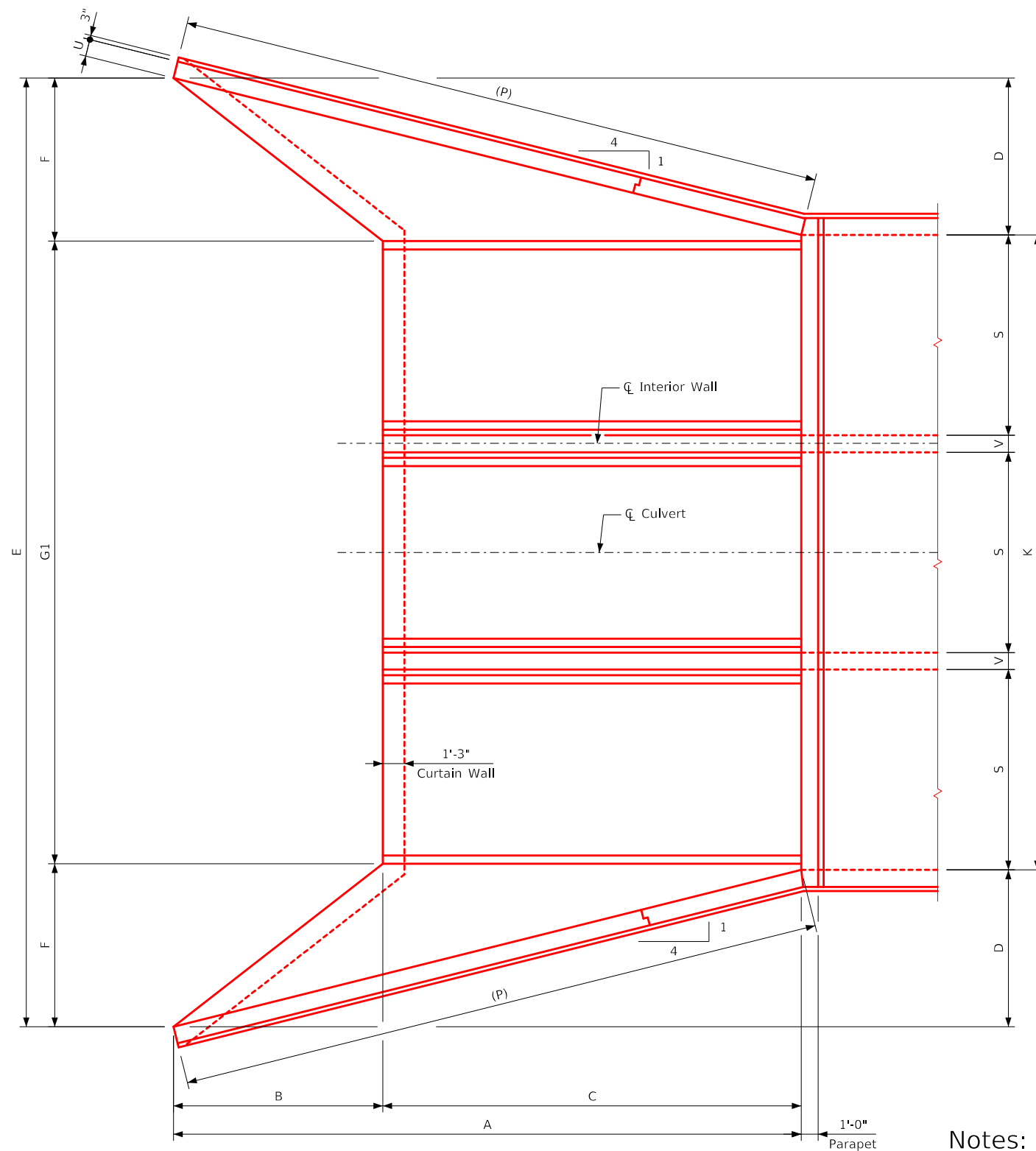
Construction:
Iowa Department of Transportation Standard Specifications for Highway and Bridge Construction, current series, plus applicable General Supplemental Specifications, Developmental Specifications, Supplemental Specifications and Special Provisions

Design Stresses:

Design stresses for the following materials are in accordance with the AASHTO LRFD Bridge Design Specifications, 8th Ed., Series of 2017:
Reinforcing steel in accordance with AASHTO LRFD Section 5, Grade 60.
Concrete in accordance with AASHTO LRFD Section 5, $f'c = 4.0$ ksi.

LATEST REVISION DATE	APPROVED BY BRIDGE ENGINEER		
		Standard Design - Triple Reinforced Concrete Box Culverts	
		<h3>Flared Wing Headwalls</h3> <p>February, 2021</p>	
		Index of Sheets, General Notes & Specifications	TRFWH G1-21

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Plan View

Notes:

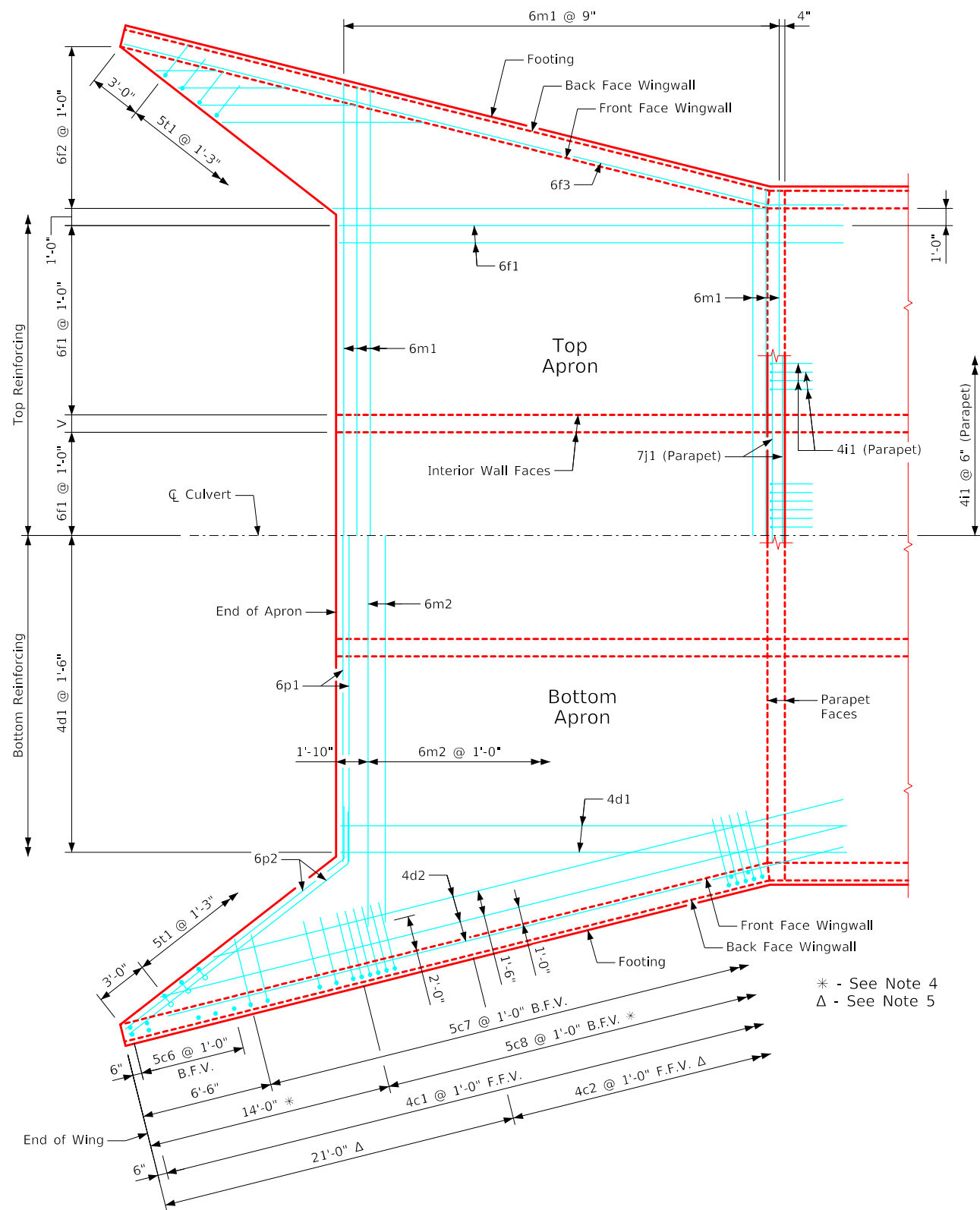
1. See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. See Sheet TRFWH 0-2-21 thru TRFWH 0-4-21 for location of certain dimensions tabulated.
3. Dimensions are in feet and inches unless otherwise noted.

S x H	12' x 12'	12' x 11'	12' x 10'	12' x 9'	12' x 8'	12' x 7'	12' x 6'	12' x 5'	12' x 4'	S x H
A	37'-0	34'-0	31'-0	28'-0	25'-0	22'-0	19'-0	16'-0	13'-0	A
B	12'-4	11'-4	10'-4	9'-4	8'-4	7'-4	6'-4	5'-4	4'-4	B
C	24'-8	22'-8	20'-8	18'-8	16'-8	14'-8	12'-8	10'-8	8'-8	C
D	9'-3	8'-6	7'-9	7'-0	6'-3	5'-6	4'-9	4'-0	3'-3	D
E	56'-6	54'-10	53'-2	51'-8	50'-2	48'-6	47'-0	45'-6	44'-0	E
F	9'-7	8'-10	8'-1	7'-4	6'-7	5'-10	5'-1	4'-4	3'-7	F
G1	37'-4	37'-2	37'-0	37'-0	37'-0	36'-10	36'-10	36'-10	36'-10	G1
G2	38'-6 $\frac{3}{8}$	38'-4 $\frac{3}{8}$	38'-2 $\frac{3}{8}$	38'-2 $\frac{3}{8}$	38'-2 $\frac{1}{2}$	38'-0 $\frac{1}{2}$	38'-0 $\frac{3}{8}$	38'-0 $\frac{1}{4}$	38'-0 $\frac{3}{8}$	G2
G3	15'-7 $\frac{3}{8}$	14'-4 $\frac{3}{8}$	13'-1 $\frac{3}{8}$	11'-10 $\frac{3}{8}$	10'-7 $\frac{1}{2}$	9'-4 $\frac{1}{2}$	8'-1 $\frac{1}{2}$	6'-10 $\frac{1}{2}$	5'-7 $\frac{1}{2}$	G3
G4	16'-5 $\frac{3}{8}$	15'-0 $\frac{1}{2}$	13'-7	12'-4	11'-1 $\frac{1}{8}$	9'-7 $\frac{3}{4}$	8'-4 $\frac{3}{4}$	7'-1 $\frac{1}{8}$	5'-11	G4
G5	3 $\frac{3}{8}$	5 $\frac{3}{8}$	7 $\frac{3}{8}$	7 $\frac{3}{8}$	7 $\frac{3}{8}$	9 $\frac{3}{8}$	9 $\frac{3}{4}$	9 $\frac{3}{4}$	9 $\frac{3}{8}$	G5
K	38'-0	37'-10	37'-8	37'-8	37'-8	37'-6	37'-6	37'-6	37'-6	K
P	38'-1 $\frac{1}{8}$	35'-0 $\frac{1}{2}$	31'-11 $\frac{1}{2}$	28'-10 $\frac{3}{8}$	25'-9 $\frac{1}{4}$	22'-8 $\frac{3}{8}$	19'-7	16'-5 $\frac{3}{8}$	13'-4 $\frac{3}{4}$	P
R1	40'-1	36'-10	33'-7	30'-4	27'-1	23'-10	20'-7	17'-4	14'-1	R1
R2	27'-0 $\frac{3}{8}$	24'-9 $\frac{1}{4}$	22'-6 $\frac{1}{2}$	20'-3 $\frac{3}{4}$	18'-0 $\frac{3}{8}$	15'-10 $\frac{3}{8}$	13'-7 $\frac{3}{8}$	11'-4 $\frac{3}{4}$	9'-2	R2
T	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	T
U	1'-0	11	10	10	10	9	9	9	9	U
V	1'-0	11	10	10	10	9	9	9	9	V
W	5'-0	4'-9	4'-6	4'-3	4'-0	3'-9	3'-6	3'-6	3'-6	W

S x H	10' x 12'	10' x 11'	10' x 10'	10' x 9'	10' x 8'	10' x 7'	10' x 6'	10' x 5'	10' x 4'	S x H
A	37'-0	34'-0	31'-0	28'-0	25'-0	22'-0	19'-0	16'-0	13'-0	A
B	12'-4	11'-4	10'-4	9'-4	8'-4	7'-4	6'-4	5'-4	4'-4	B
C	24'-8	22'-8	20'-8	18'-8	16'-8	14'-8	12'-8	10'-8	8'-8	C
D	9'-3	8'-6	7'-9	7'-0	6'-3	5'-6	4'-9	4'-0	3'-3	D
E	50'-6	48'-10	47'-2	45'-8	44'-2	42'-6	41'-0	39'-6	38'-0	E
F	9'-7	8'-10	8'-1	7'-4	6'-7	5'-10	5'-1	4'-4	3'-7	F
G1	31'-4	31'-2	31'-0	31'-0	31'-0	30'-10	30'-10	30'-10	30'-10	G1
G2	32'-6 $\frac{3}{8}$	32'-4 $\frac{3}{8}$	32'-2 $\frac{3}{8}$	32'-2 $\frac{3}{8}$	32'-2 $\frac{1}{2}$	32'-0 $\frac{1}{2}$	32'-0 $\frac{3}{8}$	32'-0 $\frac{1}{4}$	32'-0 $\frac{3}{8}$	G2
G3	15'-7 $\frac{3}{8}$	14'-4 $\frac{3}{8}$	13'-1 $\frac{3}{8}$	11'-10 $\frac{3}{8}$	10'-7 $\frac{1}{2}$	9'-4 $\frac{1}{2}$	8'-1 $\frac{1}{2}$	6'-10 $\frac{1}{2}$	5'-7 $\frac{1}{2}$	G3
G4	16'-5 $\frac{3}{8}$	15'-0 $\frac{1}{2}$	13'-7	12'-4	11'-1 $\frac{1}{8}$	9'-7 $\frac{3}{4}$	8'-4 $\frac{3}{4}$	7'-1 $\frac{1}{8}$	5'-11	G4
G5	3 $\frac{3}{8}$	5 $\frac{3}{8}$	7 $\frac{3}{8}$	7 $\frac{3}{8}$	7 $\frac{3}{8}$	9 $\frac{3}{8}$	9 $\frac{3}{4}$	9 $\frac{3}{4}$	9 $\frac{3}{8}$	G5
K	32'-0	31'-10	31'-8	31'-8	31'-8	31'-6	31'-6	31'-6	31'-6	K
P	38'-1 $\frac{1}{8}$	35'-0 $\frac{1}{2}$	31'-11 $\frac{1}{2}$	28'-10 $\frac{3}{8}$	25'-9 $\frac{1}{4}$	22'-8 $\frac{3}{8}$	19'-7	16'-5 $\frac{3}{8}$	13'-4 $\frac{3}{4}$	P
R1	40'-1	36'-10	33'-7	30'-4	27'-1	23'-10	20'-7	17'-4	14'-1	R1
R2	27'-0 $\frac{3}{8}$	24'-9 $\frac{1}{4}$	22'-6 $\frac{1}{2}$	20'-3 $\frac{3}{4}$	18'-0 $\frac{3}{8}$	15'-10 $\frac{3}{8}$	13'-7 $\frac{3}{8}$	11'-4 $\frac{3}{4}$	9'-2	R2
T	1'-1	1'-1	1'-1	1'-1	1'-1	1'-1	1'-1	1'-1	1'-1	T
U	1'-0	11	10	10	10	9	9	9	9	U
V	1'-0	11	10	10	10	9	9	9	9	V
W	5'-0	4'-9	4'-6	4'-3	4'-0	3'-9	3'-6	3'-6	3'-6	W

LATEST REVISION DATE	 APPROVED BY BRIDGE ENGINEER	 Standard Design - Triple Reinforced Concrete Box Culverts Flared Wing Headwalls February, 2021	
		Dimension Plan & Table 0° Skew	TRFWH 0-1-21

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Plan View - Top & Bottom of Apron Reinforcing

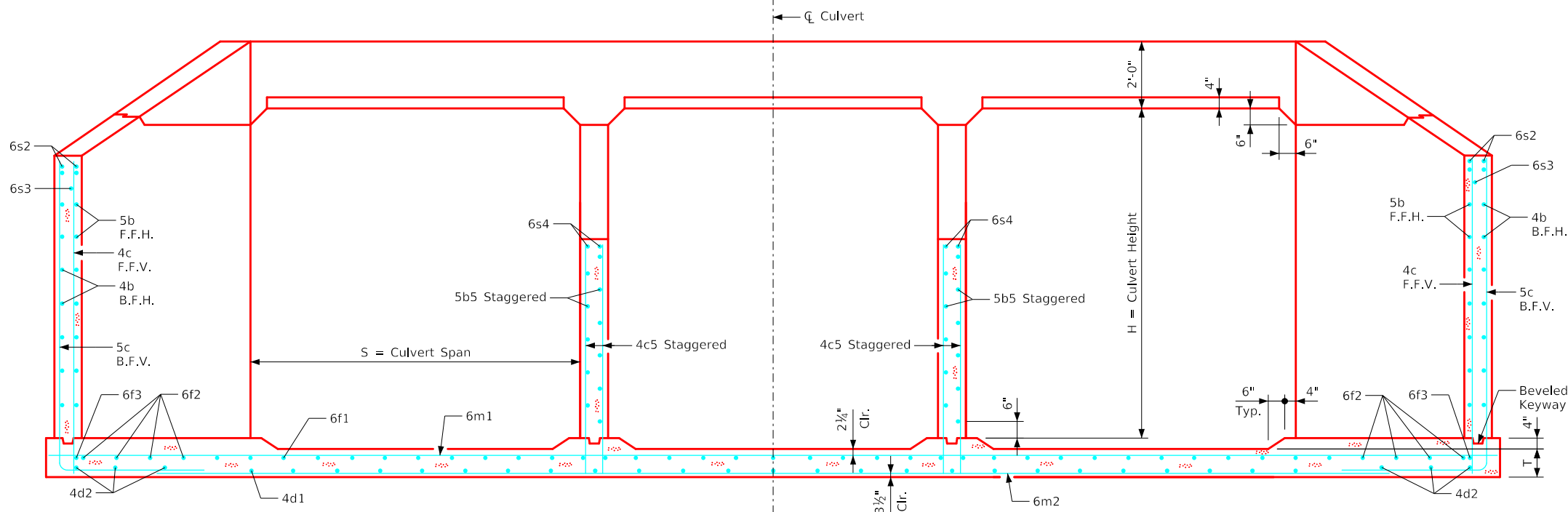
Notes:

1. Bar spacings and positions shown are similar for all sizes of headwalls in this standard.
2. Wingwall bars consistently referenced from end of wing for all headwalls.
3. Top transverse floor bars are referenced approximately 4" from the back of the parapet for all headwalls.
4. There are no 5c8 bars in the 4' & 5' height headwalls.
5. 4c2 bars used only in the 9', 10', 11' & 12' height headwalls. For dimension table see Sheet TRFWH 0-1-21.
6. For reinforcing in curtain wall see Curtain Wall Details on Sheet TRFWH 0-3-21.
7. For reinforcing in curtain wall see Curtain Wall Details on Sheet TRFWH 0-3-21.

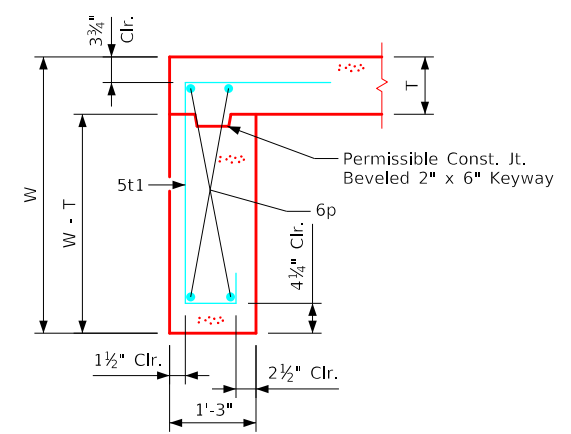
* - See Note 4
 Δ - See Note 5

LATEST REVISION DATE	 APPROVED BY BRIDGE ENGINEER	 Standard Design - Triple Reinforced Concrete Box Culverts	
		Flared Wing Headwalls February, 2021	
		Apron Details 0° Skew	TRFWH 0-2-21

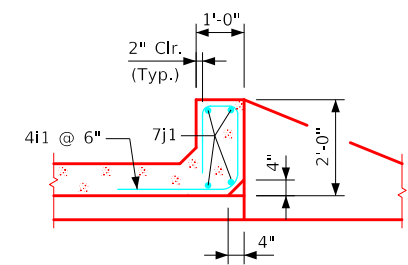
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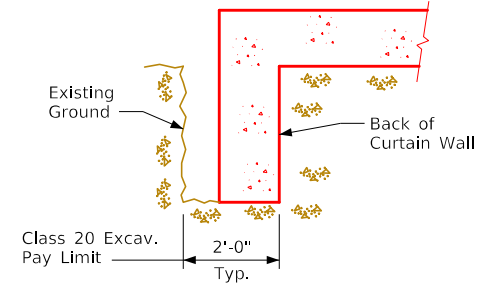
Typical Section - Near Center of Apron



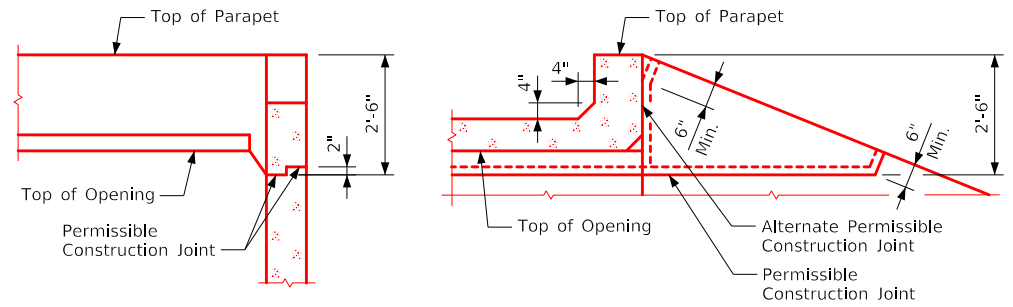
Section thru Curtain Wall



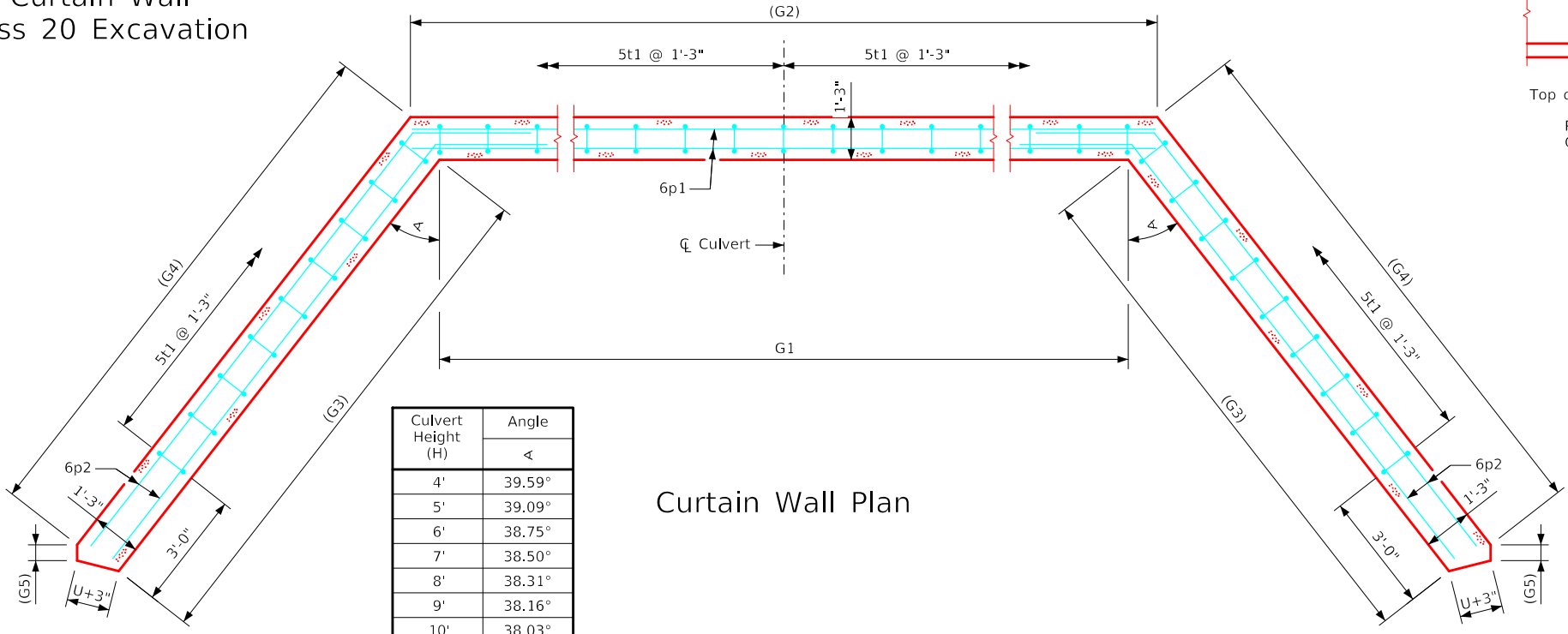
Section thru Parapet



Curtain Wall Class 20 Excavation



Top of Wingwall Details



Curtain Wall Plan

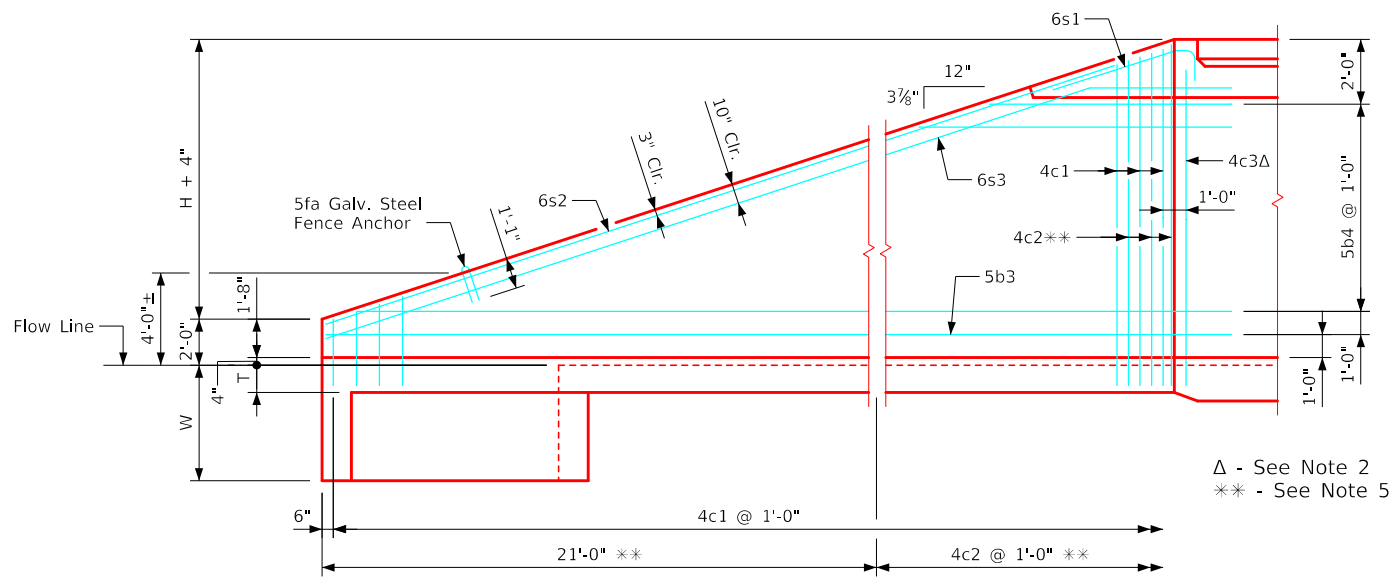
Culvert Height (H)	Angle
	α
4'	39.59°
5'	39.09°
6'	38.75°
7'	38.50°
8'	38.31°
9'	38.16°
10'	38.03°
11'	37.93°
12'	37.85°

Notes:

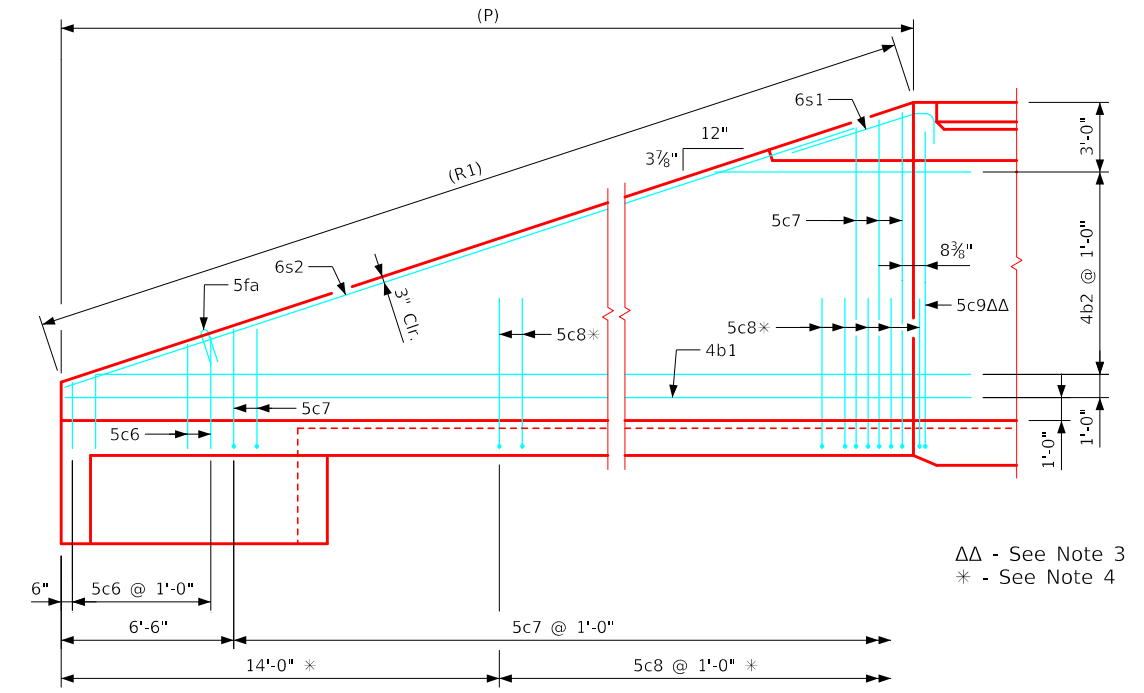
1. See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. For dimension table see Sheet TRFWH 0-1-21.

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		Parapet & Curtain Wall Details 0° Skew	TRFWH 0-3-21
		IOWADOT Highway Division Standard Design - Triple Reinforced Concrete Box Culverts Flared Wing Headwalls February, 2021	

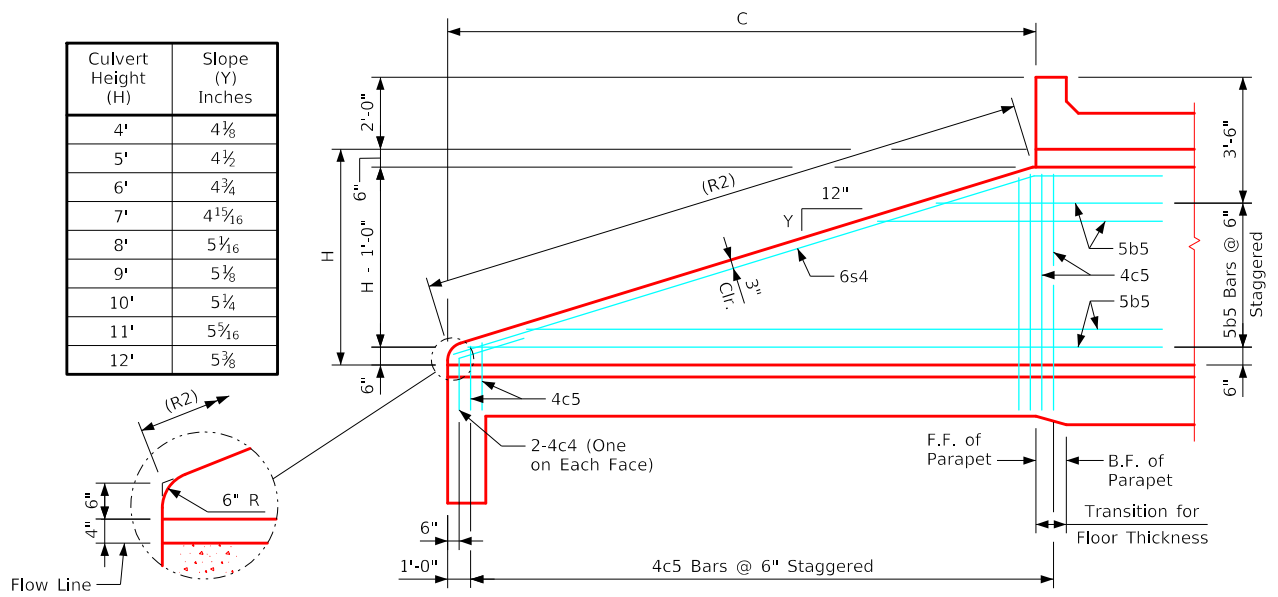
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Typical View - Front Face Wingwall Reinforcing



Typical View - Back Face Wingwall Reinforcing



Typical View - Interior Wall

Culvert Height (H)	Slope (Y) Inches
4'	4 1/8"
5'	4 1/2"
6'	4 3/4"
7'	4 15/16"
8'	5 1/16"
9'	5 1/8"
10'	5 1/4"
11'	5 3/16"
12'	5 3/8"

Notes:

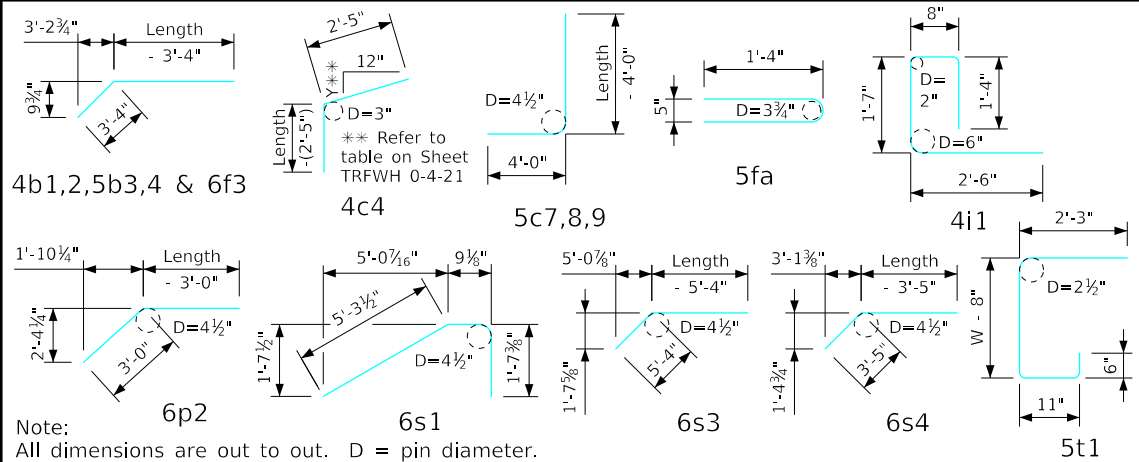
1. Bar spacings and positions shown are similar for all sizes of headwalls in this standard.
2. Two 4c3 bars for 4', 5', 11' & 12' height headwalls. One 4c3 bar for 6' thru 10' height headwalls.
3. Two 5c9 bars for 4', 5', 11' & 12' headwalls. One 5c9 bar for 6' thru 10' height headwalls.
4. Not applicable for 4' & 5' height headwalls.
5. Not applicable for 4' thru 8' height headwalls.
6. For dimension table, see sheet TRFWH 0-1-21.
7. Top of wall slope may be rounded in some instances.

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		Flared Wing Headwalls February, 2021	
		Wingwall Details 0° Skew	TRFWH 0-4-21

Bill of Reinforcing for One Headwall 0° Skew Span x Culvert Height

Bar	Location	Shape	12' x 12'			12' x 11'			12' x 10'			12' x 9'			12' x 8'			12' x 7'			Bar		
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.			
5fa	Fence Anchor (Galv.)		2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	5fa		
4b1	Wingwall, B.F.H.		2	41'-2"	58	2	38'-1"	51	2	35'-0"	47	2	31'-11"	43	2	28'-10"	39	2	25'-9"	34	4b1		
4b2	Wingwall, B.F.H.		20 Var.	2 Each 11'-11" to 39'-9"	345	18 Var.	2 Each 11'-11" to 36'-8"	292	16 Var.	2 Each 11'-11" to 33'-7"	243	14 Var.	2 Each 11'-11" to 30'-6"	198	12 Var.	2 Each 11'-11" to 27'-5"	158	10 Var.	2 Each 11'-11" to 24'-4"	121	4b2		
5b3	Wingwall, F.F.H.		2	41'-3"	91	2	38'-2"	80	2	35'-1"	73	2	32'-0"	67	2	28'-11"	60	2	25'-9"	54	5b3		
5b4	Wingwall, F.F.H.		22 Var.	2 Each 8'-10" to 39'-10"	558	20 Var.	2 Each 8'-10" to 36'-9"	475	18 Var.	2 Each 8'-11" to 33'-8"	400	16 Var.	2 Each 8'-11" to 30'-7"	330	14 Var.	2 Each 8'-11" to 27'-6"	266	12 Var.	2 Each 8'-11" to 24'-4"	208	5b4		
5b5	Interior Wall, Both F.H.		42 Var.	2 Each 5'-2" to 27'-8"	719	38 Var.	2 Each 5'-3" to 25'-8"	613	34 Var.	2 Each 5'-3" to 23'-7"	511	30 Var.	2 Each 5'-3" to 21'-7"	420	26 Var.	2 Each 5'-4" to 19'-7"	338	22 Var.	2 Each 5'-5" to 17'-7"	264	5b5		
4c1	Wingwall, F.F.V.		76 Var.	2 Each 2'-10" to 14'-10"	448	70 Var.	2 Each 2'-10" to 13'-10"	390	64 Var.	2 Each 2'-10" to 12'-11"	337	58 Var.	2 Each 2'-10" to 11'-11"	286	52 Var.	2 Each 2'-10" to 10'-11"	239	46 Var.	2 Each 2'-10" to 10'-0"	197	4c1		
4c2	Wingwall, F.F.V.		36 Var.	2 Each 9'-6" to 15'-0"	295	30 Var.	2 Each 9'-6" to 14'-0"	235	24 Var.	2 Each 9'-6" to 13'-1"	181	18 Var.	2 Each 9'-6" to 12'-1"	130	--	--	--	--	--	--	4c2		
4c3	Wingwall, F.F.V.		4	13'-9"	37	4	12'-9"	34	2	11'-9"	16	2	10'-9"	14	2	9'-9"	13	2	8'-9"	12	4c3		
4c4	Interior Wall, Both F.V.		4	4'-2"	11	4	4'-2"	11	4	4'-2"	11	4	4'-2"	11	4	4'-2"	11	4	4'-2"	11	4c4		
4c5	Interior Wall, Both F.V.		100 Var.	2 Each 2'-0" to 12'-11"	498	92 Var.	2 Each 2'-0" to 11'-11"	428	84 Var.	2 Each 2'-0" to 10'-11"	362	76 Var.	2 Each 1'-11" to 9'-11"	300	68 Var.	2 Each 1'-11" to 8'-11"	246	60 Var.	2 Each 1'-11" to 7'-10"	195	4c5		
5c6	Wingwall, B.F.V.		12 Var.	2 Each 2'-10" to 4'-6"	46	12 Var.	2 Each 2'-10" to 4'-6"	46	12 Var.	2 Each 2'-10" to 4'-6"	46	12 Var.	2 Each 2'-10" to 4'-6"	46	12 Var.	2 Each 2'-10" to 4'-6"	46	12 Var.	2 Each 2'-10" to 4'-6"	46	5c6		
5c7	Wingwall, B.F.V.		64 Var.	2 Each 8'-10" to 18'-10"	923	58 Var.	2 Each 8'-10" to 17'-10"	807	52 Var.	2 Each 8'-10" to 16'-11"	698	46 Var.	2 Each 8'-10" to 15'-11"	594	40 Var.	2 Each 8'-10" to 14'-11"	495	34 Var.	2 Each 8'-10" to 14'-0"	405	5c7		
5c8	Wingwall, B.F.V.		50	10'-6"	548	44	10'-6"	482	38	10'-6"	416	32	10'-6"	350	26	10'-6"	285	20	10'-6"	219	5c8		
5c9	Wingwall, B.F.V.		4	17'-9"	74	4	16'-9"	70	2	15'-9"	33	2	14'-9"	31	2	13'-9"	29	2	12'-9"	27	5c9		
4d1	Apron, Longit., Bott.		25	27'-11"	466	25	25'-11"	433	25	23'-11"	399	25	21'-11"	366	25	19'-11"	333	25	17'-11"	299	4d1		
4d2	Apron, Longit., Bott.		6	36'-3"	145	6	33'-2"	133	6	30'-1"	121	6	27'-0"	108	6	23'-11"	96	6	20'-10"	84	4d2		
6f1	Apron, Longit., Top		37	27'-11"	1551	37	25'-11"	1440	37	23'-11"	1329	37	21'-11"	1218	37	19'-11"	1107	37	17'-11"	996	6f1		
6f2	Apron, Longit., Top		16 Var.	2 Each 5'-10" to 24'-10"	368	16 Var.	2 Each 3'-10" to 22'-10"	320	14 Var.	2 Each 4'-6" to 20'-10"	266	12 Var.	2 Each 5'-3" to 18'-10"	217	10 Var.	2 Each 5'-11" to 16'-10"	171	10 Var.	2 Each 3'-11" to 14'-10"	141	6f2		
6f3	Apron, Longit., Top		2	41'-3"	131	2	38'-2"	115	2	35'-1"	105	2	32'-0"	96	2	28'-11"	87	2	25'-9"	77	6f3		
4i1	Parapet, Vertical		77	6'-1"	313	75	6'-1"	305	75	6'-1"	305	75	6'-1"	305	75	6'-1"	305	75	6'-1"	305	4i1		
7j1	Parapet, Horizontal		4	39'-8"	324	4	39'-4"	322	4	39'-0"	319	4	39'-0"	319	4	39'-0"	319	4	38'-8"	316	7j1		
6m1	Apron, Trans., Top		34 Var.	39'-10" to 52'-3"	2471	31 Var.	39'-6" to 50'-9"	2206	29 Var.	39'-2" to 49'-8"	2029	26 Var.	39'-2" to 48'-7"	1797	23 Var.	39'-2" to 47'-5"	1568	21 Var.	38'-10" to 46'-4"	1405	6m1		
6m2	Apron, Trans., Bott.		24 Var.	33'-9" to 45'-3"	1464	22 Var.	33'-7" to 44'-1"	1316	20 Var.	33'-5" to 42'-11"	1168	18 Var.	33'-5" to 41'-11"	1033	16 Var.	33'-5" to 40'-11"	900	14 Var.	33'-3" to 39'-9"	768	6m2		
6p1	Curtain, Horizontal		4	38'-3"	230	4	38'-1"	229	4	37'-11"	228	4	37'-11"	228	4	37'-11"	228	4	37'-9"	227	6p1		
6p2	Curtain, Horizontal		8	18'-7"	223	8	17'-4"	208	8	16'-1"	193	8	14'-10"	178	8	13'-7"	163	8	12'-4"	148	6p2		
6s1	Wing Slope, Both F.		4	7'-8"	46	4	7'-8"	46	4	7'-8"	46	4	7'-8"	46	4	7'-8"	46	4	7'-8"	46	6s1		
6s2	Wing Slope, Both F.		4	37'-1"	223	4	33'-10"	203	4	30'-7"	184	4	27'-4"	164	4	24'-1"	145	4	20'-10"	125	6s2		
6s3	Wing Slope, F.F.		2	43'-2"	137	2	39'-11"	120	2	36'-8"	110	2	33'-5"	100	2	30'-2"	91	2	26'-11"	81	6s3		
6s4	Interior Wall, Both F.		4	30'-3"	182	4	28'-0"	168	4	25'-9"	155	4	23'-6"	141	4	21'-4"	128	4	19'-1"	115	6s4		
5t1	Curtain, Vertical		51	8'-0"	426	49	7'-9"	396	47	7'-6"	368	45	7'-3"	340	43	7'-0"	314	41	6'-9"	289	5t1		
Estimated Quantities One Headwall			Reinf. Steel			13,357 LB			11,980 LB			10,705 LB			9,482 LB			8,232 LB			7,221 LB		
			Concrete			3.8			3.7			3.6			3.6			3.6			3.5		
			Wingwalls			34.0			26.5			20.4			16.9			13.7			9.7		
			Apron *			74.7			67.0			59.7			53.2			45.8			40.4		
			112.5 CY			97.2 CY			83.7 CY			73.7 CY			63.1 CY			53.6 CY					

Bent Bar Details



Headwall Notes:

- See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
- This headwall is based on a 3:1 slope normal to centerline of roadway.
- The sides of the apron are to be formed to ensure correct line and grade.
- All apron reinforcing steel is to be supported by bar chairs at intervals of not more than 3'-0" in either direction as outlined in the Standard Specifications.
- Clear distance from face of concrete to near reinforcing bar is to be 2" unless otherwise noted or shown. Clearance to the bottom ends of vertical bars shall be 3 inches.
- Concrete quantities are estimated from back of parapet.
- Horizontal tails of bars "b" & "s" estimated to extend 2'-5" beyond back of parapet (into end of barrel). Longitudinal bars "d", "6f1" and "6f3" estimated to project into end section of barrel a minimum of 2'-5" beyond back of parapet. The "length" column reflects total number of feet necessary to meet these requirements.
- Dimensions are in feet and inches unless otherwise noted.

Δ Includes top of wingwall quantities.
 * Assumes apron and floor are equal thickness, adjust concrete quantities for transition where apron and floor thickness are not equal.

Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

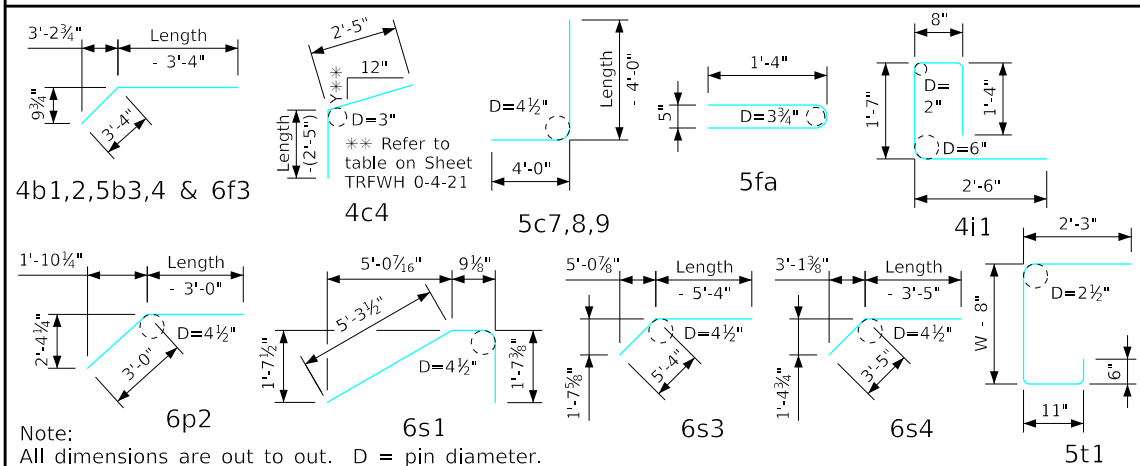
LATEST REVISION DATE	APPROVED BY BRIDGE ENGINEER 	IOWA DOT Highway Division	
		Standard Design - Triple Reinforced Concrete Box Culverts	
		Flared Wing Headwalls	
		February, 2021	
Quantity Tabulation 12'-0" Span 0° Skew		TRFWH 0-5-21 Sheet 1 of 2	

ENGLISHLRFDTRIPLECULVERTSFWH.DGN - TRFWH 0-5-21 S2 - THIS SHEET ISSUED 02-2021.

Bill of Reinforcing for One Headwall 0° Skew Span x Culvert Height

Bar	Location	Shape	12' x 6'			12' x 5'			12' x 4'			Bar		
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.			
5fa	Fence Anchor (Galv.)		2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	5fa		
4b1	Wingwall, B.F.H.		2	22'-8"	30	2	19'-7"	26	2	16'-6"	22	4b1		
4b2	Wingwall, B.F.H.		8 Var.	2 Each 11'-11" to 21'-3"	89	6 Var.	2 Each 11'-11" to 18'-2"	60	4 Var.	2 Each 11'-11" to 15'-1"	36	4b2		
5b3	Wingwall, F.F.H.		2	22'-8"	47	2	19'-7"	41	2	16'-6"	34	5b3		
5b4	Wingwall, F.F.H.		10 Var.	2 Each 8'-11" to 21'-3"	157	8 Var.	2 Each 8'-11" to 18'-2"	113	6 Var.	2 Each 8'-11" to 15'-1"	75	5b4		
5b5	Interior Wall, Both F.H.		18 Var.	2 Each 5'-5" to 15'-7"	197	14 Var.	2 Each 5'-7" to 13'-7"	140	10 Var.	2 Each 5'-9" to 11'-6"	90	5b5		
4c1	Wingwall, F.F.V.		40 Var.	2 Each 2'-10" to 9'-0"	158	32 Var.	2 Each 2'-10" to 7'-9"	113	26 Var.	2 Each 2'-10" to 6'-9"	83	4c1		
4c2	Wingwall, F.F.V.		--	--	--	--	--	--	--	--	--	4c2		
4c3	Wingwall, F.F.V.		2	7'-9"	10	4	6'-9"	18	4	5'-9"	15	4c3		
4c4	Interior Wall, Both F.V.		4	4'-2"	11	4	4'-2"	11	4	4'-1"	11	4c4		
4c5	Interior Wall, Both F.V.		52 Var.	2 Each 1'-11" to 6'-10"	152	44 Var.	2 Each 1'-11" to 5'-10"	114	36 Var.	2 Each 1'-11" to 4'-10"	81	4c5		
5c6	Wingwall, B.F.V.		12 Var.	2 Each 2'-10" to 4'-6"	46	12 Var.	2 Each 2'-10" to 4'-6"	46	12 Var.	2 Each 2'-10" to 4'-6"	46	5c6		
5c7	Wingwall, B.F.V.		28 Var.	2 Each 8'-10" to 13'-0"	319	20 Var.	2 Each 8'-10" to 11'-9"	215	14 Var.	2 Each 8'-10" to 10'-9"	143	5c7		
5c8	Wingwall, B.F.V.		14	10'-6"	153	--	--	--	--	--	--	5c8		
5c9	Wingwall, B.F.V.		2	11'-9"	25	4	10'-9"	45	4	9'-9"	41	5c9		
4d1	Apron, Longit., Bott.		25	15'-11"	266	25	13'-11"	232	25	11'-11"	199	4d1		
4d2	Apron, Longit., Bott.		6	17'-8"	71	6	14'-7"	58	6	11'-6"	46	4d2		
6f1	Apron, Longit., Top		37	15'-11"	885	37	13'-11"	773	37	11'-11"	662	6f1		
6f2	Apron, Longit., Top		8 Var.	2 Each 4'-7" to 12'-10"	105	6 Var.	2 Each 5'-4" to 10'-10"	73	4 Var.	2 Each 6'-1" to 8'-10"	45	6f2		
6f3	Apron, Longit., Top		2	22'-8"	68	2	19'-7"	59	2	16'-6"	50	6f3		
4i1	Parapet, Vertical		75	6'-1"	305	75	6'-1"	305	75	6'-1"	305	4i1		
7j1	Parapet, Horizontal		4	38'-8"	316	4	38'-8"	316	4	38'-8"	316	7j1		
6m1	Apron, Trans., Top		18 Var.	38'-10" to 45'-3"	1187	15 Var.	38'-10" to 44'-1"	974	13 Var.	38'-10" to 43'-4"	835	6m1		
6m2	Apron, Trans., Bott.		12 Var.	33'-3" to 38'-9"	649	10 Var.	33'-3" to 37'-9"	533	8 Var.	33'-3" to 36'-9"	421	6m2		
6p1	Curtain, Horizontal		4	37'-9"	227	4	37'-9"	227	4	37'-9"	227	6p1		
6p2	Curtain, Horizontal		8	11'-1"	133	8	9'-10"	118	8	8'-7"	103	6p2		
6s1	Wing Slope, Both F.		4	7'-8"	46	4	7'-8"	46	4	7'-8"	46	6s1		
6s2	Wing Slope, Both F.		4	17'-7"	106	4	14'-4"	86	4	11'-1"	67	6s2		
6s3	Wing Slope, F.F.		2	23'-8"	71	2	20'-5"	61	2	17'-2"	52	6s3		
6s4	Interior Wall, Both F.		4	16'-10"	101	4	14'-7"	88	4	12'-4"	74	6s4		
5t1	Curtain, Vertical		39	6'-6"	264	37	6'-6"	251	35	6'-6"	237	5t1		
Estimated Quantities One Headwall			Reinf. Steel			6200 LB			5148 LB			4368 LB		
			Concrete			45.5 CY			38.6 CY			32.1 CY		

Bent Bar Details



Headwall Notes:

- See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
- This headwall is based on a 3:1 slope normal to centerline of roadway.
- The sides of the apron are to be formed to ensure correct line and grade.
- All apron reinforcing steel is to be supported by bar chairs at intervals of not more than 3'-0" in either direction as outlined in the Standard Specifications.
- Clear distance from face of concrete to near reinforcing bar is to be 2" unless otherwise noted or shown. Clearance to the bottom ends of vertical bars shall be 3 inches.
- Concrete quantities are estimated from back of parapet.
- Horizontal tails of bars "b" & "s" estimated to extend 2'-5" beyond back of parapet (into end of barrel). Longitudinal bars "d", "6f1" and "6f3" estimated to project into end section of barrel a minimum of 2'-5" beyond back of parapet. The "length" column reflects total number of feet necessary to meet these requirements.
- Dimensions are in feet and inches unless otherwise noted.

Δ Includes top of wingwall quantities.
 * Assumes apron and floor are equal thickness, adjust concrete quantities for transition where apron and floor thickness are not equal.

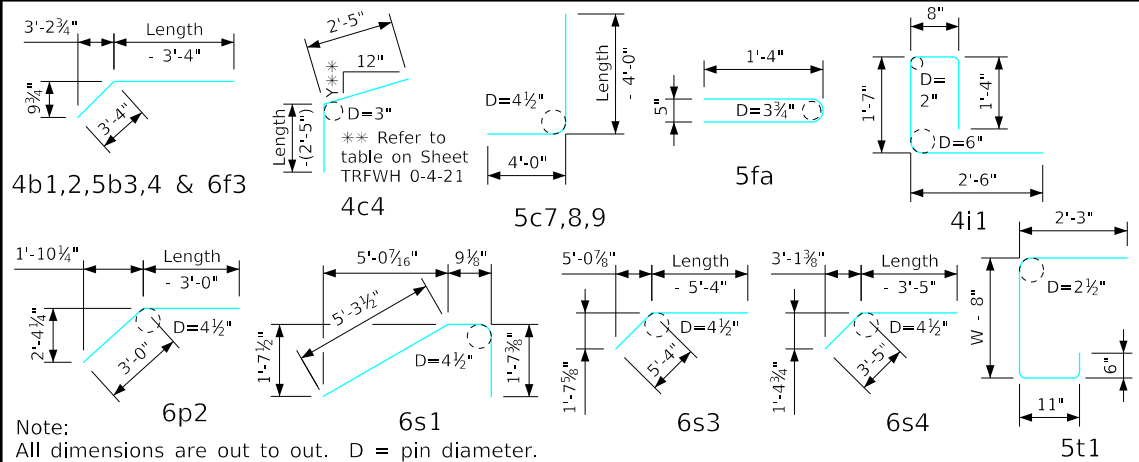
Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

LATEST REVISION DATE	 APPROVED BY BRIDGE ENGINEER		
		Standard Design - Triple Reinforced Concrete Box Culverts	
		<h2 style="margin: 0;">Flared Wing Headwalls</h2>	
		February, 2021	
<h3 style="margin: 0;">Quantity Tabulation</h3>		<h3 style="margin: 0;">TRFWH</h3>	
<h3 style="margin: 0;">12'-0" Span</h3>		<h3 style="margin: 0;">0-5-21</h3>	
<h3 style="margin: 0;">0° Skew</h3>		<h3 style="margin: 0;">Sheet 2 of 2</h3>	

Bill of Reinforcing for One Headwall 0° Skew Span x Culvert Height

Bar	Location	Shape	10' x 12'			10' x 11'			10' x 10'			10' x 9'			10' x 8'			10' x 7'			Bar		
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.			
5fa	Fence Anchor (Galv.)		2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	5fa		
4b1	Wingwall, B.F.H.		2	41'-2"	58	2	38'-1"	51	2	35'-0"	47	2	31'-11"	43	2	28'-10"	39	2	25'-9"	34	4b1		
4b2	Wingwall, B.F.H.		20 Var.	2 Each 11'-11" to 39'-9"	345	18 Var.	2 Each 11'-11" to 36'-8"	292	16 Var.	2 Each 11'-11" to 33'-7"	243	14 Var.	2 Each 11'-11" to 30'-6"	198	12 Var.	2 Each 11'-11" to 27'-5"	158	10 Var.	2 Each 11'-11" to 24'-4"	121	4b2		
5b3	Wingwall, F.F.H.		2	41'-3"	91	2	38'-2"	80	2	35'-1"	73	2	32'-0"	67	2	28'-11"	60	2	25'-9"	54	5b3		
5b4	Wingwall, F.F.H.		22 Var.	2 Each 8'-10" to 39'-10"	558	20 Var.	2 Each 8'-10" to 36'-9"	475	18 Var.	2 Each 8'-11" to 33'-8"	400	16 Var.	2 Each 8'-11" to 30'-7"	330	14 Var.	2 Each 8'-11" to 27'-6"	266	12 Var.	2 Each 8'-11" to 24'-4"	208	5b4		
5b5	Interior Wall, Both F.H.		42 Var.	2 Each 5'-2" to 27'-8"	719	38 Var.	2 Each 5'-3" to 25'-8"	613	34 Var.	2 Each 5'-3" to 23'-7"	511	30 Var.	2 Each 5'-3" to 21'-7"	420	26 Var.	2 Each 5'-4" to 19'-7"	338	22 Var.	2 Each 5'-5" to 17'-7"	264	5b5		
4c1	Wingwall, F.F.V.		76 Var.	2 Each 2'-9" to 14'-9"	444	70 Var.	2 Each 2'-9" to 13'-9"	386	64 Var.	2 Each 2'-9" to 12'-10"	333	58 Var.	2 Each 2'-9" to 11'-10"	283	52 Var.	2 Each 2'-9" to 10'-10"	236	46 Var.	2 Each 2'-9" to 9'-11"	195	4c1		
4c2	Wingwall, F.F.V.		36 Var.	2 Each 9'-5" to 14'-11"	293	30 Var.	2 Each 9'-5" to 13'-11"	234	24 Var.	2 Each 9'-5" to 13'-0"	180	18 Var.	2 Each 9'-5" to 12'-0"	129	--	--	--	--	--	--	4c2		
4c3	Wingwall, F.F.V.		4	13'-8"	37	4	12'-8"	34	2	11'-8"	16	2	10'-8"	14	2	9'-8"	13	2	8'-8"	12	4c3		
4c4	Interior Wall, Both F.V.		4	4'-1"	11	4	4'-1"	11	4	4'-1"	11	4	4'-1"	11	4	4'-1"	11	4	4'-1"	11	4c4		
4c5	Interior Wall, Both F.V.		100 Var.	2 Each 1'-11" to 12'-10"	493	92 Var.	2 Each 1'-11" to 11'-10"	423	84 Var.	2 Each 1'-11" to 10'-10"	358	76 Var.	2 Each 1'-10" to 9'-10"	296	68 Var.	2 Each 1'-10" to 8'-10"	242	60 Var.	2 Each 1'-10" to 7'-9"	192	4c5		
5c6	Wingwall, B.F.V.		12 Var.	2 Each 2'-9" to 4'-5"	45	12 Var.	2 Each 2'-9" to 4'-5"	45	12 Var.	2 Each 2'-9" to 4'-5"	45	12 Var.	2 Each 2'-9" to 4'-5"	45	12 Var.	2 Each 2'-9" to 4'-5"	45	12 Var.	2 Each 2'-9" to 4'-5"	45	5c6		
5c7	Wingwall, B.F.V.		64 Var.	2 Each 8'-9" to 18'-9"	918	58 Var.	2 Each 8'-9" to 17'-9"	802	52 Var.	2 Each 8'-9" to 16'-10"	694	46 Var.	2 Each 8'-9" to 15'-10"	590	40 Var.	2 Each 8'-9" to 14'-10"	492	34 Var.	2 Each 8'-9" to 13'-11"	402	5c7		
5c8	Wingwall, B.F.V.		50	10'-6"	548	44	10'-6"	482	38	10'-6"	416	32	10'-6"	350	26	10'-6"	285	20	10'-6"	219	5c8		
5c9	Wingwall, B.F.V.		4	17'-8"	74	4	16'-8"	70	2	15'-8"	33	2	14'-8"	31	2	13'-8"	29	2	12'-8"	26	5c9		
4d1	Apron, Longit., Bott.		21	27'-11"	392	21	25'-11"	364	21	23'-11"	336	21	21'-11"	307	21	19'-11"	279	21	17'-11"	251	4d1		
4d2	Apron, Longit., Bott.		6	36'-3"	145	6	33'-2"	133	6	30'-1"	121	6	27'-0"	108	6	23'-11"	96	6	20'-10"	84	4d2		
6f1	Apron, Longit., Top		31	27'-11"	1300	31	25'-11"	1207	31	23'-11"	1114	31	21'-11"	1020	31	19'-11"	927	31	17'-11"	834	6f1		
6f2	Apron, Longit., Top		16 Var.	2 Each 5'-10" to 24'-10"	368	16 Var.	2 Each 3'-10" to 22'-10"	320	14 Var.	2 Each 4'-6" to 20'-10"	266	12 Var.	2 Each 5'-3" to 18'-10"	217	10 Var.	2 Each 5'-11" to 16'-10"	171	10 Var.	2 Each 3'-11" to 14'-10"	141	6f2		
6f3	Apron, Longit., Top		2	41'-3"	131	2	38'-2"	115	2	35'-1"	105	2	32'-0"	96	2	28'-11"	87	2	25'-9"	77	6f3		
4i1	Parapet, Vertical		65	6'-1"	264	63	6'-1"	256	63	6'-1"	256	63	6'-1"	256	63	6'-1"	256	63	6'-1"	256	4i1		
7j1	Parapet, Horizontal		4	33'-8"	275	4	33'-4"	273	4	33'-0"	270	4	33'-0"	270	4	33'-0"	270	4	32'-8"	267	7j1		
6m1	Apron, Trans., Top		34 Var.	33'-10" to 46'-3"	2107	31 Var.	33'-6" to 44'-9"	1869	29 Var.	33'-2" to 43'-8"	1710	26 Var.	33'-2" to 42'-7"	1505	23 Var.	33'-2" to 41'-5"	1303	21 Var.	32'-10" to 40'-4"	1158	6m1		
6m2	Apron, Trans., Bott.		24 Var.	27'-9" to 39'-3"	1208	22 Var.	27'-7" to 38'-1"	1085	20 Var.	27'-5" to 36'-11"	966	18 Var.	27'-5" to 35'-11"	856	16 Var.	27'-5" to 34'-11"	749	14 Var.	27'-3" to 33'-9"	641	6m2		
6p1	Curtain, Horizontal		4	32'-3"	194	4	32'-1"	193	4	31'-11"	192	4	31'-11"	192	4	31'-11"	192	4	31'-9"	191	6p1		
6p2	Curtain, Horizontal		8	18'-7"	223	8	17'-4"	208	8	16'-1"	193	8	14'-10"	178	8	13'-7"	163	8	12'-4"	148	6p2		
6s1	Wing Slope, Both F.		4	7'-8"	46	4	7'-8"	46	4	7'-8"	46	4	7'-8"	46	4	7'-8"	46	4	7'-8"	46	6s1		
6s2	Wing Slope, Both F.		4	37'-1"	223	4	33'-10"	203	4	30'-7"	184	4	27'-4"	164	4	24'-1"	145	4	20'-10"	125	6s2		
6s3	Wing Slope, F.F.		2	43'-2"	137	2	39'-11"	120	2	36'-8"	110	2	33'-5"	100	2	30'-2"	91	2	26'-11"	81	6s3		
6s4	Interior Wall, Both F.		4	30'-3"	182	4	28'-0"	168	4	25'-9"	155	4	23'-6"	141	4	21'-4"	128	4	19'-1"	115	6s4		
5t1	Curtain, Vertical		47	8'-0"	392	45	7'-9"	364	43	7'-6"	336	41	7'-3"	310	39	7'-0"	285	37	6'-9"	260	5t1		
Estimated Quantities One Headwall			Reinf. Steel			12,227 LB			10,928 LB			9726 LB			8579 LB			7408 LB			6464 LB		
			Concrete			3.3			3.2			3.1			3.1			3.1			3.0		
			Wingwalls			34.0			26.5			20.4			16.9			13.7			9.7		
			Apron *			63.7			56.9			50.5			44.9			38.5			33.9		
			101.0 CY			86.6 CY			74.0 CY			64.9 CY			55.3 CY			46.6 CY					

Bent Bar Details



Headwall Notes:

- See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
- This headwall is based on a 3:1 slope normal to centerline of roadway.
- The sides of the apron are to be formed to ensure correct line and grade.
- All apron reinforcing steel is to be supported by bar chairs at intervals of not more than 3'-0" in either direction as outlined in the Standard Specifications.
- Clear distance from face of concrete to near reinforcing bar is to be 2" unless otherwise noted or shown. Clearance to the bottom ends of vertical bars shall be 3 inches.
- Concrete quantities are estimated from back of parapet.
- Horizontal tails of bars "b" & "s" estimated to extend 2'-5" beyond back of parapet (into end of barrel). Longitudinal bars "d", "6f1" and "6f3" estimated to project into end section of barrel a minimum of 2'-5" beyond back of parapet. The "length" column reflects total number of feet necessary to meet these requirements.
- Dimensions are in feet and inches unless otherwise noted.

Δ Includes top of wingwall quantities.
 * Assumes apron and floor are equal thickness, adjust concrete quantities for transition where apron and floor thickness are not equal.

Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

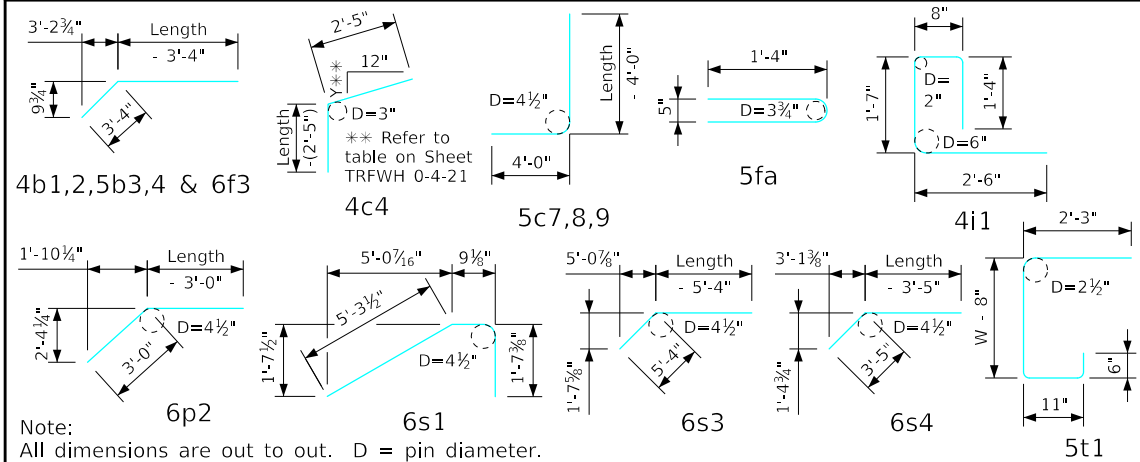
LATEST REVISION DATE	APPROVED BY BRIDGE ENGINEER 	IOWA DOT Highway Division	
		Standard Design - Triple Reinforced Concrete Box Culverts	
		Flared Wing Headwalls	
		February, 2021	
Quantity Tabulation 10'-0" Span 0° Skew		TRFWH 0-6-21 Sheet 1 of 2	

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Bill of Reinforcing for One Headwall 0° Skew Span x Culvert Height

Bar	Location	Shape	10' x 6'			10' x 5'			10' x 4'			Bar		
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.			
5fa	Fence Anchor (Galv.)		2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	5fa		
4b1	Wingwall, B.F.H.		2	22'-8"	30	2	19'-7"	26	2	16'-6"	22	4b1		
4b2	Wingwall, B.F.H.		8 Var.	2 Each 11'-11" to 21'-3"	89	6 Var.	2 Each 11'-11" to 18'-2"	60	4 Var.	2 Each 11'-11" to 15'-1"	36	4b2		
5b3	Wingwall, F.F.H.		2	22'-8"	47	2	19'-7"	41	2	16'-6"	34	5b3		
5b4	Wingwall, F.F.H.		10 Var.	2 Each 8'-11" to 21'-3"	157	8 Var.	2 Each 8'-11" to 18'-2"	113	6 Var.	2 Each 8'-11" to 15'-1"	75	5b4		
5b5	Interior Wall, Both F.H.		18 Var.	2 Each 5'-5" to 15'-7"	197	14 Var.	2 Each 5'-7" to 13'-7"	140	10 Var.	2 Each 5'-9" to 11'-6"	90	5b5		
4c1	Wingwall, F.F.V.		40 Var.	2 Each 2'-9" to 8'-11"	156	32 Var.	2 Each 2'-9" to 7'-8"	111	26 Var.	2 Each 2'-9" to 6'-8"	82	4c1		
4c2	Wingwall, F.F.V.		--	--	--	--	--	--	--	--	--	4c2		
4c3	Wingwall, F.F.V.		2	7'-8"	10	4	6'-8"	18	4	5'-8"	15	4c3		
4c4	Interior Wall, Both F.V.		4	4'-1"	11	4	4'-1"	11	4	4'-0"	11	4c4		
4c5	Interior Wall, Both F.V.		52 Var.	2 Each 1'-10" to 6'-9"	149	44 Var.	2 Each 1'-10" to 5'-9"	111	36 Var.	2 Each 1'-10" to 4'-9"	79	4c5		
5c6	Wingwall, B.F.V.		12 Var.	2 Each 2'-9" to 4'-5"	45	12 Var.	2 Each 2'-9" to 4'-5"	45	12 Var.	2 Each 2'-9" to 4'-5"	45	5c6		
5c7	Wingwall, B.F.V.		28 Var.	2 Each 8'-9" to 12'-11"	316	20 Var.	2 Each 8'-9" to 11'-8"	213	14 Var.	2 Each 8'-9" to 10'-8"	142	5c7		
5c8	Wingwall, B.F.V.		14	10'-6"	153	--	--	--	--	--	--	5c8		
5c9	Wingwall, B.F.V.		2	11'-8"	24	4	10'-8"	45	4	9'-8"	40	5c9		
4d1	Apron, Longit., Bott.		21	15'-11"	223	21	13'-11"	195	21	11'-11"	167	4d1		
4d2	Apron, Longit., Bott.		6	17'-8"	71	6	14'-7"	58	6	11'-6"	46	4d2		
6f1	Apron, Longit., Top		31	15'-11"	741	31	13'-11"	648	31	11'-11"	555	6f1		
6f2	Apron, Longit., Top		8 Var.	2 Each 4'-7" to 12'-10"	105	6 Var.	2 Each 5'-4" to 10'-10"	73	4 Var.	2 Each 6'-1" to 8'-10"	45	6f2		
6f3	Apron, Longit., Top		2	22'-8"	68	2	19'-7"	59	2	16'-6"	50	6f3		
4i1	Parapet, Vertical		63	6'-1"	256	63	6'-1"	256	63	6'-1"	256	4i1		
7j1	Parapet, Horizontal		4	32'-8"	267	4	32'-8"	267	4	32'-8"	267	7j1		
6m1	Apron, Trans., Top		18 Var.	32'-10" to 39'-3"	974	15 Var.	32'-10" to 38'-1"	799	13 Var.	32'-10" to 37'-4"	685	6m1		
6m2	Apron, Trans., Bott.		12 Var.	27'-3" to 32'-9"	541	10 Var.	27'-3" to 31'-9"	443	8 Var.	27'-3" to 30'-9"	348	6m2		
6p1	Curtain, Horizontal		4	31'-9"	191	4	31'-9"	191	4	31'-9"	191	6p1		
6p2	Curtain, Horizontal		8	11'-1"	133	8	9'-10"	118	8	8'-7"	103	6p2		
6s1	Wing Slope, Both F.		4	7'-8"	46	4	7'-8"	46	4	7'-8"	46	6s1		
6s2	Wing Slope, Both F.		4	17'-7"	106	4	14'-4"	86	4	11'-1"	67	6s2		
6s3	Wing Slope, F.F.		2	23'-8"	71	2	20'-5"	61	2	17'-2"	52	6s3		
6s4	Interior Wall, Both F.		4	16'-10"	101	4	14'-7"	88	4	12'-4"	74	6s4		
5t1	Curtain, Vertical		35	6'-6"	237	33	6'-6"	224	31	6'-6"	210	5t1		
Estimated Quantities One Headwall			Reinf. Steel			5521 LB			4552 LB			3839 LB		
			Concrete			39.4 CY			33.2 CY			27.4 CY		
			Parapet Δ			3.0			3.0			3.0		
			Wingwalls			7.4			5.4			3.7		
			Apron *			29.0			24.8			20.7		

Bent Bar Details



Headwall Notes:

- See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
- This headwall is based on a 3:1 slope normal to centerline of roadway.
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- Dimensions are in feet and inches unless otherwise noted.

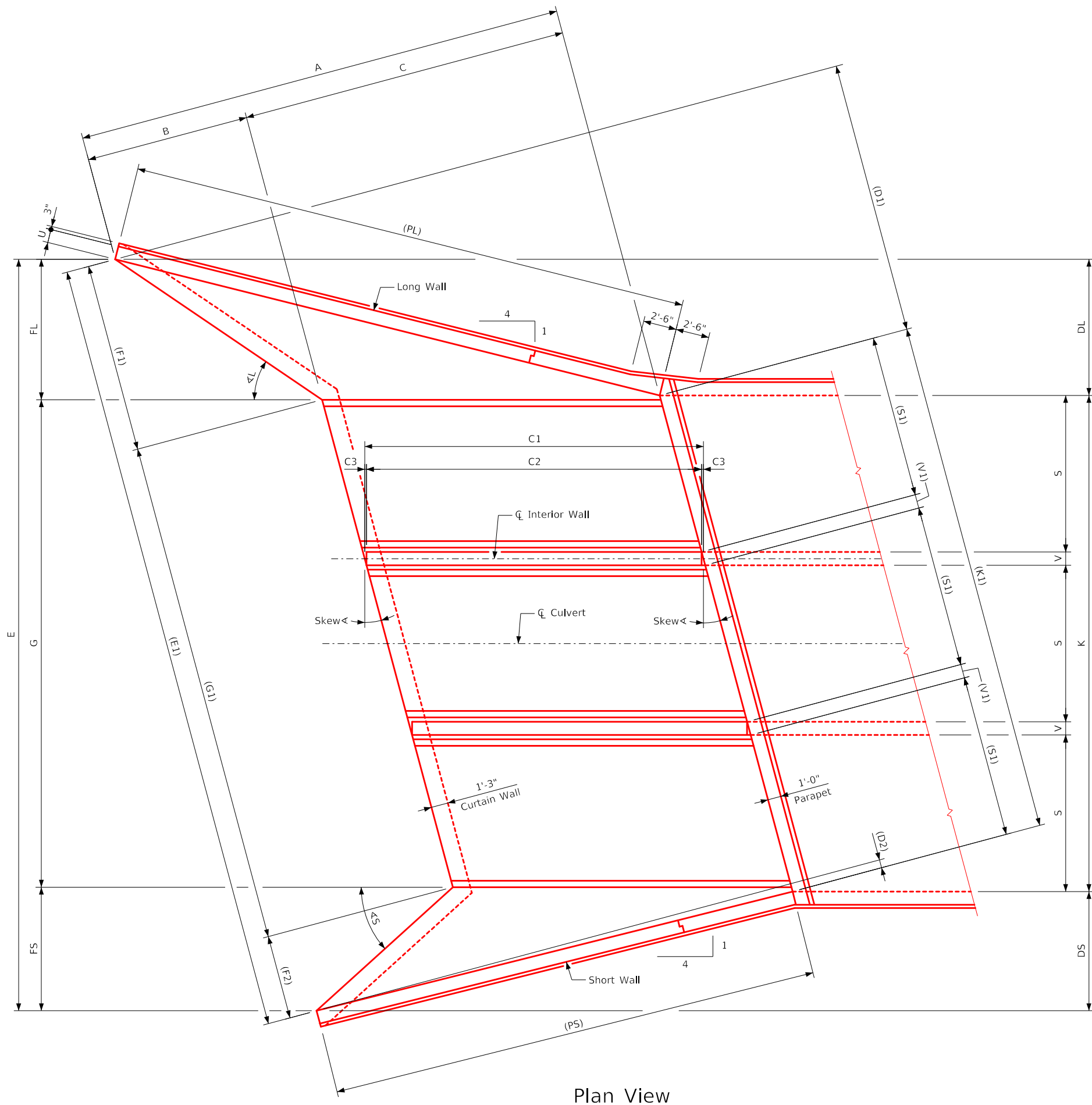
Δ Includes top of wingwall quantities.

* Assumes apron and floor are equal thickness, adjust concrete quantities for transition where apron and floor thickness are not equal.

Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

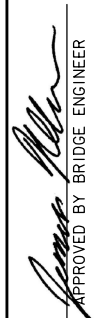

LATEST REVISION DATE	 APPROVED BY BRIDGE ENGINEER		
		Standard Design - Triple Reinforced Concrete Box Culverts	
		<h2 style="margin: 0;">Flared Wing Headwalls</h2>	
		February, 2021	
		Quantity Tabulation 10'-0" Span 0° Skew	TRFWH 0-6-21 Sheet 2 of 2

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Plan View


- Notes:
1. See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
 2. See Sheet TRFWH 15-2-21 for dimensions table.
 3. See Sheet TRFWH 15-5-21 for Angle L & Angle S.

LATEST REVISION DATE	 APPROVED BY BRIDGE ENGINEER	 Standard Design - Triple Reinforced Concrete Box Culverts	
		Flared Wing Headwalls February, 2021	
		Dimension Plan 15° Skew	TRFWH 15-1-21

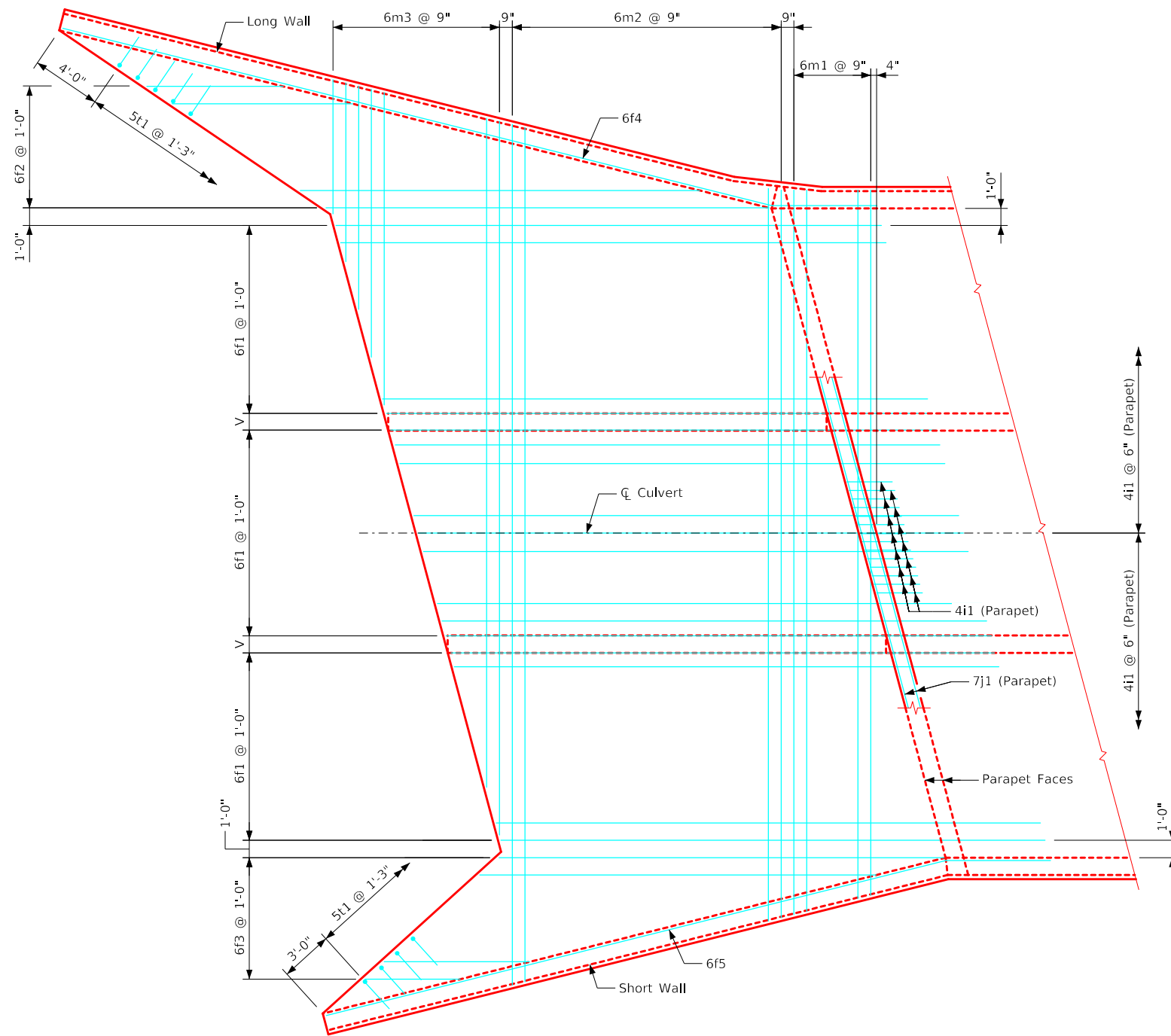
Dimension Table																			
S x H	12' x 12'	12' x 11'	12' x 10'	12' x 9'	12' x 8'	12' x 7'	12' x 6'	12' x 5'	12' x 4'	10' x 12'	10' x 11'	10' x 10'	10' x 9'	10' x 8'	10' x 7'	10' x 6'	10' x 5'	10' x 4'	S x H
A	37'-0	34'-0	31'-0	28'-0	25'-0	22'-0	19'-0	16'-0	13'-0	37'-0	34'-0	31'-0	28'-0	25'-0	22'-0	19'-0	16'-0	13'-0	A
B	12'-4	11'-4	10'-4	9'-4	8'-4	7'-4	6'-4	5'-4	4'-4	12'-4	11'-4	10'-4	9'-4	8'-4	7'-4	6'-4	5'-4	4'-4	B
C	24'-8	22'-8	20'-8	18'-8	16'-8	14'-8	12'-8	10'-8	8'-8	24'-8	22'-8	20'-8	18'-8	16'-8	14'-8	12'-8	10'-8	8'-8	C
C1	25'-6 1/2	23'-5 1/2	21'-4 3/4	19'-3 3/8	17'-3	15'-2 1/4	13'-1 3/8	11'-0 1/2	8'-11 3/8	25'-6 1/2	23'-5 1/2	21'-4 3/4	19'-3 3/8	17'-3	15'-2 1/4	13'-1 3/8	11'-0 1/2	8'-11 3/8	C1
C2	25'-3 3/4	23'-2 3/8	21'-2 1/2	19'-1 1/4	17'-0 3/8	14'-11 3/4	12'-11	10'-10 3/8	8'-9 1/4	25'-3 3/4	23'-2 3/8	21'-2 1/2	19'-1 1/4	17'-0 3/8	14'-11 3/4	12'-11	10'-10 3/8	8'-9 1/4	C2
C3	1 3/8	1 1/2	1 1/8	1 3/8	1 3/8	1 1/4	1 1/4	1 1/4	1 1/4	1 3/8	1 1/2	1 1/8	1 3/8	1 3/8	1 1/4	1 1/4	1 1/4	1 1/4	C3
DL	10'-3 3/8	9'-5 3/8	8'-7 1/4	7'-9 1/4	6'-11 1/4	6'-1 1/4	5'-3 3/4	4'-5 3/4	3'-7 3/4	10'-3 3/8	9'-5 3/8	8'-7 1/4	7'-9 1/4	6'-11 1/4	6'-1 1/4	5'-3 3/4	4'-5 3/4	3'-7 3/4	DL
DS	8'-11 3/4	8'-3	7'-6 1/4	6'-9 1/2	6'-0 3/4	5'-4	4'-7 1/4	3'-10 3/8	3'-1 1/8	8'-11 3/4	8'-3	7'-6 1/4	6'-9 1/2	6'-0 3/4	5'-4	4'-7 1/4	3'-10 3/8	3'-1 1/8	DS
D1	20'-6 1/2	18'-10 1/2	17'-2 1/2	15'-6 1/2	13'-10 1/2	12'-2 1/2	10'-6 3/8	8'-10 3/8	7'-2 3/8	20'-6 1/2	18'-10 1/2	17'-2 1/2	15'-6 1/2	13'-10 1/2	12'-2 1/2	10'-6 3/8	8'-10 3/8	7'-2 3/8	D1
D2	7 1/2	6 3/8	6 1/4	5 3/8	5	4 1/2	3 3/8	3 1/4	2 3/8	7 1/2	6 3/8	6 1/4	5 3/8	5	4 1/2	3 3/8	3 1/4	2 3/8	D2
E	57'-2 3/8	55'-6 1/8	53'-9 3/8	52'-2 3/4	50'-8	48'-11 3/4	47'-4 1/2	45'-9 3/8	44'-3 3/8	51'-2 3/8	49'-6 3/8	47'-9 3/8	46'-2 3/4	44'-8	42'-11 3/4	41'-4 1/2	39'-9 3/8	38'-3 3/8	E
E1	59'-3 3/8	57'-5 3/8	55'-8 3/4	54'-0 3/8	52'-5 1/2	50'-8	49'-0 3/8	47'-5 1/4	45'-9 3/8	53'-0 1/2	51'-3 3/8	49'-5 3/8	47'-10 1/4	46'-2 3/8	44'-5 1/2	42'-10 3/8	41'-2 3/4	39'-7 3/4	E1
FL	10'-7 3/8	9'-9 3/8	8'-11 1/4	8'-1 1/4	7'-3 3/4	6'-5 3/4	5'-7 3/4	4'-9 3/4	3'-11 3/4	10'-7 3/8	9'-9 3/8	8'-11 1/4	8'-1 1/4	7'-3 3/4	6'-5 3/4	5'-7 3/4	4'-9 3/4	3'-11 3/4	FL
FS	9'-3 3/4	8'-7	7'-10 1/4	7'-1 1/2	6'-4 3/4	5'-8	4'-11 3/4	4'-2 3/8	3'-5 1/8	9'-3 3/4	8'-7	7'-10 1/4	7'-1 1/2	6'-4 3/4	5'-8	4'-11 3/4	4'-2 3/8	3'-5 1/8	FS
F1	14'-3 3/4	13'-1 3/4	12'-0 3/4	10'-10 3/8	9'-9 3/8	8'-7 1/2	7'-6	6'-4 3/8	5'-2 3/8	14'-3 3/4	13'-1 3/4	12'-0 3/4	10'-10 3/8	9'-9 3/8	8'-7 1/2	7'-6	6'-4 3/8	5'-2 3/8	F1
F2	6'-4	5'-10 3/8	5'-4 3/8	4'-10 1/2	4'-4 3/8	3'-10 3/8	3'-5	2'-11 1/4	2'-5 3/8	6'-4	5'-10 3/8	5'-4 3/8	4'-10 1/2	4'-4 3/8	3'-10 3/8	3'-5	2'-11 1/4	2'-5 3/8	F2
G	37'-4	37'-2	37'-0	37'-0	37'-0	36'-10	36'-10	36'-10	36'-10	31'-4	31'-2	31'-0	31'-0	31'-0	30'-10	30'-10	30'-10	30'-10	G
G1	38'-7 3/4	38'-5 3/4	38'-3 3/8	38'-3 3/8	38'-3 3/8	38'-1 3/8	38'-1 3/8	38'-1 3/8	38'-1 3/8	32'-5 1/4	32'-3 3/4	32'-1 1/8	32'-1 1/8	32'-1 1/8	31'-11	31'-11	31'-11	31'-11	G1
G2	39'-10 1/2	39'-8 1/2	39'-6 3/8	39'-6 1/4	39'-6 1/4	39'-4 1/8	39'-4	39'-3 3/8	39'-3 3/4	33'-8	33'-5 7/8	33'-3 3/4	33'-3 3/4	33'-3 3/4	33'-1 3/8	33'-1 1/2	33'-1 3/8	33'-1 1/4	G2
G3	18'-10 3/8	17'-4 1/4	15'-10 3/8	14'-4 3/4	12'-10	11'-3 3/8	9'-9 3/4	8'-3 3/8	6'-9 3/8	18'-10 3/8	17'-4 1/4	15'-10 3/8	14'-4 3/4	12'-10	11'-3 3/8	9'-9 3/4	8'-3 3/8	6'-9 3/8	G3
G4	19'-6 3/8	17'-9 3/8	16'-0 3/8	14'-6 3/8	13'-0 1/2	11'-3 3/8	9'-9 3/8	8'-3 1/2	6'-9 3/8	19'-6 3/8	17'-9 3/8	16'-0 3/8	14'-6 3/8	13'-0 1/2	11'-3 3/8	9'-9 3/8	8'-3 1/2	6'-9 3/8	G4
G5	13'-10 3/8	12'-9	11'-7 3/4	10'-6 3/8	9'-5	8'-3 3/4	7'-2 3/8	6'-1	4'-11 3/4	13'-10 3/8	12'-9	11'-7 3/4	10'-6 3/8	9'-5	8'-3 3/4	7'-2 3/8	6'-1	4'-11 3/4	G5
G6	14'-11 1/4	13'-7 7/8	12'-4 3/8	11'-3 3/8	10'-1 3/4	8'-10 3/8	7'-9 3/8	6'-7 7/8	5'-6 3/8	14'-11 1/4	13'-7 7/8	12'-4 3/8	11'-3 3/8	10'-1 3/4	8'-10 3/8	7'-9 3/8	6'-7 7/8	5'-6 3/8	G6
G7	2 3/8	5 3/8	8 1/8	8 1/8	8 1/8	10 3/4	10 3/8	10 3/8	10 1/2	2 3/8	5 3/8	8 1/8	8 1/8	8 1/8	10 3/4	10 3/8	10 3/8	10 1/2	G7
G8	3 3/4	5 3/8	7 1/2	7 1/2	7 1/2	9 1/4	9 1/4	9 1/4	9 1/2	3 3/4	5 3/8	7 1/2	7 1/2	7 1/2	9 1/4	9 1/4	9 1/4	9 1/2	G8
K	38'-0	37'-10	37'-8	37'-8	37'-8	37'-6	37'-6	37'-6	37'-6	32'-0	31'-10	31'-8	31'-8	31'-8	31'-6	31'-6	31'-6	31'-6	K
K1	39'-4 3/8	39'-2	39'-0	39'-0	39'-0	38'-9 3/8	38'-9 3/8	38'-9 3/8	38'-9 3/8	33'-1 1/2	32'-11 1/2	32'-9 3/8	32'-9 3/8	32'-9 3/8	32'-7 3/8	32'-7 3/8	32'-7 3/8	32'-7 3/8	K1
PL	42'-3 3/8	38'-10 3/8	35'-5 1/2	32'-0 3/4	28'-7 3/8	25'-2	21'-8 3/4	18'-3 3/8	14'-10 3/8	42'-3 3/8	38'-10 3/8	35'-5 1/2	32'-0 3/4	28'-7 3/8	25'-2	21'-8 3/4	18'-3 3/8	14'-10 3/8	PL
PS	37'-0 3/8	34'-0	31'-0	28'-0	25'-0	22'-0	19'-0	16'-0	13'-0	37'-0 3/8	34'-0	31'-0	28'-0	25'-0	22'-0	19'-0	16'-0	13'-0	PS
RL	44'-1	40'-6 3/8	36'-11 3/8	33'-4 3/4	29'-9 3/8	26'-2 1/2	22'-7 3/8	19'-0 3/4	15'-5 3/8	44'-1	40'-6 3/8	36'-11 3/8	33'-4 3/4	29'-9 3/8	26'-2 1/2	22'-7 3/8	19'-0 3/4	15'-5 3/8	RL
RS	39'-0 3/8	35'-10 3/8	32'-8 3/8	29'-6 1/4	26'-4 1/4	23'-2 3/8	20'-0 3/8	16'-10 3/8	13'-8 1/2	39'-0 3/8	35'-10 3/8	32'-8 3/8	29'-6 1/4	26'-4 1/4	23'-2 3/8	20'-0 3/8	16'-10 3/8	13'-8 1/2	RS
R1	27'-6 3/4	25'-3 3/8	23'-0 3/8	20'-8 1/2	18'-5	16'-1 3/8	13'-10 3/8	11'-6 3/8	9'-3 3/4	27'-6 3/4	25'-3 3/8	23'-0 3/8	20'-8 1/2	18'-5	16'-1 3/8	13'-10 3/8	11'-6 3/8	9'-3 3/4	R1
S1	12'-5 3/8	12'-5 1/8	12'-5 1/8	12'-5 1/8	12'-5 1/8	12'-5 1/8	12'-5 1/8	12'-5 1/8	12'-5 1/8	10'-4 3/4	10'-4 3/4	10'-4 3/4	10'-4 3/4	10'-4 3/4	10'-4 3/4	10'-4 3/4	10'-4 3/4	10'-4 3/4	S1
T	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-1	1'-1	1'-1	1'-1	1'-1	1'-1	1'-1	1'-1	1'-1	T
U	1'-0	11	10	10	10	9	9	9	9	1'-0	11	10	10	10	9	9	9	9	U
V	1'-0	11	10	10	10	9	9	9	9	1'-0	11	10	10	10	9	9	9	9	V
V1	1'-0 3/8	11 3/8	10 3/8	10 3/8	10 3/8	9 3/8	9 3/8	9 3/8	9 3/8	1'-0 3/8	11 3/8	10 3/8	10 3/8	10 3/8	9 3/8	9 3/8	9 3/8	9 3/8	V1
W	5'-0	4'-9	4'-6	4'-3	4'-0	3'-9	3'-6	3'-6	3'-6	5'-0	4'-9	4'-6	4'-3	4'-0	3'-9	3'-6	3'-6	3'-6	W

Notes:

- See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
- See Sheet TRFWH 15-1-21 and sheets TRFWH 15-3-21 thru TRFWH 15-6-21 for location of certain dimensions tabulated.
- Dimensions are in feet and inches unless otherwise noted.

LATEST REVISION DATE	APPROVED BY BRIDGE ENGINEER	 Standard Design - Triple Reinforced Concrete Box Culverts	
		Flared Wing Headwalls February, 2021	
		Dimension Table 15° Skew	TRFWH 15-2-21



ENGLISHLRFDDESIGNEDTRIPLECULVERTSFWH.DGN - TRFWH 15-3-21 - THIS SHEET ISSUED 02-2021.



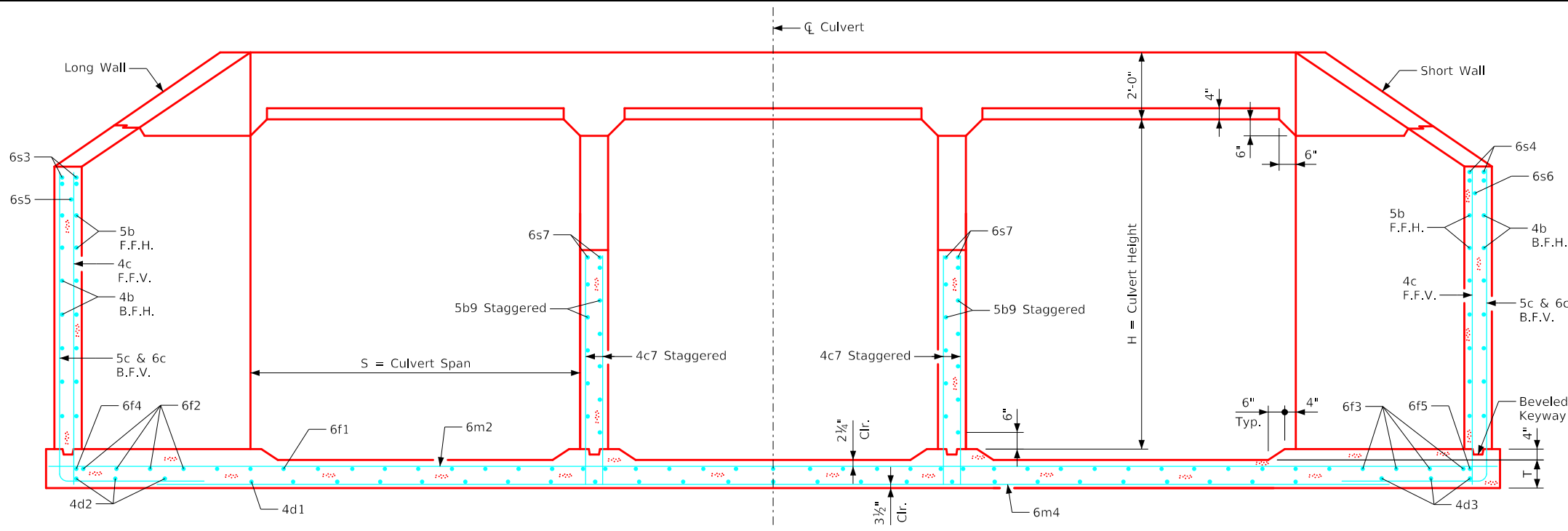
Plan View - Top of Apron Reinforcing

Notes:

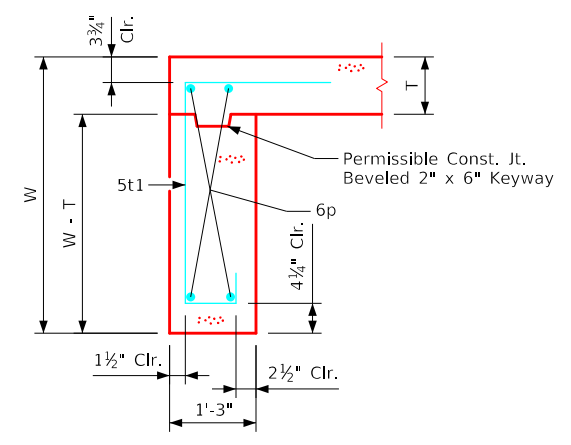
1. Bar spacings and positions shown are similar for all sizes of headwalls in this standard.
2. Top transverse floor bars are referenced approximately 4" from the back of the parapet for all headwalls.
3. For dimension table see Sheet TRFWH 15-2-21.
4. For reinforcing in curtain wall see Curtain Wall Details on Sheet TRFWH 15-5-21.

LATEST REVISION DATE	 APPROVED BY BRIDGE ENGINEER		
		Standard Design - Triple Reinforced Concrete Box Culverts Flared Wing Headwalls February, 2021	
		Top Apron Detail 15° Skew	TRFWH 15-3-21

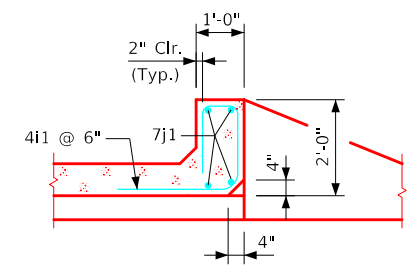
ENGLISHLRFDDESIGNEDTRIPLECULVERTSFWH.DGN - TRFWH 15-5-21 - THIS SHEET ISSUED 02-2021.



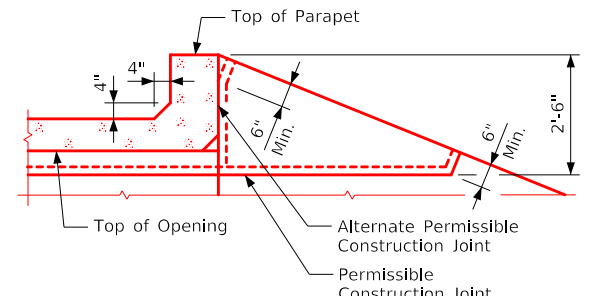
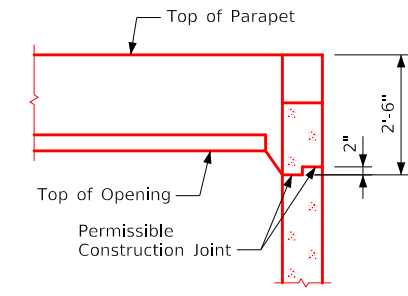
Typical Section - Near Center of Apron



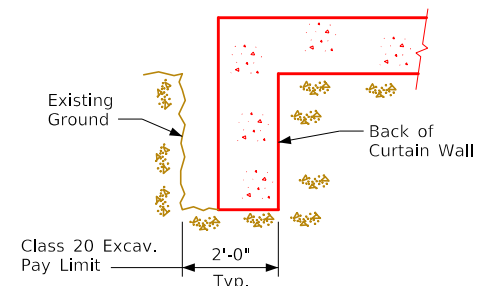
Section thru Curtain Wall



Section thru Parapet

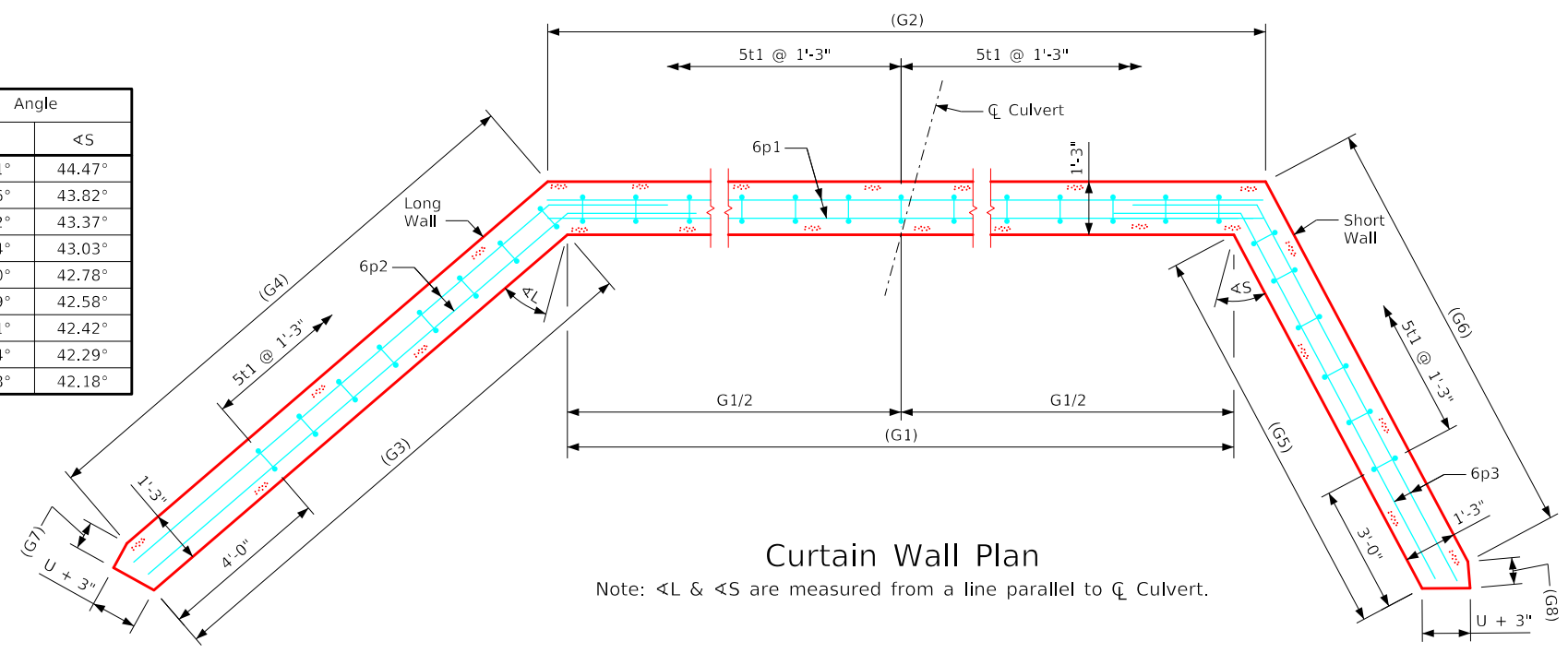


Top of Wingwall Details



Curtain Wall Class 20 Excavation

Culvert Height (H)	Angle	
	<L	<S
4'	35.41°	44.47°
5'	35.06°	43.82°
6'	34.82°	43.37°
7'	34.64°	43.03°
8'	34.50°	42.78°
9'	34.39°	42.58°
10'	34.31°	42.42°
11'	34.24°	42.29°
12'	34.18°	42.18°



Curtain Wall Plan

Note: <L & <S are measured from a line parallel to \bar{C} Culvert.

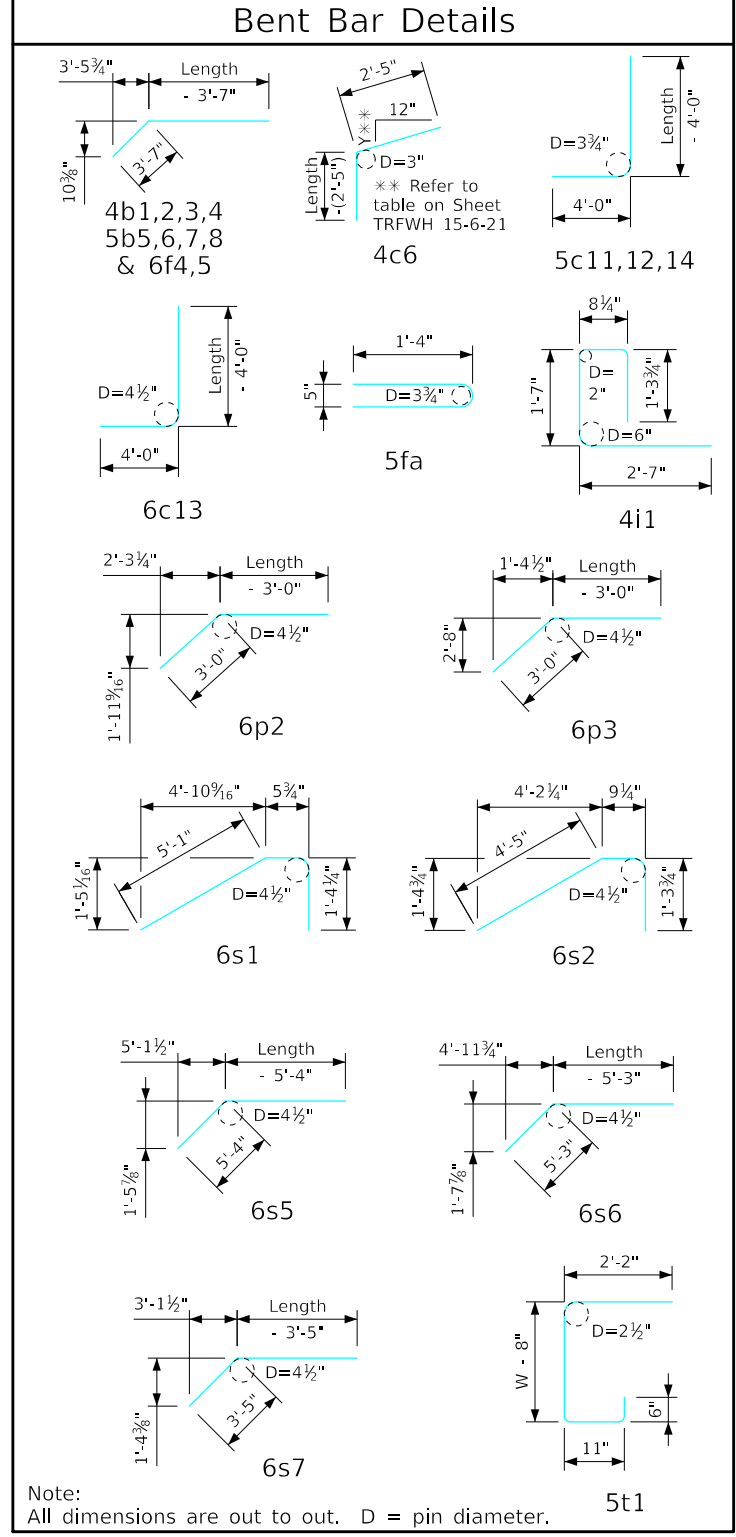
Notes:

1. See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. For dimension table see Sheet TRFWH 15-2-21.

LATEST REVISION DATE	 APPROVED BY BRIDGE ENGINEER		
		Standard Design - Triple Reinforced Concrete Box Culverts	
		Flared Wing Headwalls	
		February, 2021	
		Parapet & Curtain Wall Details 15° Skew	TRFWH 15-5-21

Bill of Reinforcing for One Headwall 15° Skew Span x Culvert Height

Bar	Location	Shape	12' x 12'			12' x 11'			12' x 10'			12' x 9'			12' x 8'			Bar		
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.			
5fa	Fence Anchor (Galv.)		2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	5fa		
4b1	Wingwall, B.F.H. Long		1	45'-7"	32	1	42'-2"	30	1	38'-9"	26	1	35'-4"	24	1	31'-11"	21	4b1		
4b2	Wingwall, B.F.H. Short		1	40'-4"	29	1	37'-4"	25	1	34'-4"	23	1	31'-4"	21	1	28'-4"	19	4b2		
4b3	Wingwall, B.F.H. Long		10 Var.	13'-2 to 44'-0"	194	9 Var.	13'-2 to 40'-7"	163	8 Var.	13'-2 to 37'-2"	134	7 Var.	13'-2 to 33'-9"	110	6 Var.	13'-2 to 30'-4"	87	4b3		
4b4	Wingwall, B.F.H. Short		10 Var.	11'-11 to 38'-11"	170	9 Var.	11'-11 to 35'-11"	144	8 Var.	11'-11 to 32'-11"	120	7 Var.	11'-11 to 29'-11"	98	6 Var.	11'-11 to 26'-11"	78	4b4		
5b5	Wingwall, F.F.H. Long		1	45'-8"	50	1	42'-3"	47	1	38'-10"	41	1	35'-5"	37	1	31'-11"	33	5b5		
5b6	Wingwall, F.F.H. Short		1	40'-4"	45	1	37'-4"	39	1	34'-4"	36	1	31'-4"	33	1	28'-4"	30	5b6		
5b7	Wingwall, F.F.H. Long		11 Var.	9'-10 to 44'-1"	314	10 Var.	9'-10 to 40'-8"	266	9 Var.	9'-10 to 37'-3"	221	8 Var.	9'-10 to 33'-10"	182	7 Var.	9'-10 to 30'-5"	147	5b7		
5b8	Wingwall, F.F.H. Short		11 Var.	9'-0 to 39'-0"	275	10 Var.	9'-0 to 36'-0"	235	9 Var.	9'-0 to 33'-0"	197	8 Var.	9'-0 to 30'-0"	163	7 Var.	9'-0 to 27'-0"	131	5b8		
5b9	Interior Wall, Both F.H.		42 Var.	2 Each 5'-6 to 28'-6"	745	38 Var.	2 Each 5'-6 to 26'-5"	632	34 Var.	2 Each 5'-6 to 24'-4"	529	30 Var.	2 Each 5'-7 to 22'-3"	435	26 Var.	2 Each 5'-7 to 20'-2"	349	5b9		
4c1	Wingwall, F.F.V. Long		42 Var.	2'-10 to 14'-10"	248	39 Var.	2'-10 to 13'-11"	218	35 Var.	2'-10 to 12'-9"	182	32 Var.	2'-10 to 11'-11"	158	29 Var.	2'-10 to 11'-0"	134	4c1		
4c2	Wingwall, F.F.V. Short		37 Var.	2'-10 to 14'-10"	218	34 Var.	2'-10 to 13'-10"	189	31 Var.	2'-10 to 12'-10"	162	28 Var.	2'-10 to 11'-10"	137	25 Var.	2'-10 to 10'-10"	114	4c2		
4c3	Wingwall, F.F.V. Long		19 Var.	9'-8 to 14'-11"	156	16 Var.	9'-8 to 14'-1"	127	12 Var.	9'-8 to 12'-11"	91	9 Var.	9'-8 to 12'-0"	65	--	--	--	4c3		
4c4	Wingwall, F.F.V. Short		17 Var.	9'-8 to 15'-0"	140	14 Var.	9'-8 to 14'-0"	111	11 Var.	9'-8 to 13'-0"	83	8 Var.	9'-8 to 12'-0"	58	--	--	--	4c4		
4c5	Wingwall, F.F.V. Long		2	13'-9"	18	1	12'-9"	9	2	11'-9"	16	2	10'-9"	14	1	9'-9"	7	4c5		
4c5	Wingwall, F.F.V. Short		2	13'-9"	18	2	12'-9"	17	2	11'-9"	16	2	10'-9"	14	2	9'-9"	13	4c5		
4c6	Interior Wall, Both F.V.		4	4'-2"	11	4	4'-2"	11	4	4'-2"	11	4	4'-2"	11	4	4'-2"	11	4c6		
4c7	Interior Wall, Both F.V.		98 Var.	2 Each 2'-0 to 12'-5"	472	90 Var.	1'-11 to 11'-5"	401	82 Var.	1'-11 to 10'-5"	338	74 Var.	1'-11 to 9'-6"	282	66 Var.	1'-11 to 8'-6"	230	4c7		
4c8	Interior Wall, Both F.V.		4	12'-7"	34	4	11'-7"	31	4	10'-7"	28	4	9'-7"	26	4	8'-7"	23	4c8		
5c9	Wingwall, B.F.V. Long		9 Var.	2'-10 to 5'-2"	38	9 Var.	2'-10 to 5'-2"	38	9 Var.	2'-10 to 5'-2"	38	9 Var.	2'-10 to 5'-2"	38	9 Var.	2'-10 to 5'-2"	38	5c9		
5c10	Wingwall, B.F.V. Short		6 Var.	2'-10 to 4'-6"	23	6 Var.	2'-10 to 4'-6"	23	6 Var.	2'-10 to 4'-6"	23	6 Var.	2'-10 to 4'-6"	23	6 Var.	2'-10 to 4'-6"	23	5c10		
5c11	Wingwall, B.F.V. Long		33 Var.	9'-6 to 18'-10"	488	30 Var.	9'-6 to 17'-11"	429	26 Var.	9'-6 to 16'-9"	356	23 Var.	9'-6 to 15'-11"	305	20 Var.	9'-6 to 15'-0"	256	5c11		
5c12	Wingwall, B.F.V. Short		31 Var.	8'-10 to 18'-10"	447	28 Var.	8'-10 to 17'-10"	389	25 Var.	8'-10 to 16'-10"	335	22 Var.	8'-10 to 15'-10"	283	19 Var.	8'-10 to 14'-10"	235	5c12		
6c13	Wingwall, B.F.V. Long		27	10'-6"	426	24	10'-6"	379	20	10'-6"	315	17	10'-6"	268	14	10'-6"	221	6c13		
6c13	Wingwall, B.F.V. Short		24	10'-6"	379	21	10'-6"	331	18	10'-6"	284	15	10'-6"	237	12	10'-6"	189	6c13		
5c14	Wingwall, B.F.V. Long		2	17'-9"	37	1	16'-9"	17	2	15'-9"	33	2	14'-9"	31	1	13'-9"	14	5c14		
5c14	Wingwall, B.F.V. Short		2	17'-9"	37	2	16'-9"	35	2	15'-9"	33	2	14'-9"	31	2	13'-9"	29	5c14		
4d1	Apron, Longit., Bott.		25	28'-10"	482	25	26'-9"	447	25	24'-9"	413	25	22'-8"	379	25	20'-7"	344	4d1		
4d2	Apron, Longit., Bott. Long		3	40'-3"	86	3	36'-10"	74	3	33'-5"	67	3	30'-0"	60	3	26'-7"	53	4d2		
4d3	Apron, Longit., Bott. Short		3	35'-6"	71	3	32'-5"	65	3	29'-5"	59	3	26'-5"	53	3	23'-5"	47	4d3		
6f1	Apron, Longit., Top		37	28'-10"	1602	37	26'-9"	1487	37	24'-9"	1375	37	22'-8"	1260	37	20'-7"	1144	6f1		
6f2	Apron, Longit., Top Long		9 Var.	5'-5 to 25'-7"	210	8 Var.	5'-10 to 23'-6"	176	7 Var.	6'-3 to 21'-5"	145	6 Var.	6'-8 to 19'-5"	118	5 Var.	7'-2 to 17'-4"	92	6f2		
6f3	Apron, Longit., Top Short		8 Var.	5'-5 to 25'-8"	187	7 Var.	6'-3 to 23'-8"	157	6 Var.	7'-0 to 21'-7"	129	6 Var.	4'-11 to 19'-6"	110	5 Var.	5'-9 to 17'-5"	87	6f3		
6f4	Apron, Longit., Top Long		1	45'-8"	72	1	42'-3"	67	1	38'-10"	58	1	35'-5"	53	1	31'-11"	48	6f4		
6f5	Apron, Longit., Top Short		1	40'-4"	64	1	37'-4"	56	1	34'-4"	52	1	31'-4"	47	1	28'-4"	43	6f5		
4i1	Parapet, Vertical		77	6'-2"	317	75	6'-2"	309	75	6'-2"	309	75	6'-2"	309	75	6'-2"	309	4i1		
7j1	Parapet, Horizontal		4	41'-0"	355	4	40'-8"	352	4	40'-4"	350	4	40'-4"	350	4	40'-4"	350	7j1		
6m1	Apron, Trans., Top		8 Var.	41'-3 to 42'-7"	533	8 Var.	40'-11 to 42'-3"	529	8 Var.	40'-7 to 41'-11"	525	8 Var.	40'-7 to 41'-11"	525	8 Var.	40'-7 to 41'-11"	525	6m1		
6m2	Apron, Trans., Top		21 Var.	42'-10 to 50'-4"	1546	18 Var.	42'-6 to 48'-11"	1301	15 Var.	42'-2 to 47'-5"	1064	12 Var.	42'-2 to 46'-3"	840	10 Var.	42'-2 to 45'-6"	695	6m2		
6m3	Apron, Trans., Top		13 Var.	8'-10 to 40'-2"	482	13 Var.	8'-9 to 40'-1"	480	14 Var.	6'-1 to 40'-1"	489	14 Var.	6'-3 to 40'-2"	492	13 Var.	6'-4 to 37'-8"	430	6m3		
6m4	Apron, Trans., Bott.		24 Var.	34'-11 to 47'-4"	1533	22 Var.	34'-9 to 46'-1"	1379	20 Var.	34'-7 to 44'-10"	1225	18 Var.	34'-7 to 43'-9"	1084	16 Var.	34'-7 to 42'-8"	947	6m4		
6p1	Curtain, Horizontal		4	39'-7"	238	4	39'-5"	237	4	39'-3"	236	4	39'-3"	236	4	39'-3"	236	6p1		
6p2	Curtain, Horizontal, Long		4	21'-9"	131	4	20'-3"	122	4	18'-9"	113	4	17'-3"	104	4	15'-9"	95	6p2		
6p3	Curtain, Horizontal, Short		4	16'-10"	101	4	15'-9"	95	4	14'-7"	88	4	13'-6"	81	4	12'-5"	75	6p3		
6s1	Wing Slope, Both F., Long		2	6'-11"	21	2	6'-11"	21	2	6'-11"	21	2	6'-11"	21	2	6'-11"	21	6s1		
6s2	Wing Slope, Both F., Short		2	6'-6"	20	2	6'-6"	20	2	6'-6"	20	2	6'-6"	20	2	6'-6"	20	6s2		
6s3	Wing Slope, Both F., Long		2	41'-3"	131	2	37'-9"	113	2	34'-2"	103	2	30'-7"	92	2	27'-0"	81	6s3		
6s4	Wing Slope, Both F., Short		2	36'-11"	111	2	33'-9"	101	2	30'-7"	92	2	27'-5"	82	2	24'-3"	73	6s4		
6s5	Wing Slope, F.F. Long		1	46'-5"	73	1	42'-10"	68	1	39'-3"	59	1	35'-8"	54	1	32'-1"	48	6s5		
6s6	Wing Slope, F.F. Short		1	41'-8"	66	1	38'-6"	58	1	35'-4"	53	1	32'-2"	48	1	29'-0"	44	6s6		
6s7	Interior Wall, Both F.H.		4	30'-9"	185	4	28'-6"	171	4	26'-3"	158	4	23'-11"	144	4	21'-8"	130	6s7		
5t1	Curtain, Vertical		52	7'-11"	429	50	7'-8"	400	48	7'-5"	371	47	7'-2"	351	45	6'-11"	325	5t1		
			Reinf. Steel			14,096 LB			12,627 LB			11,251 LB			10,003 LB			8700 LB		
			Concrete			117.6 CY			101.9 CY			87.6 CY			77.0 CY			67.1 CY		
			Parapet Δ			4.0			3.9			3.8			3.8			3.8		
			Wingwalls			35.6			28.0			21.5			17.8			14.4		
			Apron *			78.0			70.0			62.3			55.4			48.9		



Δ Includes top of wingwall quantities.
 * Assumes apron and floor are equal thickness, adjust concrete quantities for transition where apron and floor thickness are not equal.

Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

"Short" Denotes Short Wingwall
 "Long" Denotes Long Wingwall

- ### Headwall Notes:
- See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
 - This headwall is based on a 3:1 slope normal to centerline of roadway.
 - The sides of the apron are to be formed to ensure correct line and grade.
 - All apron reinforcing steel is to be supported by bar chairs at intervals of not more than 3'-0" in either direction as outlined in the Standard Specifications.
 - Clear distance from face of concrete to near reinforcing bar is to be 2" unless otherwise noted or shown. Clearance to the bottom ends of vertical bars shall be 3 inches.
 - Concrete quantities are estimated from back of parapet.
 - Horizontal tails of bars "b" & "s" estimated to extend 2'-5" beyond back of parapet (into end of barrel). Longitudinal bars "d", "6f1", "6f4" and "6f5" estimated to project into end section of barrel a minimum of 2'-5" beyond back of parapet. The "length" column reflects total number of feet necessary to meet these requirements.
 - Dimensions are in feet and inches unless otherwise noted.

LATEST REVISION DATE

Standard Design - Triple Reinforced Concrete Box Culverts

Flared Wing Headwalls

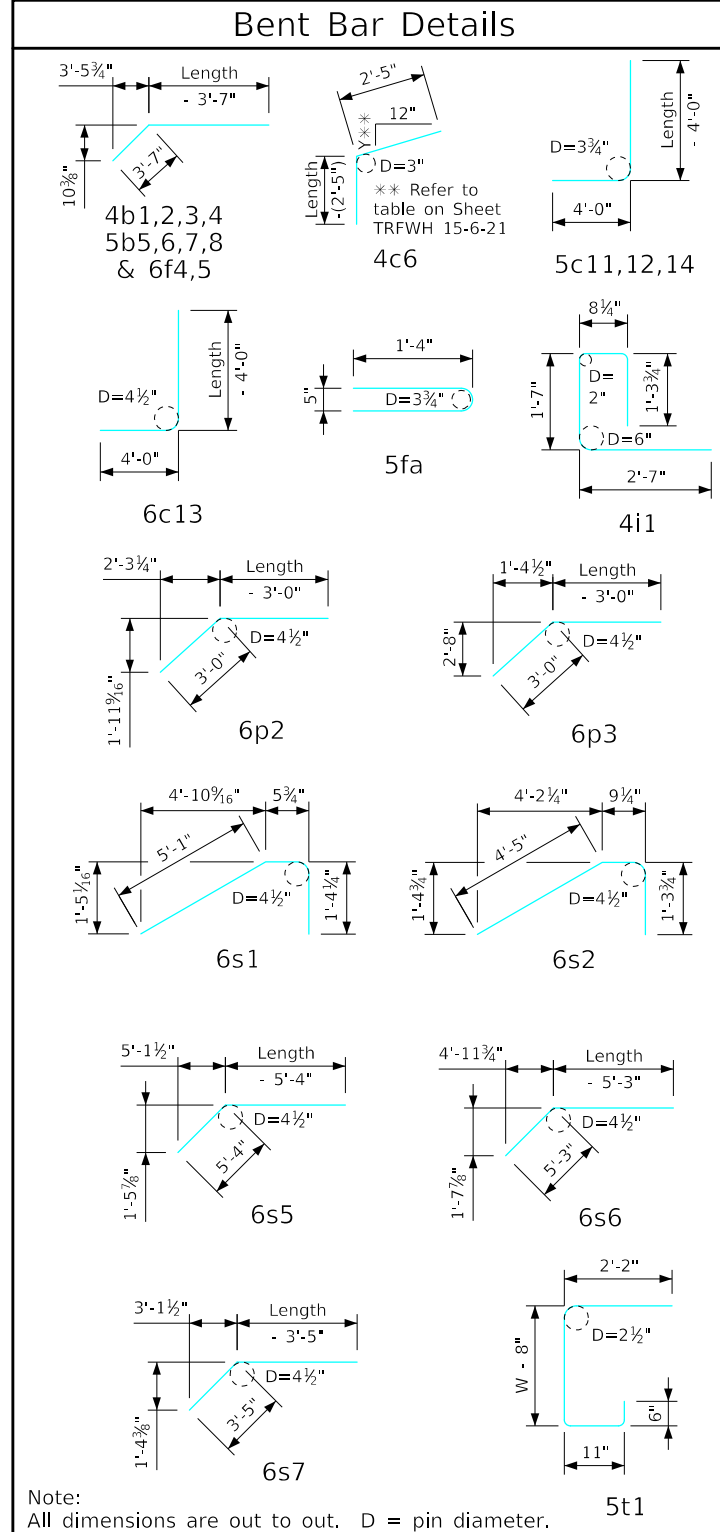
February, 2021

Quantity Tabulation 12'-0" Span 15° Skew	TRFWH 15-7-21 Sheet 1 of 2
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ENGLISHLRFDDESIGNEDTRIPLECULVERTSFWH.DGN - TRFWH 15-7-21 S1 - THIS SHEET ISSUED 02-2021.

Bill of Reinforcing for One Headwall 15° Skew Span x Culvert Height

Bar	Location	Shape	12' x 7'			12' x 6'			12' x 5'			12' x 4'			Bar
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	
5fa	Fence Anchor (Galv.)		2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	5fa
4b1	Wingwall, B.F.H. Long		1	28'-6"	19	1	25'-1"	17	1	21'-7"	14	1	18'-2"	12	4b1
4b2	Wingwall, B.F.H. Short		1	25'-4"	17	1	22'-4"	15	1	19'-4"	13	1	16'-4"	11	4b2
4b3	Wingwall, B.F.H. Long		5 Var.	13'-2 to 26'-11"	67	4 Var.	13'-2 to 23'-6"	49	3 Var.	13'-2 to 20'-1"	33	2 Var.	13'-2 to 16'-7"	20	4b3
4b4	Wingwall, B.F.H. Short		5 Var.	11'-11 to 23'-11"	60	4 Var.	11'-11 to 20'-11"	44	3 Var.	11'-11 to 17'-11"	30	2 Var.	11'-11 to 14'-11"	18	4b4
5b5	Wingwall, F.F.H. Long		1	28'-6"	30	1	25'-1"	26	1	21'-8"	23	1	18'-3"	19	5b5
5b6	Wingwall, F.F.H. Short		1	25'-4"	26	1	22'-4"	23	1	19'-4"	20	1	16'-4"	17	5b6
5b7	Wingwall, F.F.H. Long		6 Var.	9'-10 to 26'-11"	115	5 Var.	9'-10 to 23'-6"	87	4 Var.	9'-10 to 20'-1"	62	3 Var.	9'-9 to 16'-8"	41	5b7
5b8	Wingwall, F.F.H. Short		6 Var.	9'-0 to 24'-0"	103	5 Var.	9'-0 to 21'-0"	78	4 Var.	9'-0 to 18'-0"	56	3 Var.	9'-0 to 15'-0"	38	5b8
5b9	Interior Wall, Both F.H.		22 Var.	2 Each 5'-8 to 18'-2	273	18 Var.	2 Each 5'-9 to 16'-1	205	14 Var.	2 Each 5'-10 to 14'-0	145	10 Var.	2 Each 6'-0 to 11'-10	93	5b9
4c1	Wingwall, F.F.V. Long		25 Var.	2'-10 to 9'-10	106	22 Var.	2'-10 to 9'-0	87	18 Var.	2'-10 to 7'-10	64	15 Var.	2'-10 to 6'-11	49	4c1
4c2	Wingwall, F.F.V. Short		22 Var.	2'-10 to 9'-10	93	19 Var.	2'-10 to 8'-10	74	16 Var.	2'-10 to 7'-10	57	13 Var.	2'-10 to 6'-10	42	4c2
4c3	Wingwall, F.F.V. Long		--	--	--	--	--	--	--	--	--	--	--	--	4c3
4c4	Wingwall, F.F.V. Short		--	--	--	--	--	--	--	--	--	--	--	--	4c4
4c5	Wingwall, F.F.V. Long		2	8'-9	12	1	7'-9	5	2	6'-9	9	1	5'-9	4	4c5
4c5	Wingwall, F.F.V. Short		2	8'-9	12	2	7'-9	10	2	6'-9	9	2	5'-9	8	4c5
4c6	Interior Wall, Both F.V.		4	4'-2	11	4	4'-2	11	4	4'-2	11	4	4'-1	11	4c6
4c7	Interior Wall, Both F.V.		56 Var.	2 Each 1'-11 to 7'-4	173	48 Var.	2 Each 1'-11 to 6'-4	132	40 Var.	2 Each 1'-11 to 5'-5	98	32 Var.	2 Each 1'-10 to 4'-5	67	4c7
4c8	Interior Wall, Both F.V.		4	7'-7	20	4	6'-7	18	4	5'-7	15	4	4'-7	12	4c8
5c9	Wingwall, B.F.V. Long		9 Var.	2'-10 to 5'-2	38	9 Var.	2'-10 to 5'-2	38	9 Var.	2'-10 to 5'-2	38	9 Var.	2'-10 to 5'-2	38	5c9
5c10	Wingwall, B.F.V. Short		6 Var.	2'-10 to 4'-6	23	6 Var.	2'-10 to 4'-6	23	6 Var.	2'-10 to 4'-6	23	6 Var.	2'-10 to 4'-6	23	5c10
5c11	Wingwall, B.F.V. Long		16 Var.	9'-6 to 13'-10	195	13 Var.	9'-6 to 13'-0	153	9 Var.	9'-6 to 11'-10	100	6 Var.	9'-6 to 10'-11	64	5c11
5c12	Wingwall, B.F.V. Short		16 Var.	8'-10 to 13'-10	189	13 Var.	8'-10 to 12'-10	147	10 Var.	8'-10 to 11'-10	108	7 Var.	8'-10 to 10'-10	72	5c12
6c13	Wingwall, B.F.V. Long		10	10'-6	158	7	10'-6	110	--	--	--	--	--	--	6c13
6c13	Wingwall, B.F.V. Short		9	10'-6	142	6	10'-6	95	--	--	--	--	--	--	6c13
5c14	Wingwall, B.F.V. Long		2	12'-9	27	1	11'-9	12	2	10'-9	22	1	9'-9	10	5c14
5c14	Wingwall, B.F.V. Short		2	12'-9	27	2	11'-9	25	2	10'-9	22	2	9'-9	20	5c14
4d1	Apron, Longit., Bott.		25	18'-6	309	25	16'-5	274	25	14'-4	239	25	12'-4	206	4d1
4d2	Apron, Longit., Bott. Long		3	23'-1	46	3	19'-8	39	3	16'-3	33	3	12'-10	26	4d2
4d3	Apron, Longit., Bott. Short		3	20'-5	41	3	17'-5	35	3	14'-5	29	3	11'-5	23	4d3
6f1	Apron, Longit., Top		37	18'-6	1028	37	16'-5	912	37	14'-4	797	37	12'-4	685	6f1
6f2	Apron, Longit., Top Long		4 Var.	7'-7 to 15'-3	69	4 Var.	5'-6 to 13'-2	56	3 Var.	5'-11 to 11'-1	38	2 Var.	6'-5 to 9'-0	23	6f2
6f3	Apron, Longit., Top Short		4 Var.	6'-7 to 15'-4	66	4 Var.	4'-5 to 13'-3	53	3 Var.	5'-3 to 11'-2	37	2 Var.	6'-2 to 9'-1	23	6f3
6f4	Apron, Longit., Top Long		1	28'-6	43	1	25'-1	38	1	21'-8	33	1	18'-3	27	6f4
6f5	Apron, Longit., Top Short		1	25'-4	38	1	22'-4	34	1	19'-4	29	1	16'-4	25	6f5
4i1	Parapet, Vertical		75	6'-2	309	75	6'-2	309	75	6'-2	309	75	6'-2	309	4i1
7j1	Parapet, Horizontal		4	40'-0	327	4	40'-0	327	4	40'-0	327	4	40'-0	327	7j1
6m1	Apron, Trans., Top		8 Var.	40'-3 to 41'-7	521	8 Var.	40'-3 to 41'-7	521	8 Var.	40'-3 to 41'-7	521	7 Var.	40'-3 to 41'-4	454	6m1
6m2	Apron, Trans., Top		7 Var.	41'-10 to 44'-1	477	4 Var.	41'-10 to 42'-11	269	1	41'-10	66	1	35'-5	53	6m2
6m3	Apron, Trans., Top		13 Var.	6'-3 to 37'-7	428	14 Var.	3'-9 to 37'-9	436	14 Var.	3'-10 to 37'-10	438	12 Var.	4'-0 to 32'-8	330	6m3
6m4	Apron, Trans., Bott.		14 Var.	34'-5 to 41'-5	808	12 Var.	34'-5 to 40'-4	677	10 Var.	34'-5 to 39'-3	553	8 Var.	34'-5 to 38'-2	436	6m4
6p1	Curtain, Horizontal		4	39'-1	235	4	39'-1	235	4	39'-0	234	4	39'-0	234	6p1
6p2	Curtain, Horizontal, Long		4	14'-2	85	4	12'-8	76	4	11'-2	67	4	9'-8	58	6p2
6p3	Curtain, Horizontal, Short		4	11'-3	68	4	10'-2	61	4	9'-1	55	4	7'-11	48	6p3
6s1	Wing Slope, Both F., Long		2	6'-11	21	2	6'-11	21	2	6'-11	21	2	6'-11	21	6s1
6s2	Wing Slope, Both F., Short		2	6'-6	20	2	6'-6	20	2	6'-6	20	2	6'-6	20	6s2
6s3	Wing Slope, Both F., Long		2	23'-5	70	2	19'-10	60	2	16'-3	49	2	12'-8	38	6s3
6s4	Wing Slope, Both F., Short		2	21'-1	63	2	17'-11	54	2	14'-9	44	2	11'-7	35	6s4
6s5	Wing Slope, F.F. Long		1	28'-7	43	1	25'-0	38	1	21'-5	32	1	17'-10	27	6s5
6s6	Wing Slope, F.F. Short		1	25'-10	39	1	22'-8	34	1	19'-6	29	1	16'-4	25	6s6
6s7	Interior Wall, Both F.H.		4	19'-4	116	4	17'-1	103	4	14'-9	89	4	12'-6	75	6s7
5t1	Curtain, Vertical		42	6'-8	292	40	6'-5	268	38	6'-5	254	36	6'-5	241	5t1
	Estimated Quantities One Headwall	Reinf. Steel	7504 LB			6440 LB			5321 LB			4464 LB			
		Concrete	Parapet Δ	3.7		3.7		3.7		3.7		3.7			
			Wingwalls	10.3		7.9		5.8		40.4		3.9			
			Apron *	41.8	55.8 CY		36.1		30.9		25.9		33.5		



Δ Includes top of wingwall quantities.
 * Assumes apron and floor are equal thickness, adjust concrete quantities for transition where apron and floor thickness are not equal.
 Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.
 "Short" Denotes Short Wingwall
 "Long" Denotes Long Wingwall

Headwall Notes:

- See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
- This headwall is based on a 3:1 slope normal to centerline of roadway.
- The sides of the apron are to be formed to ensure correct line and grade.
- All apron reinforcing steel is to be supported by bar chairs at intervals of not more than 3'-0" in either direction as outlined in the Standard Specifications.
- Clear distance from face of concrete to near reinforcing bar is to be 2" unless otherwise noted or shown. Clearance to the bottom ends of vertical bars shall be 3 inches.
- Concrete quantities are estimated from back of parapet.
- Horizontal tails of bars "b" & "s" estimated to extend 2'-5" beyond back of parapet (into end of barrel). Longitudinal bars "d", "6f1", "6f4" and "6f5" estimated to project into end section of barrel a minimum of 2'-5" beyond back of parapet. The "length" column reflects total number of feet necessary to meet these requirements.
- Dimensions are in feet and inches unless otherwise noted.

IOWA DOT Highway Division

Standard Design - Triple Reinforced Concrete Box Culverts

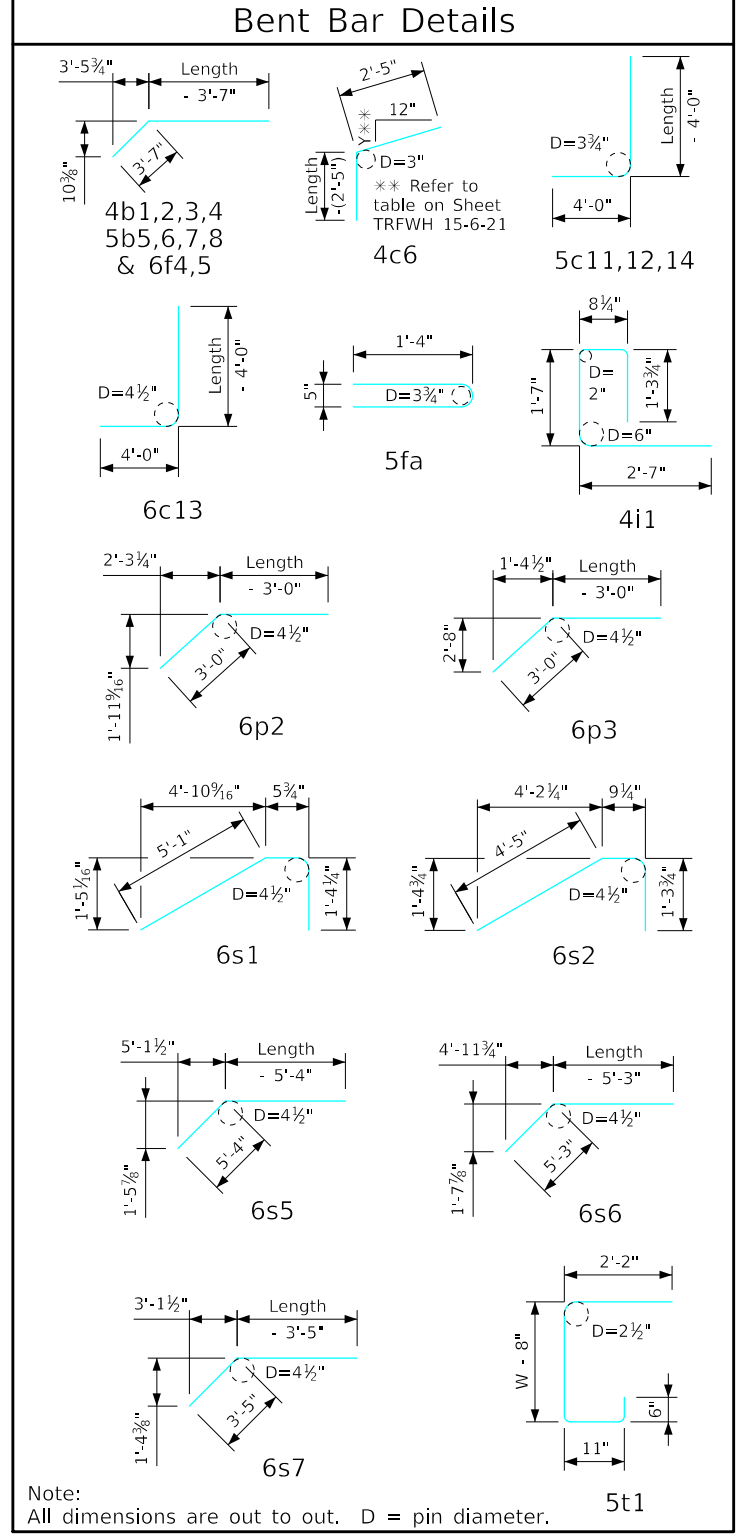
Flared Wing Headwalls

February, 2021

Quantity Tabulation 12'-0" Span 15° Skew	TRFWH 15-7-21 Sheet 2 of 2
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Bill of Reinforcing for One Headwall 15° Skew Span x Culvert Height

Bar	Location	Shape	10' x 12'			10' x 11'			10' x 10'			10' x 9'			10' x 8'			Bar		
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.			
5fa	Fence Anchor (Galv.)		2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	5fa		
4b1	Wingwall, B.F.H. Long		1	45'-7"	32	1	42'-2"	30	1	38'-9"	26	1	35'-4"	24	1	31'-11"	21	4b1		
4b2	Wingwall, B.F.H. Short		1	40'-4"	29	1	37'-4"	25	1	34'-4"	23	1	31'-4"	21	1	28'-4"	19	4b2		
4b3	Wingwall, B.F.H. Long		10 Var.	13'-2 to 44'-0"	194	9 Var.	13'-2 to 40'-7"	163	8 Var.	13'-2 to 37'-2"	134	7 Var.	13'-2 to 33'-9"	110	6 Var.	13'-2 to 30'-4"	87	4b3		
4b4	Wingwall, B.F.H. Short		10 Var.	11'-11 to 38'-11"	170	9 Var.	11'-11 to 35'-11"	144	8 Var.	11'-11 to 32'-11"	120	7 Var.	11'-11 to 29'-11"	98	6 Var.	11'-11 to 26'-11"	78	4b4		
5b5	Wingwall, F.F.H. Long		1	45'-8"	50	1	42'-3"	47	1	38'-10"	41	1	35'-5"	37	1	31'-11"	33	5b5		
5b6	Wingwall, F.F.H. Short		1	40'-4"	45	1	37'-4"	39	1	34'-4"	36	1	31'-4"	33	1	28'-4"	30	5b6		
5b7	Wingwall, F.F.H. Long		11 Var.	9'-10 to 44'-1"	314	10 Var.	9'-10 to 40'-8"	266	9 Var.	9'-10 to 37'-3"	221	8 Var.	9'-10 to 33'-10"	182	7 Var.	9'-10 to 30'-5"	147	5b7		
5b8	Wingwall, F.F.H. Short		11 Var.	9'-0 to 39'-0"	275	10 Var.	9'-0 to 36'-0"	235	9 Var.	9'-0 to 33'-0"	197	8 Var.	9'-0 to 30'-0"	163	7 Var.	9'-0 to 27'-0"	131	5b8		
5b9	Interior Wall, Both F.H.		42 Var.	2 Each 5'-6 to 28'-6"	745	38 Var.	2 Each 5'-6 to 26'-5"	632	34 Var.	2 Each 5'-6 to 24'-4"	529	30 Var.	2 Each 5'-7 to 22'-3"	435	26 Var.	2 Each 5'-7 to 20'-2"	349	5b9		
4c1	Wingwall, F.F.V. Long		42 Var.	2'-9 to 14'-9"	245	39 Var.	2'-9 to 13'-10"	216	35 Var.	2'-9 to 12'-8"	180	32 Var.	2'-9 to 11'-10"	156	29 Var.	2'-9 to 10'-11"	132	4c1		
4c2	Wingwall, F.F.V. Short		37 Var.	2'-9 to 14'-9"	216	34 Var.	2'-9 to 13'-9"	187	31 Var.	2'-9 to 12'-9"	160	28 Var.	2'-9 to 11'-9"	136	25 Var.	2'-9 to 10'-9"	113	4c2		
4c3	Wingwall, F.F.V. Long		19 Var.	9'-7 to 14'-10"	155	16 Var.	9'-7 to 14'-0"	126	12 Var.	9'-7 to 12'-10"	90	9 Var.	9'-7 to 11'-11"	65	--	--	--	4c3		
4c4	Wingwall, F.F.V. Short		17 Var.	9'-7 to 14'-11"	139	14 Var.	9'-7 to 13'-11"	110	11 Var.	9'-7 to 12'-11"	83	8 Var.	9'-7 to 11'-11"	57	--	--	--	4c4		
4c5	Wingwall, F.F.V. Long		2	13'-8"	18	1	12'-8"	8	2	11'-8"	16	2	10'-8"	14	1	9'-8"	6	4c5		
4c5	Wingwall, F.F.V. Short		2	13'-8"	18	2	12'-8"	17	2	11'-8"	16	2	10'-8"	14	2	9'-8"	13	4c5		
4c6	Interior Wall, Both F.V.		4	4'-1"	11	4	4'-1"	11	4	4'-1"	11	4	4'-1"	11	4	4'-1"	11	4c6		
4c7	Interior Wall, Both F.V.		98 Var.	2 Each 1'-11 to 12'-4"	466	90 Var.	2 Each 1'-10 to 11'-4"	396	82 Var.	2 Each 1'-10 to 10'-4"	333	74 Var.	2 Each 1'-10 to 9'-5"	278	66 Var.	2 Each 1'-10 to 8'-5"	226	4c7		
4c8	Interior Wall, Both F.V.		4	12'-6"	33	4	11'-6"	31	4	10'-6"	28	4	9'-6"	25	4	8'-6"	23	4c8		
5c9	Wingwall, B.F.V. Long		9 Var.	2'-9 to 5'-1"	37	9 Var.	2'-9 to 5'-1"	37	9 Var.	2'-9 to 5'-1"	37	9 Var.	2'-9 to 5'-1"	37	9 Var.	2'-9 to 5'-1"	37	5c9		
5c10	Wingwall, B.F.V. Short		6 Var.	2'-9 to 4'-5"	22	6 Var.	2'-9 to 4'-5"	22	6 Var.	2'-9 to 4'-5"	22	6 Var.	2'-9 to 4'-5"	22	6 Var.	2'-9 to 4'-5"	22	5c10		
5c11	Wingwall, B.F.V. Long		33 Var.	9'-5 to 18'-9"	485	30 Var.	9'-5 to 17'-10"	426	26 Var.	9'-5 to 16'-8"	354	23 Var.	9'-5 to 15'-10"	303	20 Var.	9'-5 to 14'-11"	254	5c11		
5c12	Wingwall, B.F.V. Short		31 Var.	8'-9 to 18'-9"	445	28 Var.	8'-9 to 17'-9"	387	25 Var.	8'-9 to 16'-9"	332	22 Var.	8'-9 to 15'-9"	281	19 Var.	8'-9 to 14'-9"	233	5c12		
6c13	Wingwall, B.F.V. Long		27	10'-6"	426	24	10'-6"	379	20	10'-6"	315	17	10'-6"	268	14	10'-6"	221	6c13		
6c13	Wingwall, B.F.V. Short		24	10'-6"	379	21	10'-6"	331	18	10'-6"	284	15	10'-6"	237	12	10'-6"	189	6c13		
5c14	Wingwall, B.F.V. Long		2	17'-8"	37	1	16'-8"	17	2	15'-8"	33	2	14'-8"	31	1	13'-8"	14	5c14		
5c14	Wingwall, B.F.V. Short		2	17'-8"	37	2	16'-8"	35	2	15'-8"	33	2	14'-8"	31	2	13'-8"	29	5c14		
4d1	Apron, Longit., Bott.		21	28'-10"	404	21	26'-9"	375	21	24'-9"	347	21	22'-8"	318	21	20'-7"	289	4d1		
4d2	Apron, Longit., Bott. Long		3	40'-3"	86	3	36'-10"	74	3	33'-5"	67	3	30'-0"	60	3	26'-7"	53	4d2		
4d3	Apron, Longit., Bott. Short		3	35'-6"	71	3	32'-5"	65	3	29'-5"	59	3	26'-5"	53	3	23'-5"	47	4d3		
6f1	Apron, Longit., Top		31	28'-10"	1343	31	26'-9"	1246	31	24'-9"	1152	31	22'-8"	1055	31	20'-7"	958	6f1		
6f2	Apron, Longit., Top Long		9 Var.	5'-5 to 25'-7"	210	8 Var.	5'-10 to 23'-6"	176	7 Var.	6'-3 to 21'-5"	145	6 Var.	6'-8 to 19'-5"	118	5 Var.	7'-2 to 17'-4"	92	6f2		
6f3	Apron, Longit., Top Short		8 Var.	5'-5 to 25'-8"	187	7 Var.	6'-3 to 23'-8"	157	6 Var.	7'-0 to 21'-7"	129	6 Var.	4'-11 to 19'-6"	110	5 Var.	5'-9 to 17'-5"	87	6f3		
6f4	Apron, Longit., Top Long		1	45'-8"	72	1	42'-3"	67	1	38'-10"	58	1	35'-5"	53	1	31'-11"	48	6f4		
6f5	Apron, Longit., Top Short		1	40'-4"	64	1	37'-4"	56	1	34'-4"	52	1	31'-4"	47	1	28'-4"	43	6f5		
4i1	Parapet, Vertical		65	6'-2"	268	63	6'-2"	260	63	6'-2"	260	63	6'-2"	260	63	6'-2"	260	4i1		
7j1	Parapet, Horizontal		4	34'-10"	285	4	34'-6"	282	4	34'-1"	279	4	34'-1"	279	4	34'-1"	279	7j1		
6m1	Apron, Trans., Top		7 Var.	35'-1 to 36'-2"	375	7 Var.	34'-9 to 35'-10"	371	7 Var.	34'-4 to 35'-6"	367	7 Var.	34'-4 to 35'-6"	367	7 Var.	34'-4 to 35'-6"	367	6m1		
6m2	Apron, Trans., Top		23 Var.	36'-6 to 44'-9"	1451	20 Var.	36'-2 to 43'-3"	1225	17 Var.	35'-9 to 41'-9"	1008	14 Var.	35'-9 to 40'-8"	811	12 Var.	35'-9 to 39'-11"	682	6m2		
6m3	Apron, Trans., Top		11 Var.	8'-8 to 34'-9"	359	11 Var.	8'-7 to 34'-8"	357	12 Var.	5'-11 to 34'-8"	366	12 Var.	6'-0 to 34'-9"	367	11 Var.	6'-2 to 32'-3"	317	6m3		
6m4	Apron, Trans., Bott.		24 Var.	28'-8 to 41'-1"	1268	22 Var.	28'-6 to 39'-10"	1129	20 Var.	28'-4 to 38'-7"	1005	18 Var.	28'-4 to 37'-6"	890	16 Var.	28'-4 to 36'-5"	778	6m4		
6p1	Curtain, Horizontal		4	33'-5"	201	4	33'-2"	199	4	33'-0"	198	4	33'-0"	198	4	33'-0"	198	6p1		
6p2	Curtain, Horizontal, Long		4	21'-9"	131	4	20'-3"	122	4	18'-9"	113	4	17'-3"	104	4	15'-9"	95	6p2		
6p3	Curtain, Horizontal, Short		4	16'-10"	101	4	15'-9"	95	4	14'-7"	88	4	13'-6"	81	4	12'-5"	75	6p3		
6s1	Wing Slope, Both F., Long		2	6'-11"	21	2	6'-11"	21	2	6'-11"	21	2	6'-11"	21	2	6'-11"	21	6s1		
6s2	Wing Slope, Both F., Short		2	6'-6"	20	2	6'-6"	20	2	6'-6"	20	2	6'-6"	20	2	6'-6"	20	6s2		
6s3	Wing Slope, Both F., Long		2	41'-3"	131	2	37'-9"	113	2	34'-2"	103	2	30'-7"	92	2	27'-0"	81	6s3		
6s4	Wing Slope, Both F., Short		2	36'-11"	111	2	33'-9"	101	2	30'-7"	92	2	27'-5"	82	2	24'-3"	73	6s4		
6s5	Wing Slope, F.F. Long		1	46'-5"	73	1	42'-10"	68	1	39'-3"	59	1	35'-8"	54	1	32'-1"	48	6s5		
6s6	Wing Slope, F.F. Short		1	41'-8"	66	1	38'-6"	58	1	35'-4"	53	1	32'-2"	48	1	29'-0"	44	6s6		
6s7	Interior Wall, Both F.H.		4	30'-9"	185	4	28'-6"	171	4	26'-3"	158	4	23'-11"	144	4	21'-8"	130	6s7		
5t1	Curtain, Vertical		46	7'-11"	380	44	7'-8"	352	42	7'-5"	325	41	7'-2"	306	39	6'-11"	281	5t1		
			Reinf. Steel			12,892 LB			11,483 LB			10,184 LB			9,013 LB			7,790 LB		
Estimated Quantities One Headwall			Concrete			3.5			3.4			3.3			3.3			3.3		
			Parapet Δ			105.6 CY			28.0			21.5			17.8			14.4		
			Wingwalls			66.5			59.5			52.8			46.9			41.2		
			Apron *																	



Δ Includes top of wingwall quantities.
 * Assumes apron and floor are equal thickness, adjust concrete quantities for transition where apron and floor thickness are not equal.

Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

"Short" Denotes Short Wingwall
 "Long" Denotes Long Wingwall

- ### Headwall Notes:
- See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
 - This headwall is based on a 3:1 slope normal to centerline of roadway.
 - The sides of the apron are to be formed to ensure correct line and grade.
 - All apron reinforcing steel is to be supported by bar chairs at intervals of not more than 3'-0" in either direction as outlined in the Standard Specifications.
 - Clear distance from face of concrete to near reinforcing bar is to be 2" unless otherwise noted or shown. Clearance to the bottom ends of vertical bars shall be 3 inches.
 - Concrete quantities are estimated from back of parapet.
 - Horizontal tails of bars "b" & "s" estimated to extend 2'-5" beyond back of parapet (into end of barrel). Longitudinal bars "d", "6f1", "6f4" and "6f5" estimated to project into end section of barrel a minimum of 2'-5" beyond back of parapet. The "length" column reflects total number of feet necessary to meet these requirements.
 - Dimensions are in feet and inches unless otherwise noted.

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWADOT Highway Division

Standard Design - Triple Reinforced Concrete Box Culverts

Flared Wing Headwalls

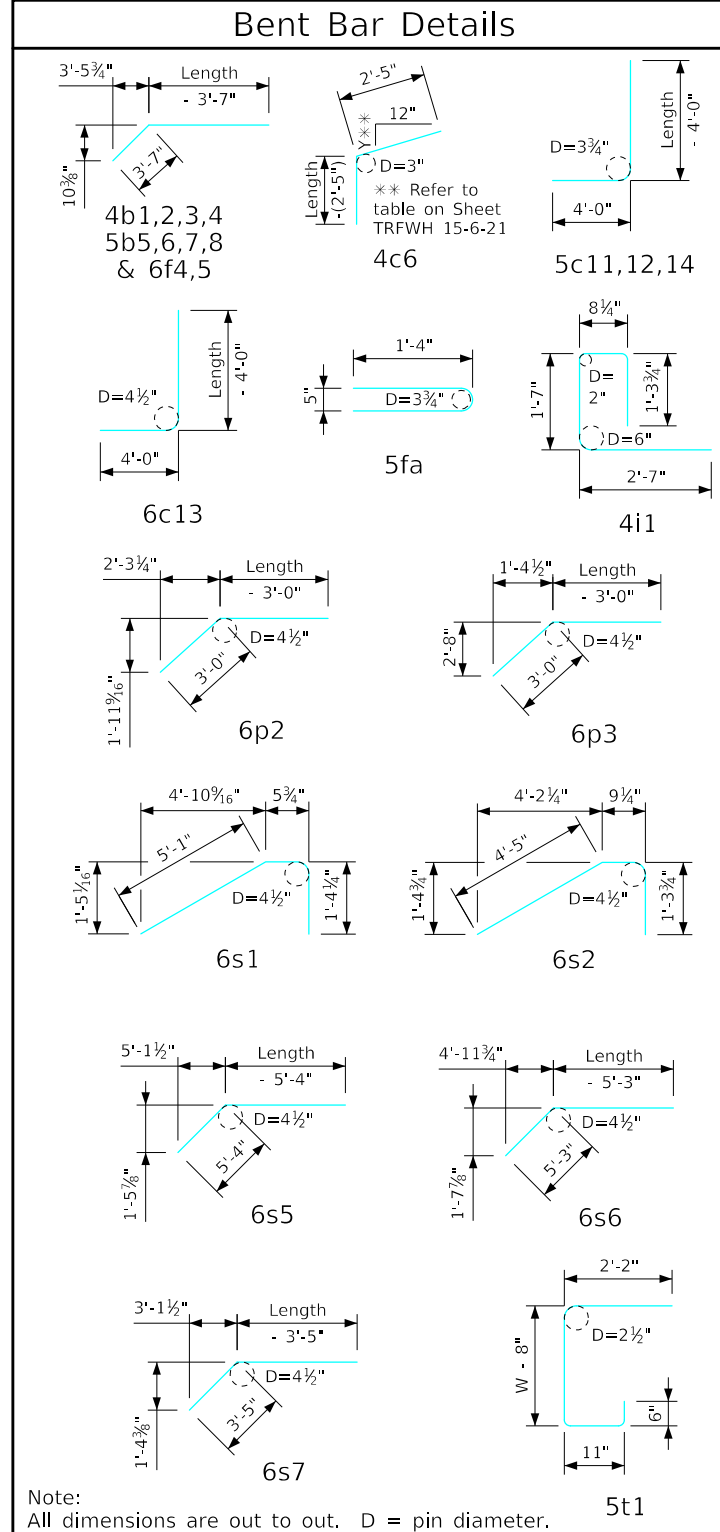
February, 2021

Quantity Tabulation 10'-0" Span 15° Skew	TRFWH 15-8-21 Sheet 1 of 2
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ENGLISHLRFDDESIGNEDTRIPLECULVERTSFWH.DGN - TRFWH 15-8-21 S1 - THIS SHEET ISSUED 02-2021.

Bill of Reinforcing for One Headwall 15° Skew Span x Culvert Height

Bar	Location	Shape	10' x 7'			10' x 6'			10' x 5'			10' x 4'			Bar		
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.			
5fa	Fence Anchor (Galv.)		2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	5fa		
4b1	Wingwall, B.F.H. Long		1	28'-6"	19	1	25'-1"	17	1	21'-7"	14	1	18'-2"	12	4b1		
4b2	Wingwall, B.F.H. Short		1	25'-4"	17	1	22'-4"	15	1	19'-4"	13	1	16'-4"	11	4b2		
4b3	Wingwall, B.F.H. Long		5 Var.	13'-2 to 26'-11"	67	4 Var.	13'-2 to 23'-6"	49	3 Var.	13'-2 to 20'-1"	33	2 Var.	13'-2 to 16'-7"	20	4b3		
4b4	Wingwall, B.F.H. Short		5 Var.	11'-11 to 23'-11"	60	4 Var.	11'-11 to 20'-11"	44	3 Var.	11'-11 to 17'-11"	30	2 Var.	11'-11 to 14'-11"	18	4b4		
5b5	Wingwall, F.F.H. Long		1	28'-6"	30	1	25'-1"	26	1	21'-8"	23	1	18'-3"	19	5b5		
5b6	Wingwall, F.F.H. Short		1	25'-4"	26	1	22'-4"	23	1	19'-4"	20	1	16'-4"	17	5b6		
5b7	Wingwall, F.F.H. Long		6 Var.	9'-10 to 26'-11"	115	5 Var.	9'-10 to 23'-6"	87	4 Var.	9'-10 to 20'-1"	62	3 Var.	9'-9 to 16'-8"	41	5b7		
5b8	Wingwall, F.F.H. Short		6 Var.	9'-0 to 24'-0"	103	5 Var.	9'-0 to 21'-0"	78	4 Var.	9'-0 to 18'-0"	56	3 Var.	9'-0 to 15'-0"	38	5b8		
5b9	Interior Wall, Both F.H.		22 Var.	2 Each 5'-8 to 18'-2	273	18 Var.	2 Each 5'-9 to 16'-1	205	14 Var.	2 Each 5'-10 to 14'-0	145	10 Var.	2 Each 6'-0 to 11'-10	93	5b9		
4c1	Wingwall, F.F.V. Long		25 Var.	2'-9 to 9'-9	104	22 Var.	2'-9 to 8'-11	86	18 Var.	2'-9 to 7'-9	63	15 Var.	2'-9 to 6'-10	48	4c1		
4c2	Wingwall, F.F.V. Short		22 Var.	2'-9 to 9'-9	92	19 Var.	2'-9 to 8'-9	73	16 Var.	2'-9 to 7'-9	56	13 Var.	2'-9 to 6'-9	41	4c2		
4c3	Wingwall, F.F.V. Long		--	--	--	--	--	--	--	--	--	--	--	--	4c3		
4c4	Wingwall, F.F.V. Short		--	--	--	--	--	--	--	--	--	--	--	--	4c4		
4c5	Wingwall, F.F.V. Long		2	8'-8	12	1	7'-8	5	2	6'-8	9	1	5'-8	4	4c5		
4c5	Wingwall, F.F.V. Short		2	8'-8	12	2	7'-8	10	2	6'-8	9	2	5'-8	8	4c5		
4c6	Interior Wall, Both F.V.		4	4'-1	11	4	4'-1	11	4	4'-1	11	4	4'-0	11	4c6		
4c7	Interior Wall, Both F.V.		56 Var.	2 Each 1'-10 to 7'-3	170	48 Var.	2 Each 1'-10 to 6'-3	130	40 Var.	2 Each 1'-10 to 5'-4	96	32 Var.	2 Each 1'-9 to 4'-4	65	4c7		
4c8	Interior Wall, Both F.V.		4	7'-6	20	4	6'-6	17	4	5'-6	15	4	4'-6	12	4c8		
5c9	Wingwall, B.F.V. Long		9 Var.	2'-9 to 5'-1	37	9 Var.	2'-9 to 5'-1	37	9 Var.	2'-9 to 5'-1	37	9 Var.	2'-9 to 5'-1	37	5c9		
5c10	Wingwall, B.F.V. Short		6 Var.	2'-9 to 4'-5	22	6 Var.	2'-9 to 4'-5	22	6 Var.	2'-9 to 4'-5	22	6 Var.	2'-9 to 4'-5	22	5c10		
5c11	Wingwall, B.F.V. Long		16 Var.	9'-5 to 13'-9	193	13 Var.	9'-5 to 12'-11	151	9 Var.	9'-5 to 11'-9	99	6 Var.	9'-5 to 10'-10	63	5c11		
5c12	Wingwall, B.F.V. Short		16 Var.	8'-9 to 13'-9	188	13 Var.	8'-9 to 12'-9	146	10 Var.	8'-9 to 11'-9	107	7 Var.	8'-9 to 10'-9	71	5c12		
6c13	Wingwall, B.F.V. Long		10	10'-6	158	7	10'-6	110	--	--	--	--	--	--	6c13		
6c13	Wingwall, B.F.V. Short		9	10'-6	142	6	10'-6	95	--	--	--	--	--	--	6c13		
5c14	Wingwall, B.F.V. Long		2	12'-8	26	1	11'-8	12	2	10'-8	22	1	9'-8	10	5c14		
5c14	Wingwall, B.F.V. Short		2	12'-8	26	2	11'-8	24	2	10'-8	22	2	9'-8	20	5c14		
4d1	Apron, Longit., Bott.		21	18'-6	260	21	16'-5	230	21	14'-4	201	21	12'-4	173	4d1		
4d2	Apron, Longit., Bott. Long		3	23'-1	46	3	19'-8	39	3	16'-3	33	3	12'-10	26	4d2		
4d3	Apron, Longit., Bott. Short		3	20'-5	41	3	17'-5	35	3	14'-5	29	3	11'-5	23	4d3		
6f1	Apron, Longit., Top		31	18'-6	861	31	16'-5	764	31	14'-4	667	31	12'-4	574	6f1		
6f2	Apron, Longit., Top Long		4 Var.	7'-7 to 15'-3	69	4 Var.	5'-6 to 13'-2	56	3 Var.	5'-11 to 11'-1	38	2 Var.	6'-5 to 9'-0	23	6f2		
6f3	Apron, Longit., Top Short		4 Var.	6'-7 to 15'-4	66	4 Var.	4'-5 to 13'-3	53	3 Var.	5'-3 to 11'-2	37	2 Var.	6'-2 to 9'-1	23	6f3		
6f4	Apron, Longit., Top Long		1	28'-6	43	1	25'-1	38	1	21'-8	33	1	18'-3	27	6f4		
6f5	Apron, Longit., Top Short		1	25'-4	38	1	22'-4	34	1	19'-4	29	1	16'-4	25	6f5		
4i1	Parapet, Vertical		63	6'-2	260	63	6'-2	260	63	6'-2	260	63	6'-2	260	4i1		
7j1	Parapet, Horizontal		4	33'-9	276	4	33'-9	276	4	33'-9	276	4	33'-9	276	7j1		
6m1	Apron, Trans., Top		7 Var.	34'-0 to 35'-2	364	7 Var.	34'-0 to 35'-2	364	7 Var.	34'-0 to 35'-2	364	7 Var.	34'-0 to 35'-2	364	6m1		
6m2	Apron, Trans., Top		9 Var.	35'-5 to 38'-5	499	6 Var.	35'-5 to 37'-4	328	3 Var.	35'-5 to 36'-2	161	1	35'-5	53	6m2		
6m3	Apron, Trans., Top		11 Var.	6'-1 to 32'-2	316	11 Var.	6'-2 to 32'-4	318	12 Var.	3'-8 to 32'-5	325	11 Var.	3'-9 to 29'-11	278	6m3		
6m4	Apron, Trans., Bott.		14 Var.	28'-2 to 35'-2	666	12 Var.	28'-2 to 34'-1	561	10 Var.	28'-2 to 33'-1	460	8 Var.	28'-2 to 31'-11	361	6m4		
6p1	Curtain, Horizontal		4	32'-10	197	4	32'-10	197	4	32'-10	197	4	32'-10	197	6p1		
6p2	Curtain, Horizontal, Long		4	14'-2	85	4	12'-8	76	4	11'-2	67	4	9'-8	58	6p2		
6p3	Curtain, Horizontal, Short		4	11'-3	68	4	10'-2	61	4	9'-1	55	4	7'-11	48	6p3		
6s1	Wing Slope, Both F., Long		2	6'-11	21	2	6'-11	21	2	6'-11	21	2	6'-11	21	6s1		
6s2	Wing Slope, Both F., Short		2	6'-6	20	2	6'-6	20	2	6'-6	20	2	6'-6	20	6s2		
6s3	Wing Slope, Both F., Long		2	23'-5	70	2	19'-10	60	2	16'-3	49	2	12'-8	38	6s3		
6s4	Wing Slope, Both F., Short		2	21'-1	63	2	17'-11	54	2	14'-9	44	2	11'-7	35	6s4		
6s5	Wing Slope, F.F. Long		1	28'-7	43	1	25'-0	38	1	21'-5	32	1	17'-10	27	6s5		
6s6	Wing Slope, F.F. Short		1	25'-10	39	1	22'-8	34	1	19'-6	29	1	16'-4	25	6s6		
6s7	Interior Wall, Both F.H.		4	19'-4	116	4	17'-1	103	4	14'-9	89	4	12'-6	75	6s7		
5t1	Curtain, Vertical		36	6'-8	250	34	6'-5	228	32	6'-5	214	30	6'-5	201	5t1		
Estimated Quantities One Headwall			Reinf. Steel			6706 LB			5727 LB			4700 LB			3918 LB		
			Concrete			3.2			3.2			3.2			3.2		
			Parapet Δ			3.2			7.9			5.8			3.9		
			Wingwalls			10.3			41.3			34.8			28.7		
			Apron *			35.4			30.2			25.8			21.6		



Δ Includes top of wingwall quantities.
 * Assumes apron and floor are equal thickness, adjust concrete quantities for transition where apron and floor thickness are not equal.
 Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.
 "Short" Denotes Short Wingwall
 "Long" Denotes Long Wingwall

Headwall Notes:

- See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
- This headwall is based on a 3:1 slope normal to centerline of roadway.
- The sides of the apron are to be formed to ensure correct line and grade.
- All apron reinforcing steel is to be supported by bar chairs at intervals of not more than 3'-0" in either direction as outlined in the Standard Specifications.
- Clear distance from face of concrete to near reinforcing bar is to be 2" unless otherwise noted or shown. Clearance to the bottom ends of vertical bars shall be 3 inches.
- Concrete quantities are estimated from back of parapet.
- Horizontal tails of bars "b" & "s" estimated to extend 2'-5" beyond back of parapet (into end of barrel). Longitudinal bars "d", "6f1", "6f4" and "6f5" estimated to project into end section of barrel a minimum of 2'-5" beyond back of parapet. The "length" column reflects total number of feet necessary to meet these requirements.
- Dimensions are in feet and inches unless otherwise noted.

IOWADOT Highway Division

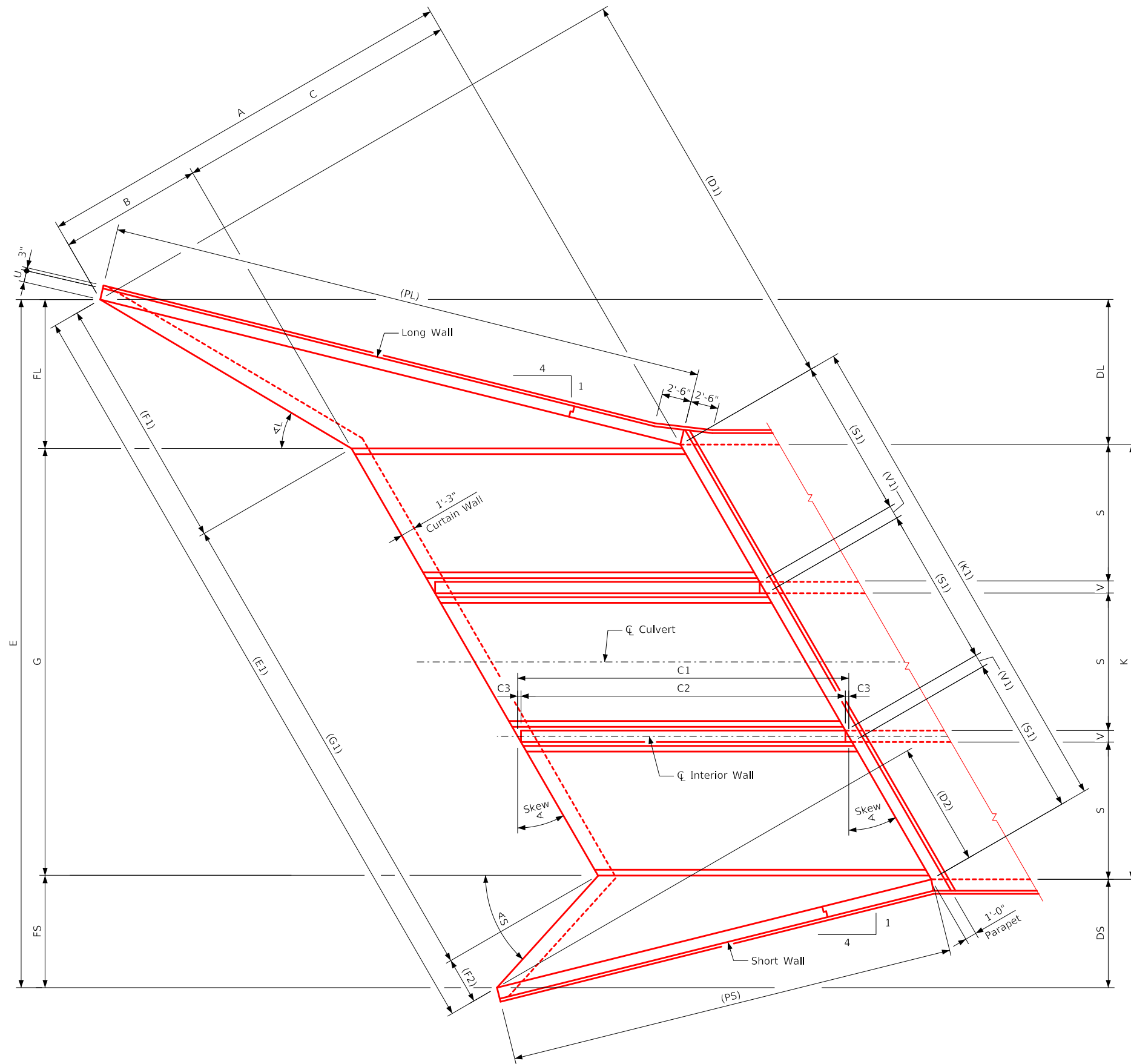
Standard Design - Triple Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation 10'-0" Span 15° Skew	TRFWH 15-8-21 Sheet 2 of 2
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Plan View

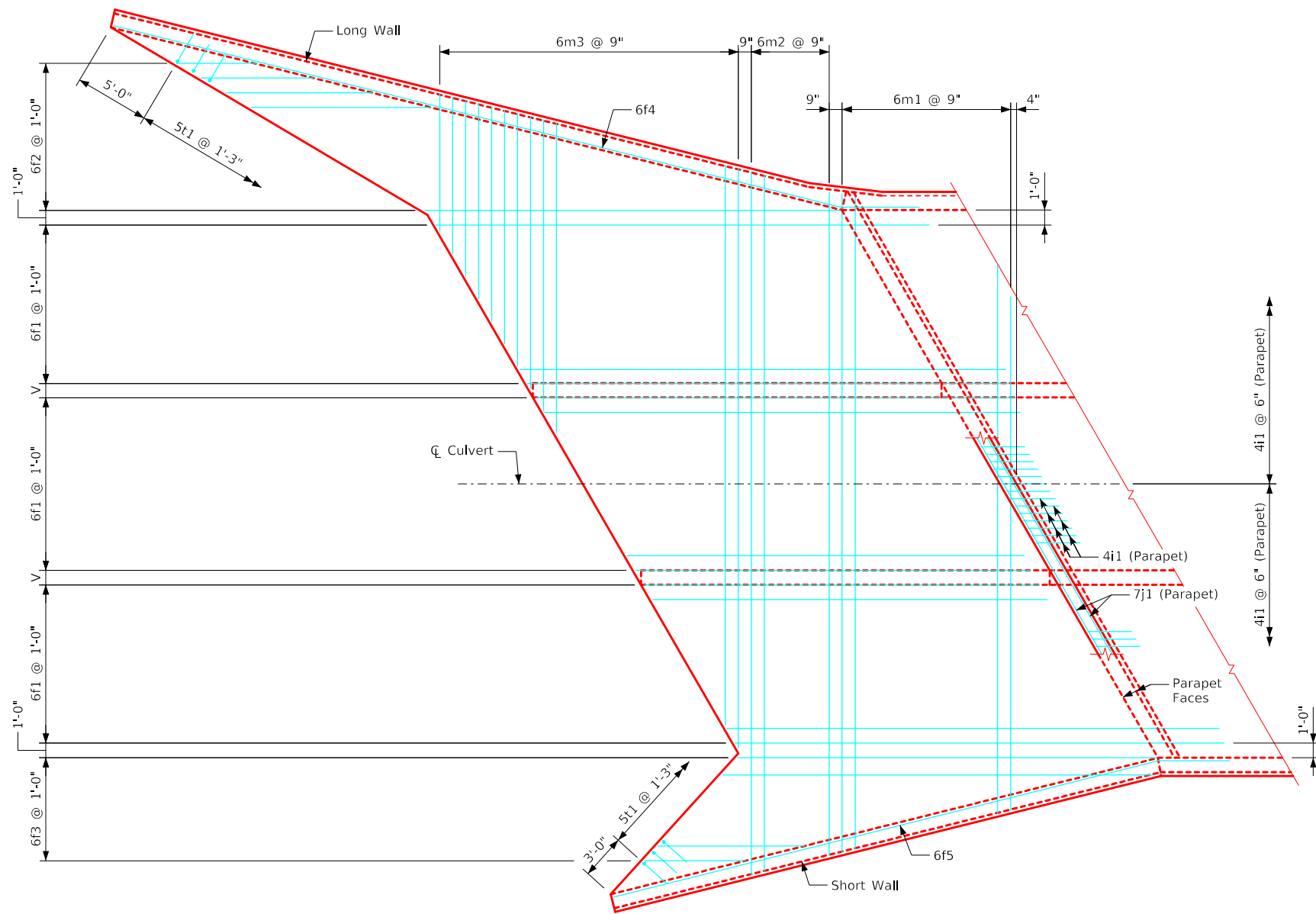
Notes:

1. See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. See Sheet TRFWH 30-2-21 for dimensions table.
3. See Sheet TRFWH 30-5-21 for Angle L & Angle S.

LATEST REVISION DATE	 APPROVED BY BRIDGE ENGINEER	 Standard Design - Triple Reinforced Concrete Box Culverts	
		Flared Wing Headwalls February, 2021	
		Dimension Plan 30° Skew	TRFWH 30-1-21

Dimension Table																				
S x H	12' x 12'	12' x 11'	12' x 10'	12' x 9'	12' x 8'	12' x 7'	12' x 6'	12' x 5'	12' x 4'	10' x 12'	10' x 11'	10' x 10'	10' x 9'	10' x 8'	10' x 7'	10' x 6'	10' x 5'	10' x 4'	S x H	
A	37'-0	34'-0	31'-0	28'-0	25'-0	22'-0	19'-0	16'-0	13'-0	37'-0	34'-0	31'-0	28'-0	25'-0	22'-0	19'-0	16'-0	13'-0	A	
B	12'-4	11'-4	10'-4	9'-4	8'-4	7'-4	6'-4	5'-4	4'-4	12'-4	11'-4	10'-4	9'-4	8'-4	7'-4	6'-4	5'-4	4'-4	B	
C	24'-8	22'-8	20'-8	18'-8	16'-8	14'-8	12'-8	10'-8	8'-8	24'-8	22'-8	20'-8	18'-8	16'-8	14'-8	12'-8	10'-8	8'-8	C	
C1	28'-5 ³ / ₄	26'-2 ¹ / ₂	23'-10 ³ / ₈	21'-6 ⁵ / ₈	19'-3	16'-11 ¹ / ₄	14'-7 ¹ / ₂	12'-3 ³ / ₄	10'-0 ¹ / ₂	28'-5 ³ / ₄	26'-2 ¹ / ₂	23'-10 ³ / ₈	21'-6 ⁵ / ₈	19'-3	16'-11 ¹ / ₄	14'-7 ¹ / ₂	12'-3 ³ / ₄	10'-0 ¹ / ₂	C1	
C2	27'-10 ¹ / ₈	25'-7 ³ / ₄	23'-4 ³ / ₈	21'-0 ¹ / ₈	18'-9 ¹ / ₈	16'-6	14'-2 ³ / ₈	11'-10 ¹ / ₈	9'-6 ¹ / ₈	27'-10 ¹ / ₈	25'-7 ³ / ₄	23'-4 ³ / ₈	21'-0 ¹ / ₈	18'-9 ¹ / ₈	16'-6	14'-2 ³ / ₈	11'-10 ¹ / ₈	9'-6 ¹ / ₈	C2	
C3	3 ¹ / ₂	3 ¹ / ₈	2 ¹ / ₈	2 ¹ / ₈	2 ¹ / ₈	2 ¹ / ₈	2 ¹ / ₈	2 ¹ / ₈	2 ¹ / ₈	3 ¹ / ₂	3 ¹ / ₈	2 ¹ / ₈	2 ¹ / ₈	2 ¹ / ₈	2 ¹ / ₈	2 ¹ / ₈	2 ¹ / ₈	2 ¹ / ₈	C3	
DL	12'-5 ³ / ₄	11'-5 ³ / ₈	10'-5 ¹ / ₂	9'-5 ³ / ₈	8'-5 ³ / ₄	7'-5 ¹ / ₈	6'-4 ⁷ / ₈	5'-4 ³ / ₄	4'-4 ³ / ₈	12'-5 ³ / ₄	11'-5 ³ / ₈	10'-5 ¹ / ₂	9'-5 ³ / ₈	8'-5 ³ / ₄	7'-5 ¹ / ₈	6'-4 ⁷ / ₈	5'-4 ³ / ₄	4'-4 ³ / ₈	DL	
DS	9'-4	8'-6 ¹ / ₈	7'-9 ¹ / ₈	7'-0 ³ / ₄	6'-3 ³ / ₈	5'-6 ¹ / ₈	4'-9 ¹ / ₂	4'-0 ³ / ₈	3'-3 ³ / ₈	9'-4	8'-6 ¹ / ₈	7'-9 ¹ / ₈	7'-0 ³ / ₄	6'-3 ³ / ₈	5'-6 ¹ / ₈	4'-9 ¹ / ₂	4'-0 ³ / ₈	3'-3 ³ / ₈	DS	
D1	35'-9 ¹ / ₄	32'-10 ¹ / ₂	29'-11 ³ / ₄	27'-0 ¹ / ₂	24'-2 ¹ / ₂	21'-3 ³ / ₄	18'-4 ¹ / ₂	15'-5 ¹ / ₂	12'-6 ¹ / ₂	35'-9 ¹ / ₄	32'-10 ¹ / ₂	29'-11 ³ / ₄	27'-0 ¹ / ₂	24'-2 ¹ / ₂	21'-3 ³ / ₄	18'-4 ¹ / ₂	15'-5 ¹ / ₂	12'-6 ¹ / ₂	D1	
D2	10'-7	9'-8 ³ / ₄	8'-10 ³ / ₈	8'-0 ¹ / ₂	7'-1 ¹ / ₂	6'-3 ¹ / ₂	5'-5 ¹ / ₄	4'-6 ¹ / ₂	3'-8 ¹ / ₂	10'-7	9'-8 ³ / ₄	8'-10 ³ / ₈	8'-0 ¹ / ₂	7'-1 ¹ / ₂	6'-3 ¹ / ₂	5'-5 ¹ / ₄	4'-6 ¹ / ₂	3'-8 ¹ / ₂	D2	
E	59'-9 ³ / ₄	57'-10 ¹ / ₈	55'-11 ³ / ₈	54'-2 ¹ / ₂	52'-4 ⁷ / ₈	50'-5 ¹ / ₂	48'-8 ³ / ₈	46'-11 ¹ / ₄	45'-2	53'-9 ³ / ₄	51'-10 ¹ / ₈	49'-11 ³ / ₈	48'-2 ¹ / ₂	46'-4 ⁷ / ₈	44'-5 ¹ / ₂	42'-8 ³ / ₈	40'-11 ¹ / ₄	39'-2	E	
E1	69'-0 ¹ / ₈	66'-10	64'-7 ³ / ₄	62'-6 ³ / ₄	60'-6 ¹ / ₂	58'-3 ³ / ₈	56'-2 ¹ / ₂	54'-2 ¹ / ₂	52'-1 ¹ / ₂	62'-1 ¹ / ₄	59'-10 ¹ / ₈	57'-8 ¹ / ₂	55'-7 ¹ / ₂	53'-7	51'-4 ³ / ₄	49'-3 ³ / ₄	47'-3 ³ / ₄	45'-2 ³ / ₄	E1	
FL	12'-9 ³ / ₄	11'-9 ¹ / ₈	10'-9 ¹ / ₂	9'-9 ¹ / ₈	8'-9 ¹ / ₄	7'-9 ¹ / ₈	6'-8 ¹ / ₂	5'-8 ³ / ₄	4'-8 ¹ / ₂	12'-9 ³ / ₄	11'-9 ¹ / ₈	10'-9 ¹ / ₂	9'-9 ¹ / ₈	8'-9 ¹ / ₄	7'-9 ¹ / ₈	6'-8 ¹ / ₂	5'-8 ³ / ₄	4'-8 ¹ / ₂	FL	
FS	9'-8	8'-10 ¹ / ₈	8'-1 ¹ / ₈	7'-4 ³ / ₄	6'-7 ³ / ₈	5'-10 ¹ / ₈	5'-1 ¹ / ₂	4'-4 ³ / ₄	3'-7 ³ / ₈	9'-8	8'-10 ¹ / ₈	8'-1 ¹ / ₈	7'-4 ³ / ₄	6'-7 ³ / ₈	5'-10 ¹ / ₈	5'-1 ¹ / ₂	4'-4 ³ / ₄	3'-7 ³ / ₈	FS	
F1	21'-11	20'-2 ¹ / ₂	18'-5 ¹ / ₈	16'-8 ¹ / ₈	14'-11 ¹ / ₄	13'-2 ¹ / ₄	11'-5 ³ / ₈	9'-8 ³ / ₈	7'-11 ³ / ₈	21'-11	20'-2 ¹ / ₂	18'-5 ¹ / ₈	16'-8 ¹ / ₈	14'-11 ¹ / ₄	13'-2 ¹ / ₄	11'-5 ³ / ₈	9'-8 ³ / ₈	7'-11 ³ / ₈	F1	
F2	4'-0 ¹ / ₂	3'-9	3'-5 ³ / ₈	3'-1 ¹ / ₈	2'-10 ¹ / ₄	2'-6 ³ / ₄	2'-3 ³ / ₈	1'-11 ¹ / ₈	1'-8	4'-0 ¹ / ₂	3'-9	3'-5 ³ / ₈	3'-1 ¹ / ₈	2'-10 ¹ / ₄	2'-6 ³ / ₄	2'-3 ³ / ₈	1'-11 ¹ / ₈	1'-8	F2	
G	37'-4	37'-2	37'-0	37'-0	37'-0	36'-10	36'-10	36'-10	36'-10	31'-4	31'-2	31'-0	31'-0	31'-0	30'-10	30'-10	30'-10	30'-10	G	
G1	43'-1 ¹ / ₄	42'-11	42'-8 ¹ / ₂	42'-8 ¹ / ₂	42'-8 ¹ / ₂	42'-6 ³ / ₈	42'-6 ³ / ₈	42'-6 ³ / ₈	42'-6 ³ / ₈	36'-2 ¹ / ₂	35'-11 ¹ / ₂	35'-9 ¹ / ₂	35'-9 ¹ / ₂	35'-9 ¹ / ₂	35'-7 ¹ / ₄	35'-7 ¹ / ₄	35'-7 ¹ / ₄	35'-7 ¹ / ₄	G1	
G2	44'-4 ¹ / ₂	44'-1 ³ / ₄	43'-11 ³ / ₈	43'-11 ³ / ₈	43'-11 ¹ / ₄	43'-8 ¹ / ₂	43'-8 ¹ / ₂	43'-8 ¹ / ₂	43'-8 ¹ / ₂	37'-5	37'-2 ¹ / ₂	37'-0 ¹ / ₄	37'-0 ¹ / ₄	37'-0 ¹ / ₄	36'-9 ³ / ₄	36'-9 ³ / ₄	36'-9 ³ / ₄	36'-9 ³ / ₄	G2	
G3	25'-1 ³ / ₄	23'-1 ¹ / ₂	21'-1 ¹ / ₂	19'-1 ¹ / ₂	17'-1 ¹ / ₄	15'-1 ¹ / ₂	13'-1	11'-0 ³ / ₄	9'-0 ³ / ₄	25'-1 ³ / ₄	23'-1 ¹ / ₂	21'-1 ¹ / ₂	19'-1 ¹ / ₂	17'-1 ¹ / ₄	15'-1 ¹ / ₂	13'-1	11'-0 ³ / ₄	9'-0 ³ / ₄	G3	
G4	25'-7 ¹ / ₈	23'-4 ¹ / ₄	21'-0 ¹ / ₈	19'-0 ¹ / ₂	17'-0 ³ / ₈	14'-8 ¹ / ₈	12'-8 ³ / ₄	10'-8 ³ / ₄	8'-8 ³ / ₄	25'-7 ¹ / ₈	23'-4 ¹ / ₄	21'-0 ¹ / ₈	19'-0 ¹ / ₂	17'-0 ³ / ₈	14'-8 ¹ / ₈	12'-8 ³ / ₄	10'-8 ³ / ₄	8'-8 ³ / ₄	G4	
G5	12'-11 ³ / ₄	11'-11 ¹ / ₄	10'-10 ³ / ₄	9'-10 ³ / ₄	8'-9 ³ / ₄	7'-9 ³ / ₄	6'-8 ³ / ₄	5'-8 ³ / ₄	4'-7 ³ / ₄	12'-11 ³ / ₄	11'-11 ¹ / ₄	10'-10 ³ / ₄	9'-10 ³ / ₄	8'-9 ³ / ₄	7'-9 ³ / ₄	6'-8 ³ / ₄	5'-8 ³ / ₄	4'-7 ³ / ₄	G5	
G6	14'-3 ¹ / ₄	13'-0 ¹ / ₂	11'-10 ¹ / ₈	10'-10 ¹ / ₈	9'-9 ¹ / ₈	8'-7 ¹ / ₂	7'-7	6'-6 ¹ / ₂	5'-6 ¹ / ₂	14'-3 ¹ / ₄	13'-0 ¹ / ₂	11'-10 ¹ / ₈	10'-10 ¹ / ₈	9'-9 ¹ / ₈	8'-7 ¹ / ₂	7'-7	6'-6 ¹ / ₂	5'-6 ¹ / ₂	G6	
G7	2 ¹ / ₄	5 ¹ / ₂	8 ¹ / ₂	8 ¹ / ₂	8 ¹ / ₂	9	9	9	9	2 ¹ / ₄	5 ¹ / ₂	8 ¹ / ₂	8 ¹ / ₂	8 ¹ / ₂	9	9	9	9	G7	
G8	4 ¹ / ₈	6 ¹ / ₈	7 ¹ / ₈	7 ¹ / ₈	7 ¹ / ₈	9	9	9	9	4 ¹ / ₈	6 ¹ / ₈	7 ¹ / ₈	7 ¹ / ₈	7 ¹ / ₈	9	9	9	9	G8	
K	38'-0	37'-10	37'-8	37'-8	37'-8	37'-6	37'-6	37'-6	37'-6	32'-0	31'-10	31'-8	31'-8	31'-8	31'-6	31'-6	31'-6	31'-6	K	
K1	43'-10 ¹ / ₂	43'-8 ¹ / ₄	43'-5 ¹ / ₂	43'-5 ¹ / ₂	43'-5 ¹ / ₂	43'-3 ¹ / ₂	43'-3 ¹ / ₂	43'-3 ¹ / ₂	43'-3 ¹ / ₂	36'-11 ¹ / ₂	36'-9 ¹ / ₂	36'-6 ¹ / ₂	36'-6 ¹ / ₂	36'-6 ¹ / ₂	36'-4 ¹ / ₂	36'-4 ¹ / ₂	36'-4 ¹ / ₂	36'-4 ¹ / ₂	K1	
PL	51'-5 ¹ / ₈	47'-3 ¹ / ₂	43'-1 ¹ / ₂	38'-11 ¹ / ₈	34'-9 ¹ / ₄	30'-7 ¹ / ₄	26'-5 ¹ / ₂	22'-3 ¹ / ₂	18'-1	51'-5 ¹ / ₈	47'-3 ¹ / ₂	43'-1 ¹ / ₂	38'-11 ¹ / ₈	34'-9 ¹ / ₄	30'-7 ¹ / ₄	26'-5 ¹ / ₂	22'-3 ¹ / ₂	18'-1	PL	
PS	38'-5 ³ / ₄	35'-4 ³ / ₈	32'-2 ¹ / ₈	29'-1 ¹ / ₂	26'-0	22'-10 ¹ / ₈	19'-9 ¹ / ₈	16'-7 ³ / ₄	13'-6 ¹ / ₄	38'-5 ³ / ₄	35'-4 ³ / ₈	32'-2 ¹ / ₈	29'-1 ¹ / ₂	26'-0	22'-10 ¹ / ₈	19'-9 ¹ / ₈	16'-7 ³ / ₄	13'-6 ¹ / ₄	PS	
RL	52'-11 ¹ / ₈	48'-7 ¹ / ₂	44'-4 ¹ / ₂	40'-0 ¹ / ₂	35'-9 ¹ / ₈	31'-5 ¹ / ₂	27'-2 ¹ / ₂	22'-10 ¹ / ₈	18'-7 ¹ / ₂	52'-11 ¹ / ₈	48'-7 ¹ / ₂	44'-4 ¹ / ₂	40'-0 ¹ / ₂	35'-9 ¹ / ₈	31'-5 ¹ / ₂	27'-2 ¹ / ₂	22'-10 ¹ / ₈	18'-7 ¹ / ₂	RL	
RS	40'-5	37'-1 ¹ / ₂	33'-10 ¹ / ₄	30'-7	27'-3 ¹ / ₂	24'-0 ¹ / ₂	20'-9	17'-5 ¹ / ₄	14'-2 ¹ / ₂	40'-5	37'-1 ¹ / ₂	33'-10 ¹ / ₄	30'-7	27'-3 ¹ / ₂	24'-0 ¹ / ₂	20'-9	17'-5 ¹ / ₄	14'-2 ¹ / ₂	RS	
R1	30'-0	27'-6 ¹ / ₄	25'-0 ¹ / ₂	22'-6 ¹ / ₂	20'-0 ¹ / ₂	17'-6 ¹ / ₄	15'-0 ¹ / ₂	12'-6 ¹ / ₂	10'-0 ¹ / ₂	30'-0	27'-6 ¹ / ₄	25'-0 ¹ / ₂	22'-6 ¹ / ₂	20'-0 ¹ / ₂	17'-6 ¹ / ₄	15'-0 ¹ / ₂	12'-6 ¹ / ₂	10'-0 ¹ / ₂	R1	
S1	13'-10 ¹ / ₄	13'-10 ¹ / ₄	13'-10 ¹ / ₄	13'-10 ¹ / ₄	13'-10 ¹ / ₄	13'-10 ¹ / ₄	13'-10 ¹ / ₄	13'-10 ¹ / ₄	13'-10 ¹ / ₄	11'-6 ¹ / ₂	11'-6 ¹ / ₂	11'-6 ¹ / ₂	11'-6 ¹ / ₂	11'-6 ¹ / ₂	11'-6 ¹ / ₂	11'-6 ¹ / ₂	11'-6 ¹ / ₂	11'-6 ¹ / ₂	S1	
T	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-1	1'-1	1'-1	1'-1	1'-1	1'-1	1'-1	1'-1	1'-1	T	
U	1'-0	11	10	10	10	9	9	9	9	1'-0	11	10	10	10	9	9	9	9	U	
V	1'-0	11	10	10	10	9	9	9	9	1'-0	11	10	10	10	9	9	9	9	V	
V1	1'-1 ¹ / ₈	1'-0 ³ / ₄	11 ¹ / ₂	11 ¹ / ₂	11 ¹ / ₂	10 ³ / ₈	10 ³ / ₈	10 ³ / ₈	10 ³ / ₈	1'-1 ¹ / ₈	1'-0 ³ / ₄	11 ¹ / ₂	11 ¹ / ₂	11 ¹ / ₂	10 ³ / ₈	10 ³ / ₈	10 ³ / ₈	10 ³ / ₈	V1	
W	5'-0	4'-9	4'-6	4'-3	4'-0	3'-9	3'-6	3'-6	3'-6	5'-0	4'-9	4'-6								

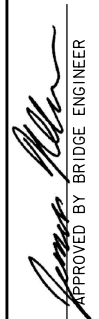

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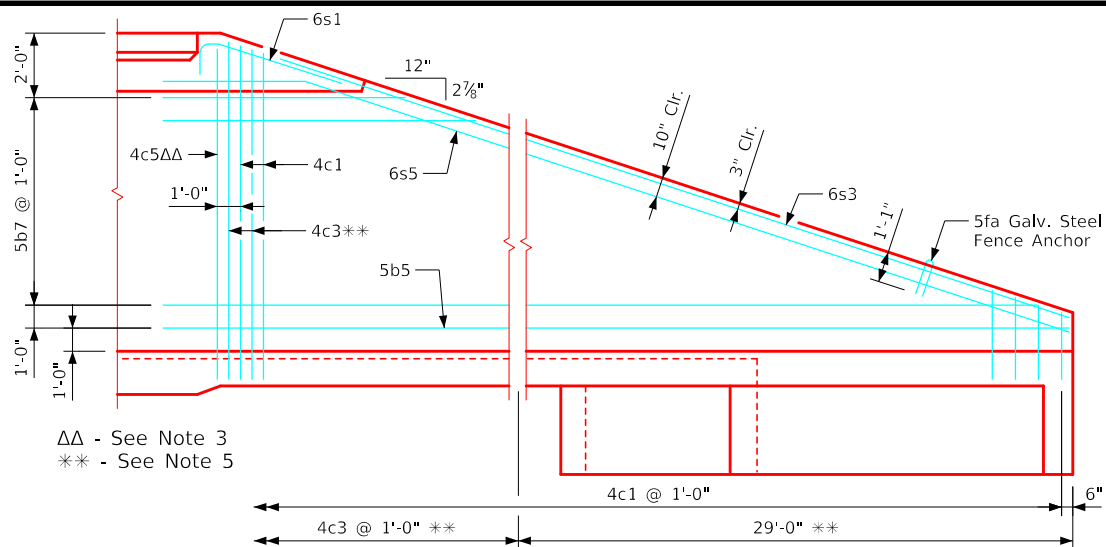


Plan View - Top of Apron Reinforcing

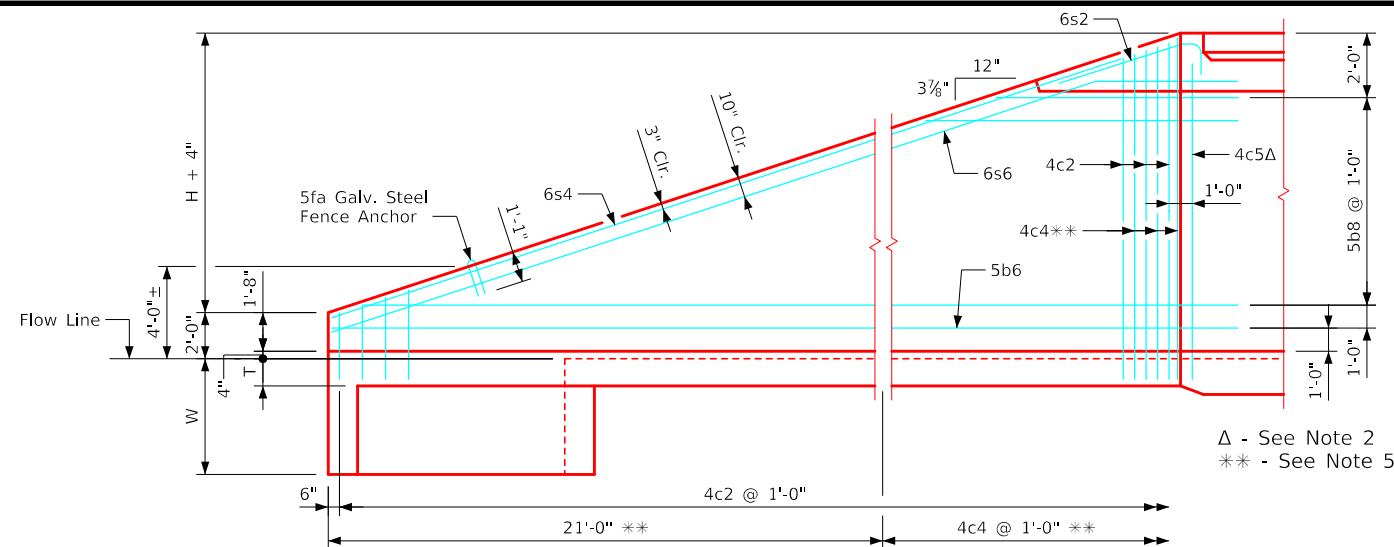
Notes:

1. Bar spacings and positions shown are similar for all sizes of headwalls in this standard.
2. Top transverse floor bars are referenced approximately 4" from the back of the parapet for all headwalls.
3. For dimension table see Sheet TRFWH 30-2-21.
4. For reinforcing in curtain wall see Curtain Wall Details on Sheet TRFWH 30-5-21.

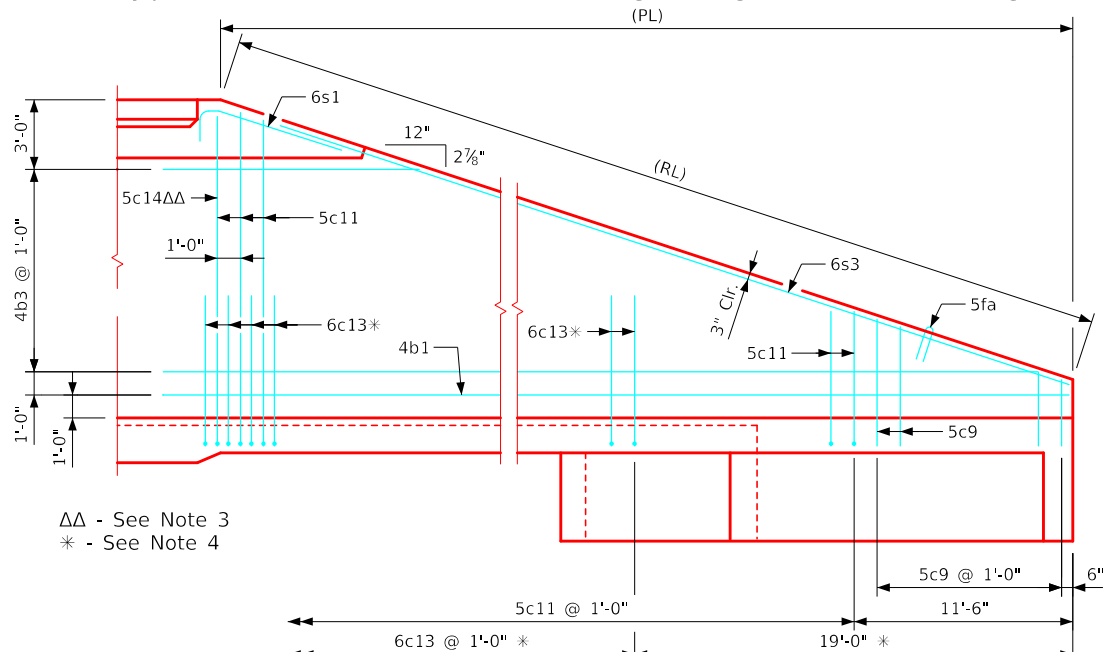
LATEST REVISION DATE	 APPROVED BY BRIDGE ENGINEER	 Standard Design - Triple Reinforced Concrete Box Culverts	
		Flared Wing Headwalls February, 2021	
		Top Apron Detail 30° Skew	TRFWH 30-3-21



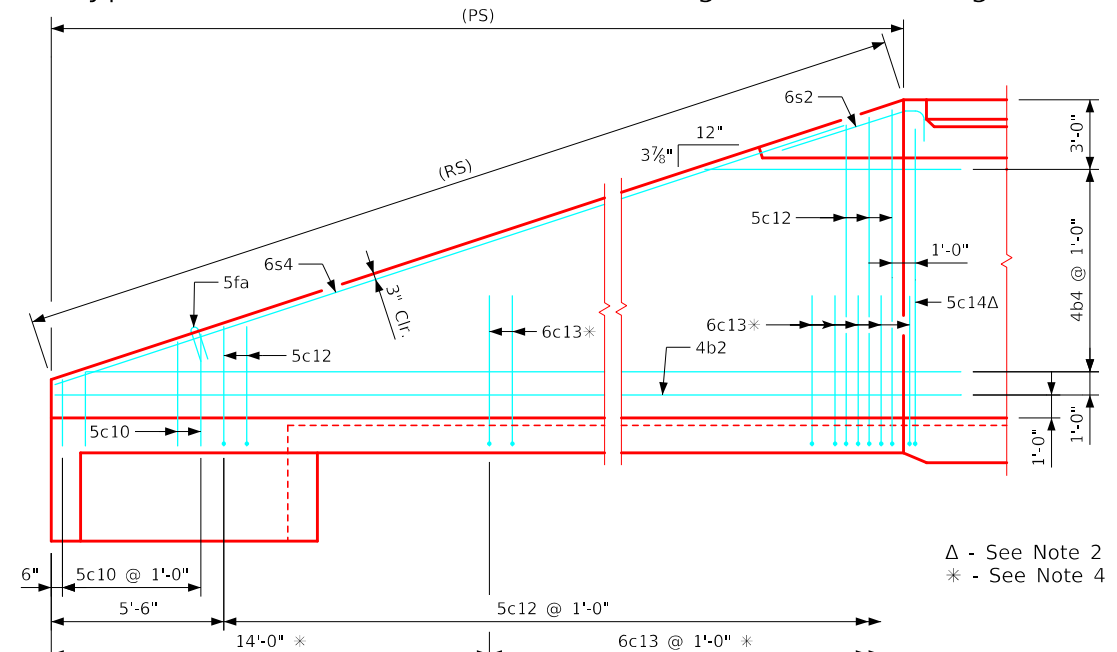
Typical View - Front Face Long Wingwall Reinforcing



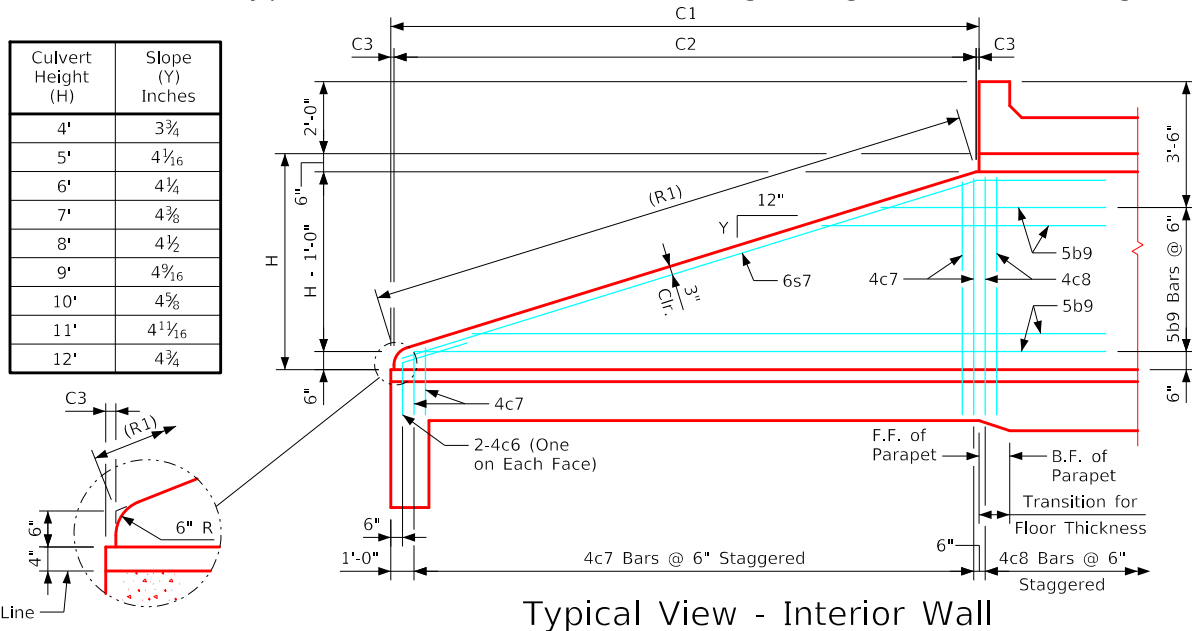
Typical View - Front Face Short Wingwall Reinforcing



Typical View - Back Face Long Wingwall Reinforcing



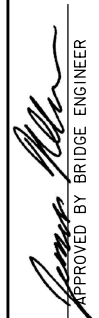

Typical View - Back Face Short Wingwall Reinforcing



Typical View - Interior Wall

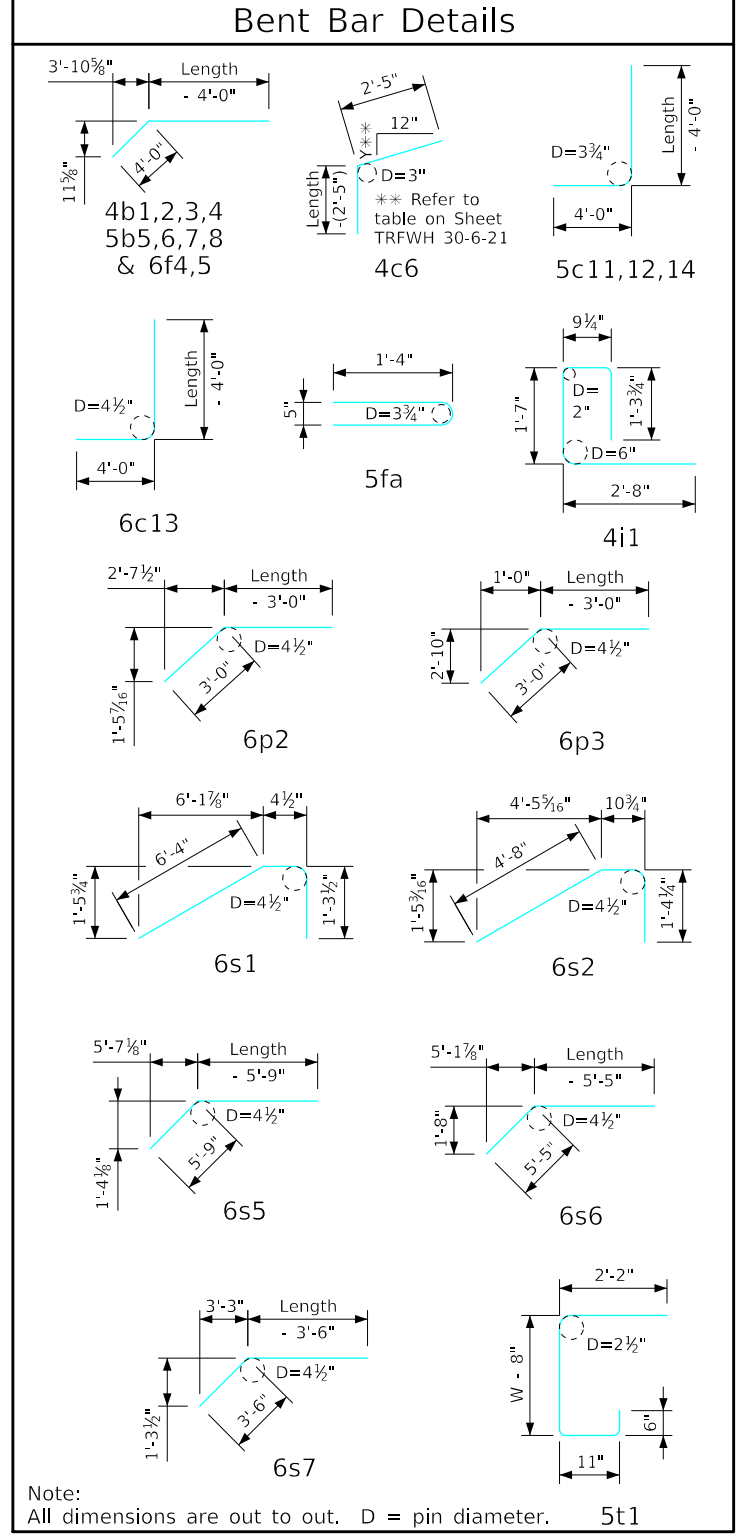
Notes:

1. Bar spacings and positions shown are similar for all sizes of headwalls in this standard.
2. Two 4c5 & two 5c14 bars for 8', 9', 10', 11' & 12' height headwalls. One 4c5 & one 5c14 bar for 4', 5', 6' & 7' height headwalls.
3. Two 4c5 & two 5c14 for 4', 5', 6', 10', 11' & 12' height headwalls. One 4c5 & one 5c14 bar for 7', 8' & 9' height headwalls.
4. Not applicable for 4' & 5' height headwalls.
5. Not applicable for 4' thru 8' height headwalls.
6. For dimension table, see sheet TRFWH 30-2-21.
7. Top of wall slope may be rounded in some instances.

LATEST REVISION DATE	 APPROVED BY BRIDGE ENGINEER	 Standard Design - Triple Reinforced Concrete Box Culverts	
		Flared Wing Headwalls February, 2021	
Wingwall Details 30° Skew		TRFWH 30-6-21	

Bill of Reinforcing for One Headwall 30° Skew Span x Culvert Height

Bar	Location	Shape	10' x 12'			10' x 11'			10' x 10'			10' x 9'			10' x 8'			Bar		
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.			
5fa	Fence Anchor (Galv.)		2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	5fa		
4b1	Wingwall, B.F.H. Long		1	55'-2	38	1	51'-0	36	1	46'-10	33	1	42'-8	30	1	38'-6	26	4b1		
4b2	Wingwall, B.F.H. Short		1	42'-2	30	1	39'-1	26	1	36'-0	24	1	32'-10	22	1	29'-9	20	4b2		
4b3	Wingwall, B.F.H. Long		10 Var.	15'-8 to 53'-3	237	9 Var.	15'-8 to 49'-1	199	8 Var.	15'-8 to 44'-11	165	7 Var.	15'-8 to 40'-9	134	6 Var.	15'-8 to 36'-7	105	4b3		
4b4	Wingwall, B.F.H. Short		10 Var.	12'-11 to 40'-9	181	9 Var.	12'-11 to 37'-8	152	8 Var.	12'-11 to 34'-7	127	7 Var.	12'-10 to 31'-5	103	6 Var.	12'-10 to 28'-4	82	4b4		
5b5	Wingwall, F.F.H. Long		1	55'-3	60	1	51'-1	56	1	46'-11	51	1	42'-9	47	1	38'-7	40	5b5		
5b6	Wingwall, F.F.H. Short		1	42'-3	46	1	39'-2	41	1	36'-0	38	1	32'-11	34	1	29'-9	31	5b6		
5b7	Wingwall, F.F.H. Long		11 Var.	11'-7 to 53'-4	382	10 Var.	11'-7 to 49'-1	324	9 Var.	11'-7 to 44'-11	270	8 Var.	11'-7 to 40'-9	221	7 Var.	11'-7 to 36'-7	176	5b7		
5b8	Wingwall, F.F.H. Short		11 Var.	9'-10 to 40'-10	293	10 Var.	9'-10 to 37'-9	248	9 Var.	9'-10 to 34'-7	208	8 Var.	9'-10 to 31'-6	172	7 Var.	9'-9 to 28'-4	139	5b8		
5b9	Interior Wall, Both F.H.		42 Var.	2 Each 6'-0 to 31'-4	818	38 Var.	2 Each 6'-0 to 29'-1	695	34 Var.	2 Each 6'-0 to 26'-9	581	30 Var.	2 Each 6'-0 to 24'-5	476	26 Var.	2 Each 6'-1 to 22'-2	383	5b9		
4c1	Wingwall, F.F.V. Long		51 Var.	2'-9 to 14'-9	298	47 Var.	2'-9 to 13'-9	259	43 Var.	2'-9 to 12'-10	224	39 Var.	2'-9 to 11'-10	190	35 Var.	2'-9 to 10'-11	160	4c1		
4c2	Wingwall, F.F.V. Short		38 Var.	2'-9 to 14'-8	221	35 Var.	2'-9 to 13'-8	192	32 Var.	2'-9 to 12'-9	166	29 Var.	2'-9 to 11'-9	140	26 Var.	2'-9 to 10'-9	117	4c2		
4c3	Wingwall, F.F.V. Long		23 Var.	9'-7 to 14'-10	188	19 Var.	9'-7 to 13'-11	149	15 Var.	9'-7 to 12'-11	113	11 Var.	9'-7 to 12'-0	79	--	--	--	4c3		
4c4	Wingwall, F.F.V. Short		18 Var.	9'-4 to 14'-10	145	15 Var.	9'-4 to 13'-10	116	12 Var.	9'-4 to 12'-10	89	9 Var.	9'-4 to 11'-11	64	--	--	--	4c4		
4c5	Wingwall, F.F.V. Long		2	13'-8	18	2	12'-8	17	2	11'-8	16	1	10'-8	7	1	9'-8	6	4c5		
4c5	Wingwall, F.F.V. Short		2	13'-8	18	2	12'-8	17	2	11'-8	16	2	10'-8	14	2	9'-8	13	4c5		
4c6	Interior Wall, Both F.V.		4	4'-1	11	4	4'-1	11	4	4'-1	11	4	4'-1	11	4	4'-1	11	4c6		
4c7	Interior Wall, Both F.V.		108 Var.	2 Each 1'-10 to 12'-3	508	100 Var.	2 Each 1'-10 to 11'-5	443	90 Var.	2 Each 1'-10 to 10'-4	366	82 Var.	2 Each 1'-10 to 9'-5	308	72 Var.	2 Each 1'-10 to 8'-4	244	4c7		
4c8	Interior Wall, Both F.V.		4	12'-6	33	4	11'-6	31	4	10'-6	28	4	9'-6	25	4	8'-6	23	4c8		
5c9	Wingwall, B.F.V. Long		11 Var.	2'-9 to 5'-2	45	11 Var.	2'-9 to 5'-2	45	11 Var.	2'-9 to 5'-2	45	11 Var.	2'-9 to 5'-2	45	11 Var.	2'-9 to 5'-2	45	5c9		
5c10	Wingwall, B.F.V. Short		5 Var.	2'-9 to 4'-1	18	5 Var.	2'-9 to 4'-1	18	5 Var.	2'-9 to 4'-1	18	5 Var.	2'-9 to 4'-1	18	5 Var.	2'-9 to 4'-1	18	5c10		
5c11	Wingwall, B.F.V. Long		40 Var.	9'-5 to 18'-9	588	36 Var.	9'-5 to 17'-9	510	32 Var.	9'-5 to 16'-10	438	28 Var.	9'-5 to 15'-10	369	24 Var.	9'-5 to 14'-11	305	5c11		
5c12	Wingwall, B.F.V. Short		33 Var.	8'-5 to 18'-8	466	30 Var.	8'-5 to 17'-8	408	27 Var.	8'-5 to 16'-9	354	24 Var.	8'-5 to 15'-9	302	21 Var.	8'-5 to 14'-9	254	5c12		
6c13	Wingwall, B.F.V. Long		33	10'-6	520	29	10'-6	457	25	10'-6	394	21	10'-6	331	17	10'-6	268	6c13		
6c13	Wingwall, B.F.V. Short		25	10'-6	394	22	10'-6	347	19	10'-6	300	16	10'-6	252	13	10'-6	205	6c13		
5c14	Wingwall, B.F.V. Long		2	17'-8	37	2	16'-8	35	2	15'-8	33	1	14'-8	15	1	13'-8	14	5c14		
5c14	Wingwall, B.F.V. Short		2	17'-8	37	2	16'-8	35	2	15'-8	33	2	14'-8	31	2	13'-8	29	5c14		
4d1	Apron, Longit., Bott.		21	31'-11	448	21	29'-7	415	21	27'-3	382	21	25'-0	351	21	22'-8	318	4d1		
4d2	Apron, Longit., Bott. Long		3	48'-9	102	3	44'-7	94	3	40'-5	86	3	36'-3	73	3	32'-1	64	4d2		
4d3	Apron, Longit., Bott. Short		3	37'-3	75	3	34'-2	68	3	31'-0	62	3	27'-11	56	3	24'-9	50	4d3		
6f1	Apron, Longit., Top		31	31'-11	1486	31	29'-7	1377	31	27'-3	1269	31	25'-0	1164	31	22'-8	1055	6f1		
6f2	Apron, Longit., Top Long		11 Var.	5'-4 to 28'-6	279	10 Var.	5'-4 to 26'-2	237	9 Var.	5'-4 to 23'-10	197	8 Var.	5'-4 to 21'-7	162	7 Var.	5'-3 to 19'-3	129	6f2		
6f3	Apron, Longit., Top Short		8 Var.	7'-0 to 28'-8	214	7 Var.	7'-9 to 26'-5	180	7 Var.	5'-5 to 24'-1	155	6 Var.	6'-2 to 21'-9	126	5 Var.	6'-11 to 19'-6	99	6f3		
6f4	Apron, Longit., Top Long		1	55'-3	86	1	51'-1	80	1	46'-11	74	1	42'-9	68	1	38'-7	58	6f4		
6f5	Apron, Longit., Top Short		1	42'-3	67	1	39'-2	59	1	36'-0	54	1	32'-11	49	1	29'-9	45	6f5		
4i1	Parapet, Vertical		65	6'-4	275	63	6'-4	267	63	6'-4	267	63	6'-4	267	63	6'-4	267	4i1		
7j1	Parapet, Horizontal		4	38'-10	318	4	38'-5	314	4	38'-1	311	4	38'-1	311	4	38'-1	311	7j1		
6m1	Apron, Trans., Top		14 Var.	36'-3 to 38'-8	788	14 Var.	35'-11 to 38'-4	781	14 Var.	35'-7 to 38'-0	774	13 Var.	35'-7 to 37'-10	717	14 Var.	35'-7 to 38'-0	774	6m1		
6m2	Apron, Trans., Top		13 Var.	39'-0 to 43'-6	842	10 Var.	38'-8 to 42'-1	628	7 Var.	38'-4 to 40'-7	422	5 Var.	38'-0 to 39'-6	291	1	38'-4	58	6m2		
6m3	Apron, Trans., Top		25 Var.	8'-4 to 35'-0	814	24 Var.	8'-7 to 34'-2	771	24 Var.	7'-9 to 33'-4	740	24 Var.	7'-1 to 32'-8	716	24 Var.	6'-5 to 32'-0	692	6m3		
6m4	Apron, Trans., Bott.		24 Var.	31'-11 to 47'-7	1476	22 Var.	31'-9 to 46'-0	1317	20 Var.	31'-7 to 44'-6	1168	18 Var.	31'-7 to 43'-1	1027	16 Var.	31'-7 to 41'-9	892	6m4		
6p1	Curtain, Horizontal		4	37'-2	223	4	36'-11	222	4	36'-9	221	4	36'-9	221	4	36'-9	221	6p1		
6p2	Curtain, Horizontal, Long		4	28'-0	168	4	26'-0	156	4	24'-0	144	4	22'-0	132	4	20'-0	120	6p2		
6p3	Curtain, Horizontal, Short		4	15'-11	96	4	14'-11	90	4	13'-10	83	4	12'-10	77	4	11'-9	71	6p3		
6s1	Wing Slope, Both F., Long		2	8'-0	24	2	8'-0	24	2	8'-0	24	2	8'-0	24	2	8'-0	24	6s1		
6s2	Wing Slope, Both F., Short		2	6'-11	21	2	6'-11	21	2	6'-11	21	2	6'-11	21	2	6'-11	21	6s2		
6s3	Wing Slope, Both F., Long		2	48'-11	154	2	44'-7	141	2	40'-4	128	2	36'-0	108	2	31'-9	95	6s3		
6s4	Wing Slope, Both F., Short		2	38'-0	114	2	34'-9	104	2	31'-6	95	2	28'-2	85	2	24'-11	75	6s4		
6s5	Wing Slope, F.F. Long		1	55'-0	86	1	50'-9	80	1	46'-5	73	1	42'-2	67	1	37'-10	57	6s5		
6s6	Wing Slope, F.F. Short		1	43'-4	68	1	40'-1	64	1	36'-9	55	1	33'-6	50	1	30'-3	45	6s6		
6s7	Interior Wall, Both F.H.		4	33'-3	200	4	30'-10	185	4	28'-4	170	4	25'-10	155	4	23'-4	140	6s7		
5t1	Curtain, Vertical		54	7'-11	446	52	7'-8	416	49	7'-5	379	47	7'-2	351	44	6'-11	317	5t1		
			Reinf. Steel			14,506 LB			12,964 LB			11,501 LB			10,115 LB			8718 LB		
Estimated Quantities One Headwall			Concrete			120.5 CY			103.6 CY			88.3 CY			77.3 CY			67.0 CY		
			Parapet Δ			3.9			3.8			3.7			3.7			3.7		
			Wingwalls			40.1			31.5			24.1			20.0			16.3		
			Apron *			76.5			68.3			60.5			53.6			47.0		



Δ Includes top of wingwall quantities.
 * Assumes apron and floor are equal thickness, adjust concrete quantities for transition where apron and floor thickness are not equal.

Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

"Short" Denotes Short Wingwall
 "Long" Denotes Long Wingwall

- ### Headwall Notes:
- See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
 - This headwall is based on a 3:1 slope normal to centerline of roadway.
 - The sides of the apron are to be formed to ensure correct line and grade.
 - All apron reinforcing steel is to be supported by bar chairs at intervals of not more than 3'-0" in either direction as outlined in the Standard Specifications.
 - Clear distance from face of concrete to near reinforcing bar is to be 2" unless otherwise noted or shown. Clearance to the bottom ends of vertical bars shall be 3 inches.
 - Concrete quantities are estimated from back of parapet.
 - Horizontal tails of bars "b" & "s" estimated to extend 2'-5" beyond back of parapet (into end of barrel). Longitudinal bars "d", "6f1", "6f4" and "6f5" estimated to project into end section of barrel a minimum of 2'-5" beyond back of parapet. The "length" column reflects total number of feet necessary to meet these requirements.
 - Dimensions are in feet and inches unless otherwise noted.

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWA DOT Highway Division

Standard Design - Triple Reinforced Concrete Box Culverts

Flared Wing Headwalls

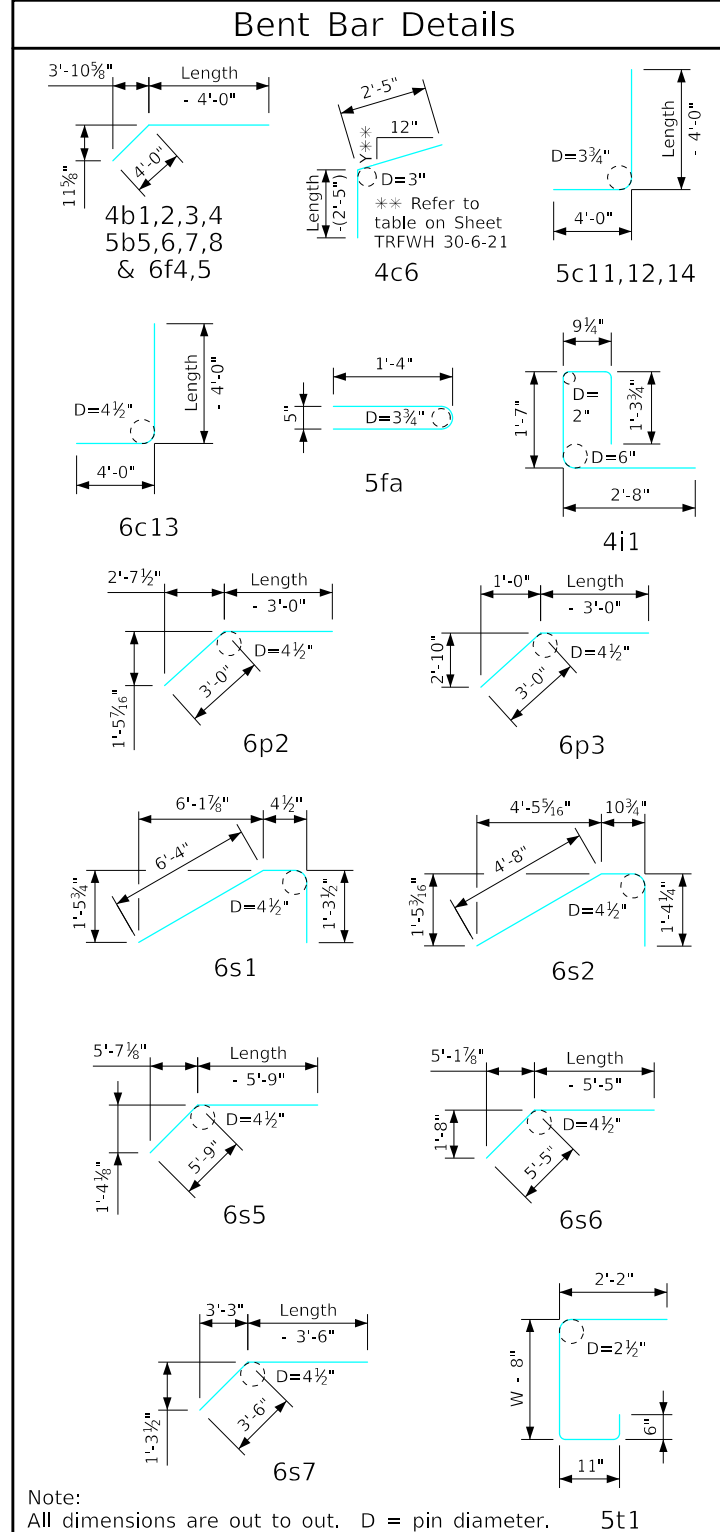
February, 2021

Quantity Tabulation 10'-0" Span 30° Skew	TRFWH 30-8-21 Sheet 1 of 2
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ENGLISHRFDSDIGNEDTRIPLECULVERTSFWH.DGN - TREWH 30-8-21 S1 - THIS SHEET ISSUED 02-2021.

Bill of Reinforcing for One Headwall 30° Skew Span x Culvert Height

Bar	Location	Shape	10' x 7'			10' x 6'			10' x 5'			10' x 4'			Bar
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	
5fa	Fence Anchor (Galv.)		2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	5fa
4b1	Wingwall, B.F.H. Long		1	34'-4"	23	1	30'-2"	20	1	26'-0"	17	1	21'-10"	15	4b1
4b2	Wingwall, B.F.H. Short		1	26'-7"	18	1	23'-6"	16	1	20'-5"	14	1	17'-3"	12	4b2
4b3	Wingwall, B.F.H. Long		5 Var.	15'-8 to 32'-5	80	4 Var.	15'-8 to 28'-3	59	3 Var.	15'-8 to 24'-1	40	2 Var.	15'-8 to 19'-10	24	4b3
4b4	Wingwall, B.F.H. Short		5 Var.	12'-10 to 25'-3	64	4 Var.	12'-10 to 22'-1	47	3 Var.	12'-9 to 19'-0	32	2 Var.	12'-9 to 15'-10	19	4b4
5b5	Wingwall, F.F.H. Long		1	34'-5"	36	1	30'-2"	31	1	26'-0"	27	1	21'-10"	23	5b5
5b6	Wingwall, F.F.H. Short		1	26'-8"	28	1	23'-6"	25	1	20'-5"	21	1	17'-4"	18	5b6
5b7	Wingwall, F.F.H. Long		6 Var.	11'-7 to 32'-5	138	5 Var.	11'-7 to 28'-3	104	4 Var.	11'-7 to 24'-1	74	3 Var.	11'-7 to 19'-11	49	5b7
5b8	Wingwall, F.F.H. Short		6 Var.	9'-9 to 25'-3	110	5 Var.	9'-9 to 22'-1	83	4 Var.	9'-9 to 19'-0	60	3 Var.	9'-8 to 15'-11	40	5b8
5b9	Interior Wall, Both F.H.		22 Var.	2 Each 6'-1 to 19'-10	297	18 Var.	2 Each 6'-2 to 17'-6	222	14 Var.	2 Each 6'-3 to 15'-2	156	10 Var.	2 Each 6'-6 to 12'-10	101	5b9
4c1	Wingwall, F.F.V. Long		31 Var.	2'-9 to 9'-11	131	26 Var.	2'-9 to 8'-9	100	22 Var.	2'-9 to 7'-9	77	18 Var.	2'-9 to 6'-10	58	4c1
4c2	Wingwall, F.F.V. Short		23 Var.	2'-9 to 9'-10	97	20 Var.	2'-9 to 8'-10	77	17 Var.	2'-9 to 7'-11	61	14 Var.	2'-9 to 6'-11	45	4c2
4c3	Wingwall, F.F.V. Long		--	--	--	--	--	--	--	--	--	--	--	--	4c3
4c4	Wingwall, F.F.V. Short		--	--	--	--	--	--	--	--	--	--	--	--	4c4
4c5	Wingwall, F.F.V. Long		1	8'-8"	6	2	7'-8"	10	2	6'-8"	9	2	5'-8"	8	4c5
4c5	Wingwall, F.F.V. Short		1	8'-8"	6	1	7'-8"	5	1	6'-8"	4	1	5'-8"	4	4c5
4c6	Interior Wall, Both F.V.		4	4'-1"	11	4	4'-0"	11	4	4'-0"	11	4	4'-0"	11	4c6
4c7	Interior Wall, Both F.V.		64 Var.	2 Each 1'-10 to 7'-5	198	54 Var.	2 Each 1'-10 to 6'-5	149	44 Var.	2 Each 1'-9 to 5'-4	104	36 Var.	2 Each 1'-9 to 4'-5	74	4c7
4c8	Interior Wall, Both F.V.		4	7'-6"	20	4	6'-6"	17	4	5'-6"	15	4	4'-6"	12	4c8
5c9	Wingwall, B.F.V. Long		11 Var.	2'-9 to 5'-2	45	11 Var.	2'-9 to 5'-2	45	11 Var.	2'-9 to 5'-2	45	11 Var.	2'-9 to 5'-2	45	5c9
5c10	Wingwall, B.F.V. Short		5 Var.	2'-9 to 4'-1	18	5 Var.	2'-9 to 4'-1	18	5 Var.	2'-9 to 4'-1	18	5 Var.	2'-9 to 4'-1	18	5c10
5c11	Wingwall, B.F.V. Long		20 Var.	9'-5 to 13'-11	243	15 Var.	9'-5 to 12'-9	173	11 Var.	9'-5 to 11'-9	121	7 Var.	9'-5 to 10'-10	74	5c11
5c12	Wingwall, B.F.V. Short		18 Var.	8'-5 to 13'-10	209	15 Var.	8'-5 to 12'-10	166	12 Var.	8'-5 to 11'-11	127	9 Var.	8'-5 to 10'-11	91	5c12
6c13	Wingwall, B.F.V. Long		13	10'-6"	205	8	10'-6"	126	--	--	--	--	--	--	6c13
6c13	Wingwall, B.F.V. Short		10	10'-6"	158	7	10'-6"	110	--	--	--	--	--	--	6c13
5c14	Wingwall, B.F.V. Long		1	12'-8"	13	2	11'-8"	24	2	10'-8"	22	2	9'-8"	20	5c14
5c14	Wingwall, B.F.V. Short		1	12'-8"	13	1	11'-8"	12	1	10'-8"	11	1	9'-8"	10	5c14
4d1	Apron, Longit., Bott.		21	20'-4"	285	21	18'-1"	254	21	15'-9"	221	21	13'-5"	188	4d1
4d2	Apron, Longit., Bott. Long		3	27'-11"	56	3	23'-9"	48	3	19'-7"	39	3	15'-4"	31	4d2
4d3	Apron, Longit., Bott. Short		3	21'-8"	43	3	18'-7"	37	3	15'-5"	31	3	12'-4"	25	4d3
6f1	Apron, Longit., Top		31	20'-4"	947	31	18'-1"	842	31	15'-9"	733	31	13'-5"	625	6f1
6f2	Apron, Longit., Top Long		6 Var.	5'-3 to 16'-11	100	5 Var.	5'-3 to 14'-7	74	4 Var.	5'-3 to 12'-4	53	3 Var.	5'-3 to 10'-0	34	6f2
6f3	Apron, Longit., Top Short		4 Var.	7'-9 to 17'-2	75	4 Var.	5'-5 to 14'-10	61	3 Var.	6'-2 to 12'-6	42	2 Var.	7'-0 to 10'-3	26	6f3
6f4	Apron, Longit., Top Long		1	34'-5"	52	1	30'-2"	45	1	26'-0"	39	1	21'-10"	33	6f4
6f5	Apron, Longit., Top Short		1	26'-8"	40	1	23'-6"	35	1	20'-5"	31	1	17'-4"	26	6f5
4i1	Parapet, Vertical		63	6'-4"	267	63	6'-4"	267	63	6'-4"	267	63	6'-4"	267	4i1
7j1	Parapet, Horizontal		4	37'-8"	308	4	37'-8"	308	4	37'-8"	308	4	37'-8"	308	7j1
6m1	Apron, Trans., Top		12 Var.	35'-3 to 37'-3	653	9 Var.	35'-3 to 36'-9	487	6 Var.	35'-3 to 36'-2	322	3 Var.	35'-3 to 35'-7	160	6m1
6m2	Apron, Trans., Top		2 Var.	30'-1 to 31'-5	92	5 Var.	26'-1 to 31'-3	215	8 Var.	22'-1 to 31'-2	320	11 Var.	18'-1 to 31'-1	406	6m2
6m3	Apron, Trans., Top		22 Var.	5'-7 to 28'-11	570	19 Var.	4'-11 to 24'-11	426	16 Var.	4'-3 to 20'-11	302	13 Var.	3'-7 to 16'-11	200	6m3
6m4	Apron, Trans., Bott.		14 Var.	31'-4 to 40'-3	756	12 Var.	31'-4 to 38'-10	632	10 Var.	31'-4 to 37'-6	517	8 Var.	31'-4 to 36'-2	406	6m4
6p1	Curtain, Horizontal		4	36'-6"	219	4	36'-6"	219	4	36'-6"	219	4	36'-6"	219	6p1
6p2	Curtain, Horizontal, Long		4	18'-0"	108	4	16'-0"	96	4	13'-11"	84	4	11'-11"	72	6p2
6p3	Curtain, Horizontal, Short		4	10'-9"	65	4	9'-8"	58	4	8'-8"	52	4	7'-7"	46	6p3
6s1	Wing Slope, Both F., Long		2	8'-0"	24	2	8'-0"	24	2	8'-0"	24	2	8'-0"	24	6s1
6s2	Wing Slope, Both F., Short		2	6'-11"	21	2	6'-11"	21	2	6'-11"	21	2	6'-11"	21	6s2
6s3	Wing Slope, Both F., Long		2	27'-5"	82	2	23'-2"	70	2	18'-10"	57	2	14'-7"	44	6s3
6s4	Wing Slope, Both F., Short		2	21'-8"	65	2	18'-4"	55	2	15'-1"	45	2	11'-10"	36	6s4
6s5	Wing Slope, F.F. Long		1	33'-7"	50	1	29'-3"	44	1	25'-0"	38	1	20'-8"	31	6s5
6s6	Wing Slope, F.F. Short		1	26'-11"	40	1	23'-8"	36	1	20'-5"	31	1	17'-1"	26	6s6
6s7	Interior Wall, Both F.H.		4	20'-10"	125	4	18'-4"	110	4	15'-10"	95	4	13'-4"	80	6s7
5t1	Curtain, Vertical		42	6'-8"	292	39	6'-5"	261	37	6'-5"	248	35	6'-5"	234	5t1
	Estimated Quantities One Headwall	Reinf. Steel	7508 LB			6381 LB			5211 LB			4345 LB			
		Concrete	Parapet Δ	3.6	55.5 CY	3.6	46.8 CY	3.6	39.3 CY	3.6	32.4 CY	3.6	32.4 CY		
			Wingwalls	11.6		8.9		6.5		4.4					
			Apron *	40.3		34.3		29.2		24.4					



Δ Includes top of wingwall quantities.
 * Assumes apron and floor are equal thickness, adjust concrete quantities for transition where apron and floor thickness are not equal.

Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

"Short" Denotes Short Wingwall
 "Long" Denotes Long Wingwall

- ### Headwall Notes:
- See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
 - This headwall is based on a 3:1 slope normal to centerline of roadway.
 - The sides of the apron are to be formed to ensure correct line and grade.
 - All apron reinforcing steel is to be supported by bar chairs at intervals of not more than 3'-0" in either direction as outlined in the Standard Specifications.
 - Clear distance from face of concrete to near reinforcing bar is to be 2" unless otherwise noted or shown. Clearance to the bottom ends of vertical bars shall be 3 inches.
 - Concrete quantities are estimated from back of parapet.
 - Horizontal tails of bars "b" & "s" estimated to extend 2'-5" beyond back of parapet (into end of barrel). Longitudinal bars "d", "6f1", "6f4" and "6f5" estimated to project into end section of barrel a minimum of 2'-5" beyond back of parapet. The "length" column reflects total number of feet necessary to meet these requirements.
 - Dimensions are in feet and inches unless otherwise noted.

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWADOT Highway Division

Standard Design - Triple Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

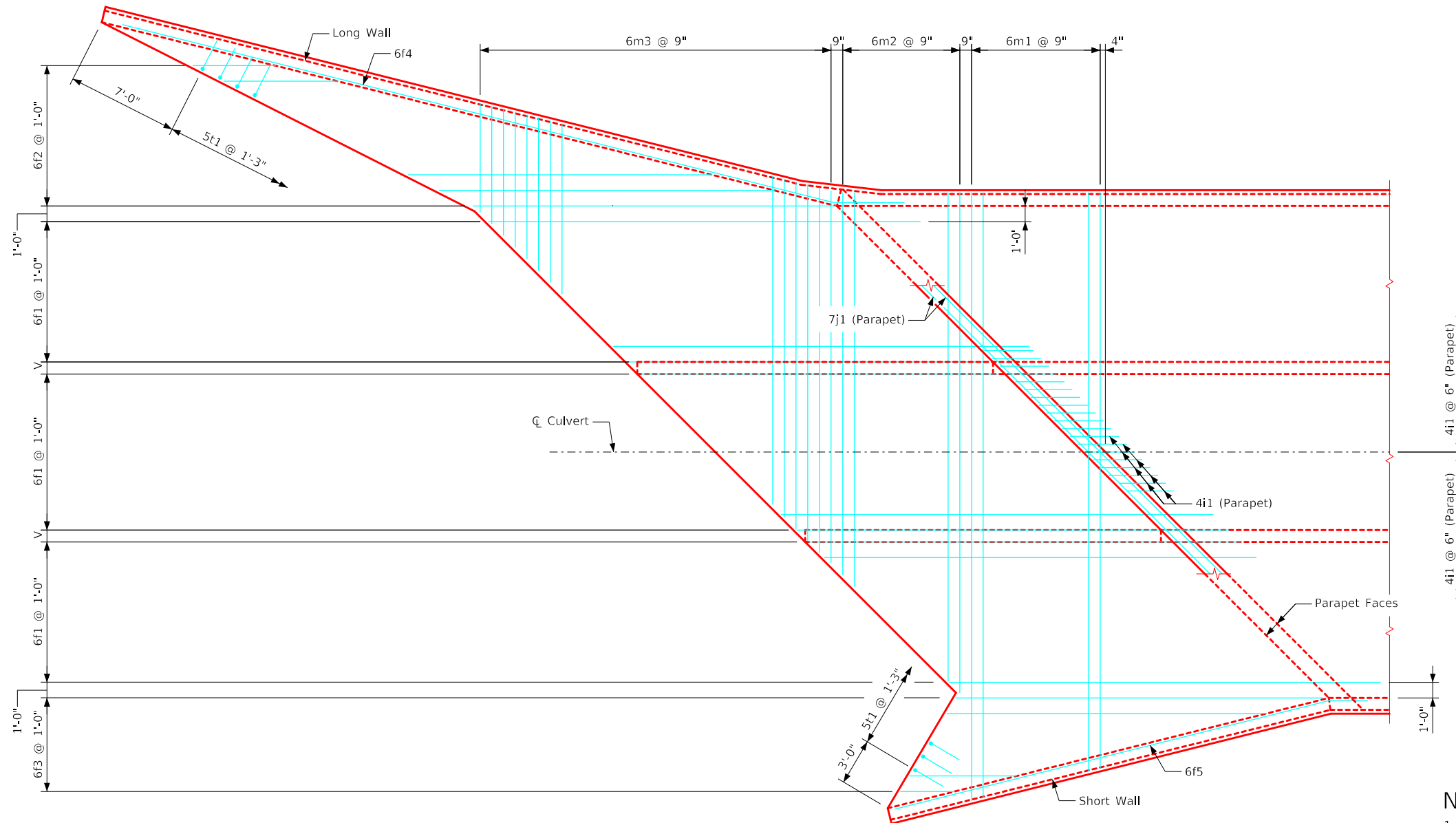
Quantity Tabulation 10'-0" Span 30° Skew	TRFWH 30-8-21 Sheet 2 of 2
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ENGLISHRFDSDGNEDTRIPLECULVERTSFHW.DGN - TREWH 30-8-21 S2 - THIS SHEET ISSUED 02-2021.

Dimension Table																			
S x H	12' x 12'	12' x 11'	12' x 10'	12' x 9'	12' x 8'	12' x 7'	12' x 6'	12' x 5'	12' x 4'	10' x 12'	10' x 11'	10' x 10'	10' x 9'	10' x 8'	10' x 7'	10' x 6'	10' x 5'	10' x 4'	S x H
A	37'-0	34'-0	31'-0	28'-0	25'-0	22'-0	19'-0	16'-0	13'-0	37'-0	34'-0	31'-0	28'-0	25'-0	22'-0	19'-0	16'-0	13'-0	A
B	12'-4	11'-4	10'-4	9'-4	8'-4	7'-4	6'-4	5'-4	4'-4	12'-4	11'-4	10'-4	9'-4	8'-4	7'-4	6'-4	5'-4	4'-4	B
C	24'-8	22'-8	20'-8	18'-8	16'-8	14'-8	12'-8	10'-8	8'-8	24'-8	22'-8	20'-8	18'-8	16'-8	14'-8	12'-8	10'-8	8'-8	C
C1	34'-10 ⁵ / ₈	32'-0 ⁵ / ₈	29'-2 ³ / ₄	26'-4 ³ / ₄	23'-6 ⁷ / ₈	20'-8 ⁷ / ₈	17'-11	15'-1	12'-3 ³ / ₈	34'-10 ⁵ / ₈	32'-0 ⁵ / ₈	29'-2 ³ / ₄	26'-4 ³ / ₄	23'-6 ⁷ / ₈	20'-8 ⁷ / ₈	17'-11	15'-1	12'-3 ³ / ₈	C1
C2	33'-10 ⁵ / ₈	31'-1 ⁵ / ₈	28'-4 ³ / ₄	25'-6 ³ / ₄	22'-8 ⁷ / ₈	19'-11 ⁵ / ₈	17'-2	14'-4	11'-6 ³ / ₈	33'-10 ⁵ / ₈	31'-1 ⁵ / ₈	28'-4 ³ / ₄	25'-6 ³ / ₄	22'-8 ⁷ / ₈	19'-11 ⁵ / ₈	17'-2	14'-4	11'-6 ³ / ₈	C2
C3	6	5 ¹ / ₂	5	5	5	4 ¹ / ₂	4 ¹ / ₂	4 ¹ / ₂	4 ¹ / ₂	6	5 ¹ / ₂	5	5	5	4 ¹ / ₂	4 ¹ / ₂	4 ¹ / ₂	4 ¹ / ₂	C3
DL	17'-5 ¹ / ₄	16'-0 ³ / ₈	14'-7 ³ / ₈	13'-2 ³ / ₈	11'-9 ³ / ₈	10'-4 ¹ / ₂	8'-11 ¹ / ₂	7'-6 ¹ / ₂	6'-1 ¹ / ₂	17'-5 ¹ / ₄	16'-0 ³ / ₈	14'-7 ³ / ₈	13'-2 ³ / ₈	11'-9 ³ / ₈	10'-4 ¹ / ₂	8'-11 ¹ / ₂	7'-6 ¹ / ₂	6'-1 ¹ / ₂	DL
DS	10'-5 ⁵ / ₈	9'-7 ³ / ₈	8'-9 ¹ / ₄	7'-11	7'-0 ⁷ / ₈	6'-2 ³ / ₈	5'-4 ¹ / ₂	4'-6 ¹ / ₄	3'-8 ³ / ₈	10'-5 ⁵ / ₈	9'-7 ³ / ₈	8'-9 ¹ / ₄	7'-11	7'-0 ⁷ / ₈	6'-2 ³ / ₈	5'-4 ¹ / ₂	4'-6 ¹ / ₄	3'-8 ³ / ₈	DS
D1	61'-8	56'-8	51'-8	46'-8	41'-8	36'-8	31'-8	26'-8	21'-8	61'-8	56'-8	51'-8	46'-8	41'-8	36'-8	31'-8	26'-8	21'-8	D1
D2	22'-2 ³ / ₈	20'-4 ³ / ₄	18'-7 ¹ / ₄	16'-9 ³ / ₈	15'-0	13'-2 ³ / ₈	11'-4 ³ / ₄	9'-7 ¹ / ₄	7'-9 ³ / ₈	22'-2 ³ / ₈	20'-4 ³ / ₄	18'-7 ¹ / ₄	16'-9 ³ / ₈	15'-0	13'-2 ³ / ₈	11'-4 ³ / ₄	9'-7 ¹ / ₄	7'-9 ³ / ₈	D2
E	65'-10 ⁷ / ₈	63'-5 ³ / ₄	61'-0 ⁵ / ₈	58'-9 ³ / ₈	56'-6 ¹ / ₄	54'-1 ¹ / ₈	51'-10	49'-6 ⁷ / ₈	47'-3 ³ / ₈	65'-10 ⁷ / ₈	63'-5 ³ / ₄	61'-0 ⁵ / ₈	58'-9 ³ / ₈	56'-6 ¹ / ₄	54'-1 ¹ / ₈	51'-10	49'-6 ⁷ / ₈	47'-3 ³ / ₈	E
E1	93'-2 ¹ / ₂	89'-9 ¹ / ₄	86'-4	83'-1 ¹ / ₈	79'-11 ¹ / ₄	76'-6	73'-3 ³ / ₈	70'-1 ¹ / ₄	66'-10 ³ / ₄	93'-2 ¹ / ₂	89'-9 ¹ / ₄	86'-4	83'-1 ¹ / ₈	79'-11 ¹ / ₄	76'-6	73'-3 ³ / ₈	70'-1 ¹ / ₄	66'-10 ³ / ₄	E1
FL	17'-9 ¹ / ₄	16'-4 ³ / ₈	14'-11 ³ / ₈	13'-6 ³ / ₈	12'-1 ³ / ₈	10'-8 ¹ / ₂	9'-3 ¹ / ₂	7'-10 ¹ / ₂	6'-5 ¹ / ₂	17'-9 ¹ / ₄	16'-4 ³ / ₈	14'-11 ³ / ₈	13'-6 ³ / ₈	12'-1 ³ / ₈	10'-8 ¹ / ₂	9'-3 ¹ / ₂	7'-10 ¹ / ₂	6'-5 ¹ / ₂	FL
FS	10'-9 ⁵ / ₈	9'-11 ³ / ₈	9'-1 ¹ / ₄	8'-3	7'-4 ³ / ₈	6'-6 ³ / ₈	5'-8 ¹ / ₂	4'-10 ¹ / ₄	4'-0 ³ / ₈	10'-9 ⁵ / ₈	9'-11 ³ / ₈	9'-1 ¹ / ₄	8'-3	7'-4 ³ / ₈	6'-6 ³ / ₈	5'-8 ¹ / ₂	4'-10 ¹ / ₄	4'-0 ³ / ₈	FS
F1	37'-5 ⁵ / ₈	34'-5 ⁵ / ₈	31'-5 ⁵ / ₈	28'-5 ⁵ / ₈	25'-5 ⁵ / ₈	22'-5 ⁵ / ₈	19'-5 ⁵ / ₈	16'-5 ⁵ / ₈	13'-5 ⁵ / ₈	37'-5 ⁵ / ₈	34'-5 ⁵ / ₈	31'-5 ⁵ / ₈	28'-5 ⁵ / ₈	25'-5 ⁵ / ₈	22'-5 ⁵ / ₈	19'-5 ⁵ / ₈	16'-5 ⁵ / ₈	13'-5 ⁵ / ₈	F1
F2	2'-11 ¹ / ₄	2'-8 ³ / ₈	2'-6 ¹ / ₂	2'-4	2'-1 ³ / ₈	1'-11 ¹ / ₄	1'-8 ³ / ₈	1'-6 ¹ / ₂	1'-4	2'-11 ¹ / ₄	2'-8 ³ / ₈	2'-6 ¹ / ₂	2'-4	2'-1 ³ / ₈	1'-11 ¹ / ₄	1'-8 ³ / ₈	1'-6 ¹ / ₂	1'-4	F2
G	37'-4	37'-2	37'-0	37'-0	37'-0	36'-10	36'-10	36'-10	36'-10	31'-4	31'-2	31'-0	31'-0	31'-0	30'-10	30'-10	30'-10	30'-10	G
G1	52'-9 ³ / ₈	52'-6 ³ / ₄	52'-3 ³ / ₈	52'-3 ³ / ₈	52'-3 ³ / ₈	52'-1 ¹ / ₈	52'-1 ¹ / ₈	52'-1 ¹ / ₈	52'-1 ¹ / ₈	44'-3 ³ / ₄	44'-0 ⁷ / ₈	43'-10 ³ / ₈	43'-10 ³ / ₈	43'-10 ³ / ₈	43'-7 ¹ / ₄	43'-7 ¹ / ₄	43'-7 ¹ / ₄	43'-7 ¹ / ₄	G1
G2	53'-11 ¹ / ₈	53'-9	53'-6 ¹ / ₈	53'-6	53'-6	53'-3	53'-2 ⁷ / ₈	53'-2 ³ / ₄	53'-2 ¹ / ₂	45'-6	45'-3 ³ / ₈	45'-0 ¹ / ₄	45'-0 ¹ / ₄	45'-0 ¹ / ₄	44'-9 ¹ / ₄	44'-9 ¹ / ₄	44'-8 ³ / ₈	44'-8 ³ / ₈	G2
G3	39'-5 ³ / ₈	36'-3 ¹ / ₂	33'-1 ¹ / ₂	29'-11 ¹ / ₂	26'-9 ⁵ / ₈	23'-7 ³ / ₈	20'-5 ³ / ₄	17'-3 ³ / ₄	14'-1 ¹ / ₈	39'-5 ³ / ₈	36'-3 ¹ / ₂	33'-1 ¹ / ₂	29'-11 ¹ / ₂	26'-9 ⁵ / ₈	23'-7 ³ / ₈	20'-5 ³ / ₄	17'-3 ³ / ₄	14'-1 ¹ / ₈	G3
G4	39'-9 ¹ / ₂	36'-3	32'-8 ¹ / ₂	29'-6 ³ / ₈	26'-4 ³ / ₈	22'-10 ¹ / ₄	19'-8 ³ / ₈	16'-6 ¹ / ₂	13'-4 ³ / ₄	39'-9 ¹ / ₂	36'-3	32'-8 ¹ / ₂	29'-6 ³ / ₈	26'-4 ³ / ₈	22'-10 ¹ / ₄	19'-8 ³ / ₈	16'-6 ¹ / ₂	13'-4 ³ / ₄	G4
G5	12'-8 ³ / ₈	11'-7 ³ / ₈	10'-7 ³ / ₈	9'-7 ¹ / ₂	8'-7 ¹ / ₄	7'-7	6'-6 ³ / ₄	5'-6 ³ / ₈	4'-6 ³ / ₈	12'-8 ³ / ₈	11'-7 ³ / ₈	10'-7 ³ / ₈	9'-7 ¹ / ₂	8'-7 ¹ / ₄	7'-7	6'-6 ³ / ₄	5'-6 ³ / ₈	4'-6 ³ / ₈	G5
G6	14'-2 ¹ / ₈	13'-0 ¹ / ₂	11'-10 ³ / ₄	10'-10 ¹ / ₂	9'-10 ³ / ₈	8'-8 ³ / ₄	7'-8 ¹ / ₂	6'-8 ³ / ₈	5'-8 ³ / ₈	14'-2 ¹ / ₈	13'-0 ¹ / ₂	11'-10 ³ / ₄	10'-10 ¹ / ₂	9'-10 ³ / ₈	8'-8 ³ / ₄	7'-8 ¹ / ₂	6'-8 ³ / ₈	5'-8 ³ / ₈	G6
G7	1 ¹ / ₈	6 ¹ / ₈	10 ¹ / ₂	10 ¹ / ₂	10 ¹ / ₂	1'-2 ³ / ₄	1'-2 ³ / ₄	1'-2 ³ / ₈	1'-2 ³ / ₈	1 ¹ / ₈	6 ¹ / ₈	10 ¹ / ₂	10 ¹ / ₂	10 ¹ / ₂	1'-2 ³ / ₄	1'-2 ³ / ₄	1'-2 ³ / ₈	1'-2 ³ / ₈	G7
G8	6 ¹ / ₈	7 ¹ / ₈	8 ¹ / ₄	8 ¹ / ₄	8 ¹ / ₄	9 ¹ / ₄	9 ¹ / ₄	9 ³ / ₈	9 ³ / ₈	6 ¹ / ₈	7 ¹ / ₈	8 ¹ / ₄	8 ¹ / ₄	8 ¹ / ₄	9 ¹ / ₄	9 ¹ / ₄	9 ³ / ₈	9 ³ / ₈	G8
K	38'-0	37'-10	37'-8	37'-8	37'-8	37'-6	37'-6	37'-6	37'-6	32'-0	31'-10	31'-8	31'-8	31'-8	31'-6	31'-6	31'-6	31'-6	K
K1	53'-8 ⁷ / ₈	53'-6	53'-3 ³ / ₄	53'-3 ³ / ₄	53'-3 ³ / ₄	53'-0 ³ / ₈	53'-0 ³ / ₈	53'-0 ³ / ₈	53'-0 ³ / ₈	45'-3	45'-0 ¹ / ₄	44'-9 ³ / ₈	44'-9 ³ / ₈	44'-9 ³ / ₈	44'-6 ⁵ / ₈	44'-6 ⁵ / ₈	44'-6 ⁵ / ₈	44'-6 ⁵ / ₈	K1
PL	71'-11	66'-1	60'-3	54'-5 ¹ / ₈	48'-7 ¹ / ₈	42'-9 ¹ / ₈	36'-11 ¹ / ₈	31'-1 ¹ / ₈	25'-3 ¹ / ₄	71'-11	66'-1	60'-3	54'-5 ¹ / ₈	48'-7 ¹ / ₈	42'-9 ¹ / ₈	36'-11 ¹ / ₈	31'-1 ¹ / ₈	25'-3 ¹ / ₄	PL
PS	43'-1 ³ / ₄	39'-7 ³ / ₄	36'-1 ⁷ / ₈	32'-7 ⁷ / ₈	29'-1 ⁷ / ₈	25'-7 ⁷ / ₈	22'-1 ⁷ / ₈	18'-7 ⁷ / ₈	15'-1 ⁷ / ₈	43'-1 ³ / ₄	39'-7 ³ / ₄	36'-1 ⁷ / ₈	32'-7 ⁷ / ₈	29'-1 ⁷ / ₈	25'-7 ⁷ / ₈	22'-1 ⁷ / ₈	18'-7 ⁷ / ₈	15'-1 ⁷ / ₈	PS
RL	72'-11 ¹ / ₈	67'-0 ³ / ₈	61'-1 ¹ / ₈	55'-2 ³ / ₈	49'-3 ³ / ₈	43'-4 ³ / ₈	37'-5 ³ / ₈	31'-6 ³ / ₈	25'-7 ³ / ₈	72'-11 ¹ / ₈	67'-0 ³ / ₈	61'-1 ¹ / ₈	55'-2 ³ / ₈	49'-3 ³ / ₈	43'-4 ³ / ₈	37'-5 ³ / ₈	31'-6 ³ / ₈	25'-7 ³ / ₈	RL
RS	44'-10 ¹ / ₂	41'-2 ¹ / ₈	37'-7 ¹ / ₄	33'-11 ¹ / ₂	30'-3 ⁷ / ₈	26'-8 ³ / ₄	23'-0 ³ / ₈	19'-4 ⁷ / ₈	15'-9 ¹ / ₄	44'-10 ¹ / ₂	41'-2 ¹ / ₈	37'-7 ¹ / ₄	33'-11 ¹ / ₂	30'-3 ⁷ / ₈	26'-8 ³ / ₄	23'-0 ³ / ₈	19'-4 ⁷ / ₈	15'-9 ¹ / ₄	RS
R1	35'-7 ¹ / ₂	32'-8 ¹ / ₂	29'-9 ³ / ₈	26'-9 ¹ / ₂	23'-9 ¹ / ₂	20'-10 ¹ / ₂	17'-10 ¹ / ₂	14'-10 ³ / ₈	11'-10 ³ / ₄	35'-7 ¹ / ₂	32'-8 ¹ / ₂	29'-9 ³ / ₈	26'-9 ¹ / ₂	23'-9 ¹ / ₂	20'-10 ¹ / ₂	17'-10 ¹ / ₂	14'-10 ³ / ₈	11'-10 ³ / ₄	R1
S1	16'-11 ¹ / ₈	16'-11 ¹ / ₈	16'-11 ¹ / ₈	16'-11 ¹ / ₈	16'-11 ¹ / ₈	16'-11 ¹ / ₈	16'-11 ¹ / ₈	16'-11 ¹ / ₈	16'-11 ¹ / ₈	14'-1 ³ / ₄	14'-1 ³ / ₄	14'-1 ³ / ₄	14'-1 ³ / ₄	14'-1 ³ / ₄	14'-1 ³ / ₄	14'-1 ³ / ₄	14'-1 ³ / ₄	14'-1 ³ / ₄	S1
T	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-1	1'-1	1'-1	1'-1	1'-1	1'-1	1'-1	1'-1	1'-1	T
U	1'-0	11	10	10	10	9	9	9	9	1'-0	11	10	10	10	9	9	9	9	U
V	1'-0	11	10	10	10	9	9	9	9	1'-0	11	10	10	10	9	9	9	9	V
V1	1'-5	1'-3 ¹ / ₂	1'-2 ¹ / ₈	1'-2 ¹ / ₈	1'-2 ¹ / ₈	1'-0 ³ / ₄	1'-0 ³ / ₄	1'-0 ³ / ₄	1'-0 ³ / ₄	1'-5	1'-3 ¹ / ₂	1'-2 ¹ / ₈	1'-2 ¹ / ₈	1'-2 ¹ / ₈	1'-0 ³ / ₄	1'-0 ³ / ₄	1'-0 ³ / ₄	1'-0 ³ / ₄	V1
W	5'-0	4'-9	4'-6	4'-3	4'-0	3'-9	3'-6	3'-6	3'-6	5'-0	4'-9	4'-6	4'-3	4'-0	3'-9	3'-6	3'-6	3'-6	W

Notes:

ENGLISHLRFDDESIGNEDTRIPLECULVERTSFHW.DGN - TRFWH 45-3-21 - THIS SHEET ISSUED 02-2021.



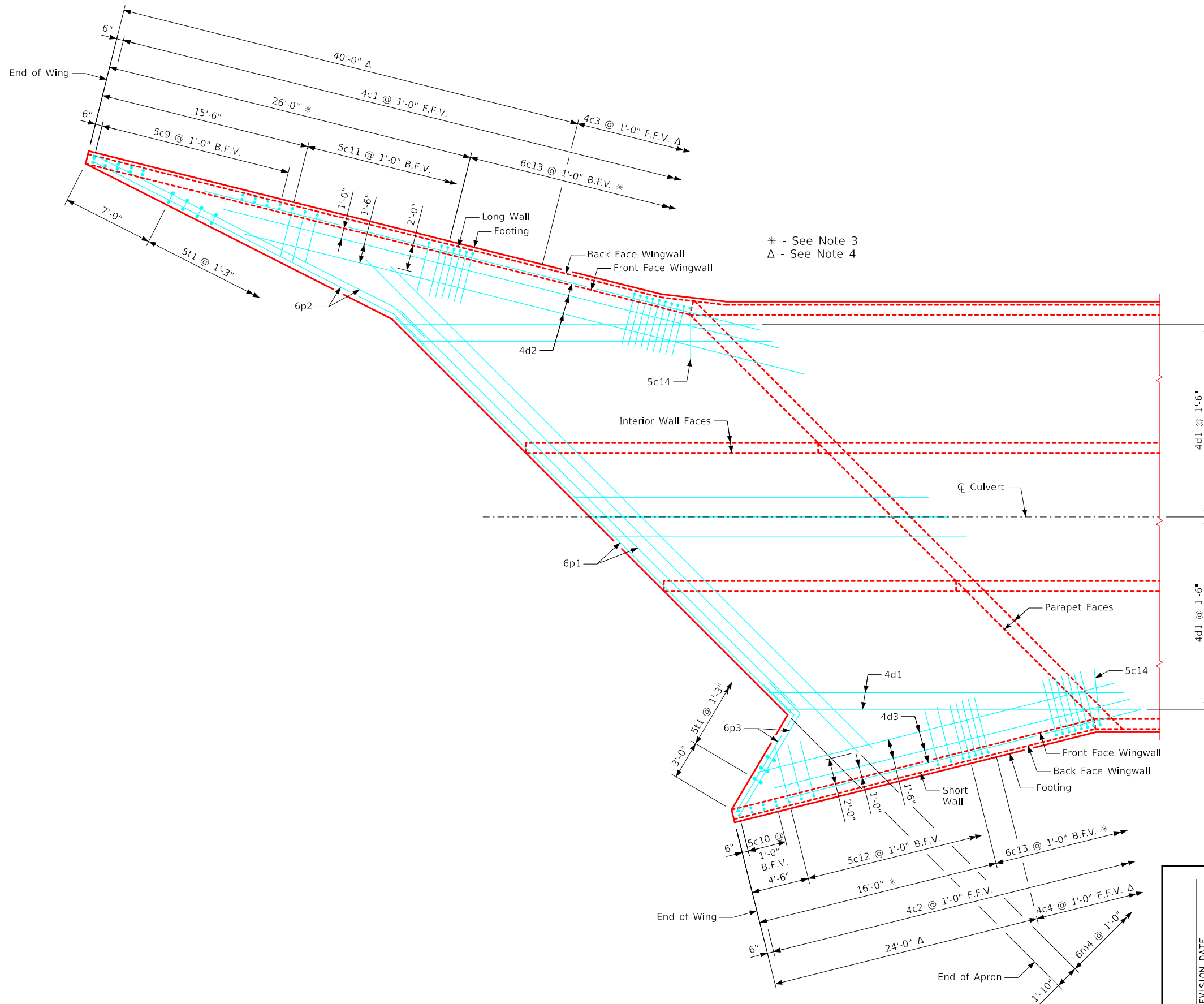
Plan View - Top of Apron Reinforcing

Notes:

1. Bar spacings and positions shown are similar for all sizes of headwalls in this standard.
2. Top transverse floor bars are referenced approximately 4" from the back of the parapet for all headwalls.
3. For dimension table see Sheet TRFWH 45-2-21.
4. For reinforcing in curtain wall see Curtain Wall Details on Sheet TRFWH 45-5-21.

LATEST REVISION DATE	 APPROVED BY BRIDGE ENGINEER	 Standard Design - Triple Reinforced Concrete Box Culverts	
		Flared Wing Headwalls February, 2021	
		Top Apron Detail 45° Skew	TRFWH 45-3-21

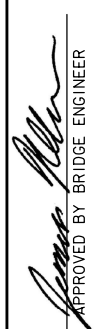

ENGLISHLRFDDESIGNEDTRIPLECULVERTSFWH.DGN - TRFWH 45-4-21 - THIS SHEET ISSUED 02-2021.

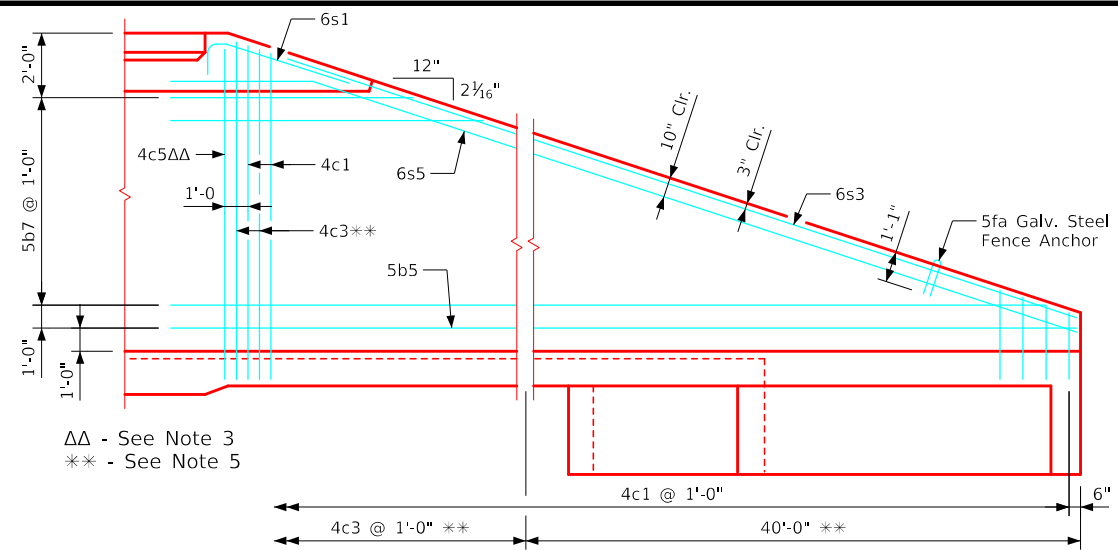


Plan View - Bottom of Apron Reinforcing

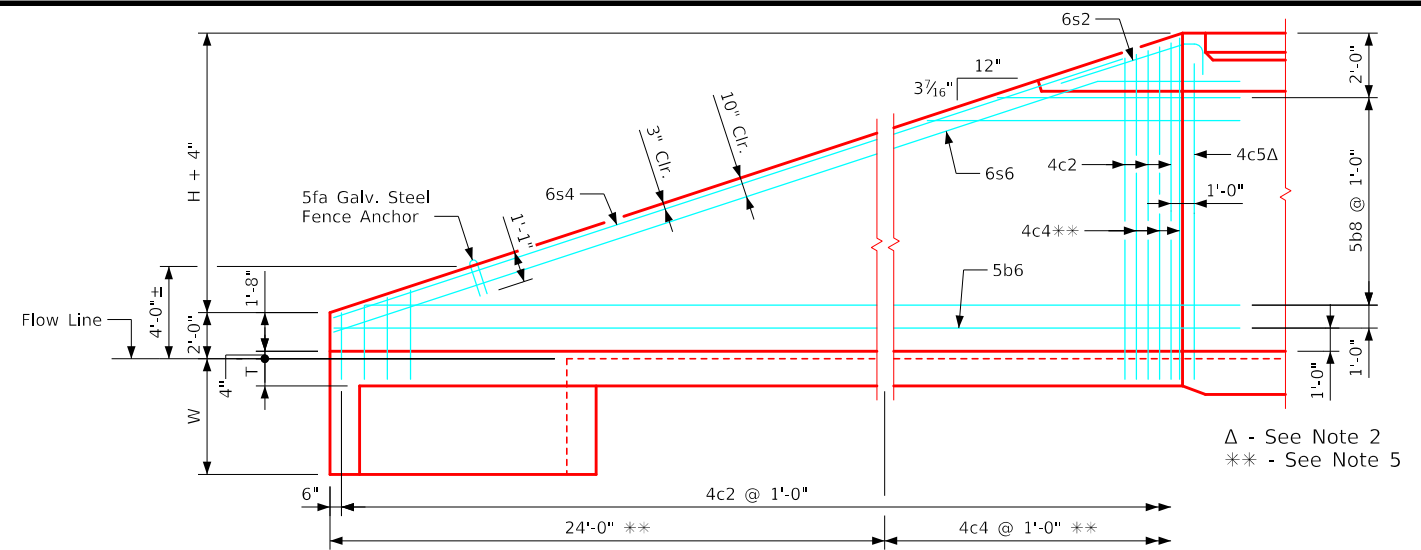
Notes:

1. Bar spacings and positions shown are similar for all sizes of headwalls in this standard.
2. Wingwall bars consistently referenced from end of wing for all headwalls.
3. There are no 6c13 bars in the 4' & 5' height headwalls.
4. 4c3 & 4c4 bars used only in the 9', 10', 11' & 12' height headwalls.
5. For dimension table see Sheet TRFWH 45-2-21.
6. For reinforcing in curtain wall see Curtain Wall Details on Sheet TRFWH 45-5-21.

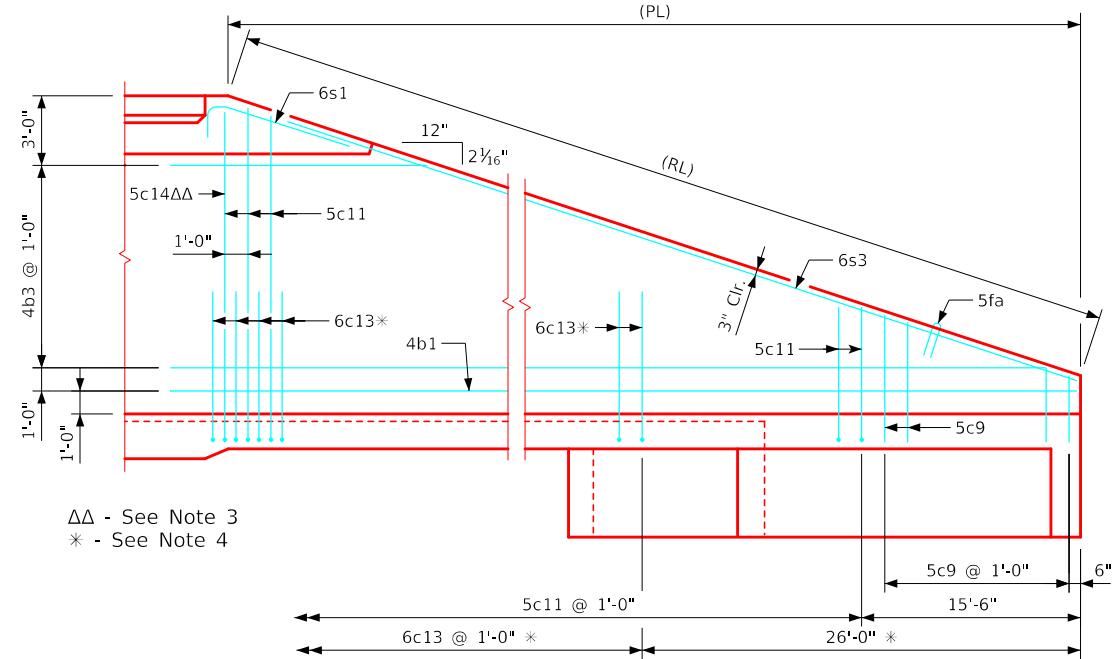
LATEST REVISION DATE	 APPROVED BY BRIDGE ENGINEER	 Standard Design - Triple Reinforced Concrete Box Culverts	
		<h3 style="margin: 0;">Flared Wing Headwalls</h3> February, 2021	
		Bottom Apron Detail 45° Skew	TRFWH 45-4-21



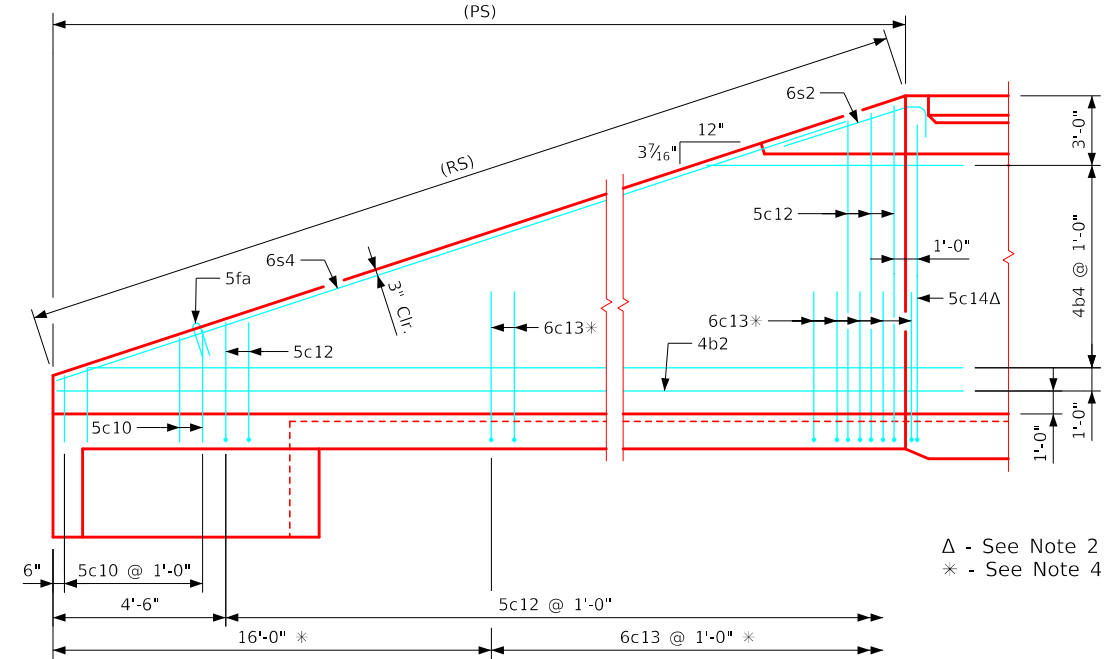
Typical View - Front Face Long Wingwall Reinforcing



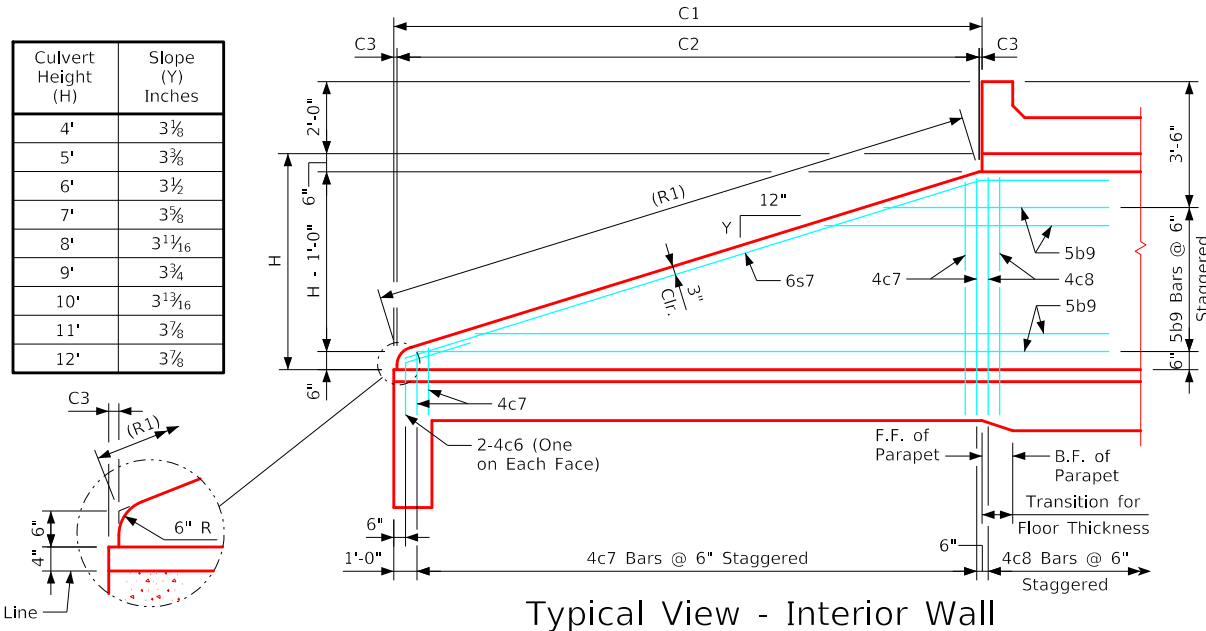
Typical View - Front Face Short Wingwall Reinforcing



Typical View - Back Face Long Wingwall Reinforcing



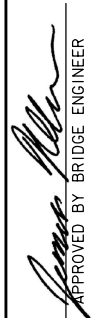

Typical View - Back Face Short Wingwall Reinforcing



Typical View - Interior Wall

Notes:

1. Bar spacings and positions shown are similar for all sizes of headwalls in this standard.
2. Two 4c5 & two 5c14 bars for 4', 6', 8', 10' & 12' height headwalls. One 4c5 & one 5c14 bar for 5', 7', 9' & 11' height headwalls.
3. Two 4c5 & two 5c14 for 4', 5', 9', 10' & 11' height headwalls. One 4c5 & one 5c14 bar for 6', 7', 8' & 12' height headwalls.
4. Not applicable for 4' & 5' height headwalls.
5. Not applicable for 4' thru 8' height headwalls.
6. For dimension table, see sheet TRFWH 45-2-21.
7. Top of wall slope may be rounded in some instances.

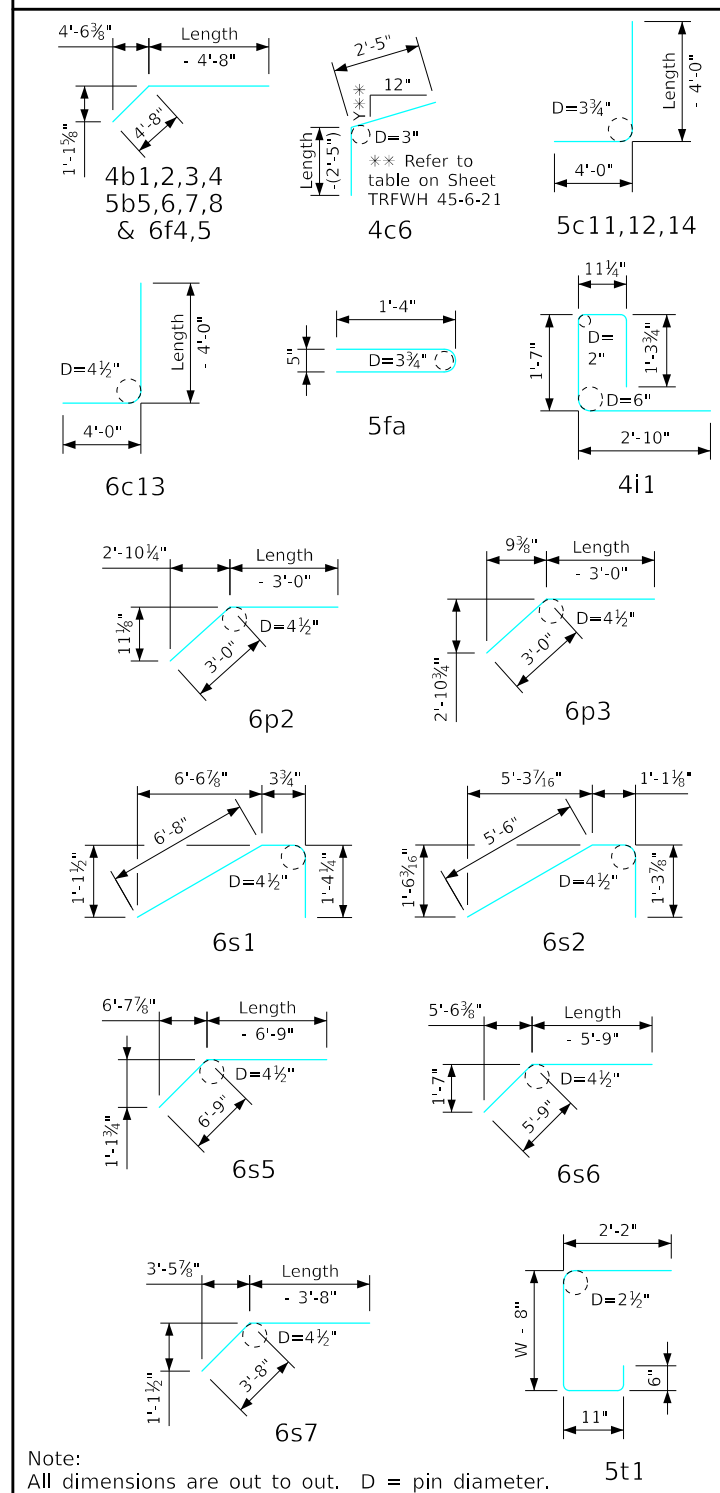
LATEST REVISION DATE	 APPROVED BY BRIDGE ENGINEER	 Standard Design - Triple Reinforced Concrete Box Culverts	
		Flared Wing Headwalls February, 2021	
		Wingwall Details 45° Skew	TRFWH 45-6-21

ENGLISHLRFDDESIGNEDTRIPLECULVERTSFWH.DGN - TRFWH 45-7-21 S1 - THIS SHEET ISSUED 02-2021.

Bill of Reinforcing for One Headwall 45° Skew Span x Culvert Height

Bar	Location	Shape	12' x 12'			12' x 11'			12' x 10'			12' x 9'			12' x 8'			Bar		
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.			
5fa	Fence Anchor (Galv.)		2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	5fa		
4b1	Wingwall, B.F.H. Long		1	76'-3"	53	1	70'-6"	49	1	64'-8"	45	1	58'-10"	41	1	53'-0"	37	4b1		
4b2	Wingwall, B.F.H. Short		1	47'-6"	33	1	44'-0"	31	1	40'-7"	29	1	37'-1"	25	1	33'-7"	22	4b2		
4b3	Wingwall, B.F.H. Long		10 Var.	21'-2" to 73'-6"	326	9 Var.	21'-2" to 67'-8"	275	8 Var.	21'-2" to 61'-11"	228	7 Var.	21'-2" to 56'-1"	185	6 Var.	21'-2" to 50'-3"	146	4b3		
4b4	Wingwall, B.F.H. Short		10 Var.	14'-6" to 45'-11"	205	9 Var.	14'-6" to 42'-5"	173	8 Var.	14'-6" to 38'-11"	143	7 Var.	14'-6" to 35'-5"	117	6 Var.	14'-6" to 31'-11"	93	4b4		
5b5	Wingwall, F.F.H. Long		1	76'-4"	82	1	70'-6"	76	1	64'-8"	70	1	58'-10"	64	1	53'-0"	58	5b5		
5b6	Wingwall, F.F.H. Short		1	47'-7"	52	1	44'-1"	48	1	40'-7"	45	1	37'-1"	39	1	33'-7"	35	5b6		
5b7	Wingwall, F.F.H. Long		11 Var.	15'-5" to 73'-7"	526	10 Var.	15'-5" to 67'-9"	446	9 Var.	15'-5" to 61'-11"	373	8 Var.	15'-5" to 56'-1"	306	7 Var.	15'-4" to 50'-3"	244	5b7		
5b8	Wingwall, F.F.H. Short		11 Var.	11'-1" to 46'-0"	333	10 Var.	11'-1" to 42'-6"	282	9 Var.	11'-1" to 39'-0"	235	8 Var.	11'-1" to 35'-6"	194	7 Var.	11'-1" to 32'-0"	157	5b8		
5b9	Interior Wall, Both F.H.		42 Var.	2 Each 6'-11" to 37'-9"	978	38 Var.	2 Each 6'-11" to 34'-11"	829	34 Var.	2 Each 6'-11" to 32'-2"	693	30 Var.	2 Each 6'-11" to 29'-4"	567	26 Var.	2 Each 7'-0" to 26'-6"	454	5b9		
4c1	Wingwall, F.F.V. Long		72 Var.	2'-9" to 15'-0"	427	66 Var.	2'-9" to 13'-11"	367	60 Var.	2'-9" to 12'-11"	314	54 Var.	2'-9" to 11'-11"	265	49 Var.	2'-9" to 11'-0"	225	4c1		
4c2	Wingwall, F.F.V. Short		43 Var.	2'-10" to 14'-10"	254	40 Var.	2'-10" to 14'-0"	225	36 Var.	2'-10" to 12'-10"	188	33 Var.	2'-10" to 12'-0"	163	29 Var.	2'-10" to 10'-10"	132	4c2		
4c3	Wingwall, F.F.V. Long		33 Var.	9'-7" to 15'-1"	272	27 Var.	9'-7" to 14'-0"	213	21 Var.	9'-7" to 13'-0"	158	15 Var.	9'-7" to 12'-0"	108	--	--	--	4c3		
4c4	Wingwall, F.F.V. Short		20 Var.	9'-7" to 15'-0"	164	17 Var.	9'-7" to 14'-1"	134	13 Var.	9'-7" to 13'-0"	98	10 Var.	9'-7" to 12'-1"	72	--	--	--	4c4		
4c5	Wingwall, F.F.V. Long		1	13'-9"	9	2	12'-9"	17	2	11'-9"	16	2	10'-9"	14	1	9'-9"	7	4c5		
4c5	Wingwall, F.F.V. Short		2	13'-9"	18	1	12'-9"	9	2	11'-9"	16	1	10'-9"	7	2	9'-9"	13	4c5		
4c6	Interior Wall, Both F.V.		4	4'-1"	11	4	4'-1"	11	4	4'-1"	11	4	4'-1"	11	4	4'-1"	11	4c6		
4c7	Interior Wall, Both F.V.		132 Var.	2 Each 1'-10" to 12'-5"	628	122 Var.	2 Each 1'-10" to 11'-6"	543	110 Var.	2 Each 1'-10" to 10'-5"	450	100 Var.	2 Each 1'-10" to 9'-6"	379	88 Var.	2 Each 1'-10" to 8'-6"	304	4c7		
4c8	Interior Wall, Both F.V.		6	12'-7"	50	6	11'-7"	46	6	10'-7"	42	6	9'-7"	38	6	8'-7"	34	4c8		
5c9	Wingwall, B.F.V. Long		15 Var.	2'-9" to 5'-2"	62	15 Var.	2'-9" to 5'-2"	62	15 Var.	2'-9" to 5'-2"	62	15 Var.	2'-9" to 5'-2"	62	15 Var.	2'-9" to 5'-2"	62	5c9		
5c10	Wingwall, B.F.V. Short		4 Var.	2'-10" to 3'-8"	14	4 Var.	2'-10" to 3'-8"	14	4 Var.	2'-10" to 3'-8"	14	4 Var.	2'-10" to 3'-8"	14	4 Var.	2'-10" to 3'-8"	14	5c10		
5c11	Wingwall, B.F.V. Long		57 Var.	9'-4" to 19'-0"	842	51 Var.	9'-4" to 17'-11"	725	45 Var.	9'-4" to 16'-11"	616	39 Var.	9'-4" to 15'-11"	514	34 Var.	9'-4" to 15'-0"	431	5c11		
5c12	Wingwall, B.F.V. Short		39 Var.	8'-0" to 18'-10"	546	36 Var.	8'-0" to 18'-0"	488	32 Var.	8'-0" to 16'-10"	414	29 Var.	8'-0" to 16'-0"	363	25 Var.	8'-0" to 14'-10"	298	5c12		
6c13	Wingwall, B.F.V. Long		47	10'-6"	741	41	10'-6"	647	35	10'-6"	552	29	10'-6"	457	24	10'-6"	379	6c13		
6c13	Wingwall, B.F.V. Short		28	10'-6"	442	25	10'-6"	394	21	10'-6"	331	18	10'-6"	284	14	10'-6"	221	6c13		
5c14	Wingwall, B.F.V. Long		1	17'-9"	19	2	16'-9"	35	2	15'-9"	33	2	14'-9"	31	1	13'-9"	14	5c14		
5c14	Wingwall, B.F.V. Short		2	17'-9"	37	1	16'-9"	17	2	15'-9"	33	1	14'-9"	15	2	13'-9"	29	5c14		
4d1	Apron, Longit., Bott.		25	38'-6"	643	25	35'-8"	596	25	32'-10"	548	25	30'-0"	501	25	27'-2"	454	4d1		
4d2	Apron, Longit., Bott. Long		3	68'-10"	143	3	63'-0"	131	3	57'-2"	119	3	51'-5"	108	3	45'-7"	96	4d2		
4d3	Apron, Longit., Bott. Short		3	42'-7"	90	3	39'-1"	78	3	35'-7"	71	3	32'-1"	64	3	28'-7"	57	4d3		
6f1	Apron, Longit., Top		37	38'-6"	2140	37	35'-8"	1982	37	32'-10"	1825	37	30'-0"	1667	37	27'-2"	1510	6f1		
6f2	Apron, Longit., Top Long		15 Var.	6'-7" to 34'-10"	467	14 Var.	5'-8" to 32'-0"	396	12 Var.	6'-11" to 29'-2"	325	11 Var.	6'-1" to 26'-4"	268	9 Var.	7'-3" to 23'-6"	208	6f2		
6f3	Apron, Longit., Top Short		9 Var.	8'-1" to 35'-2"	292	8 Var.	8'-8" to 32'-4"	246	8 Var.	5'-9" to 29'-6"	212	7 Var.	6'-4" to 26'-8"	173	6 Var.	6'-10" to 23'-10"	138	6f3		
6f4	Apron, Longit., Top Long		1	76'-4"	118	1	70'-6"	110	1	64'-8"	101	1	58'-10"	92	1	53'-0"	83	6f4		
6f5	Apron, Longit., Top Short		1	47'-7"	75	1	44'-1"	70	1	40'-7"	65	1	37'-1"	56	1	33'-7"	50	6f5		
4i1	Parapet, Vertical		77	6'-8"	343	75	6'-8"	334	75	6'-8"	334	75	6'-8"	334	75	6'-8"	334	4i1		
7j1	Parapet, Horizontal		4	56'-1"	478	4	55'-7"	474	4	55'-1"	470	4	55'-1"	470	4	55'-1"	470	7j1		
6m1	Apron, Trans., Top		23 Var.	44'-8" to 48'-9"	1697	20 Var.	44'-3" to 47'-10"	1456	16 Var.	43'-11" to 46'-9"	1148	12 Var.	43'-11" to 46'-0"	854	9 Var.	43'-11" to 45'-5"	636	6m1		
6m2	Apron, Trans., Top		4 Var.	36'-3" to 38'-6"	225	7 Var.	33'-3" to 37'-9"	373	11 Var.	30'-3" to 37'-9"	562	15 Var.	27'-5" to 37'-11"	736	18 Var.	24'-7" to 37'-4"	837	6m2		
6m3	Apron, Trans., Top		46 Var.	10'-3" to 35'-7"	1583	42 Var.	9'-7" to 32'-7"	1330	39 Var.	8'-3" to 29'-8"	1111	35 Var.	7'-8" to 26'-10"	907	31 Var.	7'-1" to 24'-0"	724	6m3		
6m4	Apron, Trans., Bott.		24 Var.	47'-4" to 71'-10"	2235	22 Var.	47'-1" to 69'-6"	2006	20 Var.	46'-10" to 67'-1"	1784	18 Var.	46'-10" to 65'-0"	1577	16 Var.	46'-10" to 62'-10"	1376	6m4		
6p1	Curtain, Horizontal		4	53'-8"	337	4	53'-6"	336	4	53'-3"	334	4	53'-3"	334	4	53'-3"	334	6p1		
6p2	Curtain, Horizontal, Long		4	42'-4"	269	4	39'-2"	235	4	36'-0"	216	4	32'-10"	197	4	29'-8"	178	6p2		
6p3	Curtain, Horizontal, Short		4	15'-8"	94	4	14'-7"	88	4	13'-7"	82	4	12'-7"	76	4	11'-7"	70	6p3		
6s1	Wing Slope, Both F., Long		2	8'-4"	25	2	8'-4"	25	2	8'-4"	25	2	8'-4"	25	2	8'-4"	25	6s1		
6s2	Wing Slope, Both F., Short		2	7'-11"	24	2	7'-11"	24	2	7'-11"	24	2	7'-11"	24	2	7'-11"	24	6s2		
6s3	Wing Slope, Both F., Long		2	68'-7"	213	2	62'-8"	196	2	56'-9"	178	2	50'-10"	160	2	44'-11"	142	6s3		
6s4	Wing Slope, Both F., Short		2	41'-8"	132	2	38'-0"	114	2	34'-5"	103	2	30'-9"	92	2	27'-1"	81	6s4		
6s5	Wing Slope, F.F. Long		1	74'-8"	116	1	68'-9"	107	1	62'-10"	98	1	56'-11"	89	1	51'-0"	80	6s5		
6s6	Wing Slope, F.F. Short		1	47'-8"	75	1	44'-0"	70	1	40'-4"	64	1	36'-9"	55	1	33'-1"	50	6s6		
6s7	Interior Wall, Both F.H.		4	39'-1"	235	4	36'-2"	217	4	33'-3"	200	4	30'-3"	182	4	27'-3"	164	6s7		
5t1	Curtain, Vertical		77	7'-11"	636	74	7'-8"	592	69	7'-5"	534	66	7'-2"	493	62	6'-11"	447	5t1		
			Reinf. Steel			19,815 LB			17,748 LB			15,748 LB			13,875 LB			11,994 LB		
			Concrete			172.5 CY			149.0 CY			127.7 CY			112.0 CY			97.0 CY		
Estimated Quantities One Headwall			Parapet Δ			5.4			5.3			5.2			5.2			5.2		
			Wingwalls			50.5			39.6			30.3			25.2			20.4		
			Apron *			116.6			104.1			92.2			81.6			71.4		

Bent Bar Details



Δ Includes top of wingwall quantities.
 * Assumes apron and floor are equal thickness, adjust concrete quantities for transition where apron and floor thickness are not equal.

Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

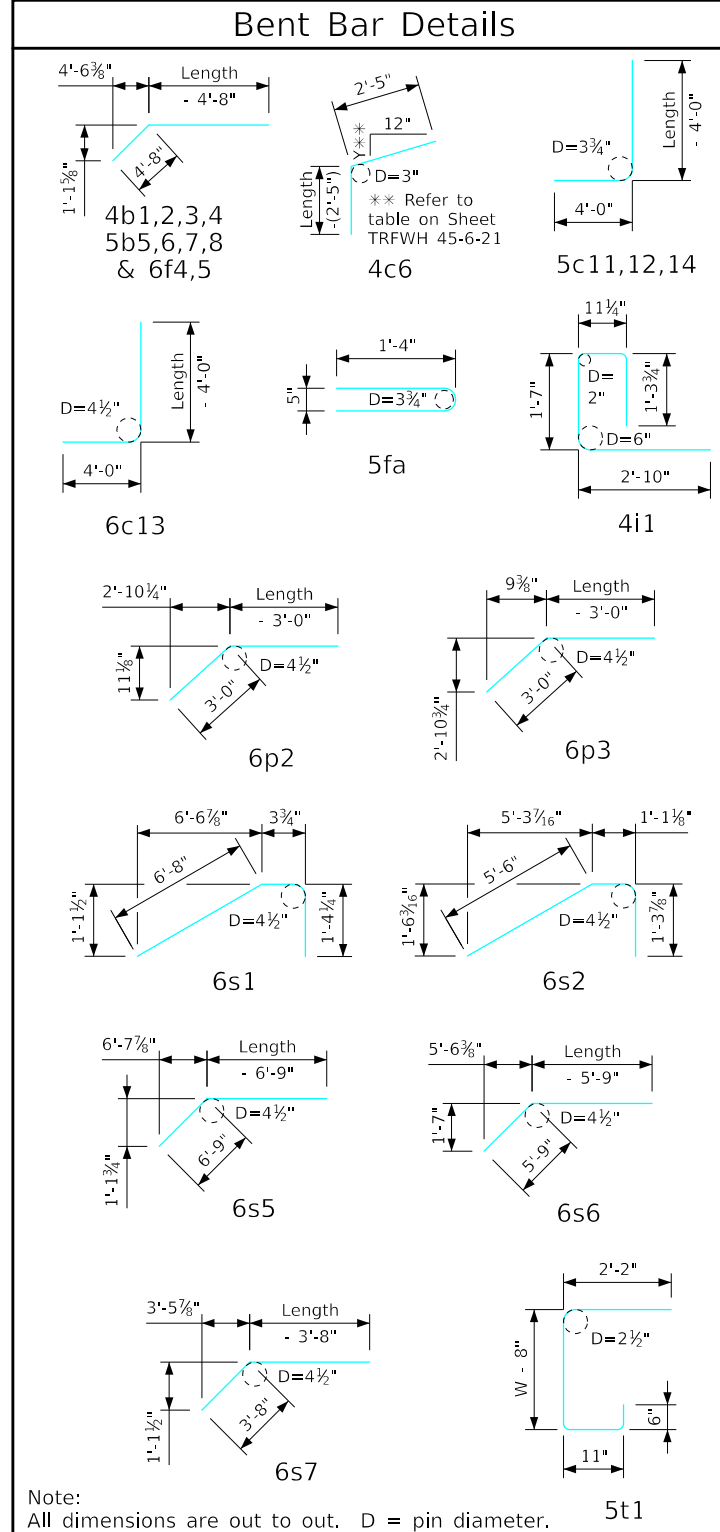
"Short" Denotes Short Wingwall
 "Long" Denotes Long Wingwall

Headwall Notes:

- See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
- This headwall is based on a 3:1 slope normal to centerline of roadway.
- The sides of the apron are to be formed to ensure correct line and grade.
- All apron reinforcing steel is to be supported by bar chairs at intervals of not more than 3'-0" in either direction as outlined in the Standard Specifications.
- Clear distance from face of concrete to near reinforcing bar is to be 2" unless otherwise noted or shown. Clearance to the bottom ends of vertical bars shall be 3 inches.
- Concrete quantities are estimated from back of parapet.
- Horizontal tails of bars "b" & "s" estimated to extend 2'-5" beyond back of parapet (into end of barrel). Longitudinal bars "d", "6f1", "6f4" and "6f5

Bill of Reinforcing for One Headwall 45° Skew Span x Culvert Height

Bar	Location	Shape	12' x 7'			12' x 6'			12' x 5'			12' x 4'			Bar
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	
5fa	Fence Anchor (Galv.)		2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	5fa
4b1	Wingwall, B.F.H. Long		1	47'-2"	33	1	41'-4"	29	1	35'-6"	24	1	29'-8"	20	4b1
4b2	Wingwall, B.F.H. Short		1	30'-1"	20	1	26'-7"	18	1	23'-1"	15	1	19'-7"	13	4b2
4b3	Wingwall, B.F.H. Long		5 Var.	21'-2 to 44'-5	111	4 Var.	21'-1 to 38'-7	80	3 Var.	21'-1 to 32'-9	54	2 Var.	21'-1 to 26'-11	32	4b3
4b4	Wingwall, B.F.H. Short		5 Var.	14'-6 to 28'-5	72	4 Var.	14'-6 to 24'-11	53	3 Var.	14'-6 to 21'-5	36	2 Var.	14'-6 to 17'-11	22	4b4
5b5	Wingwall, F.F.H. Long		1	47'-2"	52	1	41'-4"	46	1	35'-6"	37	1	29'-9"	31	5b5
5b6	Wingwall, F.F.H. Short		1	30'-1"	31	1	26'-7"	28	1	23'-1"	24	1	19'-7"	20	5b6
5b7	Wingwall, F.F.H. Long		6 Var.	15'-4 to 44'-5	189	5 Var.	15'-4 to 38'-7	141	4 Var.	15'-4 to 32'-9	100	3 Var.	15'-4 to 26'-11	66	5b7
5b8	Wingwall, F.F.H. Short		6 Var.	11'-0 to 28'-6	124	5 Var.	11'-0 to 25'-0	94	4 Var.	11'-0 to 21'-6	68	3 Var.	11'-0 to 18'-0	45	5b8
5b9	Interior Wall, Both F.H.		22 Var.	2 Each 7'-0 to 23'-8	352	18 Var.	2 Each 7'-1 to 20'-10	262	14 Var.	2 Each 7'-3 to 18'-0	184	10 Var.	2 Each 7'-5 to 15'-1	117	5b9
4c1	Wingwall, F.F.V. Long		43 Var.	2'-9 to 10'-0	183	37 Var.	2'-9 to 9'-0	145	31 Var.	2'-9 to 7'-11	110	25 Var.	2'-9 to 6'-11	81	4c1
4c2	Wingwall, F.F.V. Short		26 Var.	2'-10 to 10'-0	111	22 Var.	2'-10 to 8'-10	86	19 Var.	2'-10 to 8'-0	69	15 Var.	2'-10 to 6'-10	48	4c2
4c3	Wingwall, F.F.V. Long		--	--	--	--	--	--	--	--	--	--	--	--	4c3
4c4	Wingwall, F.F.V. Short		--	--	--	--	--	--	--	--	--	--	--	--	4c4
4c5	Wingwall, F.F.V. Long		1	8'-9	6	1	7'-9	5	2	6'-9	9	2	5'-9	8	4c5
4c5	Wingwall, F.F.V. Short		1	8'-9	6	2	7'-9	10	1	6'-9	5	2	5'-9	8	4c5
4c6	Interior Wall, Both F.V.		4	4'-1	11	4	4'-1	11	4	4'-1	11	4	4'-1	11	4c6
4c7	Interior Wall, Both F.V.		76 Var.	2 Each 1'-10 to 7'-5	235	66 Var.	2 Each 1'-10 to 6'-6	184	54 Var.	2 Each 1'-10 to 5'-5	131	44 Var.	2 Each 1'-10 to 4'-6	93	4c7
4c8	Interior Wall, Both F.V.		6	7'-7	30	6	6'-7	26	6	5'-7	22	6	4'-7	18	4c8
5c9	Wingwall, B.F.V. Long		15 Var.	2'-9 to 5'-2	62	15 Var.	2'-9 to 5'-2	62	15 Var.	2'-9 to 5'-2	62	15 Var.	2'-9 to 5'-2	62	5c9
5c10	Wingwall, B.F.V. Short		4 Var.	2'-10 to 3'-8	14	4 Var.	2'-10 to 3'-8	14	4 Var.	2'-10 to 3'-8	14	4 Var.	2'-10 to 3'-8	14	5c10
5c11	Wingwall, B.F.V. Long		28 Var.	9'-4 to 14'-0	341	22 Var.	9'-4 to 13'-0	256	16 Var.	9'-4 to 11'-11	177	10 Var.	9'-4 to 10'-11	106	5c11
5c12	Wingwall, B.F.V. Short		22 Var.	8'-0 to 14'-0	252	18 Var.	8'-0 to 12'-10	196	15 Var.	8'-0 to 12'-0	156	11 Var.	8'-0 to 10'-10	108	5c12
6c13	Wingwall, B.F.V. Long		18	10'-6	284	12	10'-6	189	--	--	--	--	--	--	6c13
6c13	Wingwall, B.F.V. Short		11	10'-6	173	7	10'-6	110	--	--	--	--	--	--	6c13
5c14	Wingwall, B.F.V. Long		1	12'-9	13	1	11'-9	12	2	10'-9	22	2	9'-9	20	5c14
5c14	Wingwall, B.F.V. Short		1	12'-9	13	2	11'-9	25	1	10'-9	11	2	9'-9	20	5c14
4d1	Apron, Longit., Bott.		25	24'-5	408	25	21'-7	360	25	18'-9	313	25	15'-11	266	4d1
4d2	Apron, Longit., Bott. Long		3	39'-9	80	3	33'-11	68	3	28'-1	56	3	22'-3	45	4d2
4d3	Apron, Longit., Bott. Short		3	25'-1	50	3	21'-7	43	3	18'-1	36	3	14'-7	29	4d3
6f1	Apron, Longit., Top		37	24'-5	1357	37	21'-7	1199	37	18'-9	1042	37	15'-11	885	6f1
6f2	Apron, Longit., Top Long		8 Var.	6'-5 to 20'-8	163	7 Var.	5'-7 to 17'-10	123	5 Var.	6'-10 to 15'-0	82	4 Var.	6'-0 to 12'-2	55	6f2
6f3	Apron, Longit., Top Short		5 Var.	7'-4 to 21'-0	106	4 Var.	7'-11 to 18'-2	78	3 Var.	8'-6 to 15'-4	54	2 Var.	9'-1 to 12'-6	32	6f3
6f4	Apron, Longit., Top Long		1	47'-2	74	1	41'-4	66	1	35'-6	53	1	29'-9	45	6f4
6f5	Apron, Longit., Top Short		1	30'-1	45	1	26'-7	40	1	23'-1	35	1	19'-7	29	6f5
4i1	Parapet, Vertical		75	6'-8	334	75	6'-8	334	75	6'-8	334	75	6'-8	334	4i1
7j1	Parapet, Horizontal		4	54'-8	467	4	54'-8	467	4	54'-8	467	4	54'-8	467	7j1
6m1	Apron, Trans., Top		5 Var.	43'-7 to 44'-4	348	1	43'-7	69	27 Var.	16'-0 to 35'-6	1044	27 Var.	13'-2 to 32'-8	929	6m1
6m2	Apron, Trans., Top		22 Var.	21'-8 to 37'-5	976	26 Var.	18'-10 to 37'-7	1102	20 Var.	4'-8 to 15'-4	300	16 Var.	4'-1 to 12'-6	199	6m2
6m3	Apron, Trans., Top		27 Var.	6'-5 to 21'-0	556	23 Var.	5'-10 to 18'-2	415	--	--	--	--	--	--	6m3
6m4	Apron, Trans., Bott.		14 Var.	46'-7 to 60'-6	1177	12 Var.	46'-7 to 58'-4	989	10 Var.	46'-7 to 56'-2	808	8 Var.	46'-7 to 54'-1	634	6m4
6p1	Curtain, Horizontal		4	53'-0	333	4	52'-11	332	4	52'-11	332	4	52'-11	332	6p1
6p2	Curtain, Horizontal, Long		4	26'-6	159	4	23'-4	140	4	20'-2	121	4	17'-0	102	6p2
6p3	Curtain, Horizontal, Short		4	10'-7	64	4	9'-6	57	4	8'-6	51	4	7'-6	45	6p3
6s1	Wing Slope, Both F., Long		2	8'-4	25	2	8'-4	25	2	8'-4	25	2	8'-4	25	6s1
6s2	Wing Slope, Both F., Short		2	7'-11	24	2	7'-11	24	2	7'-11	24	2	7'-11	24	6s2
6s3	Wing Slope, Both F., Long		2	39'-0	117	2	33'-1	99	2	27'-2	82	2	21'-3	64	6s3
6s4	Wing Slope, Both F., Short		2	23'-6	71	2	19'-10	60	2	16'-2	49	2	12'-7	38	6s4
6s5	Wing Slope, F.F. Long		1	45'-1	71	1	39'-2	59	1	33'-3	50	1	27'-5	41	6s5
6s6	Wing Slope, F.F. Short		1	29'-5	44	1	25'-10	39	1	22'-2	33	1	18'-6	28	6s6
6s7	Interior Wall, Both F.H.		4	24'-4	146	4	21'-4	128	4	18'-4	110	4	15'-4	92	6s7
5t1	Curtain, Vertical		59	6'-8	410	55	6'-5	368	53	6'-5	355	49	6'-5	328	5t1
	Estimated Quantities One Headwall	Reinf. Steel	10,329 LB			8772 LB			7203 LB			6037 LB			
		Concrete	80.9 CY			68.2 CY			57.4 CY			47.3 CY			
		Parapet Δ	5.1			5.1			5.1			5.1			
		Wingwalls	14.6			11.1			8.1			5.5			
		Apron *	61.2			52.0			44.2			36.7			



Δ Includes top of wingwall quantities.

* Assumes apron and floor are equal thickness, adjust concrete quantities for transition where apron and floor thickness are not equal.

Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

"Short" Denotes Short Wingwall
"Long" Denotes Long Wingwall

Headwall Notes:

- See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
- This headwall is based on a 3:1 slope normal to centerline of roadway.
- The sides of the apron are to be formed to ensure correct line and grade.
- All apron reinforcing steel is to be supported by bar chairs at intervals of not more than 3'-0" in either direction as outlined in the Standard Specifications.
- Clear distance from face of concrete to near reinforcing bar is to be 2" unless otherwise noted or shown. Clearance to the bottom ends of vertical bars shall be 3 inches.
- Concrete quantities are estimated from back of parapet.
- Horizontal tails of bars "b" & "s" estimated to extend 2'-5" beyond back of parapet (into end of barrel). Longitudinal bars "d", "6f1", "6f4" and "6f5" estimated to project into end section of barrel a minimum of 2'-5" beyond back of parapet. The "length" column reflects total number of feet necessary to meet these requirements.
- Dimensions are in feet and inches unless otherwise noted.

IOWADOT Highway Division

Standard Design - Triple Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

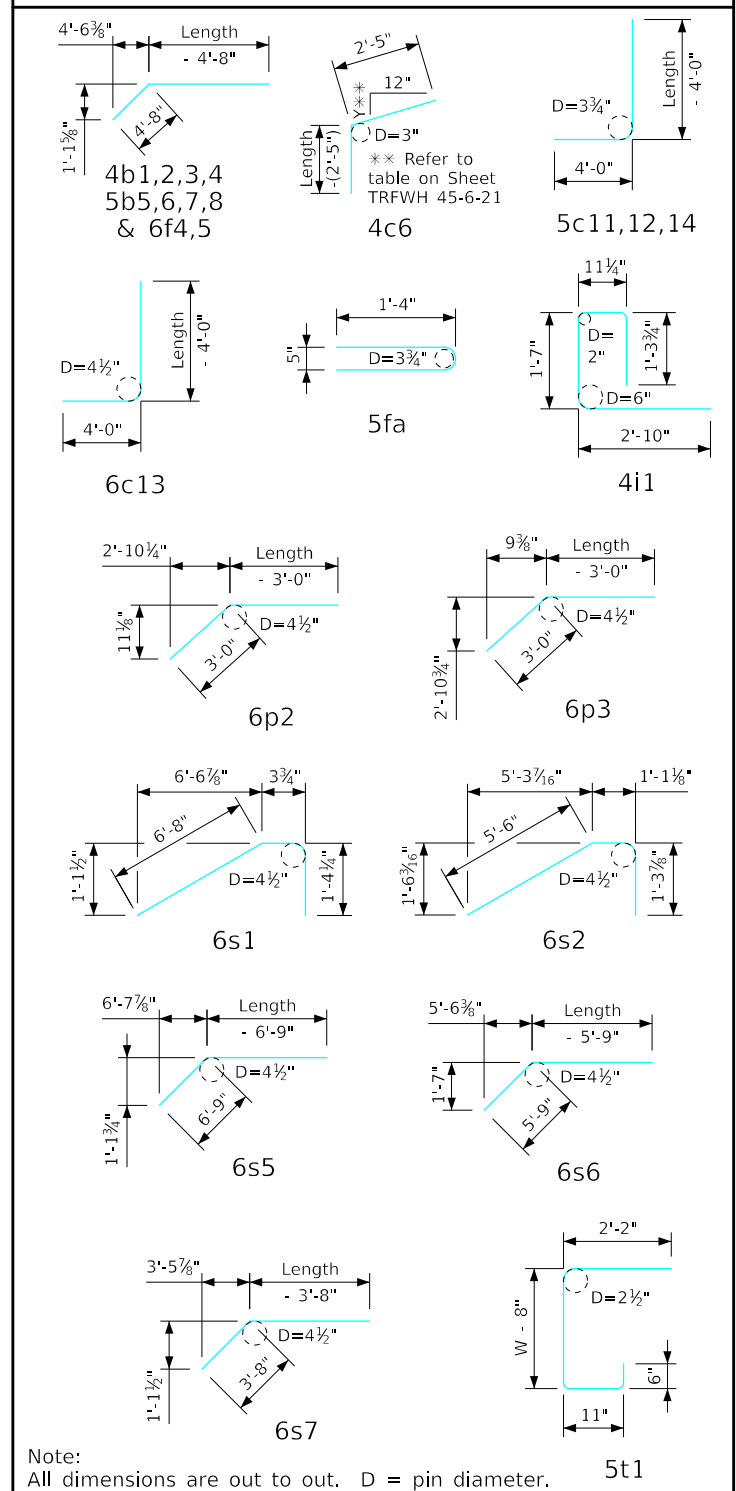
Quantity Tabulation 12'-0" Span 45° Skew	TRFWH 45-7-21 Sheet 2 of 2
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ENGLISHLRFDDESIGNEDTRIPLECULVERTSFWH.DGN - TRFWH 45-8-21 S1 - THIS SHEET ISSUED 02-2021.

Bill of Reinforcing for One Headwall 45° Skew Span x Culvert Height

Bar	Location	Shape	10' x 12'			10' x 11'			10' x 10'			10' x 9'			10' x 8'			Bar		
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.			
5fa	Fence Anchor (Galv.)		2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	5fa		
4b1	Wingwall, B.F.H. Long		1	76'-3"	53	1	70'-6"	49	1	64'-8"	45	1	58'-10"	41	1	53'-0"	37	4b1		
4b2	Wingwall, B.F.H. Short		1	47'-6"	33	1	44'-0"	31	1	40'-7"	29	1	37'-1"	25	1	33'-7"	22	4b2		
4b3	Wingwall, B.F.H. Long		10 Var.	21'-2 to 73'-6"	326	9 Var.	21'-2 to 67'-8"	275	8 Var.	21'-2 to 61'-11"	228	7 Var.	21'-2 to 56'-1"	185	6 Var.	21'-2 to 50'-3"	146	4b3		
4b4	Wingwall, B.F.H. Short		10 Var.	14'-6 to 45'-11"	205	9 Var.	14'-6 to 42'-5"	173	8 Var.	14'-6 to 38'-11"	143	7 Var.	14'-6 to 35'-5"	117	6 Var.	14'-6 to 31'-11"	93	4b4		
5b5	Wingwall, F.F.H. Long		1	76'-4"	82	1	70'-6"	76	1	64'-8"	70	1	58'-10"	64	1	53'-0"	58	5b5		
5b6	Wingwall, F.F.H. Short		1	47'-7"	52	1	44'-1"	48	1	40'-7"	45	1	37'-1"	39	1	33'-7"	35	5b6		
5b7	Wingwall, F.F.H. Long		11 Var.	15'-5 to 73'-7"	526	10 Var.	15'-5 to 67'-9"	446	9 Var.	15'-5 to 61'-11"	373	8 Var.	15'-5 to 56'-1"	306	7 Var.	15'-4 to 50'-3"	244	5b7		
5b8	Wingwall, F.F.H. Short		11 Var.	11'-1 to 46'-0"	333	10 Var.	11'-1 to 42'-6"	282	9 Var.	11'-1 to 39'-0"	235	8 Var.	11'-1 to 35'-6"	194	7 Var.	11'-1 to 32'-0"	157	5b8		
5b9	Interior Wall, Both F.H.		42 Var.	2 Each 6'-11 to 37'-9"	978	38 Var.	2 Each 6'-11 to 34'-11"	829	34 Var.	2 Each 6'-11 to 32'-2"	693	30 Var.	2 Each 6'-11 to 29'-4"	567	26 Var.	2 Each 7'-0 to 26'-6"	454	5b9		
4c1	Wingwall, F.F.V. Long		72 Var.	2'-8 to 14'-11"	423	66 Var.	2'-8 to 13'-10"	364	60 Var.	2'-8 to 12'-10"	311	54 Var.	2'-8 to 11'-10"	262	49 Var.	2'-8 to 10'-11"	222	4c1		
4c2	Wingwall, F.F.V. Short		43 Var.	2'-9 to 14'-9"	251	40 Var.	2'-9 to 13'-11"	223	36 Var.	2'-9 to 12'-9"	186	33 Var.	2'-9 to 11'-11"	162	29 Var.	2'-9 to 10'-9"	131	4c2		
4c3	Wingwall, F.F.V. Long		33 Var.	9'-6 to 15'-0"	270	27 Var.	9'-6 to 13'-11"	211	21 Var.	9'-6 to 12'-11"	157	15 Var.	9'-6 to 11'-11"	107	--	--	--	4c3		
4c4	Wingwall, F.F.V. Short		20 Var.	9'-6 to 14'-11"	163	17 Var.	9'-6 to 14'-0"	133	13 Var.	9'-6 to 12'-11"	97	10 Var.	9'-6 to 12'-0"	72	--	--	--	4c4		
4c5	Wingwall, F.F.V. Long		1	13'-8"	9	2	12'-8"	17	2	11'-8"	16	2	10'-8"	14	1	9'-8"	6	4c5		
4c5	Wingwall, F.F.V. Short		2	13'-8"	18	1	12'-8"	8	2	11'-8"	16	1	10'-8"	7	2	9'-8"	13	4c5		
4c6	Interior Wall, Both F.V.		4	4'-0"	11	4	4'-0"	11	4	4'-0"	11	4	4'-0"	11	4	4'-0"	11	4c6		
4c7	Interior Wall, Both F.V.		132 Var.	2 Each 1'-9 to 12'-4"	621	122 Var.	2 Each 1'-9 to 11'-5"	537	110 Var.	2 Each 1'-9 to 10'-4"	444	100 Var.	2 Each 1'-9 to 9'-5"	373	88 Var.	2 Each 1'-9 to 8'-5"	299	4c7		
4c8	Interior Wall, Both F.V.		6	12'-6"	50	6	11'-6"	46	6	10'-6"	42	6	9'-6"	38	6	8'-6"	34	4c8		
5c9	Wingwall, B.F.V. Long		15 Var.	2'-8 to 5'-1"	61	15 Var.	2'-8 to 5'-1"	61	15 Var.	2'-8 to 5'-1"	61	15 Var.	2'-8 to 5'-1"	61	15 Var.	2'-8 to 5'-1"	61	5c9		
5c10	Wingwall, B.F.V. Short		4 Var.	2'-9 to 3'-7"	13	4 Var.	2'-9 to 3'-7"	13	4 Var.	2'-9 to 3'-7"	13	4 Var.	2'-9 to 3'-7"	13	4 Var.	2'-9 to 3'-7"	13	5c10		
5c11	Wingwall, B.F.V. Long		57 Var.	9'-3 to 18'-11"	837	51 Var.	9'-3 to 17'-10"	720	45 Var.	9'-3 to 16'-10"	612	39 Var.	9'-3 to 15'-10"	510	34 Var.	9'-3 to 14'-11"	428	5c11		
5c12	Wingwall, B.F.V. Short		39 Var.	7'-11 to 18'-9"	542	36 Var.	7'-11 to 17'-11"	485	32 Var.	7'-11 to 16'-9"	412	29 Var.	7'-11 to 15'-11"	360	25 Var.	7'-11 to 14'-9"	296	5c12		
6c13	Wingwall, B.F.V. Long		47	10'-6"	741	41	10'-6"	647	35	10'-6"	552	29	10'-6"	457	24	10'-6"	379	6c13		
6c13	Wingwall, B.F.V. Short		28	10'-6"	442	25	10'-6"	394	21	10'-6"	331	18	10'-6"	284	14	10'-6"	221	6c13		
5c14	Wingwall, B.F.V. Long		1	17'-8"	18	2	16'-8"	35	2	15'-8"	33	2	14'-8"	31	1	13'-8"	14	5c14		
5c14	Wingwall, B.F.V. Short		2	17'-8"	37	1	16'-8"	17	2	15'-8"	33	1	14'-8"	15	2	13'-8"	29	5c14		
4d1	Apron, Longit., Bott.		21	38'-6"	540	21	35'-8"	500	21	32'-10"	461	21	30'-0"	421	21	27'-2"	381	4d1		
4d2	Apron, Longit., Bott. Long		3	68'-10"	143	3	63'-0"	131	3	57'-2"	119	3	51'-5"	108	3	45'-7"	96	4d2		
4d3	Apron, Longit., Bott. Short		3	42'-7"	90	3	39'-1"	78	3	35'-7"	71	3	32'-1"	64	3	28'-7"	57	4d3		
6f1	Apron, Longit., Top		31	38'-6"	1793	31	35'-8"	1661	31	32'-10"	1529	31	30'-0"	1397	31	27'-2"	1265	6f1		
6f2	Apron, Longit., Top Long		15 Var.	6'-7 to 34'-10"	467	14 Var.	5'-8 to 32'-0"	396	12 Var.	6'-11 to 29'-2"	325	11 Var.	6'-1 to 26'-4"	268	9 Var.	7'-3 to 23'-6"	208	6f2		
6f3	Apron, Longit., Top Short		9 Var.	8'-1 to 35'-2"	292	8 Var.	8'-8 to 32'-4"	246	8 Var.	5'-9 to 29'-6"	212	7 Var.	6'-4 to 26'-8"	173	6 Var.	6'-10 to 23'-10"	138	6f3		
6f4	Apron, Longit., Top Long		1	76'-4"	118	1	70'-6"	110	1	64'-8"	101	1	58'-10"	92	1	53'-0"	83	6f4		
6f5	Apron, Longit., Top Short		1	47'-7"	75	1	44'-1"	70	1	40'-7"	65	1	37'-1"	56	1	33'-7"	50	6f5		
4i1	Parapet, Vertical		65	6'-8"	289	63	6'-8"	281	63	6'-8"	281	63	6'-8"	281	63	6'-8"	281	4i1		
7j1	Parapet, Horizontal		4	47'-7"	409	4	47'-1"	405	4	46'-8"	401	4	46'-8"	401	4	46'-8"	401	7j1		
6m1	Apron, Trans., Top		23 Var.	37'-11 to 42'-0"	1420	23 Var.	37'-6 to 41'-8"	1400	20 Var.	37'-2 to 40'-9"	1185	16 Var.	37'-2 to 40'-0"	931	13 Var.	37'-2 to 39'-5"	748	6m1		
6m2	Apron, Trans., Top		4 Var.	42'-3 to 43'-5"	272	1	41'-11"	67	3 Var.	30'-3 to 31'-9"	140	7 Var.	27'-5 to 31'-11"	312	10 Var.	24'-7 to 31'-4"	420	6m2		
6m3	Apron, Trans., Top		42 Var.	10'-3 to 33'-4"	1375	41 Var.	9'-7 to 32'-1"	1283	39 Var.	8'-3 to 29'-8"	1111	35 Var.	7'-8 to 26'-10"	907	31 Var.	7'-1 to 24'-0"	724	6m3		
6m4	Apron, Trans., Bott.		24 Var.	38'-10 to 63'-4"	1921	22 Var.	38'-7 to 61'-0"	1718	20 Var.	38'-4 to 58'-7"	1521	18 Var.	38'-4 to 56'-6"	1340	16 Var.	38'-4 to 54'-4"	1164	6m4		
6p1	Curtain, Horizontal		4	45'-3"	286	4	45'-0"	285	4	44'-9"	283	4	44'-9"	283	4	44'-9"	283	6p1		
6p2	Curtain, Horizontal, Long		4	42'-4"	269	4	39'-2"	235	4	36'-0"	216	4	32'-10"	197	4	29'-8"	178	6p2		
6p3	Curtain, Horizontal, Short		4	15'-8"	94	4	14'-7"	88	4	13'-7"	82	4	12'-7"	76	4	11'-7"	70	6p3		
6s1	Wing Slope, Both F., Long		2	8'-4"	25	2	8'-4"	25	2	8'-4"	25	2	8'-4"	25	2	8'-4"	25	6s1		
6s2	Wing Slope, Both F., Short		2	7'-11"	24	2	7'-11"	24	2	7'-11"	24	2	7'-11"	24	2	7'-11"	24	6s2		
6s3	Wing Slope, Both F., Long		2	68'-7"	213	2	62'-8"	196	2	56'-9"	178	2	50'-10"	160	2	44'-11"	142	6s3		
6s4	Wing Slope, Both F., Short		2	41'-8"	132	2	38'-0"	114	2	34'-5"	103	2	30'-9"	92	2	27'-1"	81	6s4		
6s5	Wing Slope, F.F. Long		1	74'-8"	116	1	68'-9"	107	1	62'-10"	98	1	56'-11"	89	1	51'-0"	80	6s5		
6s6	Wing Slope, F.F. Short		1	47'-8"	75	1	44'-0"	70	1	40'-4"	64	1	36'-9"	55	1	33'-1"	50	6s6		
6s7	Interior Wall, Both F.H.		4	39'-1"	235	4	36'-2"	217	4	33'-3"	200	4	30'-3"	182	4	27'-3"	164	6s7		
5t1	Curtain, Vertical		69	7'-11"	570	66	7'-8"	528	63	7'-5"	487	60	7'-2"	448	56	6'-11"	404	5t1		
			Reinf. Steel			18,344 LB			16,372 LB			14,476 LB			12,703 LB			10,926 LB		
			Concrete			4.8			4.7			4.6			4.6			4.6		
			Parapet Δ			4.8			39.6			30.3			25.2			20.4		
			Wingwalls			50.5			133.7			113.8			99.4			85.7		
			Apron *			100.5			89.4			78.9			69.6			60.7		
			155.8 CY			133.7 CY			113.8 CY			99.4 CY			85.7 CY					

Bent Bar Details



Δ Includes top of wingwall quantities.
 * Assumes apron and floor are equal thickness, adjust concrete quantities for transition where apron and floor thickness are not equal.

Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

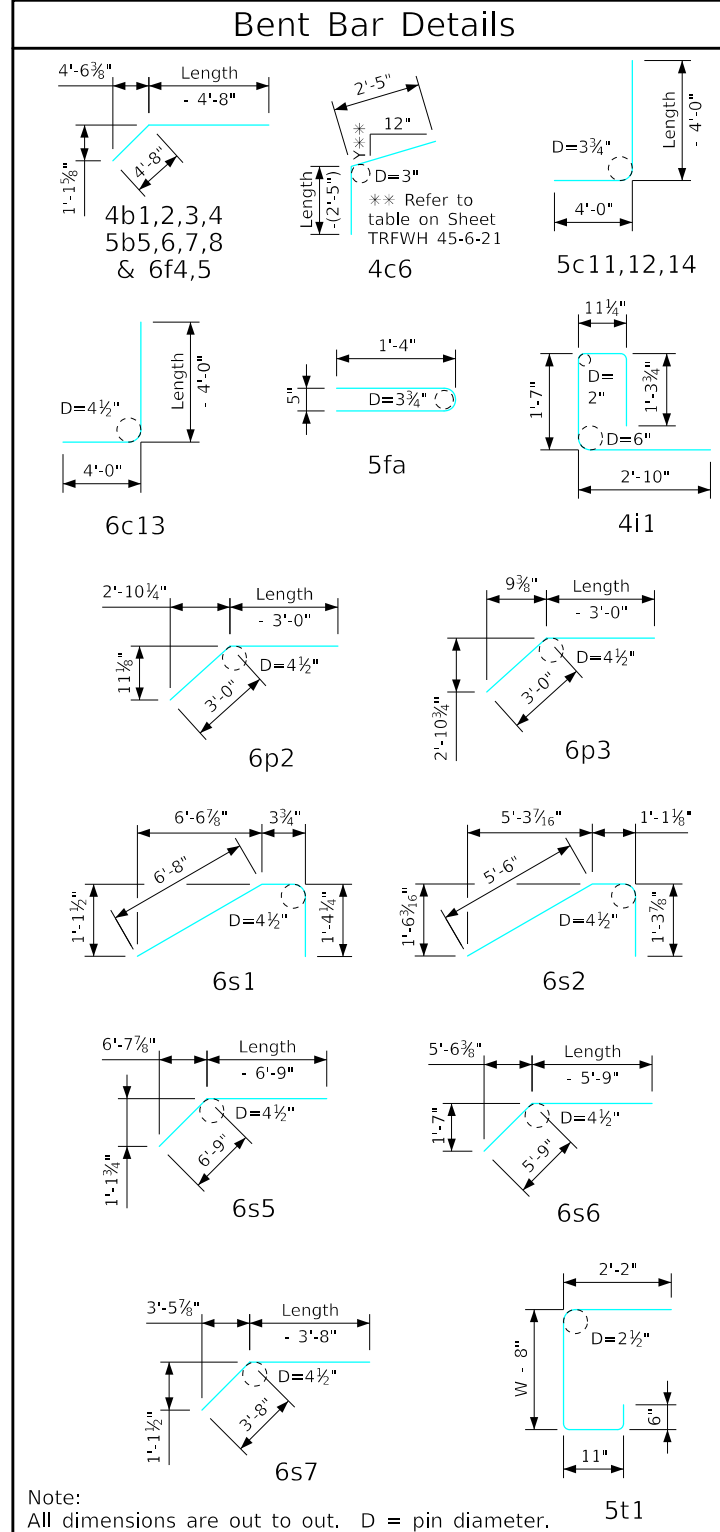
"Short" Denotes Short Wingwall
 "Long" Denotes Long Wingwall

Headwall Notes:

- See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
- This headwall is based on a 3:1 slope normal to centerline of roadway.
- The sides of the apron are to be formed to ensure correct line and grade.
- All apron reinforcing steel is to be supported by bar chairs at intervals of not more than 3'-0" in either direction as outlined in the Standard Specifications.
- Clear distance from face of concrete to near reinforcing bar is to be 2" unless otherwise noted or shown. Clearance to the bottom ends of vertical bars shall be 3 inches.
- Concrete quantities are estimated from back of parapet.
- Horizontal tails of bars "b" & "s" estimated to extend 2'-5" beyond back of parapet (into end of barrel). Longitudinal bars "d", "6f1", "6f4" and "6f5" estimated to project into end section of

Bill of Reinforcing for One Headwall 45° Skew Span x Culvert Height

Bar	Location	Shape	10' x 7'			10' x 6'			10' x 5'			10' x 4'			Bar
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	
5fa	Fence Anchor (Galv.)		2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	5fa
4b1	Wingwall, B.F.H. Long		1	47'-2"	33	1	41'-4"	29	1	35'-6"	24	1	29'-8"	20	4b1
4b2	Wingwall, B.F.H. Short		1	30'-1"	20	1	26'-7"	18	1	23'-1"	15	1	19'-7"	13	4b2
4b3	Wingwall, B.F.H. Long		5 Var.	21'-2 to 44'-5	111	4 Var.	21'-1 to 38'-7	80	3 Var.	21'-1 to 32'-9	54	2 Var.	21'-1 to 26'-11	32	4b3
4b4	Wingwall, B.F.H. Short		5 Var.	14'-6 to 28'-5	72	4 Var.	14'-6 to 24'-11	53	3 Var.	14'-6 to 21'-5	36	2 Var.	14'-6 to 17'-11	22	4b4
5b5	Wingwall, F.F.H. Long		1	47'-2"	52	1	41'-4"	46	1	35'-6"	37	1	29'-9"	31	5b5
5b6	Wingwall, F.F.H. Short		1	30'-1"	31	1	26'-7"	28	1	23'-1"	24	1	19'-7"	20	5b6
5b7	Wingwall, F.F.H. Long		6 Var.	15'-4 to 44'-5	189	5 Var.	15'-4 to 38'-7	141	4 Var.	15'-4 to 32'-9	100	3 Var.	15'-4 to 26'-11	66	5b7
5b8	Wingwall, F.F.H. Short		6 Var.	11'-0 to 28'-6	124	5 Var.	11'-0 to 25'-0	94	4 Var.	11'-0 to 21'-6	68	3 Var.	11'-0 to 18'-0	45	5b8
5b9	Interior Wall, Both F.H.		22 Var.	2 Each 7'-0 to 23'-8	352	18 Var.	2 Each 7'-1 to 20'-10	262	14 Var.	2 Each 7'-3 to 18'-0	184	10 Var.	2 Each 7'-5 to 15'-1	117	5b9
4c1	Wingwall, F.F.V. Long		43 Var.	2'-8 to 9'-11	181	37 Var.	2'-8 to 8'-11	143	31 Var.	2'-8 to 7'-10	109	25 Var.	2'-8 to 6'-10	79	4c1
4c2	Wingwall, F.F.V. Short		26 Var.	2'-9 to 9'-11	110	22 Var.	2'-9 to 8'-9	85	19 Var.	2'-9 to 7'-11	68	15 Var.	2'-9 to 6'-9	48	4c2
4c3	Wingwall, F.F.V. Long		--	--	--	--	--	--	--	--	--	--	--	--	4c3
4c4	Wingwall, F.F.V. Short		--	--	--	--	--	--	--	--	--	--	--	--	4c4
4c5	Wingwall, F.F.V. Long		1	8'-8	6	1	7'-8	5	2	6'-8	9	2	5'-8	8	4c5
4c5	Wingwall, F.F.V. Short		1	8'-8	6	2	7'-8	10	1	6'-8	4	2	5'-8	8	4c5
4c6	Interior Wall, Both F.V.		4	4'-0	11	4	4'-0	11	4	4'-0	11	4	4'-0	11	4c6
4c7	Interior Wall, Both F.V.		76 Var.	2 Each 1'-9 to 7'-4	231	66 Var.	2 Each 1'-9 to 6'-5	180	54 Var.	2 Each 1'-9 to 5'-4	128	44 Var.	2 Each 1'-9 to 4'-5	91	4c7
4c8	Interior Wall, Both F.V.		6	7'-6	30	6	6'-6	26	6	5'-6	22	6	4'-6	18	4c8
5c9	Wingwall, B.F.V. Long		15 Var.	2'-8 to 5'-1	61	15 Var.	2'-8 to 5'-1	61	15 Var.	2'-8 to 5'-1	61	15 Var.	2'-8 to 5'-1	61	5c9
5c10	Wingwall, B.F.V. Short		4 Var.	2'-9 to 3'-7	13	4 Var.	2'-9 to 3'-7	13	4 Var.	2'-9 to 3'-7	13	4 Var.	2'-9 to 3'-7	13	5c10
5c11	Wingwall, B.F.V. Long		28 Var.	9'-3 to 13'-11	338	22 Var.	9'-3 to 12'-11	254	16 Var.	9'-3 to 11'-10	176	10 Var.	9'-3 to 10'-10	105	5c11
5c12	Wingwall, B.F.V. Short		22 Var.	7'-11 to 13'-11	250	18 Var.	7'-11 to 12'-9	194	15 Var.	7'-11 to 11'-11	155	11 Var.	7'-11 to 10'-9	107	5c12
6c13	Wingwall, B.F.V. Long		18	10'-6	284	12	10'-6	189	--	--	--	--	--	--	6c13
6c13	Wingwall, B.F.V. Short		11	10'-6	173	7	10'-6	110	--	--	--	--	--	--	6c13
5c14	Wingwall, B.F.V. Long		1	12'-8	13	1	11'-8	12	2	10'-8	22	2	9'-8	20	5c14
5c14	Wingwall, B.F.V. Short		1	12'-8	13	2	11'-8	24	1	10'-8	11	2	9'-8	20	5c14
4d1	Apron, Longit., Bott.		21	24'-5	343	21	21'-7	303	21	18'-9	263	21	15'-11	223	4d1
4d2	Apron, Longit., Bott. Long		3	39'-9	80	3	33'-11	68	3	28'-1	56	3	22'-3	45	4d2
4d3	Apron, Longit., Bott. Short		3	25'-1	50	3	21'-7	43	3	18'-1	36	3	14'-7	29	4d3
6f1	Apron, Longit., Top		31	24'-5	1137	31	21'-7	1005	31	18'-9	873	31	15'-11	741	6f1
6f2	Apron, Longit., Top Long		8 Var.	6'-5 to 20'-8	163	7 Var.	5'-7 to 17'-10	123	5 Var.	6'-0 to 15'-0	82	4 Var.	6'-0 to 12'-2	55	6f2
6f3	Apron, Longit., Top Short		5 Var.	7'-4 to 21'-0	106	4 Var.	7'-11 to 18'-2	78	3 Var.	8'-6 to 15'-4	54	2 Var.	9'-1 to 12'-6	32	6f3
6f4	Apron, Longit., Top Long		1	47'-2	74	1	41'-4	66	1	35'-6	53	1	29'-9	45	6f4
6f5	Apron, Longit., Top Short		1	30'-1	45	1	26'-7	40	1	23'-1	35	1	19'-7	29	6f5
4i1	Parapet, Vertical		63	6'-8	281	63	6'-8	281	63	6'-8	281	63	6'-8	281	4i1
7j1	Parapet, Horizontal		4	46'-2	397	4	46'-2	397	4	46'-2	397	4	46'-2	397	7j1
6m1	Apron, Trans., Top		9 Var.	36'-10 to 38'-4	508	5 Var.	36'-10 to 37'-7	279	1	36'-10	55	23 Var.	13'-2 to 29'-8	740	6m1
6m2	Apron, Trans., Top		14 Var.	21'-8 to 31'-5	558	18 Var.	18'-10 to 31'-7	682	22 Var.	16'-0 to 31'-9	789	16 Var.	4'-1 to 12'-6	199	6m2
6m3	Apron, Trans., Top		27 Var.	6'-5 to 21'-0	556	23 Var.	5'-10 to 18'-2	415	20 Var.	4'-8 to 15'-4	300	--	--	--	6m3
6m4	Apron, Trans., Bott.		14 Var.	38'-1 to 52'-0	991	12 Var.	38'-1 to 49'-10	829	10 Var.	38'-1 to 47'-9	674	8 Var.	38'-1 to 45'-7	524	6m4
6p1	Curtain, Horizontal		4	44'-6	282	4	44'-6	282	4	44'-5	281	4	44'-5	281	6p1
6p2	Curtain, Horizontal, Long		4	26'-6	159	4	23'-4	140	4	20'-2	121	4	17'-0	102	6p2
6p3	Curtain, Horizontal, Short		4	10'-7	64	4	9'-6	57	4	8'-6	51	4	7'-6	45	6p3
6s1	Wing Slope, Both F., Long		2	8'-4	25	2	8'-4	25	2	8'-4	25	2	8'-4	25	6s1
6s2	Wing Slope, Both F., Short		2	7'-11	24	2	7'-11	24	2	7'-11	24	2	7'-11	24	6s2
6s3	Wing Slope, Both F., Long		2	39'-0	117	2	33'-1	99	2	27'-2	82	2	21'-3	64	6s3
6s4	Wing Slope, Both F., Short		2	23'-6	71	2	19'-10	60	2	16'-2	49	2	12'-7	38	6s4
6s5	Wing Slope, F.F. Long		1	45'-1	71	1	39'-2	59	1	33'-3	50	1	27'-5	41	6s5
6s6	Wing Slope, F.F. Short		1	29'-5	44	1	25'-10	39	1	22'-2	33	1	18'-6	28	6s6
6s7	Interior Wall, Both F.H.		4	24'-4	146	4	21'-4	128	4	18'-4	110	4	15'-4	92	6s7
5t1	Curtain, Vertical		53	6'-8	369	49	6'-5	328	47	6'-5	315	43	6'-5	288	5t1
	Estimated Quantities One Headwall	Reinf. Steel	9371 LB			7924 LB			6426 LB			5329 LB			
		Concrete	Parapet Δ	4.4		4.4		4.4		4.4		4.4			
			Wingwalls	14.6		11.1		8.1		5.5		5.5			
			Apron *	51.8	70.8 CY	43.9	59.4 CY	37.2	49.7 CY	30.8	40.7 CY				



Δ Includes top of wingwall quantities.
 * Assumes apron and floor are equal thickness, adjust concrete quantities for transition where apron and floor thickness are not equal.
 Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.
 "Short" Denotes Short Wingwall
 "Long" Denotes Long Wingwall

- ### Headwall Notes:
- See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
 - This headwall is based on a 3:1 slope normal to centerline of roadway.
 - The sides of the apron are to be formed to ensure correct line and grade.
 - All apron reinforcing steel is to be supported by bar chairs at intervals of not more than 3'-0" in either direction as outlined in the Standard Specifications.
 - Clear distance from face of concrete to near reinforcing bar is to be 2" unless otherwise noted or shown. Clearance to the bottom ends of vertical bars shall be 3 inches.
 - Concrete quantities are estimated from back of parapet.
 - Horizontal tails of bars "b" & "s" estimated to extend 2'-5" beyond back of parapet (into end of barrel). Longitudinal bars "d", "6f1", "6f4" and "6f5" estimated to project into end section of barrel a minimum of 2'-5" beyond back of parapet. The "length" column reflects total number of feet necessary to meet these requirements.
 - Dimensions are in feet and inches unless otherwise noted.

IOWADOT Highway Division

Standard Design - Triple Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation 10'-0" Span 45° Skew	TRFWH 45-8-21 Sheet 2 of 2
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