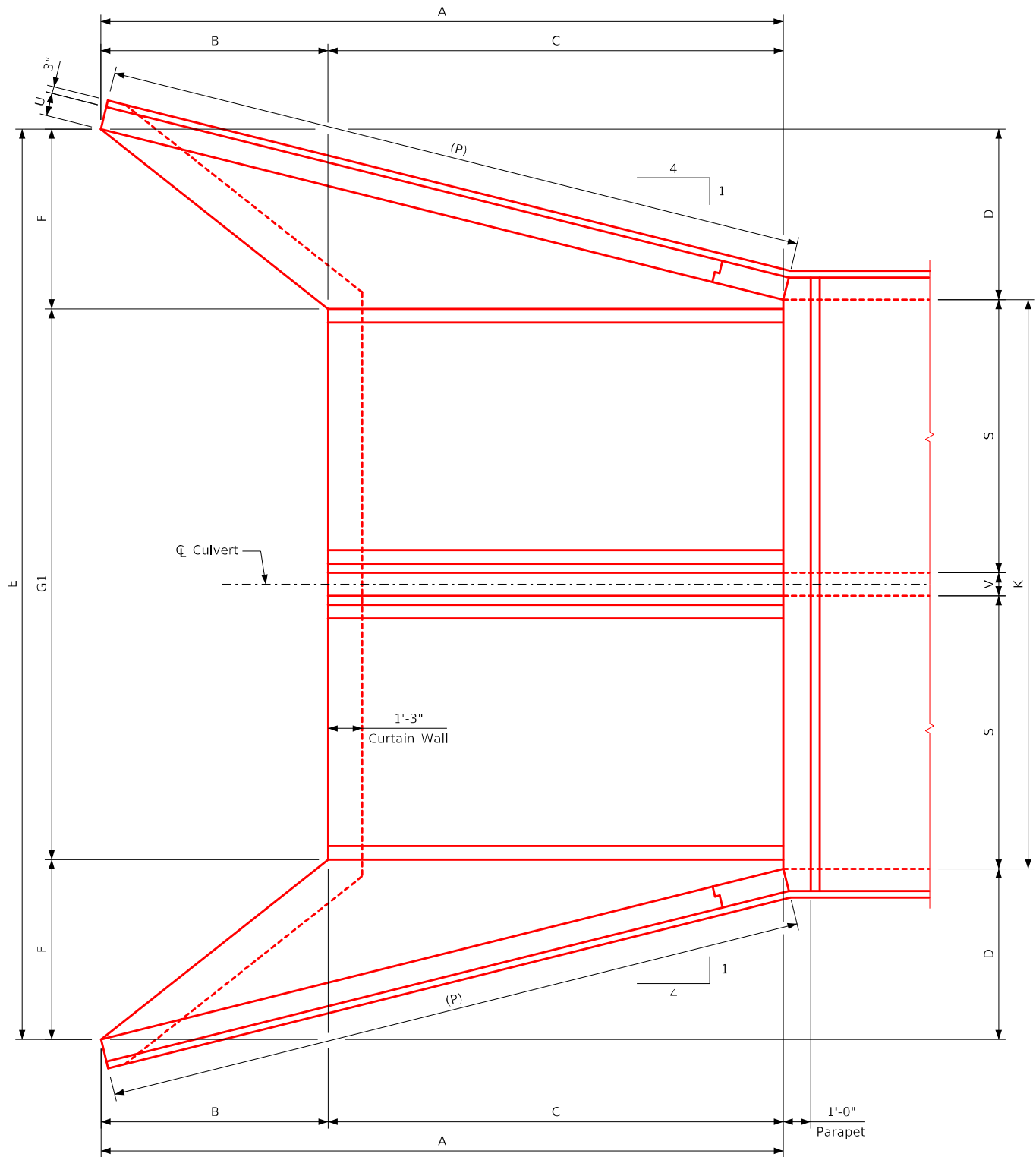


ENGLISHLRFDSignedTWINCULVERTSFWH.DGN - TWFWH 0-1-21 - THIS SHEET ISSUED 02-2021.



Plan View

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'	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	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	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	C
D	9'-3	8'-6	7'-9	7'-0	6'-3	5'-6	4'-9	4'-0	3'-3	9'-3	8'-6	7'-9	7'-0	6'-3	5'-6	D
E	43'-6	41'-11	40'-4	38'-10	37'-4	35'-9	34'-3	32'-9	31'-3	39'-6	37'-11	36'-4	34'-10	33'-4	31'-9	E
F	9'-7	8'-10	8'-1	7'-4	6'-7	5'-10	5'-1	4'-4	3'-7	9'-7	8'-10	8'-1	7'-4	6'-7	5'-10	F
G1	24'-4	24'-3	24'-2	24'-2	24'-2	24'-1	24'-1	24'-1	24'-1	20'-4	20'-3	20'-2	20'-2	20'-2	20'-1	G1
G2	25'-6½	25'-5½	25'-4¾	25'-4¾	25'-4½	25'-3½	25'-3¾	25'-3¾	25'-3¾	21'-6½	21'-5½	21'-4¾	21'-4¾	21'-4½	21'-3½	G2
G3	15'-7¾	14'-4¾	13'-1¾	11'-10¾	10'-7½	9'-4½	8'-1½	6'-10½	5'-7½	15'-7¾	14'-4¾	13'-1¾	11'-10¾	10'-7½	9'-4½	G3
G4	16'-5½	15'-0½	13'-7	12'-4	11'-1½	9'-7¾	8'-4¾	7'-1½	5'-11	16'-5½	15'-0½	13'-7	12'-4	11'-1½	9'-7¾	G4
G5	3½	5½	7½	7½	7½	9½	9¾	9¾	9½	3½	5½	7½	7½	7½	9½	G5
K	25'-0	24'-11	24'-10	24'-10	24'-10	24'-9	24'-9	24'-9	24'-9	21'-0	20'-11	20'-10	20'-10	20'-10	20'-9	K
P	38'-1½	35'-0½	31'-11½	28'-10¾	25'-9¾	22'-8½	19'-7	16'-5½	13'-4¾	38'-1½	35'-0½	31'-11½	28'-10¾	25'-9¾	22'-8½	P
R1	40'-1	36'-10	33'-7	30'-4	27'-1	23'-10	20'-7	17'-4	14'-1	40'-1	36'-10	33'-7	30'-4	27'-1	23'-10	R1
R2	27'-0½	24'-9¼	22'-6½	20'-3¾	18'-0¾	15'-10½	13'-7¾	11'-4¾	9'-2	27'-0½	24'-9¼	22'-6½	20'-3¾	18'-0¾	15'-10½	R2
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	T
U	1'-0	11	10	10	10	9	9	9	9	1'-0	11	10	10	10	9	U
V	1'-0	11	10	10	10	9	9	9	9	1'-0	11	10	10	10	9	V
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	W

Dimension Table

S x H	10' x 6'	10' x 5'	10' x 4'	8' x 10'	8' x 9'	8' x 8'	8' x 7'	8' x 6'	8' x 5'	8' x 4'	S x H
A	19'-0	16'-0	13'-0	31'-0	28'-0	25'-0	22'-0	19'-0	16'-0	13'-0	A
B	6'-4	5'-4	4'-4	10'-4	9'-4	8'-4	7'-4	6'-4	5'-4	4'-4	B
C	12'-8	10'-8	8'-8	20'-8	18'-8	16'-8	14'-8	12'-8	10'-8	8'-8	C
D	4'-9	4'-0	3'-3	7'-9	7'-0	6'-3	5'-6	4'-9	4'-0	3'-3	D
E	30'-3	28'-9	27'-3	32'-4	30'-10	29'-4	27'-9	26'-3	24'-9	23'-3	E
F	5'-1	4'-4	3'-7	8'-1	7'-4	6'-7	5'-10	5'-1	4'-4	3'-7	F
G1	20'-1	20'-1	20'-1	16'-2	16'-2	16'-2	16'-1	16'-1	16'-1	16'-1	G1
G2	21'-3¾	21'-3¼	21'-3½	17'-4½	17'-4¾	17'-4½	17'-3½	17'-3¾	17'-3¼	17'-3½	G2
G3	8'-1½	6'-10½	5'-7½	13'-1¾	11'-10¾	10'-7½	9'-4½	8'-1½	6'-10½	5'-7½	G3
G4	8'-4¾	7'-1½	5'-11	13'-7	12'-4	11'-1½	9'-7¾	8'-4¾	7'-1½	5'-11	G4
G5	9¾	9¾	9¾	7½	7½	7½	9½	9¾	9¾	9¾	G5
K	20'-9	20'-9	20'-9	16'-10	16'-10	16'-10	16'-9	16'-9	16'-9	16'-9	K
P	19'-7	16'-5½	13'-4¾	31'-11½	28'-10¾	25'-9¾	22'-8½	19'-7	16'-5½	13'-4¾	P
R1	20'-7	17'-4	14'-1	33'-7	30'-4	27'-1	23'-10	20'-7	17'-4	14'-1	R1
R2	13'-7¾	11'-4¾	9'-2	22'-6½	20'-3¾	18'-0¾	15'-10½	13'-7¾	11'-4¾	9'-2	R2
T	1'-1	1'-1	1'-1	1'-0	1'-0	1'-0	1'-0	1'-0	1'-0	1'-0	T
U	9	9	9	10	10	10	9	9	9	9	U
V	9	9	9	10	10	10	9	9	9	9	V
W	3'-6	3'-6	3'-6	4'-6	4'-3	4'-0	3'-9	3'-6	3'-6	3'-6	W

Notes:

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

LATEST REVISION DATE


APPROVED BY BRIDGE ENGINEER


Standard Design - Twin Reinforced Concrete Box Culverts
Flared Wing Headwalls
February, 2021

Dimension Plan
& Table
0° Skew

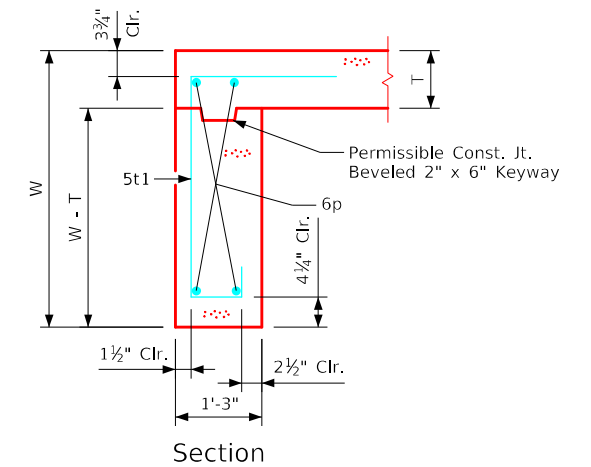
TWFWH
0-1-21



Angle
39.59°
39.09°
38.75°
38.50°
38.31°
38.16°
38.03°
37.93°
37.85°

The plan view shows a culvert structure with the following dimensions and details:

- Overall Dimensions:**
 - $G1$: Total length of the culvert.
 - $G2$: Length of the straight section.
 - $G3$: Length of the angled section.
 - $G4$: Length of the angled section.
 - $G5$: Width of the angled section.
- Reinforcement Details:**
 - $6p1$: Top reinforcement bars in the straight section.
 - $6p2$: Bottom reinforcement bars in the angled section.
 - $5t1 @ 1'-3"$: Top reinforcement bars in the angled section.
 - $3'-0"$: Width of the straight section.
 - $1'-3"$: Width of the angled section.
 - $U + \frac{e}{2}$: Offset dimension for the angled section.
 - A : Angle of the culvert section.
- Other Labels:**
 - ϕ Culvert: Centerline of the culvert.

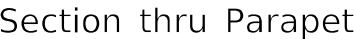
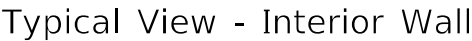


Curtain Wall Details

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.
6. For dimension table see Sheet TWFWH 0-1-21.
7. For reinforcing in curtain wall see "Curtain Wall Details" this sheet.

LATEST REVISION DATE		
	APPROVED BY BRIDGE ENGINEER	
		
Standard Design - Twin Reinforced Concrete Box Culverts		
Flared Wing Headwalls		
February, 2021		
Apron & Curtain Wall Details 0° Skew		TWFWH 0-2-21



- ## 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 TWFHW 0-1-21.
 7. Top of wall slope may be rounded in some instances.

LATEST REVISION DATE 	 APPROVED BY BRIDGE ENGINEER		
		Standard Design - Twin Reinforced Concrete Box Culverts Flared Wing Headwalls February, 2021	
		Wingwall & Parapet Details 0° Skew	TFWFH 0-3-21

ENGLISHLRFDSTWINCULVERTSFWH.DGN - TWFWH 0-5-21 S1 - THIS SHEET ISSUED 02-2021.

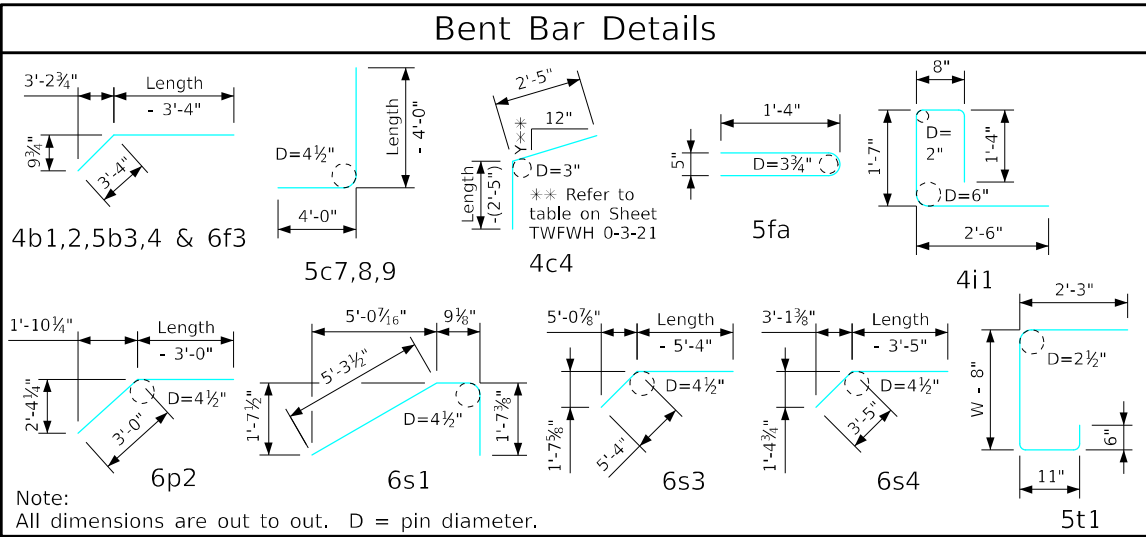
Bill of Reinforcing for One Headwall 0° Skew Span x Culvert Height																					
Bar	Location	Shape	10' x 12'			10' x 11'			10' x 10'			10' x 9'			10' x 8'			10' x 7'			Bar
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	
5fa	Fence Anchor (Galv.)		2	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.		21 Var.	5'-2 to 27'-8	360	19 Var.	5'-3 to 25'-8	306	17 Var.	5'-3 to 23'-7	256	15 Var.	5'-3 to 21'-7	210	13 Var.	5'-4 to 19'-7	169	11 Var.	5'-5 to 17'-7	132	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.		2	4'-1	5	2	4'-1	5	2	4'-1	5	2	4'-1	5	2	4'-1	5	2	4'-1	5	4c4
4c5	Interior Wall, Both F.V.		50 Var.	1'-11 to 12'-10	246	46 Var.	1'-11 to 11'-10	211	42 Var.	1'-11 to 10'-10	179	38 Var.	1'-10 to 9'-10	148	34 Var.	1'-10 to 8'-10	121	30 Var.	1'-10 to 7'-9	96	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.		15	27'-11	280	13	25'-11	225	13	23'-11	208	13	21'-11	190	13	19'-11	173	13	17'-11	156	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		20	27'-11	839	20	25'-11	779	20	23'-11	718	20	21'-11	658	20	19'-11	598	20	17'-11	538	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		43	6'-1	175	41	6'-1	167	41	6'-1	167	41	6'-1	167	41	6'-1	167	41	6'-1	167	4i1
7j1	Parapet, Horizontal		4	22'-8	185	4	22'-5	183	4	22'-2	181	4	22'-2	181	4	22'-2	181	4	21'-11	179	7j1
6m1	Apron, Trans., Top		34 Var.	22'-10 to 35'-3	1483	31 Var.	22'-7 to 33'-10	1313	29 Var.	22'-4 to 32'-10	1201	26 Var.	22'-4 to 31'-9	1056	23 Var.	22'-4 to 30'-7	914	21 Var.	22'-1 to 29'-7	815	6m1
6m2	Apron, Trans., Bott.		24 Var.	16'-9 to 28'-3	811	22 Var.	16'-8 to 27'-2	724	20 Var.	16'-7 to 26'-1	641	18 Var.	16'-7 to 25'-1	563	16 Var.	16'-7 to 24'-1	489	14 Var.	16'-6 to 23'-0	415	6m2
6p1	Curtain, Horizontal		4	21'-3	128	4	21'-2	127	4	21'-1	127	4	21'-1	127	4	21'-1	127	4	21'-0	126	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.		2	30'-3	91	2	28'-0	84	2	25'-9	77	2	23'-6	71	2	21'-4	64	2	19'-1	57	6s4
5t1	Curtain, Vertical		39	8'-0	325	37	7'-9	299	35	7'-6	274	33	7'-3	250	31	7'-0	226	29	6'-9	204	5t1
	Estimated Quantities One Headwall	Reinf. Steel		9618 LB		8525 LB		7545 LB		6621 LB		5662 LB		4914 LB							
		Concrete	Parapet Δ	2.5	80.3 CY	2.4	68.4 CY	2.3	58.1 CY	2.3	50.6 CY	2.3	42.8 CY	2.2	34.7 CY						
			Wingwalls	28.1		21.9		16.9		14.0		11.4		8.1							
			Apron *	49.7		44.1		38.9		34.3		29.1		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.

Headwall Notes:

- See Sheet TWFWH 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.



LATEST REVISION DATE		APPROVED BY BRIDGE ENGINEER		
			Standard Design - Twin Reinforced Concrete Box Culverts	
			Flared Wing Headwalls	
			February, 2021	
			Quantity Tabulation 10'-0" Span 0° Skew	TWFWH 0-5-21 Sheet 1 of 2



Twin Reinforced Concrete Box Culvert Standards - Flared Wing Headwalls

General Notes:

- 1. The RCB culvert sections are designed for HL-93 live load and earth fills of varying heights.
- 2. Vertical earth pressure, EV=0.120 kcf.
Horizontal earth pressure, EHmax = 0.060 kcf max, EHmin = 0.030 kcf.
- 3. 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.
- 4. 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.
- 5. The clear distance from face of concrete to near edge or end of reinforcing bar to be 2" unless otherwise noted.
- 6. Except for dowel bars 5r1 in slab, longitudinal reinforcing is not to extend thru the construction joints.
- 7. Floor of barrel is to be finished smooth. Sides of footing are to be formed to ensure correct line and grade.
- 8. The permissible construction joint at the top of the walls may be lowered at the Contractor's option with Engineer's approval.
- 9. 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.
- 10. 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.
- 11. Reinforcing bar clearances will be as follows:
Edge clearances: 2" except
Top of floor 2¼" to near transverse reinforcing bar
Bottom of floor 3½" to near transverse reinforcing bar
End clearances:
Vertical top 2"
Vertical bottom 3" or 3½" if overall height of the culvert is not to a full inch
Transverse 2"
 - 12. All construction joints shall be formed with a beveled keyway except at bell joints.
 - 13. All beveled keyways shall be centered.
 - 14. 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.
 - 15. 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.
 - 16. 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.
 - 17. All dimensions are in feet and inches unless otherwise noted or shown.
 - 18. Dimensions with parenthesis () indicate a reference dimension.
 - 19. See current Standard Specifications regarding concrete form removal.
 - 20. These culvert standards label all reinforcing steel with English notation (5a1 is ⅝ 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

- 21. 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.
- 22. For barrel details used in conjunction with these flared wing headwall standards, see the Twin Reinforced Concrete Box Culvert Standards (TWRCB).

Index for Twin Culvert Standards:

TWFWH G1-21	Index & General Notes
TWFWH 0-1-21	Flared Wing Hdwls., 0° Skew, Dimension Plan & Table
TWFWH 0-2-21	Flared Wing Hdwls., 0° Skew, Apron & Curtain Wall Details
TWFWH 0-3-21	Flared Wing Hdwls., 0° Skew, Wingwall & Parapet Details
TWFWH 0-4-21	Flared Wing Hdwls., 0° Skew, Quantity Tabulation, 12'-0" Span, Sheet 1 of 2
TWFWH 0-4-21	Flared Wing Hdwls., 0° Skew, Quantity Tabulation, 12'-0" Span, Sheet 2 of 2
TWFWH 0-5-21	Flared Wing Hdwls., 0° Skew, Quantity Tabulation, 10'-0" Span, Sheet 1 of 2
TWFWH 0-5-21	Flared Wing Hdwls., 0° Skew, Quantity Tabulation, 10'-0" Span, Sheet 2 of 2
TWFWH 0-6-21	Flared Wing Hdwls., 0° Skew, Quantity Tabulation, 8'-0" Span
TWFWH 15-1-21	Flared Wing Hdwls., 15° Skew, Dimension Plan
TWFWH 15-2-21	Flared Wing Hdwls., 15° Skew, Dimension Table
TWFWH 15-3-21	Flared Wing Hdwls., 15° Skew, Apron Details
TWFWH 15-4-21	Flared Wing Hdwls., 15° Skew, Parapet & Curtain Wall Details
TWFWH 15-5-21	Flared Wing Hdwls., 15° Skew, Wingwall Details
TWFWH 15-6-21	Flared Wing Hdwls., 15° Skew, Quantity Tabulation, 12'-0" Span, Sheet 1 of 2
TWFWH 15-6-21	Flared Wing Hdwls., 15° Skew, Quantity Tabulation, 12'-0" Span, Sheet 2 of 2
TWFWH 15-7-21	Flared Wing Hdwls., 15° Skew, Quantity Tabulation, 10'-0" Span, Sheet 1 of 2
TWFWH 15-7-21	Flared Wing Hdwls., 15° Skew, Quantity Tabulation, 10'-0" Span, Sheet 2 of 2
TWFWH 15-8-21	Flared Wing Hdwls., 15° Skew, Quantity Tabulation, 8'-0" Span, Sheet 1 of 2
TWFWH 15-8-21	Flared Wing Hdwls., 15° Skew, Quantity Tabulation, 8'-0" Span, Sheet 2 of 2
TWFWH 30-1-21	Flared Wing Hdwls., 30° Skew, Dimension Plan
TWFWH 30-2-21	Flared Wing Hdwls., 30° Skew, Dimension Table
TWFWH 30-3-21	Flared Wing Hdwls., 30° Skew, Apron Details
TWFWH 30-4-21	Flared Wing Hdwls., 30° Skew, Parapet & Curtain Wall Details
TWFWH 30-5-21	Flared Wing Hdwls., 30° Skew, Wingwall Details
TWFWH 30-6-21	Flared Wing Hdwls., 30° Skew, Quantity Tabulation, 12'-0" Span, Sheet 1 of 2
TWFWH 30-6-21	Flared Wing Hdwls., 30° Skew, Quantity Tabulation, 12'-0" Span, Sheet 2 of 2
TWFWH 30-7-21	Flared Wing Hdwls., 30° Skew, Quantity Tabulation, 10'-0" Span, Sheet 1 of 2
TWFWH 30-7-21	Flared Wing Hdwls., 30° Skew, Quantity Tabulation, 10'-0" Span, Sheet 2 of 2
TWFWH 30-8-21	Flared Wing Hdwls., 30° Skew, Quantity Tabulation, 8'-0" Span, Sheet 1 of 2
TWFWH 30-8-21	Flared Wing Hdwls., 30° Skew, Quantity Tabulation, 8'-0" Span, Sheet 2 of 2
TWFWH 45-1-21	Flared Wing Hdwls., 45° Skew, Dimension Plan
TWFWH 45-2-21	Flared Wing Hdwls., 45° Skew, Dimension Table
TWFWH 45-3-21	Flared Wing Hdwls., 45° Skew, Top Apron Detail
TWFWH 45-4-21	Flared Wing Hdwls., 45° Skew, Bottom Apron Detail
TWFWH 45-5-21	Flared Wing Hdwls., 45° Skew, Parapet & Curtain Wall Details
TWFWH 45-6-21	Flared Wing Hdwls., 45° Skew, Wingwall Details
TWFWH 45-7-21	Flared Wing Hdwls., 45° Skew, Quantity Tabulation, 12'-0" Span, Sheet 1 of 2
TWFWH 45-7-21	Flared Wing Hdwls., 45° Skew, Quantity Tabulation, 12'-0" Span, Sheet 2 of 2
TWFWH 45-8-21	Flared Wing Hdwls., 45° Skew, Quantity Tabulation, 10'-0" Span, Sheet 1 of 2
TWFWH 45-8-21	Flared Wing Hdwls., 45° Skew, Quantity Tabulation, 10'-0" Span, Sheet 2 of 2
TWFWH 45-9-21	Flared Wing Hdwls., 45° Skew, Quantity Tabulation, 8'-0" Span, Sheet 1 of 2
TWFWH 45-9-21	Flared Wing Hdwls., 45° Skew, Quantity Tabulation, 8'-0" Span, Sheet 2 of 2

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 - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

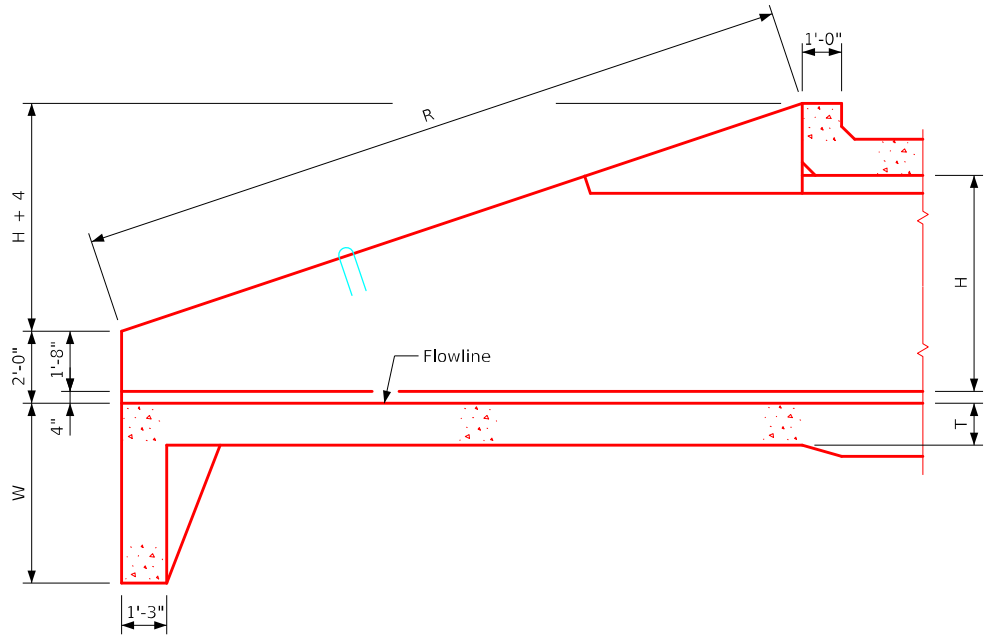
February, 2021

Index of Sheets, General Notes & Specifications

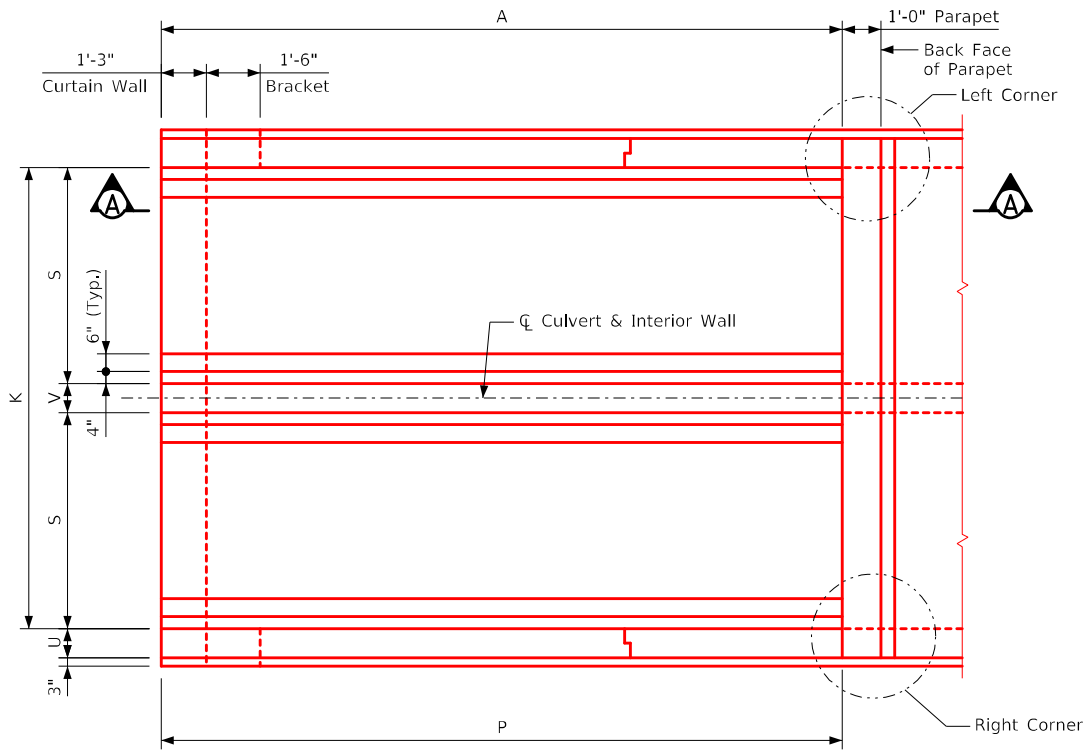
TWFWH G1-21

ENGLISHLRFDSignedTWINCULVERTSFHW.H.DGN - TWFWH G1-21 - THIS SHEET ISSUED 02-2021.

ENGLISHLRFDSDIGNEDTWINCULVERTS.DGN - TWPWH 0-1-20 - THIS SHEET ISSUED 07-2020.



Elevation Section A-A



Plan View

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	
Headwall Dimensions	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
	H	12'-0	11'-0	10'-0	9'-0	8'-0	7'-0	6'-0	5'-0	4'-0	12'-0	11'-0	10'-0	9'-0	8'-0	7'-0	6'-0	5'-0	4'-0	H
	K	25'-0	25'-0	24'-10	24'-10	24'-10	24'-9	24'-9	24'-9	24'-9	21'-0	21'-0	20'-10	20'-10	20'-9	20'-9	20'-9	20'-9	20'-9	K
	P	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	P
	R	39'-0	35'-10½	32'-8½	29'-6½	26'-4¼	23'-2¼	20'-0¾	16'-10¾	13'-8½	39'-0	35'-10½	32'-8½	29'-6½	26'-4¼	23'-2¼	20'-0¾	16'-10¾	13'-8½	R
	R1	38'-7¼	35'-5¼	32'-3¾	29'-1½	25'-11½	22'-9¾	19'-7¾	16'-5½	13'-4¾	38'-7¼	35'-5¼	32'-3¾	29'-1½	25'-11½	22'-9¾	19'-7¾	16'-5½	13'-4¾	R1
	S	12'-0	12'-0	12'-0	12'-0	12'-0	12'-0	12'-0	12'-0	10'-0	10'-0	10'-0	10'-0	10'-0	10'-0	10'-0	10'-0	10'-0	10'-0	S
Bar Spacing	T	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	1'-1	T
	U	1'-0	1'-0	10	10	10	9	9	9	9	1'-0	1'-0	10	10	10	9	9	9	9	U
	V	1'-0	1'-0	10	10	10	9	9	9	9	1'-0	1'-0	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	5'-0	4'-9	4'-6	4'-3	4'-0	3'-9	3'-6	3'-6	3'-6	W
	B	1'-0	1'-0	1'-0	1'-0	1'-0	1'-0	9	1'-0	1'-0	1'-0	1'-0	1'-0	1'-0	1'-0	1'-0	1'-0	1'-0	1'-0	B
	C	1'-0	1'-0	1'-0	1'-0	9	9	9	1'-0	1'-0	1'-0	1'-0	1'-0	9	9	9	1'-0	1'-0	1'-0	C
	D	6	6	1'-0	1'-0	1'-0	1'-0	9	1'-0	6	6	1'-0	1'-0	1'-0	1'-0	1'-0	1'-0	1'-0	1'-0	D
Bar Spacing	E	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	E

Dimension Table									
S x H	8' x 10'	8' x 9'	8' x 8'	8' x 7'	8' x 6'	8' x 5'	8' x 4'	S x H	
Headwall Dimensions	A	31'-0	28'-0	25'-0	22'-0	19'-0	16'-0	13'-0	A
	H	10'-0	9'-0	8'-0	7'-0	6'-0	5'-0	4'-0	H
	K	16'-10	16'-10	16'-10	16'-9	16'-9	16'-9	16'-9	K
	P	31'-0	28'-0	25'-0	22'-0	19'-0	16'-0	13'-0	P
	R	32'-8½	29'-6½	26'-4¼	23'-2¼	20'-0¾	16'-10¾	13'-8½	R
	R1	32'-3¾	29'-1½	25'-11½	22'-9¾	19'-7¾	16'-5½	13'-4¾	R1
	S	8'-0	8'-0	8'-0	8'-0	8'-0	8'-0	8'-0	S
Bar Spacing	T	11	11	11	11	11	11	11	T
	U	10	10	10	9	9	9	9	U
	V	10	10	10	9	9	9	9	V
	W	4'-6	4'-3	4'-0	3'-9	3'-6	3'-6	3'-6	W
	B	1'-0	1'-0	1'-0	1'-0	1'-0	1'-0	1'-0	B
	C	1'-0	1'-0	9	9	9	1'-0	1'-0	C
	D	6	6	9	1'-0	1'-0	1'-0	1'-0	D
Bar Spacing	E	1'-0	1'-0	1'-0	1'-0	1'-0	1'-0	1'-0	E

- Notes:
1. See Sheet TWRCB G2-20 for General Notes, Specifications, and Design Stresses.
 2. See Sheets TWPWH 0-2-20 thru 0-5-20 for location of certain dimensions tabulated.
 3. Dimensions are in feet and inches unless otherwise noted.

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER



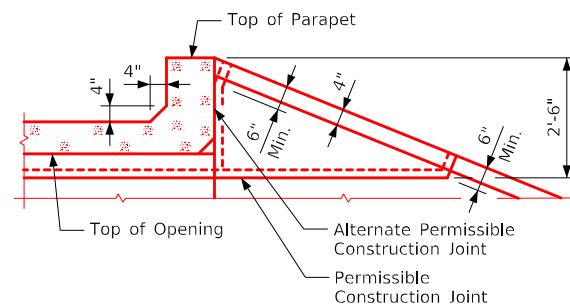
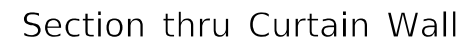
Standard Design - Twin Reinforced Concrete Box Culverts

Parallel Wing Headwalls

July, 2020

Dimension Table
0° Skew

TWPWH
0-1-20



Top of Wingwall Details

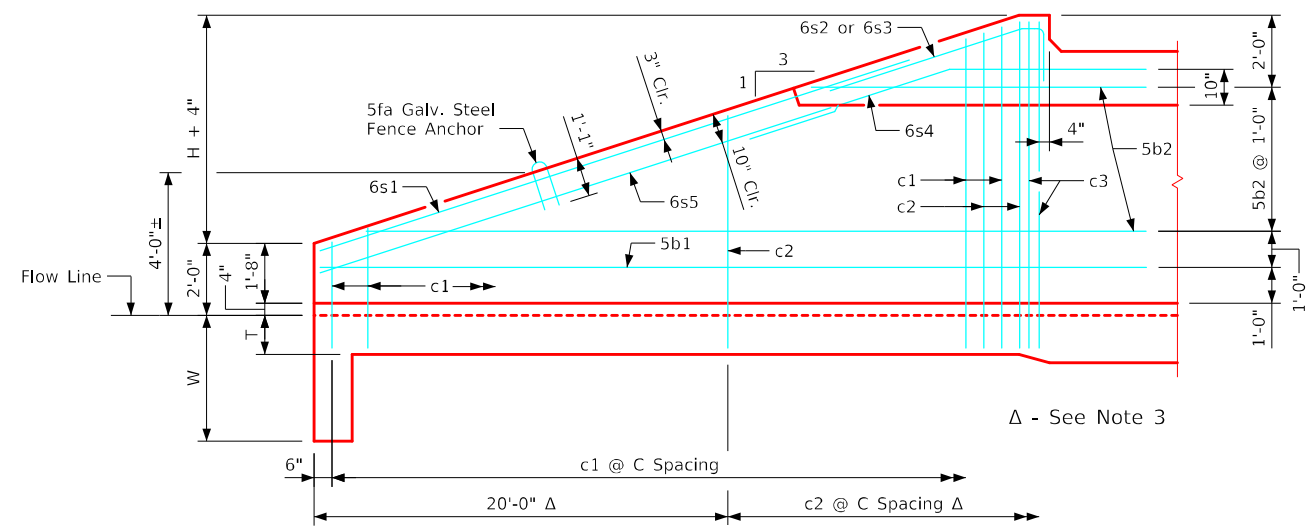


Notes:

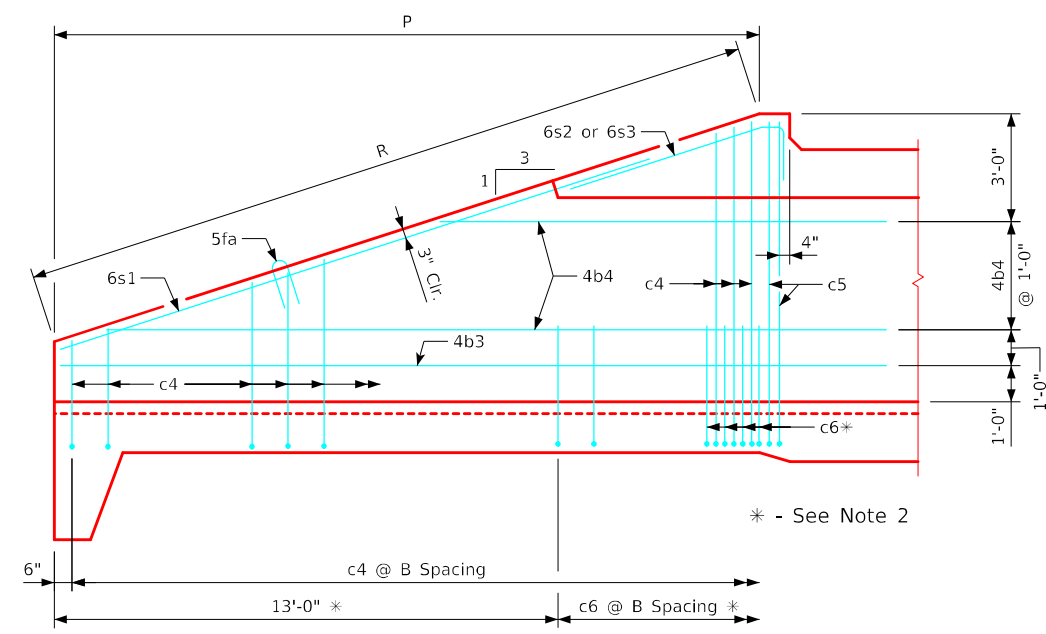
1. See Sheet TWRCB G2-20 for General Notes, Specifications, and Design Stresses.
2. For dimension table see Sheet TWPWH 0-1-20.

August 2022 LATEST REVISION DATE	 APPROVED BY BRIDGE ENGINEER		
		Standard Design - Twin Reinforced Concrete Box Culverts Parallel Wing Headwalls July, 2020	
		Cross Section Details 0° Skew	TWPWH 0-2-20

ENGLISHLRFDSTWNCULVERTS.DGN - TWPWH 0-3-20 - THIS SHEET ISSUED 07-2020.

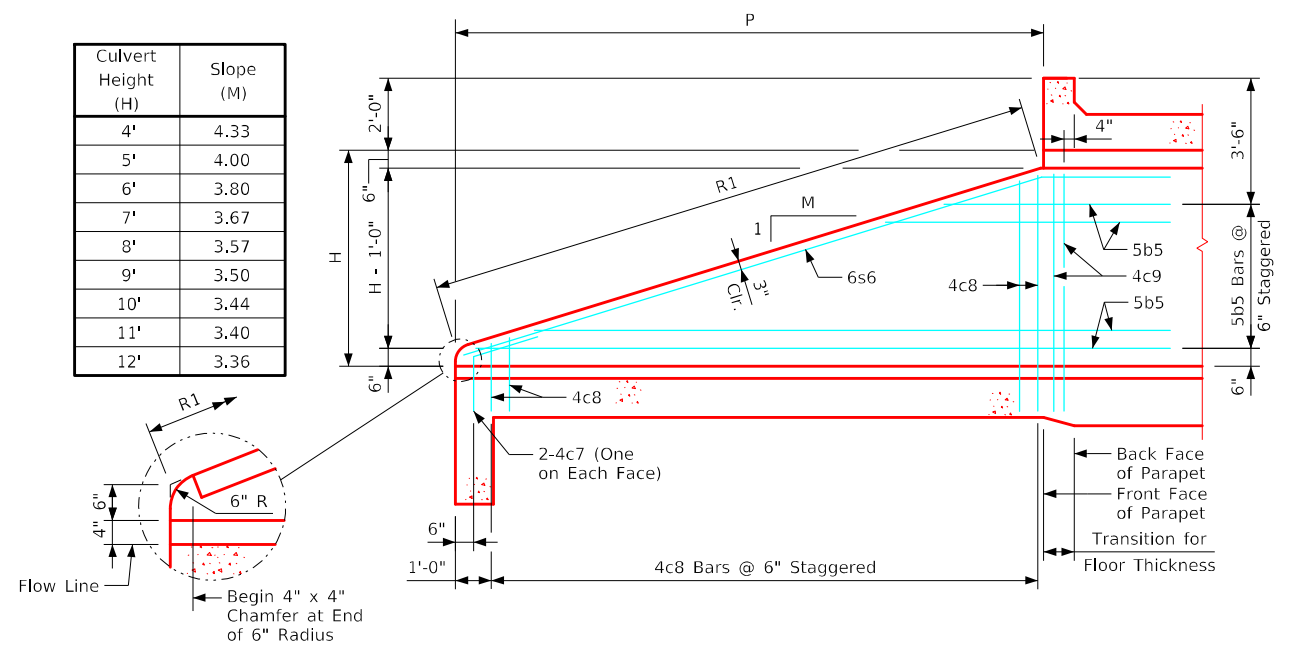


Typical View - Front Face Wingwall Reinforcing



Typical View - Back Face Wingwall Reinforcing

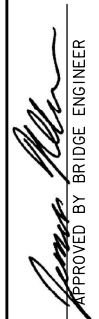
Culvert Height (H)	Slope (M)
4'	4.33
5'	4.00
6'	3.80
7'	3.67
8'	3.57
9'	3.50
10'	3.44
11'	3.40
12'	3.36



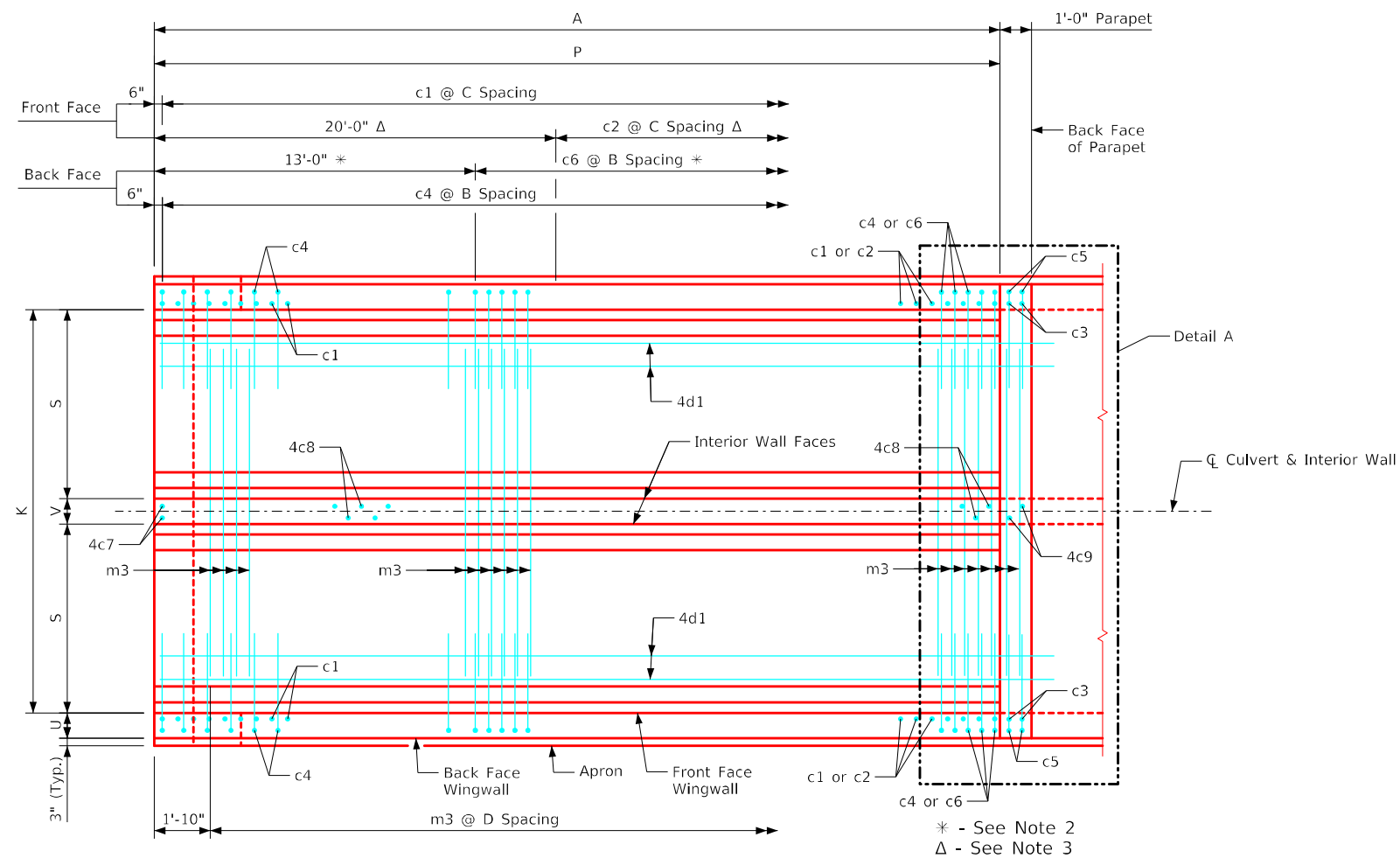
Typical View - Interior Wall

Notes:

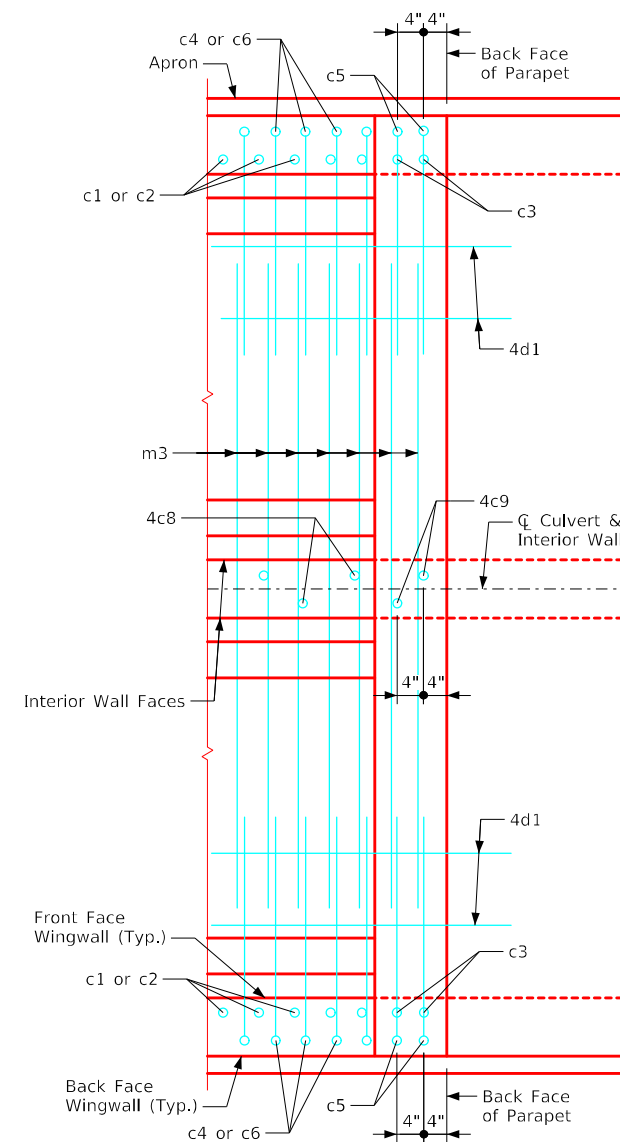
1. Bar spacings and positions shown are similar for all sizes of headwalls in this standard.
2. Not applicable for 4' thru 5' height headwalls.
3. Not applicable for 4' thru 8' height headwalls.
4. For headwall dimensions and bar spacing see Sheet TWPWH 0-1-20.
5. Apron m3 bars are to be centered on $\mathcal{C}$ culvert.
6. B.F.V. (c5) and F.F.V. (c3) and interior wall both F.V. (c9) bars are approximately 4" from the back of parapet for all headwalls.

LATEST REVISION DATE	 APPROVED BY BRIDGE ENGINEER	 Standard Design - Twin Reinforced Concrete Box Culverts	
		Parallel Wing Headwalls	
		July, 2020	
Wingwall Elevations 0° Skew		TWPWH 0-3-20	

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Plan View - Bottom Apron Reinforcing
(Curtain Wall Reinforcing not shown, See Sheet TWPWH 0-2-20)



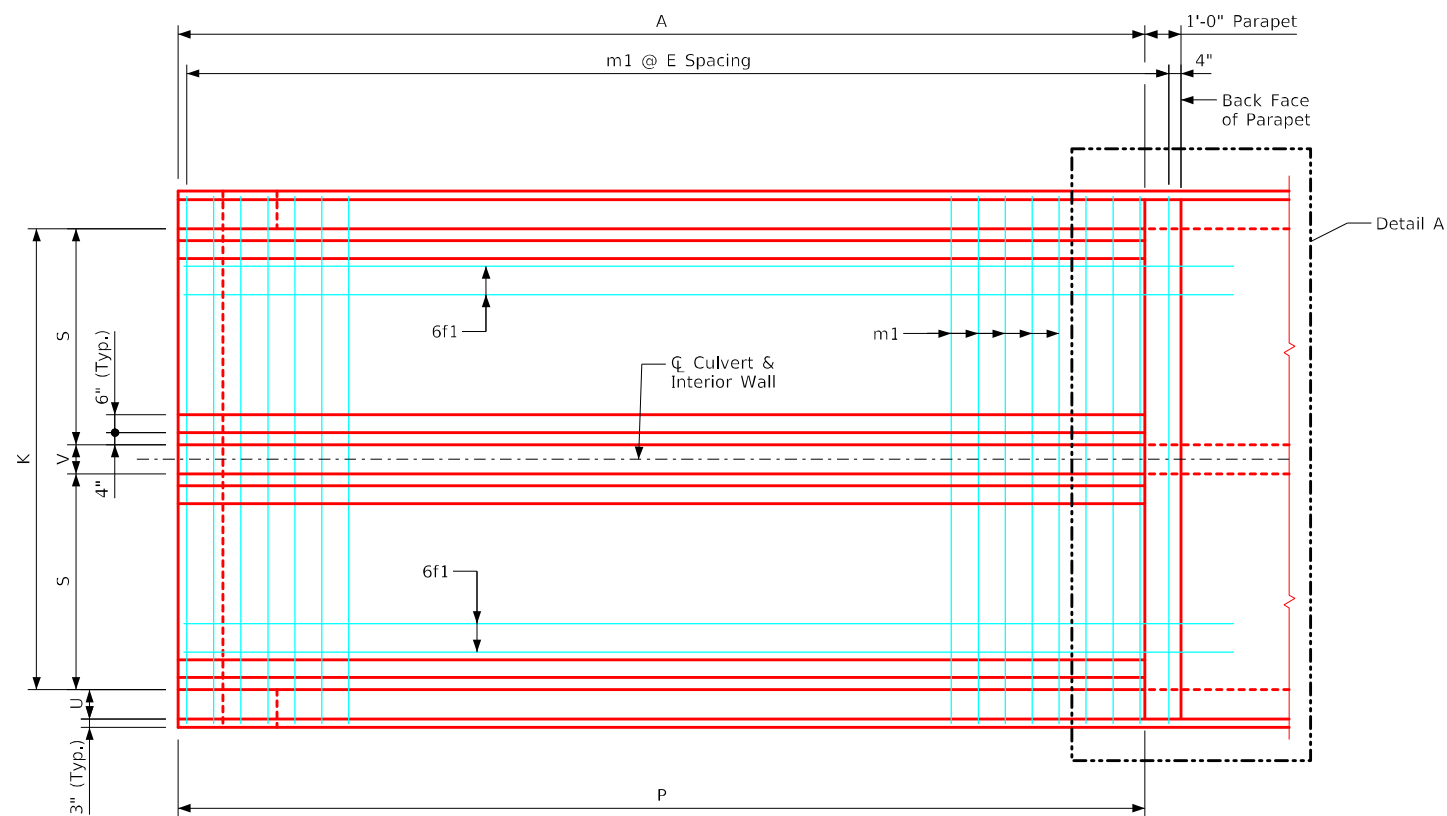
Detail A

Notes:

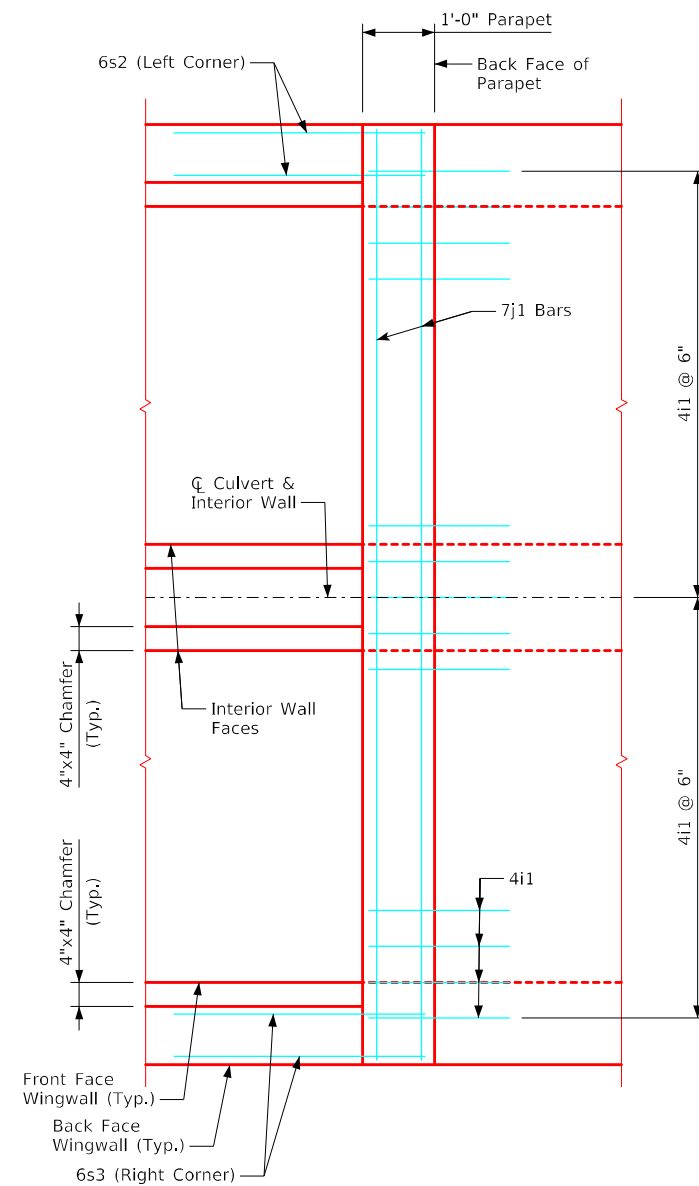
1. Bar spacings and positions shown are similar for all sizes of headwalls in this standard.
2. Not applicable for 4' thru 5' height headwalls.
3. Not applicable for 4' thru 8' height headwalls.
4. For headwall dimensions and bar spacing see Sheet TWPWH 0-1-20.
5. Apron m3 bars are to be centered on $\bar{C}$ culvert.
6. B.F.V. (c5), F.F.V. (c3) and interior wall both F.V. (c9) bars are approximately 4" from the back of parapet for all headwalls.

LATEST REVISION DATE			
		Standard Design - Twin Reinforced Concrete Box Culverts	
		Parallel Wing Headwalls	
		July, 2020	
APPROVED BY BRIDGE ENGINEER		Bottom Apron Reinforcing 0° Skew	TWPWH 0-4-20

ENGLISHLRFDSTWNCULVERTS.DGN - TWPWH 0-5-20 - THIS SHEET ISSUED 07-2020.



Plan View - Top Apron Reinforcing
(Wall Reinforcing not shown for clarity)



Detail A
(Showing parapet bars only)

Notes:

1. Bar spacings and positions shown are similar for all sizes of headwalls in this standard.
2. For headwall dimensions and bar spacing see Sheet TWPWH 0-1-20.
3. Top transverse apron bars are referenced approximately 4" from the back of the parapet for all headwalls.

LATEST REVISION DATE	 APPROVED BY BRIDGE ENGINEER		
		Standard Design - Twin Reinforced Concrete Box Culverts	
		Parallel Wing Headwalls	
		July, 2020	
		Parapet Reinforcing & Top Apron Reinforcing 0° Skew	TWPWH 0-5-20

ENGLISHLRFDSIGNEDTWINCULVERTS.DGN - TWPVH 0-7-20 S1 - THIS SHEET ISSUED 07-2020.

c Bar Pin Diameter	
Bar Size	D
5	3¾"
6	4½"

Bill of Reinforcing for One Headwall 0° Skew Span x Culvert Height																																
Location		Shape	10' x 12'				10' x 11'				10' x 10'				10' x 9'				10' x 8'				10' x 7'									
			Bar	No.	Length	Wt.	Bar	No.	Length	Wt.	Bar	No.	Length	Wt.	Bar	No.	Length	Wt.	Bar	No.	Length	Wt.	Bar	No.	Length	Wt.						
Fence Anchor (Galv.)			5fa	2	2'-10"	6	5fa	2	2'-10"	6	5fa	2	2'-10"	6	5fa	2	2'-10"	6	5fa	2	2'-10"	6	5fa	2	2'-10"	6						
Wingwall, F.F.H.			5b1	2	40'-3"	89	5b1	2	37'-3"	78	5b1	2	34'-3"	71	5b1	2	31'-3"	65	5b1	2	28'-3"	59	5b1	2	25'-3"	53						
Wingwall, F.F.H.			5b2	22 Var.	2 Each 8'-10 to 38'-10	547	5b2	20 Var.	2 Each 8'-10 to 35'-10	466	5b2	18 Var.	2 Each 8'-10 to 32'-10	391	5b2	16 Var.	2 Each 8'-10 to 29'-10	323	5b2	14 Var.	2 Each 8'-10 to 26'-10	260	5b2	12 Var.	2 Each 8'-10 to 23'-10	204						
Wingwall, B.F.H.			4b3	2	40'-3"	57	4b3	2	37'-3"	50	4b3	2	34'-3"	46	4b3	2	31'-3"	42	4b3	2	28'-3"	38	4b3	2	25'-3"	34						
Wingwall, B.F.H.			4b4	20 Var.	2 Each 11'-10 to 38'-10	338	4b4	18 Var.	2 Each 11'-10 to 35'-10	287	4b4	16 Var.	2 Each 11'-10 to 32'-10	239	4b4	14 Var.	2 Each 11'-10 to 29'-10	195	4b4	12 Var.	2 Each 11'-10 to 26'-10	155	4b4	10 Var.	2 Each 11'-10 to 23'-10	119						
Interior Wall, Both F.H.			5b5	21 Var.	6'-3 to 39'-10	505	5b5	19 Var.	6'-3 to 36'-10	427	5b5	17 Var.	6'-4 to 33'-10	356	5b5	15 Var.	6'-4 to 30'-10	291	5b5	13 Var.	6'-5 to 27'-10	232	5b5	11 Var.	6'-6 to 24'-10	180						
Wingwall, F.F.V.			5c1	74 Var.	2 Each 2'-7 to 14'-7	662	5c1	68 Var.	2 Each 2'-7 to 13'-7	573	4c1	62 Var.	2 Each 2'-7 to 12'-7	314	4c1	56 Var.	2 Each 2'-7 to 11'-7	265	4c1	66 Var.	2 Each 2'-7 to 10'-7	290	4c1	58 Var.	2 Each 2'-7 to 9'-7	236						
Wingwall, F.F.V.			5c2	36 Var.	2 Each 9'-1 to 14'-9	447	5c2	30 Var.	2 Each 9'-1 to 13'-9	357	4c2	24 Var.	2 Each 9'-1 to 12'-9	175	4c2	18 Var.	2 Each 9'-1 to 11'-9	125	c2	--	--	--	c2	--	--	--						
Wingwall, F.F.V. (L)			5c3	2	15'-0"	31	5c3	2	14'-0"	29	4c3	2	13'-0"	17	4c3	2	12'-0"	16	4c3	2	11'-0"	15	4c3	2	10'-0"	13						
Wingwall, F.F.V. (R)			5c3	2	15'-0"	31	5c3	2	14'-0"	29	4c3	2	13'-0"	17	4c3	2	12'-0"	16	4c3	2	11'-0"	15	4c3	2	10'-0"	13						
Wingwall, B.F.V.			6c4	74 Var.	2 Each 6'-3 to 18'-3	1362	5c4	68 Var.	2 Each 6'-3 to 17'-3	833	5c4	62 Var.	2 Each 6'-3 to 16'-3	727	5c4	56 Var.	2 Each 6'-3 to 15'-3	628	5c4	50 Var.	2 Each 6'-3 to 14'-3	535	5c4	44 Var.	2 Each 6'-3 to 13'-3	447						
Wingwall, B.F.V. (L)			6c5	2	18'-6"	56	5c5	2	17'-6"	37	5c5	2	16'-6"	34	5c5	2	15'-6"	32	5c5	2	14'-6"	30	5c5	2	13'-6"	28						
Wingwall, B.F.V. (R)			6c5	2	18'-6"	56	5c5	2	17'-6"	37	5c5	2	16'-6"	34	5c5	2	15'-6"	32	5c5	2	14'-6"	30	5c5	2	13'-6"	28						
Wingwall, B.F.V.			6c6	50	8'-6"	638	5c6	44	8'-6"	390	5c6	38	8'-6"	337	5c6	32	8'-6"	284	5c6	26	8'-6"	231	5c6	20	8'-6"	177						
Interior Wall, Both F.V			4c7	2	3'-9"	5	4c7	2	3'-9"	5	4c7	2	3'-9"	5	4c7	2	3'-9"	5	4c7	2	3'-9"	5	4c7	2	3'-9"	5						
Interior Wall, Both F.V			4c8	73 Var.	1'-6 to 12'-3	335	4c8	67 Var.	1'-6 to 11'-3	285	4c8	61 Var.	1'-6 to 10'-3	239	4c8	55 Var.	1'-6 to 9'-3	197	4c8	49 Var.	1'-6 to 8'-3	160	4c8	43 Var.	1'-6 to 7'-3	126						
Interior Wall, Both F.V			4c9	2	12'-6"	17	4c9	2	11'-6"	15	4c9	2	10'-6"	14	4c9	2	9'-6"	13	4c9	2	8'-6"	11	4c9	2	7'-6"	10						
Apron, Longit., Bott.			4d1	22	40'-3"	627	4d1	22	37'-3"	547	4d1	22	34'-3"	503	4d1	22	31'-3"	459	4d1	22	28'-3"	415	4d1	22	25'-3"	371						
Apron, Longit., Top			6f1	22	40'-3"	1410	6f1	22	37'-3"	1231	6f1	22	34'-3"	1132	6f1	22	31'-3"	1033	6f1	22	28'-3"	933	6f1	22	25'-3"	834						
Parapet, Vertical			4i1	43	6'-5"	184	4i1	43	6'-5"	184	4i1	41	6'-5"	176	4i1	41	6'-5"	176	4i1	41	6'-5"	176	4i1	41	6'-5"	176						
Parapet, Horizontal			7j1	4	22'-8"	185	7j1	4	22'-8"	185	7j1	4	22'-2"	181	7j1	4	22'-2"	181	7j1	4	22'-2"	181	7j1	4	21'-11"	179						
Apron, Trans., Top			5m1	51	23'-2"	1232	5m1	47	23'-2"	1136	5m1	43	22'-8"	1017	5m1	39	22'-8"	922	5m1	35	22'-8"	827	5m1	31	22'-5"	725						
Apron, Trans., Top			m2	--	--	--	m2	--	--	--	m2	--	--	--	m2	--	--	--	m2	--	--	--	m2	--	--	--						
Apron, Trans., Bott.			5m3	73	19'-7"	1491	5m3	67	19'-7"	1369	6m3	31	19'-11"	927	5m3	28	19'-1"	557	5m3	25	19'-1"	498	5m3	22	18'-10"	432						
Curtain, Horiz.			6p1	6	23'-2"	209	6p1	6	23'-2"	209	6p1	6	22'-8"	204	6p1	6	22'-8"	204	6p1	6	22'-8"	204	6p1	5	22'-5"	168						
Wing Slope, Both F.			6s1	4	35'-8"	214	6s1	4	32'-7"	196	6s1	4	29'-5"	177	6s1	4	26'-3"	158	6s1	4	23'-1"	139	6s1	4	19'-11"	120						
Wing Slope, Both F. (L)			6s2	2	7'-9"	23	6s2	2	7'-9"	23	6s2	2	7'-9"	23	6s2	2	7'-9"	23	6s2	2	7'-9"	23	6s2	2	7'-9"	23						
Wing Slope, Both F. (R)			6s3	2	7'-9"	23	6s3	2	7'-9"	23	6s3	2	7'-9"	23	6s3	2	7'-9"	23	6s3	2	7'-9"	23	6s3	2	7'-9"	23						
Wing Slope, F.F.			6s4	2	11'-5"	34	6s4	2	11'-5"	34	6s4	2	11'-5"	34	6s4	2	11'-5"	34	6s4	2	11'-5"	34	6s4	2	11'-5"	34						
Wing Slope, F.F.			6s5	2	33'-2"	100	6s5	2	30'-0"	90	6s5	2	26'-10"	81	6s5	2	23'-8"	71	6s5	2	20'-6"	62	6s5	2	17'-4"	52						
Interior Wall, Both F.			6s6	2	41'-10"	133	6s6	2	38'-8"	116	6s6	2	35'-6"	107	6s6	2	32'-4"	97	6s6	2	29'-2"	88	6s6	2	26'-0"	78						
Curtain, Vert.			5t1	22	7'-11"	182	5t1	22	7'-8"	176	5t1	21	7'-5"	162	5t1	21	7'-2"	157	5t1	21	6'-11"	151	5t1	21	6'-8"	146						
Curtain, Vert. Ends			5t2	4	7'-11"	33	5t2	4	7'-8"	32	5t2	4	7'-5"	31	5t2	4	7'-2"	30	5t2	4	6'-11"	29	5t2	4	6'-8"	28						
Bracket, Vert.			5u1	4	6'-7"	27	5u1	4	6'-4"	26	5u1	4	6'-2"	26	5u1	4	5'-11"	25	5u1	4	5'-8"	24	5u1	4	5'-6"	23						
Estimated Quantities One Headwall	Reinf. Steel		11,289 LB				9481 LB				7826 LB				6685 LB				5879 LB				5091 LB									
	Concrete	Parapet Δ	2.5	75.6 CY				2.5	67.9 CY				2.3	55.7 CY				2.3	49.3 CY				2.3	43.3 CY				2.2	36.1 CY			
		Wingwalls	30.0					25.6					17.9					14.8					12.0									
		Apron *	43.1					39.8					35.5					32.2					29.0									

Δ Includes top of wingwall quantities.

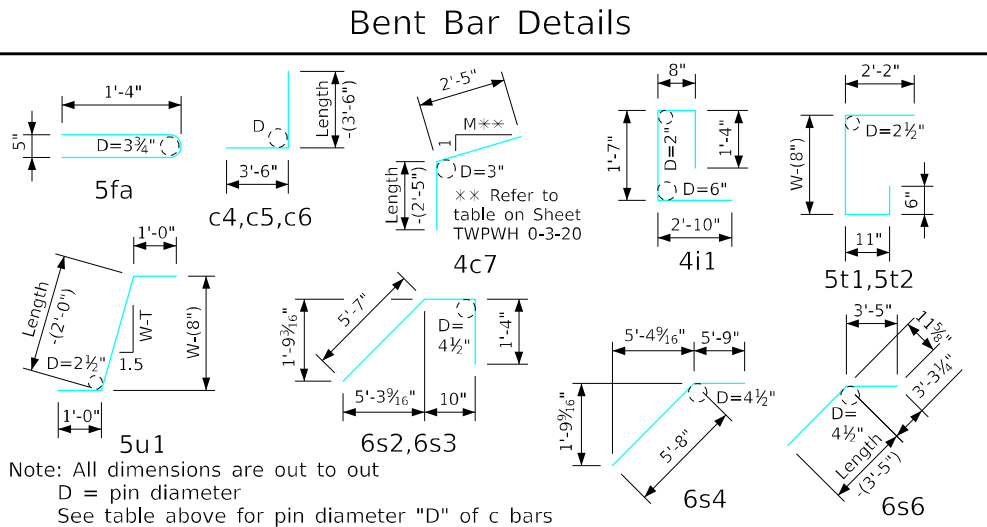
* Assumes apron and floor are equal thickness, adjust concrete quantities for transition where apron and floor thickness are not equal.

Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap.

Headwall Notes:

1. This headwall is based on a 3:1 slope normal to centerline of roadway.
2. The sides of the apron are to be formed to ensure correct line and grade.
3. 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.
4. 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.
5. Concrete quantities are estimated from back of parapet.
6. Horizontal tails of bars "b" & "s" estimated to extend 2'-5" beyond back of parapet (into end of barrel). Longitudinal bars "4d1" and "6f1" 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.
7. Dimensions are in feet and inches unless otherwise noted.

(L) - Indicates bar located at left corner.
(R) - Indicates bar located at right corner.
Refer to Sheet TWPWH 0-1-20 for left and right corner locations.

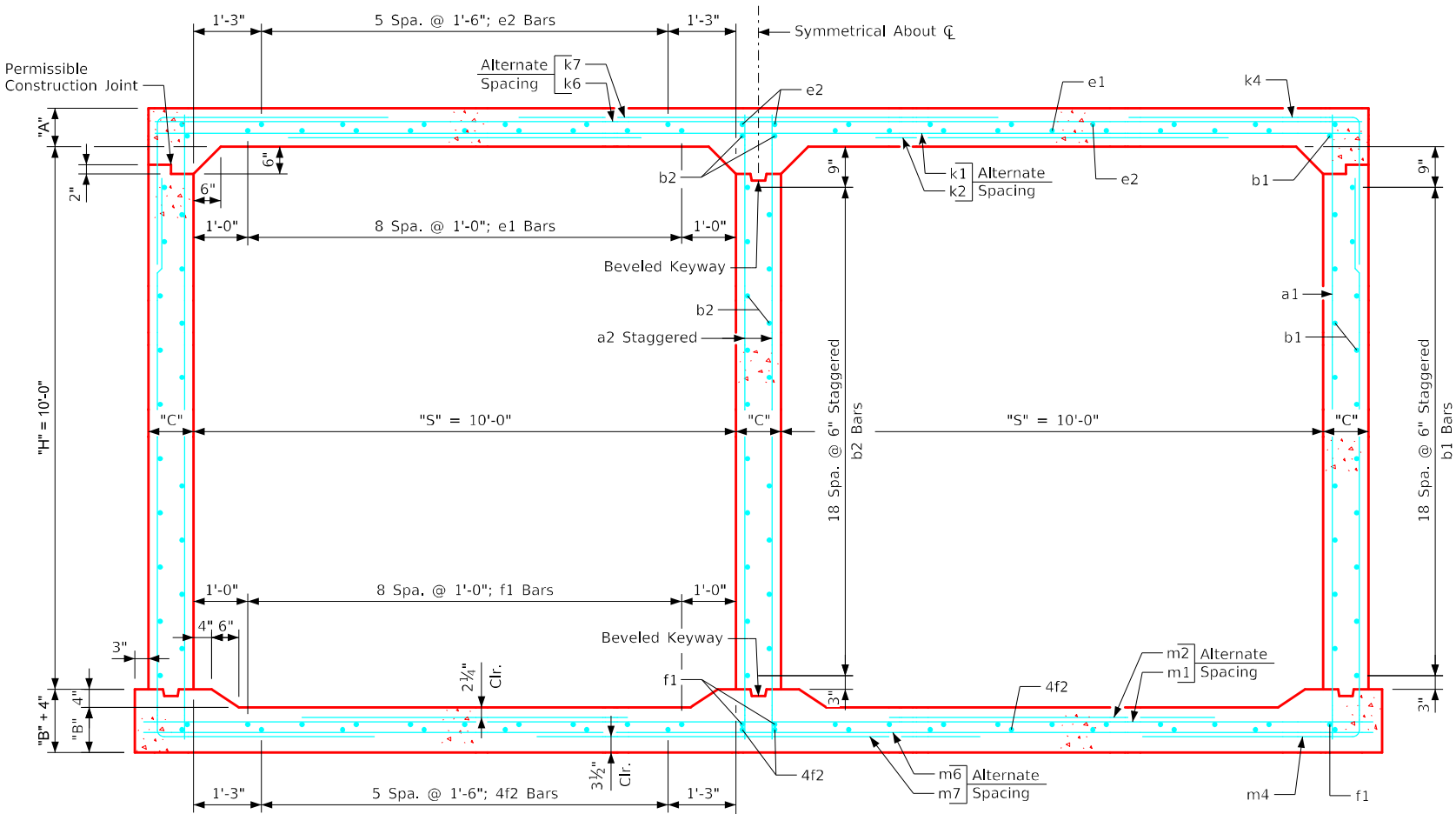


LATEST REVISION DATE		APPROVED BY BRIDGE ENGINEER		
			Standard Design - Twin Reinforced Concrete Box Culverts	
			Parallel Wing Headwalls	
			July, 2020	
			Quantity Tabulation 10'-0" Span 0° Skew	TWPWH 0-7-20 Sheet 1 of 2

ENGLISHLRFDSDIGNEDTWINCULVERTS.DGN - TWRCB 10-10-20 - THIS SHEET ISSUED 07-2020.

Variable Dimensions and Quantities for Twin 10' x 10' Barrel Sections																																																							
Dimensions												Bar List																																											
												a1			a2			b1			b2			e1		e2		f1		f2		k1		k2		k4					k6		k7		k9										
Fill	S	H	A	B	C	D	E	U	W	X	Z	Size	Sp.	L	Size	Sp.	L	Size	Sp.	No.	Size	Sp.	No.	Size	Sp.	No.	Size	Sp.	No.	Size	Sp.	No.	Size	Sp.	No.	Size	Sp.	L	Size	Sp.	L	Size	Sp.	L	Size	Sp.	L								
0	10	10	13	12	10	9	9	0'-0	6'-3	1'-8	6'-3	4	12	12'-0	7	9	12'-0	4	6	40	4	6	21	4	12	18	4	18	16	4	12	22	4	18	16	6	18	22'-2	5	18	11'-1	6	12	10'-4	6'-5	3'-11	4	12	22'-2	5	18	12'-10	5	4.5	22'-2
1	10	10	12.5	11.5	10	9	9	0'-6	6'-5	2'-1	6'-3	4	12	11'-11	7	9	11'-11	4	6	40	4	6	21	4	12	18	4	18	16	4	12	22	4	18	16	6	18	22'-2	5	18	10'-7	5	6	10'-1	6'-8	3'-5	5	18	22'-2	5	18	12'-10	5	4.5	22'-2
2	10	10	9	10	10	9	9	1'-10	6'-5	2'-8	4'-7	4	12	11'-6	7	9	11'-6	4	6	40	4	6	21	5	12	18	4	18	16	4	12	22	4	18	16	5	9	22'-2	4	9	8'-1	5	6	9'-10	6'-8	3'-2	5	12	22'-2	5	12	12'-10	5	4.5	22'-2
3	10	10	8	10	10	9	9	1'-10	4'-9	2'-2	3'-10	4	12	11'-5	7	9	11'-5	4	6	40	4	6	21	4	12	18	4	18	16	4	12	22	4	18	16	5	12	22'-2	5	12	8'-2	5	6	7'-7	4'-6	3'-1	4	12	22'-2	6	12	9'-6	6	4.5	22'-2
4	10	10	8	10	10	9	9	2'-1	4'-2	2'-2	3'-7	4	12	11'-5	7	9	11'-5	4	6	40	4	6	21	4	12	18	4	18	16	4	12	22	4	18	16	5	12	22'-2	5	12	7'-10	5	6	7'-3	4'-2	3'-1	4	12	22'-2	6	12	8'-4	6	4.5	22'-2
5-7	10	10	8	10	10	9	9	2'-3	3'-11	3'-2	3'-9	4	12	11'-5	7	9	11'-5	4	6	40	4	6	21	4	12	18	4	18	16	4	12	22	4	18	16	5	12	22'-2	5	12	7'-4	5	6	7'-1	4'-0	3'-1	5	12	22'-2	6	12	7'-10	6	4.5	22'-2
8-10	10	10	9	11.5	10	9	9	2'-2	3'-9	2'-1	3'-5	4	12	11'-7	7	9	11'-7	4	6	40	4	6	21	4	12	18	4	18	16	4	12	22	4	18	16	5	12	22'-2	5	12	7'-7	6	9	7'-8	3'-10	3'-10	4	12	22'-2	7	12	7'-6	7	4.5	22'-2
11-13	10	10	11	13.5	10	9	9	1'-10	3'-6	2'-0	3'-7	4	9	11'-11	7	9	11'-11	4	6	40	4	6	21	4	12	18	4	18	16	4	12	22	4	18	16	6	18	22'-2	6	18	8'-8	6	9	7'-6	3'-9	3'-9	5	9	22'-2	5	9	7'-0	5	4.5	22'-2
14-16	10	10	12.5	15	10.5	9	9	1'-10	3'-7	1'-11	3'-9	4	9	12'-2	7	9	12'-2	4	6	40	4	6	21	4	12	18	4	18	16	4	12	22	4	18	16	6	18	22'-3	6	18	8'-10	5	6	7'-4	3'-8	3'-8	4	9	22'-3	6	9	7'-2	6	4.5	22'-3
17-19	10	10	14	16	11	6	9	1'-6	3'-9	2'-2	3'-10	4	6	12'-5	7	9	12'-5	4	6	40	4	6	21	4	12	18	4	18	16	4	12	22	4	18	16	6	18	22'-5	6	18	9'-8	6	9	8'-0	4'-0	4'-0	4	9	22'-5	6	9	7'-6	6	4.5	22'-5
20-22	10	10	14.5	17	11.5	9	9	1'-7	3'-9	1'-11	3'-11	4	9	12'-6	7	9	12'-6	4	6	40	4	6	21	4	12	18	4	18	16	4	12	22	4	18	16	5	12	22'-6	5	12	9'-7	5	6	7'-4	3'-8	3'-8	5	12	22'-6	7	12	7'-6	7	4.5	22'-6
23-25	10	10	16.5	18	12	6	9	1'-1	3'-11	1'-7	4'-0	4	6	12'-9	7	9	12'-9	4	6	40	4	6	21	4	12	18	4	18	16	4	12	22	4	18	16	5	12	22'-8	5	12	10'-3	6	9	7'-11	3'-8	4'-3	4	9	22'-8	6	9	7'-10	6	4.5	22'-8

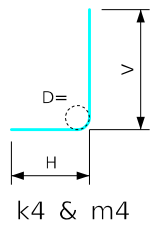
	Bar List																				Quantities							
	m1				m2			m4					m6			m7			m9			Concrete (CY/FT)				Steel		
Fill	Size	Sp.	L	Size	Sp.	L	Size	Sp.	L	H	V	Size	Sp.	L	Size	Sp.	L	Size	Sp.	L	Size	Sp.	L	Slab	Floor	Walls	Total	(LB/FT)
0	6	18	22'-8	6	18	8'-10	7	12	16'-10	6'-5	10'-5	4	9	22'-8	4	9	12'-6	4	4.5	22'-8	0.964	0.914	0.887	2.765	383.53			
1	5	12	22'-8	5	12	8'-1	5	6	16'-10	6'-5	10'-5	4	9	22'-8	4	9	12'-6	4	4.5	22'-8	0.929	0.878	0.887	2.694	389.50			
2	5	9	22'-8	4	9	6'-8	5	6	14'-11	4'-8	10'-3	5	18	22'-8	8	18	9'-2	8	4.5	22'-8	0.686	0.772	0.887	2.345	411.76			
3	5	12	22'-8	5	12	7'-8	5	6	14'-5	4'-2	10'-3	4	9	22'-8	5	9	7'-8	5	4.5	22'-8	0.616	0.772	0.887	2.275	373.37			
4	5	12	22'-8	5	12	7'-7	5	6	14'-3	4'-0	10'-3	4	9	22'-8	5	9	7'-2	5	4.5	22'-8	0.616	0.772	0.887	2.275	368.11			
5-7	5	9	22'-8	4	9	5'-8	5	6	14'-1	3'-10	10'-3	4	12	22'-8	7	12	7'-6	7	4.5	22'-8	0.616	0.772	0.887	2.275	377.79			
8-10	5	12	22'-8	5	12	8'-2	6	9	14'-3	3'-10	10'-5	5	9	22'-8	5	9	6'-10	5	4.5	22'-8	0.686	0.878	0.887	2.451	384.82			
11-13	5	12	22'-8	5	12	8'-5	6	9	14'-4	3'-9	10'-7	5	9	22'-8	5	9	7'-2	5	4.5	22'-8	0.825	1.020	0.887	2.732	401.47			
14-16	5	12	22'-9	5	12	9'-0	5	6	14'-5	3'-9	10'-8	4	9	22'-9	6	9	7'-6	6	4.5	22'-9	0.936	1.132	0.934	3.002	394.61			
17-19	5	9	22'-11	4	9	8'-5	6	9	14'-6	3'-9	10'-9	5	12	22'-11	7	12	7'-8	7	4.5	22'-11	1.048	1.211	0.978	3.237	421.32			
20-22	5	9	23'-0	4	9	8'-11	5	6	14'-8	3'-10	10'-10	5	12	23'-0	7	12	7'-10	7	4.5	23'-0	1.091	1.291	1.022	3.404	416.24			
23-25	5	9	23'-2	4	9	9'-9	6	9	14'-8	3'-9	10'-11	5	9	23'-2	6	9	8'-0	6	4.5	23'-2	1.240	1.372	1.067	3.679	435.63			



Twin 10' x 10' Barrel Section

Bent Bar Detail

Bars	D
5	3 3/4"
6	4 1/2"
7	5 1/4"



Note:
All dimensions are out to out.
D = pin diameter.

Notes:

- Dimensions listed on this sheet to be used in conjunction with Sheet TWRCB G3-20.
- Fill, dimensions "S" and "H" are in feet.
- Dimensions "A", "B", "C", "D", and "Sp." listed in the bar list are in inches.
- Dimensions "L", "H", "V" are in feet and inches.

LATEST REVISION DATE


APPROVED BY BRIDGE ENGINEER


Standard Design
Twin Reinforced Concrete
Box Culverts
July, 2020

Culvert Barrel
Details
10' x 10' Barrel Sections

TWRCB
10-10-20



Twin Reinforced Concrete Box Culvert Standards

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TWRCB G3-20	Typical Culvert Barrel Details
TWRCB 8-4-20	Culvert Barrel Details, 8' x 4' Barrel Sections
TWRCB 8-5-20	Culvert Barrel Details, 8' x 5' Barrel Sections
TWRCB 8-6-20	Culvert Barrel Details, 8' x 6' Barrel Sections
TWRCB 8-7-20	Culvert Barrel Details, 8' x 7' Barrel Sections
TWRCB 8-8-20	Culvert Barrel Details, 8' x 8' Barrel Sections
TWRCB 8-9-20	Culvert Barrel Details, 8' x 9' Barrel Sections
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TWRCB 12-12-20	Culvert Barrel Details, 12' x 12' Barrel Sections
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TWPWH 45-2-20	Parallel Wing Hdwls., 45° Skew, Dimension Table
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TWPWH 45-4-20	Parallel Wing Hdwls., 45° Skew, Wingwall Elev.
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LATEST REVISION DATE	 APPROVED BY BRIDGE ENGINEER		
		Standard Design Twin Reinforced Concrete Box Culverts July, 2020	
		Index of Sheets	TWRCB G1-20



Twin Reinforced Concrete Box Culvert Standards

General Notes:

- 1. The RCB culvert sections are designed for HL-93 live load and earth fills of varying heights.
- 2. Vertical earth pressure, EV=0.120 kcf.
Horizontal earth pressure, EHmax = 0.060 kcf max, EHmin = 0.030 kcf.
- 3. 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.
- 4. 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.
- 5. The clear distance from face of concrete to near edge or end of reinforcing bar to be 2" unless otherwise noted.
- 6. Except for dowel bars 5r1 in slab, longitudinal reinforcing is not to extend thru the construction joints.
- 7. Floor of barrel is to be finished smooth. Sides of footing are to be formed to insure correct line and grade.
- 8. The permissible construction joint at the top of the walls may be lowered at the Contractor's option with Engineer's approval.
- 9. 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.
- 10. 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.

- 11. Reinforcing bar clearances will be as follows:
Edge clearances: 2" except
Top of floor 2¼" to near transverse reinforcing bar
Bottom of floor 3½" to near transverse reinforcing bar
End clearances:
Vertical top 2"
Vertical bottom 3" or 3½" if overall height of the culvert is not to a full inch
Transverse 2"
12. All construction joints shall be formed with a beveled keyway except at bell joints.
- 13. All beveled keyways shall be centered.
- 14. 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.
- 15. 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.
- 16. 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.
- 17. All dimensions are in feet and inches unless otherwise noted or shown.
- 18. See current Standard Specifications regarding concrete form removal.
- 19. These culvert standards label all reinforcing steel with English notation (5a1 is ⅝ 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

- 20. 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.

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

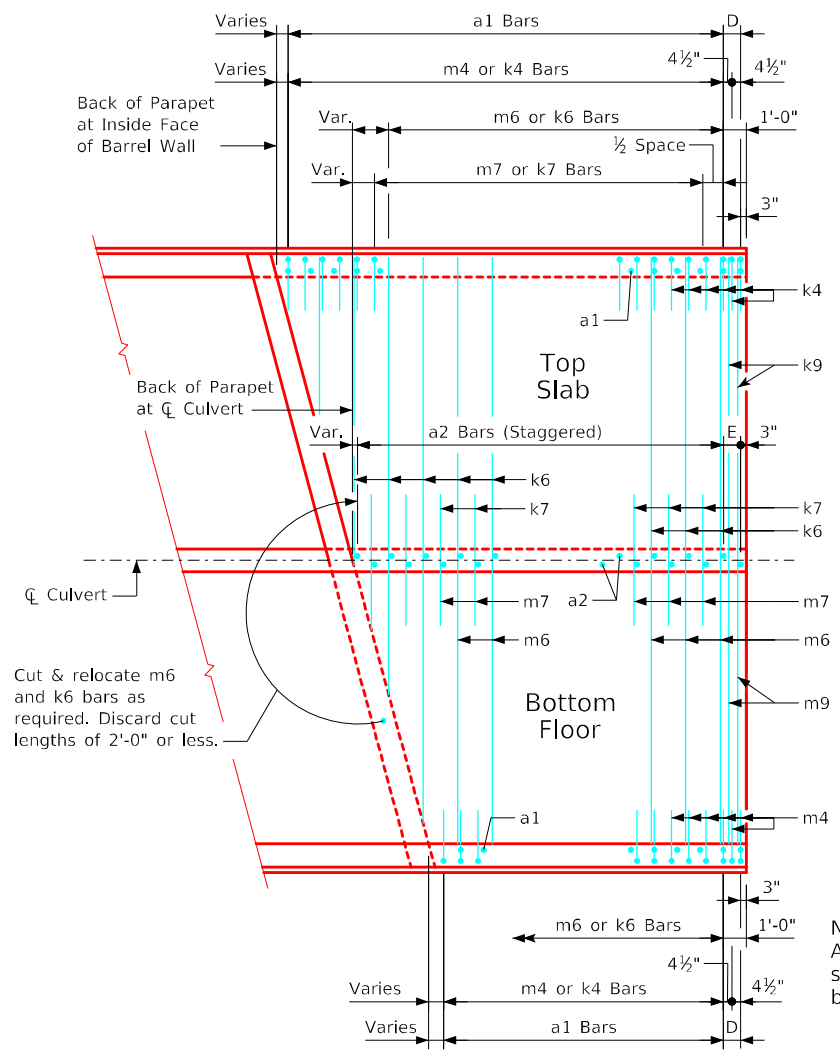
Design Stresses:

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.

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		General Notes & Specifications	TWRCB G2-20

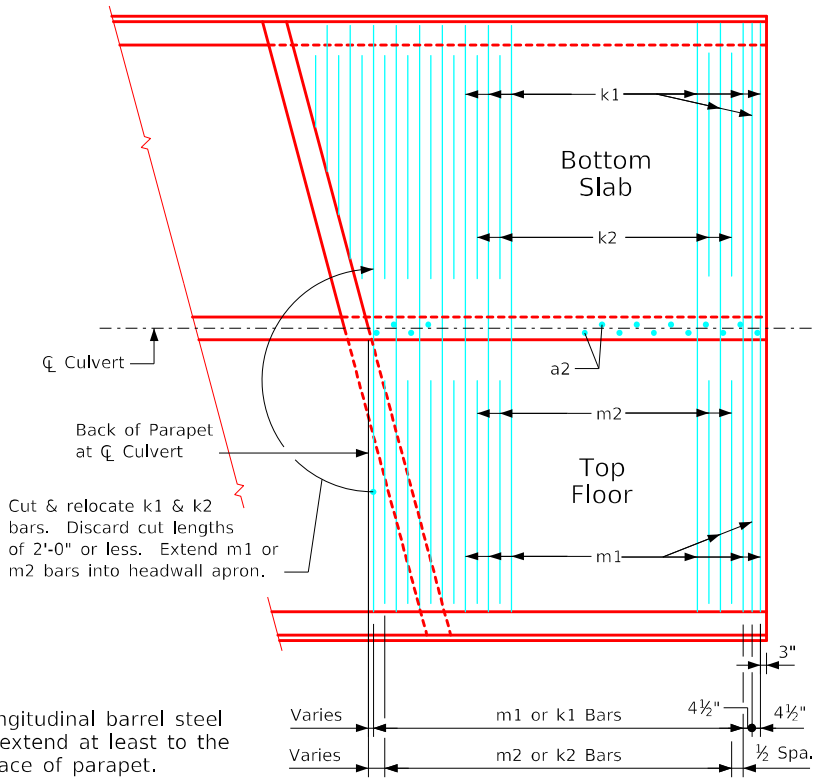
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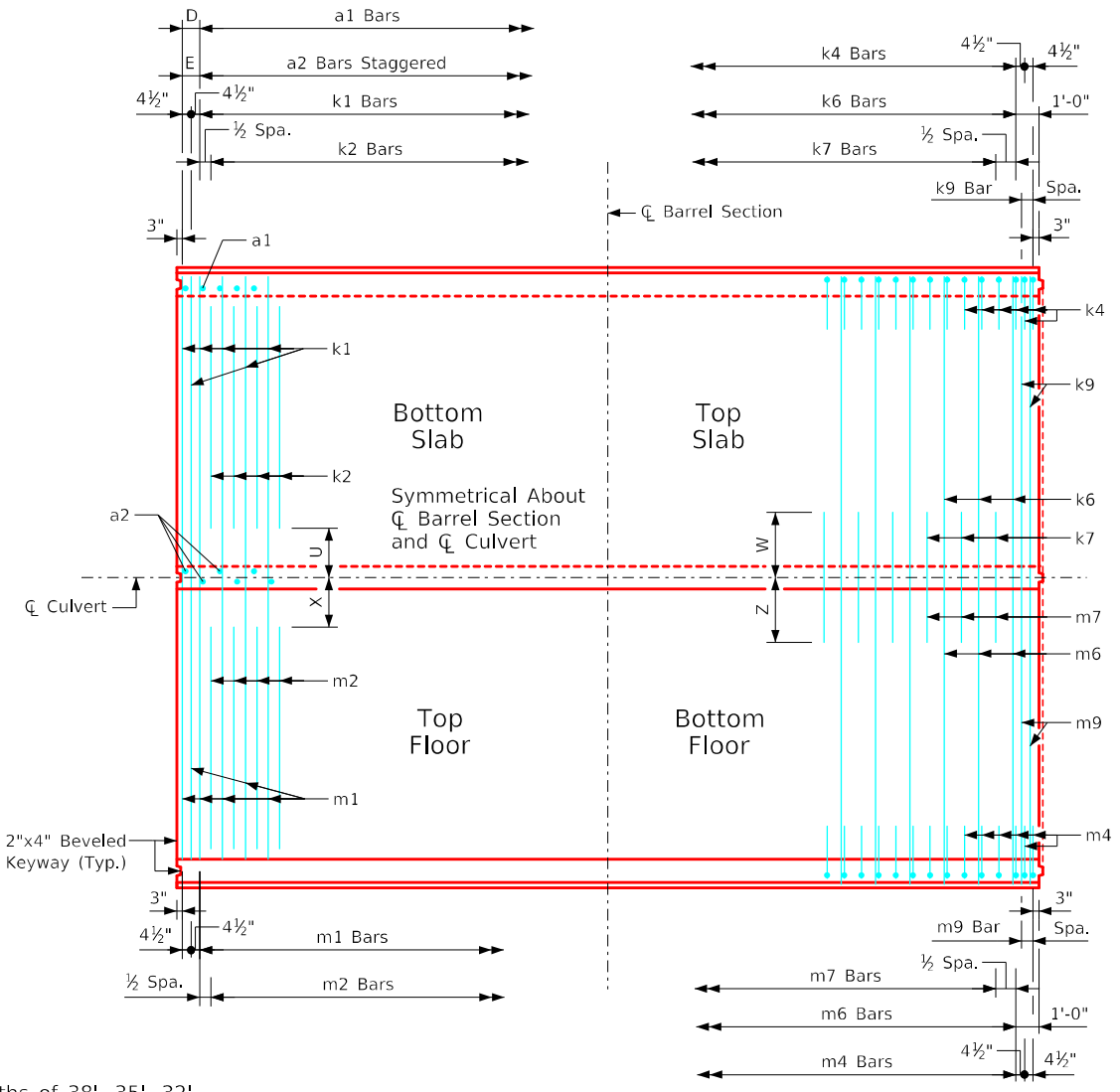
Note:
All longitudinal barrel steel shall extend at least to the backface of parapet.

End Section Plan Views
(Keyways not shown)

Note:
End section details shown are for a 15° skew barrel. Use for skews of 30° & 45° by increasing the number of transverse reinforcing bars required to be cut and relocated.

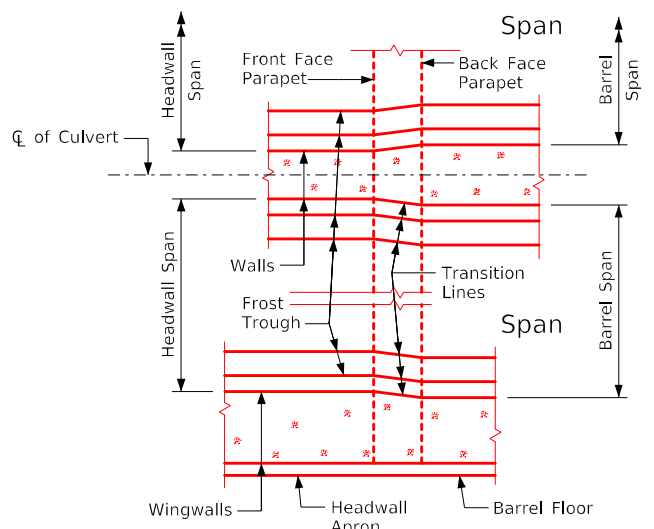


Note:
Typical for lengths of 38', 35', 32', 29', and 26'. These lengths are shown as typical because all transverse and vertical reinforcing steel spacing repeats in 3'-0" intervals.



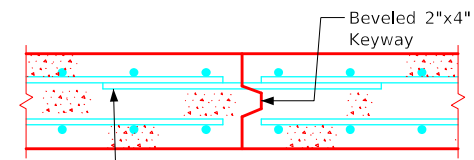
Standard Section Plan View
(Keyway is to be omitted when bell joints are used)

Note:
Dimensions listed on this sheet to be used in conjunction with dimensions and quantities for barrel section sheets.



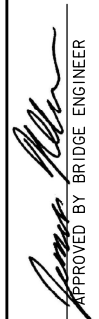
Transition Wall Details

5r1 Bars - One Const. Jt.			
Span	No.	Weight (LB)	
8'-0"	18	66	
10'-0"	22	80	
12'-0"	26	95	



One set of 5r1 x 3'-6" dowel bars @ 1'-0" spacing required in slab at all culvert barrel joints, except joints with bell joints. See table for number required and total weight.

Top Slab Construction Joint Detail

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		Typical Culvert Barrel Details	TWRCB G3-20