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 Stardards (TWRCB).

Index for Twin Culvert Standards:

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

IOWA DOT Highway Administration

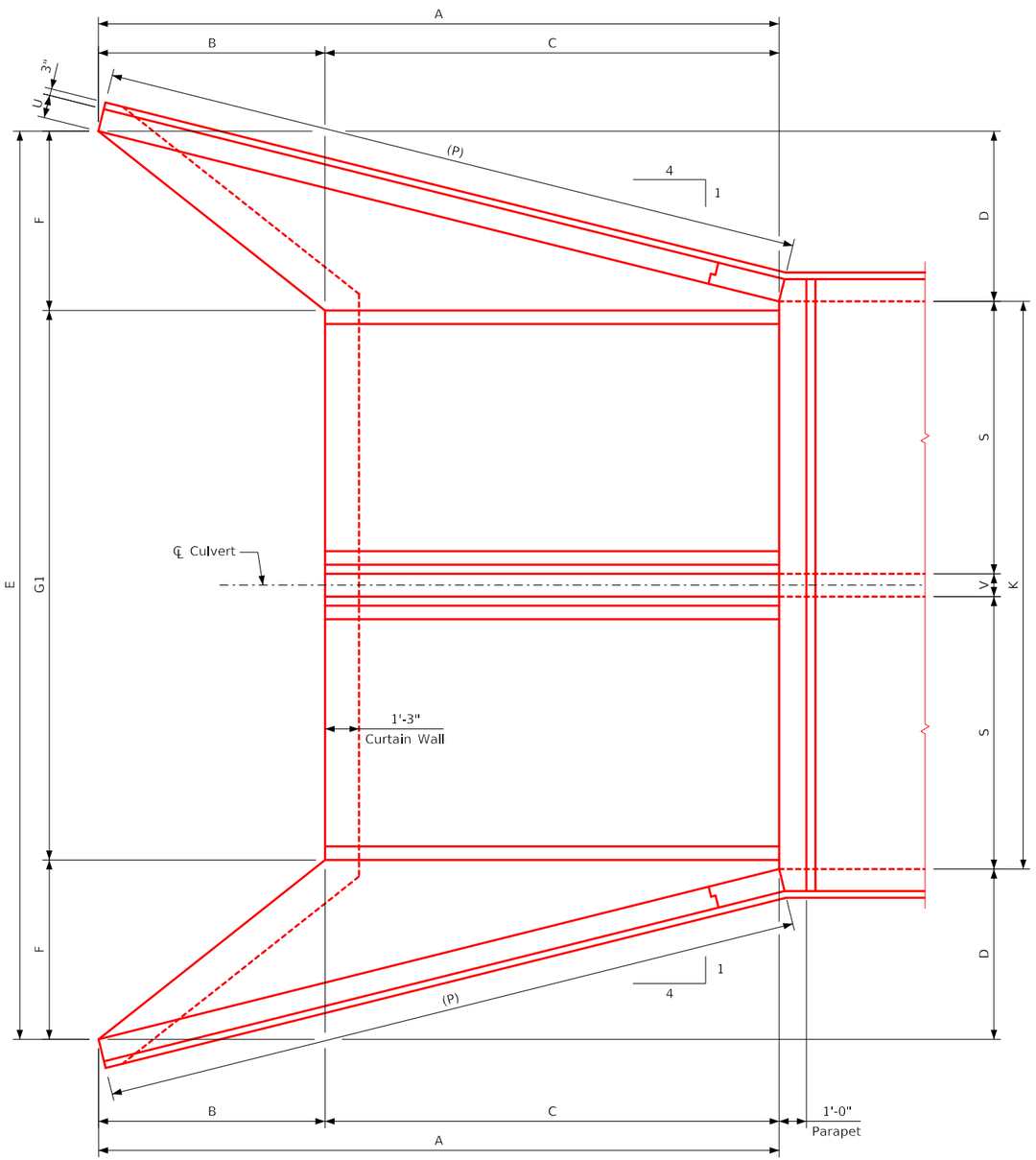
Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Index of Sheets, General Notes & Specifications	TWFWH G1-21

ENGLISHLRFDSIGNEDTWINCULVERTSFWH.DGN - TWFWH G1-21 - 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'-6⅝	25'-5⅝	25'-4⅝	25'-4⅝	25'-4½	25'-3½	25'-3⅜	25'-3¼	25'-3⅛	21'-6⅝	21'-5⅝	21'-4⅝	21'-4⅝	21'-4½	21'-3½	G2
G3	15'-7⅜	14'-4⅜	13'-1⅜	11'-10⅜	10'-7½	9'-4½	8'-1½	6'-10½	5'-7½	15'-7⅜	14'-4⅜	13'-1⅜	11'-10⅜	10'-7½	9'-4½	G3
G4	16'-5⅞	15'-0½	13'-7	12'-4	11'-1⅛	9'-7¾	8'-4¾	7'-1⅞	5'-11	16'-5⅞	15'-0½	13'-7	12'-4	11'-1⅛	9'-7¾	G4
G5	3⅛	5⅜	7⅝	7⅝	7⅝	9⅞	9¾	9¾	9⅝	3⅛	5⅜	7⅝	7⅝	7⅝	9⅞	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'-1⅝	35'-0½	31'-11½	28'-10⅜	25'-9¼	22'-8⅛	19'-7	16'-5⅞	13'-4¾	38'-1⅝	35'-0½	31'-11½	28'-10⅜	25'-9¼	22'-8⅛	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'-0⅛	24'-9¼	22'-6½	20'-3¾	18'-0⅞	15'-10⅛	13'-7⅜	11'-4¾	9'-2	27'-0⅛	24'-9¼	22'-6½	20'-3¾	18'-0⅞	15'-10⅛	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'-3⅜	21'-3¼	21'-3⅛	17'-4⅜	17'-4⅜	17'-4½	17'-3½	17'-3⅜	17'-3¼	17'-3⅛	G2
G3	8'-1½	6'-10½	5'-7½	13'-1⅜	11'-10⅜	10'-7½	9'-4½	8'-1½	6'-10½	5'-7½	G3
G4	8'-4¾	7'-1⅞	5'-11	13'-7	12'-4	11'-1⅛	9'-7¾	8'-4¾	7'-1⅞	5'-11	G4
G5	9¾	9¾	9⅝	7⅝	7⅝	7⅝	9⅞	9¾	9¾	9⅝	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'-5⅞	13'-4¾	31'-11½	28'-10⅜	25'-9¼	22'-8⅛	19'-7	16'-5⅞	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'-7⅜	11'-4¾	9'-2	22'-6½	20'-3¾	18'-0⅞	15'-10⅛	13'-7⅜	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

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IOWADOT Highway Administration

Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Dimension Plan & Table 0° Skew

TWFWH 0-1-21

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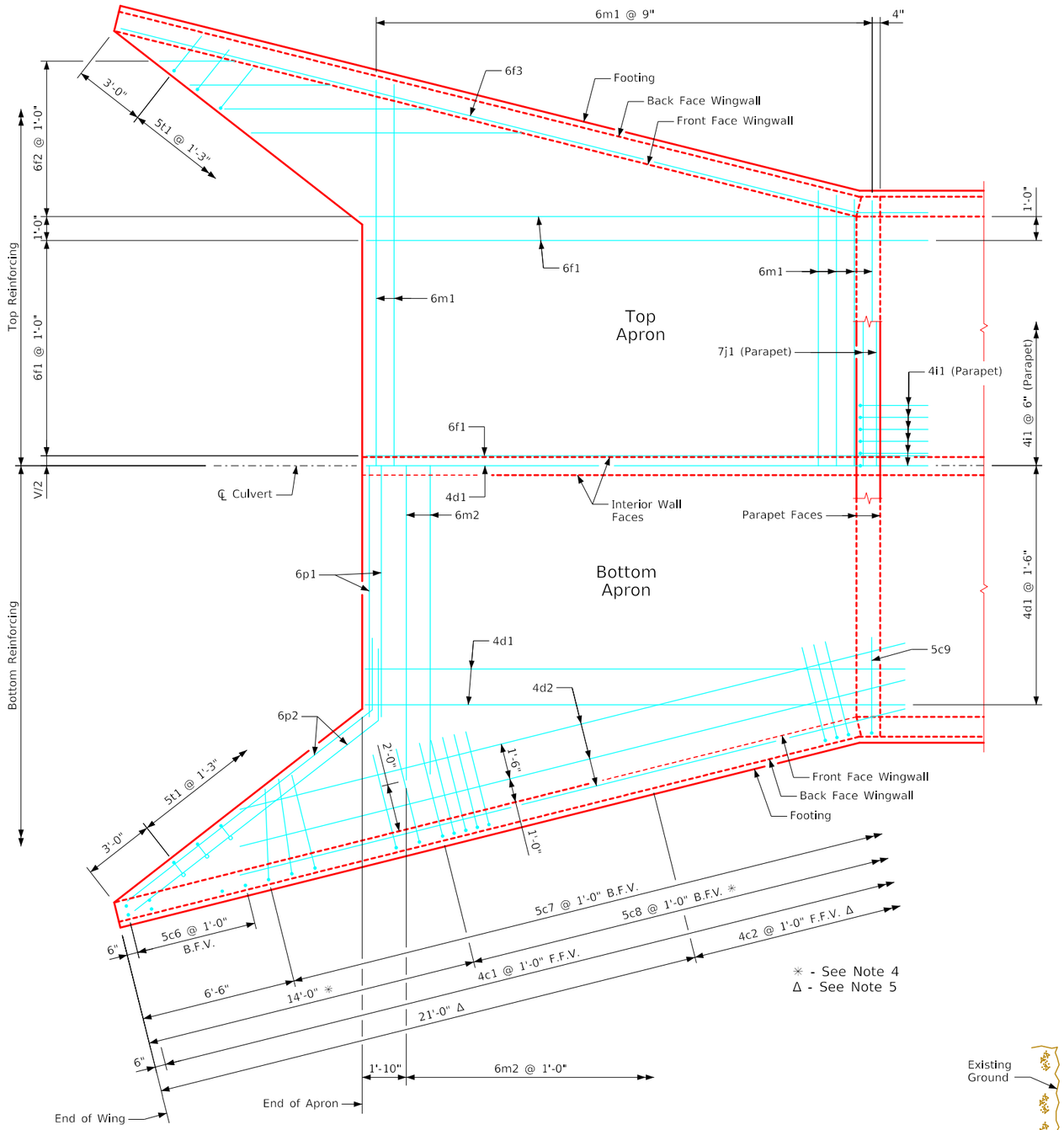
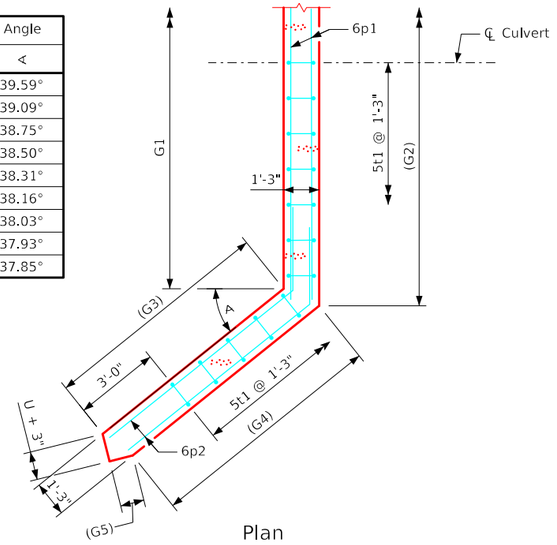
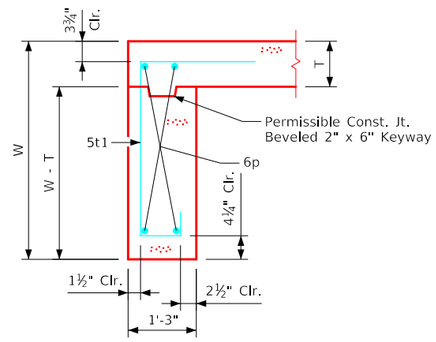


Plan View - Top & Bottom of Apron Reinforcing

Culvert Height (H)	Angle ∢
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°

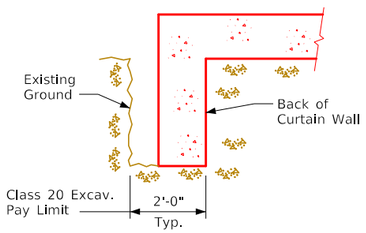


Plan



Section

Curtain Wall Details



Curtain Wall
Class 20 Excavation

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.

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Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Apron & Curtain Wall Details 0° Skew

TWFWH 0-2-21

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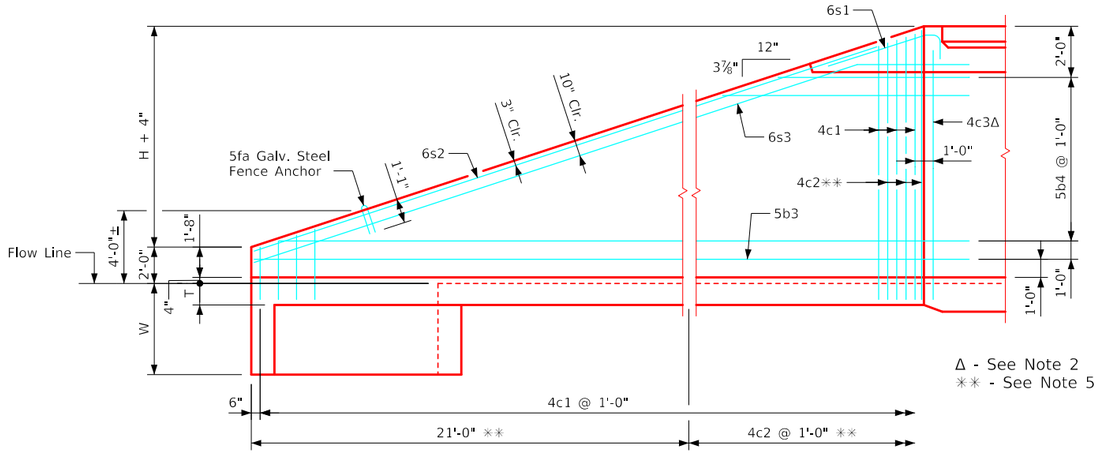
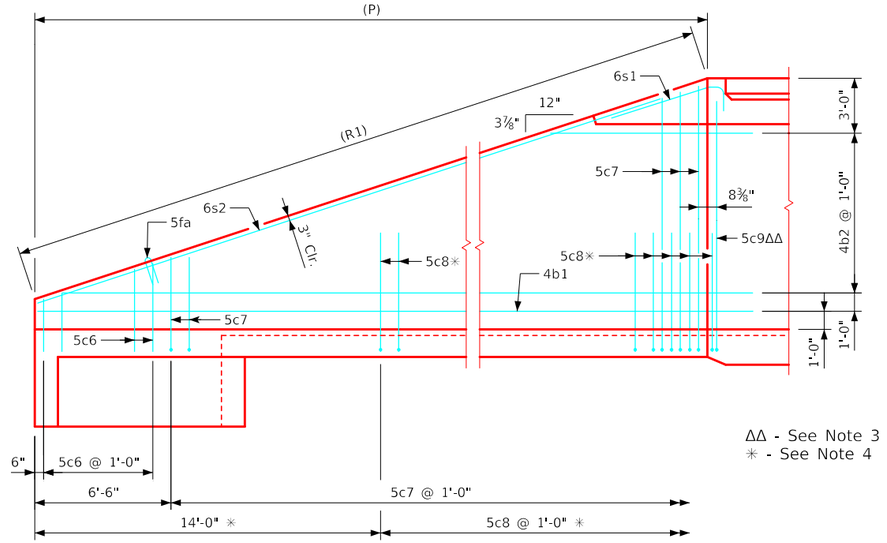


Δ - See Note 2
∗∗ - See Note 5

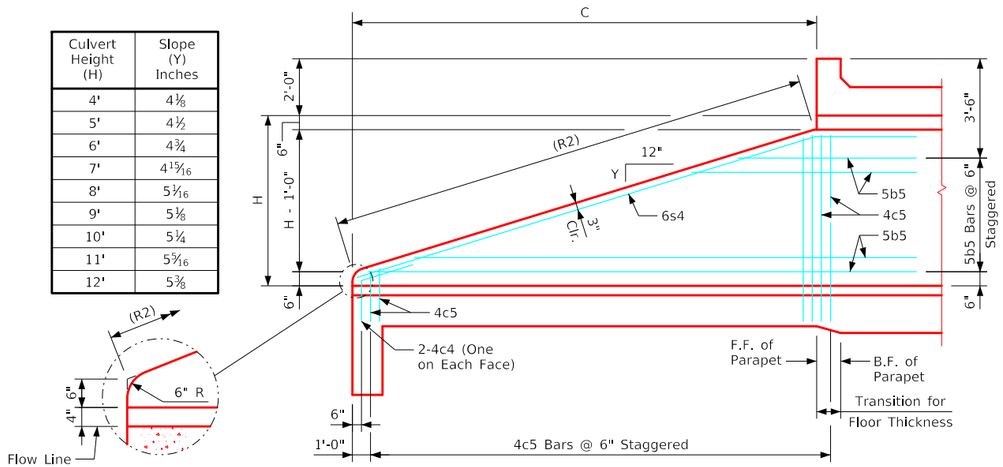
Typical View - Front Face Wingwall Reinforcing



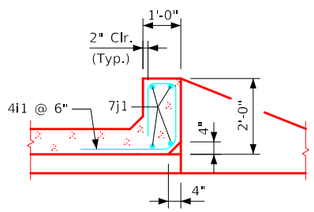
ΔΔ - See Note 3
∗ - See Note 4

Typical View - Back Face Wingwall Reinforcing

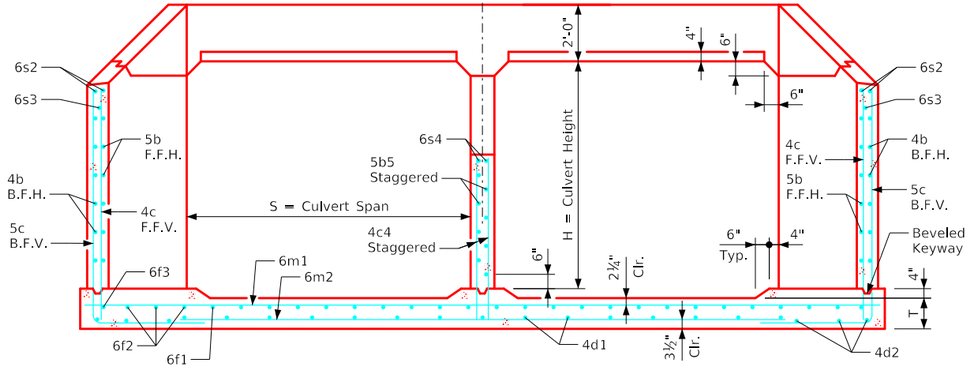
Culvert Height (H)	Slope (Y) Inches
4'	4⅛
5'	4½
6'	4¾
7'	4 15/16
8'	5 1/16
9'	5⅛
10'	5¼
11'	5 5/16
12'	5⅜



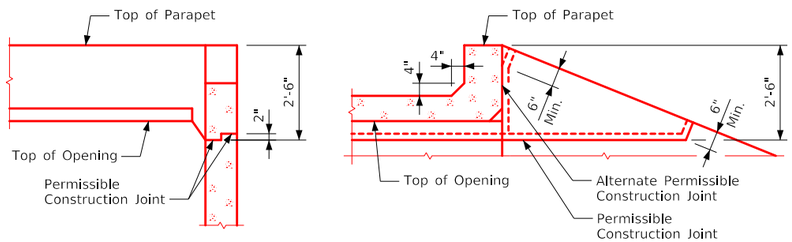
Typical View - Interior Wall



Section thru Parapet



Typical Section - Near Center of Apron



Top of Wingwall Details

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 headalls.
4. Not applicable for 4' & 5' height headwalls.
5. Not applicable for 4' thru 8' height headwalls.
6. For dimension table, see sheet TWFWH 0-1-21.
7. Top of wall slope may be rounded in some instances.

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Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Wingwall & Parapet Details 0° Skew

TWFWH 0-3-21

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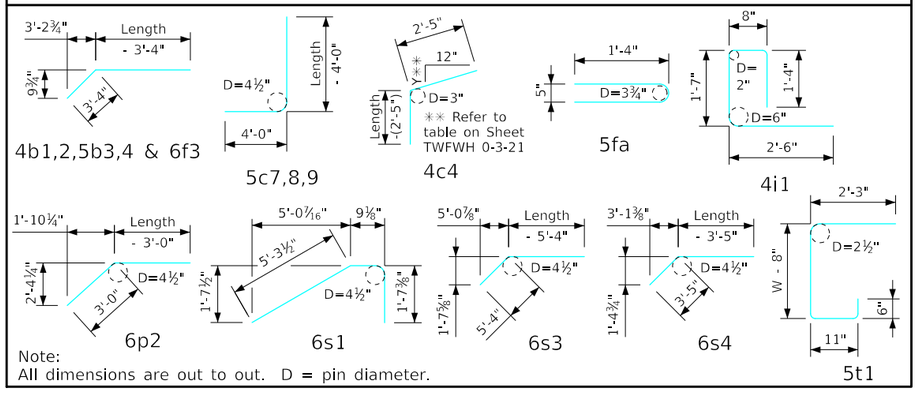
Bill of Reinforcing for One Headwall 0° Skew Span x Culvert Height

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.		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'-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.		2	4'-2	6	2	4'-2	6	2	4'-2	6	2	4'-2	6	2	4'-2	6	2	4'-2	6	4c4
4c5	Interior Wall, Both F.V.		50 Var.	2'-0 to 12'-11	249	46 Var.	2'-0 to 11'-11	214	42 Var.	2'-0 to 10'-11	181	38 Var.	1'-11 to 9'-11	150	34 Var.	1'-11 to 8'-11	123	30 Var.	1'-11 to 7'-10	98	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.		17	27'-11	317	17	25'-11	294	17	23'-11	272	17	21'-11	249	17	19'-11	226	17	17'-11	203	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		24	27'-11	1006	24	25'-11	934	24	23'-11	862	24	21'-11	790	24	19'-11	718	24	17'-11	646	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		51	6'-1	207	49	6'-1	199	49	6'-1	199	49	6'-1	199	49	6'-1	199	49	6'-1	199	4i1
7j1	Parapet, Horizontal		4	26'-8	218	4	26'-5	216	4	26'-2	214	4	26'-2	214	4	26'-2	214	4	25'-11	212	7j1
6m1	Apron, Trans., Top		34 Var.	26'-10 to 39'-3	1687	31 Var.	26'-7 to 37'-10	1500	29 Var.	26'-4 to 36'-10	1376	26 Var.	26'-4 to 35'-9	1212	23 Var.	26'-4 to 34'-7	1052	21 Var.	26'-1 to 33'-7	941	6m1
6m2	Apron, Trans., Bott.		24 Var.	20'-9 to 32'-3	955	22 Var.	20'-8 to 31'-2	856	20 Var.	20'-7 to 30'-1	761	18 Var.	20'-7 to 29'-1	671	16 Var.	20'-7 to 28'-1	585	14 Var.	20'-6 to 27'-0	499	6m2
6p1	Curtain, Horizontal		4	25'-3	152	4	25'-2	151	4	25'-1	151	4	25'-1	151	4	25'-1	151	4	25'-0	150	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		41	8'-0	342	39	7'-9	315	37	7'-6	289	35	7'-3	265	33	7'-0	241	31	6'-9	218	5t1
	Estimated Quantities One Headwall	Reinf. Steel		10,292 LB			9188 LB			8165 LB			7192 LB			6183 LB			5392 LB		
		Concrete Parapet Δ	2.8			2.7			2.6			2.6			2.6			2.5			
		Concrete Wingwalls	28.1	88.2 CY		21.9	75.7 CY		16.9	64.7 CY		14.0	56.6 CY		11.4	46.4 CY		8.1	39.3 CY		
		Concrete Apron ✳	57.3			51.1			45.2			40.0			32.4			28.7			

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.

Bent Bar Details



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

Headwall Notes:

1. See Sheet TWFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. This headwall is based on a 3:1 slope normal to centerline of roadway.
3. The sides of the apron are to be formed to ensure correct line and grade.
4. 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.
5. 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.
6. Concrete quantities are estimated from back of parapet.
7. 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.
8. Dimensions are in feet and inches unless otherwise noted.

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWADOT Highway Administration

Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
12'-0" Span
0° Skew

TWFWH
0-4-21
Sheet 1 of 2

ENGLISHLRFDSIGNEDTWINCULVERTSFWH.DGN - TWFWH 0-4-21 S1 - THIS SHEET ISSUED 02-2021.

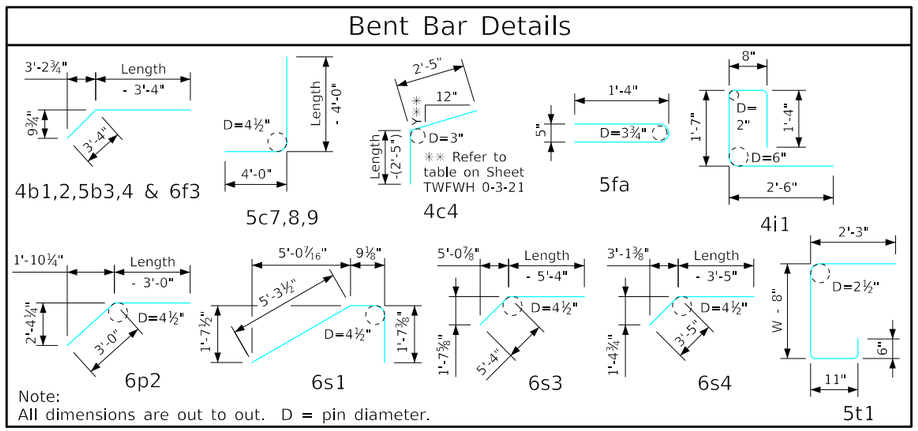
Bill of Reinforcing for One Headwall 0° Skew Span x Culvert Height

Bar	Location	Shape	12' x 6' No.	12' x 6' Length	12' x 6' Wt.	12' x 5' No.	12' x 5' Length	12' x 5' Wt.	12' x 4' No.	12' x 4' Length	12' x 4' Wt.	Bar
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.		9 Var.	5'-5 to 15'-7	99	7 Var.	5'-7 to 13'-7	70	5 Var.	5'-9 to 11'-6	45	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.		2	4'-2	6	2	4'-2	6	2	4'-1	5	4c4
4c5	Interior Wall, Both F.V.		26 Var.	1'-11 to 6'-10	76	22 Var.	1'-11 to 5'-10	57	18 Var.	1'-11 to 4'-10	41	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.		17	15'-11	181	17	13'-11	158	17	11'-11	135	4d1
4d2	Apron, Longit., Bott.		6	17'-8	71	6	14'-7	58	6	11'-6	46	4d2
6f1	Apron, Longit., Top		24	15'-11	574	24	13'-11	502	24	11'-11	430	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		49	6'-1	199	49	6'-1	199	49	6'-1	199	4i1
7j1	Parapet, Horizontal		4	25'-11	212	4	25'-11	212	4	25'-11	212	7j1
6m1	Apron, Trans., Top		18 Var.	26'-1 to 32'-6	792	15 Var.	26'-1 to 31'-4	647	13 Var.	26'-1 to 30'-7	553	6m1
6m2	Apron, Trans., Bott.		12 Var.	20'-6 to 26'-0	419	10 Var.	20'-6 to 25'-0	342	8 Var.	20'-6 to 24'-0	267	6m2
6p1	Curtain, Horizontal		4	25'-0	150	4	25'-0	150	4	25'-0	150	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.		2	16'-10	51	2	14'-7	44	2	12'-4	37	6s4
5t1	Curtain, Vertical		29	6'-6	197	27	6'-6	183	25	6'-6	169	5t1
	Estimated Quantities One Headwall	Reinf. Steel		4596 LB			3754 LB			3153 LB		
		Concrete Parapet Δ	2.5	34.1 CY		2.5	28.6 CY		2.5	23.5 CY		
		Concrete Wingwalls	6.2			4.5			3.1			
		Concrete Apron ✳	25.4			21.6			17.9			

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.

Bent Bar Details



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

Headwall Notes:

1. See Sheet TWFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. This headwall is based on a 3:1 slope normal to centerline of roadway.
3. The sides of the apron are to be formed to ensure correct line and grade.
4. 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.
5. 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.
6. Concrete quantities are estimated from back of parapet.
7. 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.
8. Dimensions are in feet and inches unless otherwise noted.

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWADOT Highway Administration

Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
12'-0" Span
0° Skew

TWFWH
0-4-21
Sheet 2 of 2

ENGLISHLRFDSIGNEDTWINCULVERTSFWH.DGN - TWFWH 0-4-21 S2 - THIS SHEET ISSUED 02-2021.

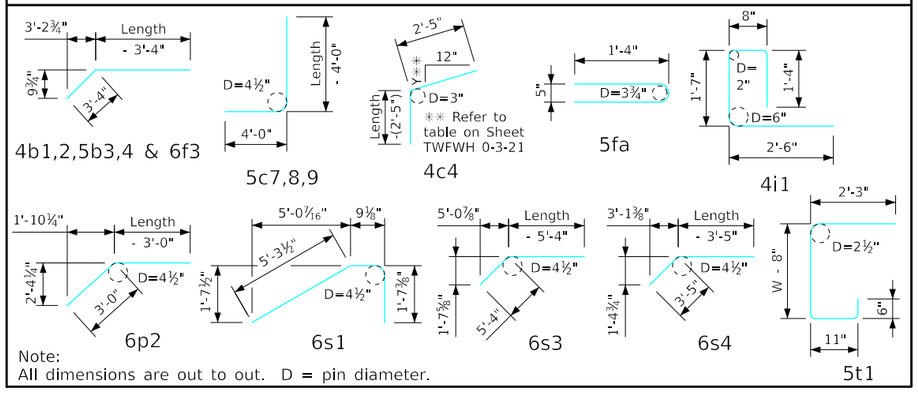
Bill of Reinforcing for One Headwall 0° Skew Span x Culvert Height

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			2.4			2.3			2.3			2.3			2.2			
		Concrete Wingwalls	28.1	80.3 CY		21.9	68.4 CY		16.9	58.1 CY		14.0	50.6 CY		11.4	42.8 CY		8.1	34.7 CY		
		Concrete 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.

Bent Bar Details



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

Headwall Notes:

1. See Sheet TWFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. This headwall is based on a 3:1 slope normal to centerline of roadway.
3. The sides of the apron are to be formed to ensure correct line and grade.
4. 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.
5. 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.
6. Concrete quantities are estimated from back of parapet.
7. 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.
8. Dimensions are in feet and inches unless otherwise noted.

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWADOT Highway Administration

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

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

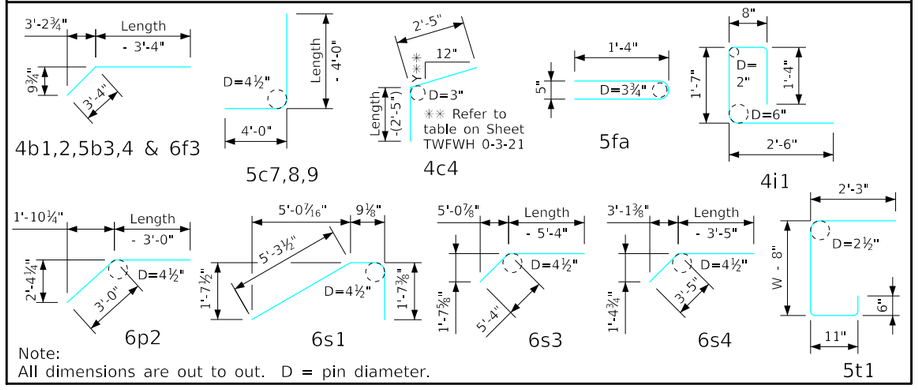
Bill of Reinforcing for One Headwall 0° Skew Span x Culvert Height

Bar	Location	Shape	10' x 6' No.	10' x 6' Length	10' x 6' Wt.	10' x 5' No.	10' x 5' Length	10' x 5' Wt.	10' x 4' No.	10' x 4' Length	10' x 4' Wt.	Bar
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.		9 Var.	5'-5 to 15'-7	99	7 Var.	5'-7 to 13'-7	70	5 Var.	5'-9 to 11'-6	45	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.		2	4'-1	5	2	4'-1	5	2	4'-0	5	4c4
4c5	Interior Wall, Both F.V.		26 Var.	1'-10 to 6'-9	75	22 Var.	1'-10 to 5'-9	56	18 Var.	1'-10 to 4'-9	40	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.		13	15'-11	138	13	13'-11	121	13	11'-11	103	4d1
4d2	Apron, Longit., Bott.		6	17'-8	71	6	14'-7	58	6	11'-6	46	4d2
6f1	Apron, Longit., Top		20	15'-11	478	20	13'-11	418	20	11'-11	358	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		41	6'-1	167	41	6'-1	167	41	6'-1	167	4i1
7j1	Parapet, Horizontal		4	21'-11	179	4	21'-11	179	4	21'-11	179	7j1
6m1	Apron, Trans., Top		18 Var.	22'-1 to 28'-6	684	15 Var.	22'-1 to 27'-4	557	13 Var.	22'-1 to 26'-7	475	6m1
6m2	Apron, Trans., Bott.		12 Var.	16'-6 to 22'-0	347	10 Var.	16'-6 to 21'-0	282	8 Var.	16'-6 to 20'-0	219	6m2
6p1	Curtain, Horizontal		4	21'-0	126	4	21'-0	126	4	21'-0	126	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.		2	16'-10	51	2	14'-7	44	2	12'-4	37	6s4
5t1	Curtain, Vertical		27	6'-6	183	25	6'-6	169	23	6'-6	156	5t1
	Estimated Quantities One Headwall	Reinf. Steel		4165 LB			3373 LB			2816 LB		
		Concrete Parapet Δ	2.2	29.9 CY		2.2	25.0 CY		2.2	20.4 CY		
		Concrete Wingwalls	6.2			4.5			3.1			
		Concrete Apron ✳	21.5			18.3			15.1			

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.

Bent Bar Details



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

Headwall Notes:

1. See Sheet TWFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. This headwall is based on a 3:1 slope normal to centerline of roadway.
3. The sides of the apron are to be formed to ensure correct line and grade.
4. 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.
5. 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.
6. Concrete quantities are estimated from back of parapet.
7. 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.
8. Dimensions are in feet and inches unless otherwise noted.

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWADOT Highway Administration

Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
10'-0" Span
0° Skew

TWFWH
0-5-21
Sheet 2 of 2

ENGLISHLRFDSIGNEDTWINCULVERTSFWH.DGN - TWFWH 0-5-21 S2 - THIS SHEET ISSUED 02-2021.

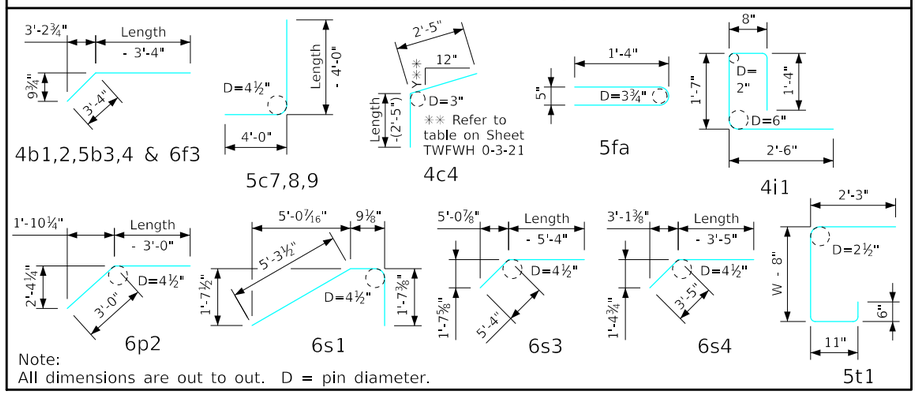
Bill of Reinforcing for One Headwall 0° Skew Span x Culvert Height

Bar	Location	Shape	8' x 10' No.	8' x 10' Length	8' x 10' Wt.	8' x 9' No.	8' x 9' Length	8' x 9' Wt.	8' x 8' No.	8' x 8' Length	8' x 8' Wt.	8' x 7' No.	8' x 7' Length	8' x 7' Wt.	8' x 6' No.	8' x 6' Length	8' x 6' Wt.	8' x 5' No.	8' x 5' Length	8' x 5' Wt.	8' x 4' No.	8' x 4' Length	8' x 4' Wt.	Bar
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	2	2'-10	6	5fa
4b1	Wingwall, B.F.H.		2	35'-0	47	2	31'-11	43	2	28'-10	39	2	25'-9	34	2	22'-8	30	2	19'-7	26	2	16'-6	22	4b1
4b2	Wingwall, B.F.H.		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	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	35'-1	73	2	32'-0	67	2	28'-11	60	2	25'-9	54	2	22'-8	47	2	19'-7	41	2	16'-6	34	5b3
5b4	Wingwall, F.F.H.		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	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.		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	9 Var.	5'-5 to 15'-7	99	7 Var.	5'-7 to 13'-7	70	5 Var.	5'-9 to 11'-6	45	5b5
4c1	Wingwall, F.F.V.		64 Var.	2 Each 2'-8 to 12'-9	330	58 Var.	2 Each 2'-8 to 11'-9	279	52 Var.	2 Each 2'-8 to 10'-9	233	46 Var.	2 Each 2'-8 to 9'-10	192	40 Var.	2 Each 2'-8 to 8'-10	154	32 Var.	2 Each 2'-8 to 7'-7	110	26 Var.	2 Each 2'-8 to 6'-7	80	4c1
4c2	Wingwall, F.F.V.		24 Var.	2 Each 9'-4 to 12'-11	178	18 Var.	2 Each 9'-4 to 11'-11	128	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4c2
4c3	Wingwall, F.F.V.		2	11'-7	15	2	10'-7	14	2	9'-7	13	2	8'-7	11	2	7'-7	10	4	6'-7	18	4	5'-7	15	4c3
4c4	Interior Wall, Both F.V.		2	4'-0	5	2	4'-0	5	2	4'-0	5	2	4'-0	5	2	4'-0	5	2	4'-0	5	2	3'-11	5	4c4
4c5	Interior Wall, Both F.V.		42 Var.	1'-10 to 10'-9	177	38 Var.	1'-9 to 9'-9	146	34 Var.	1'-9 to 8'-9	119	30 Var.	1'-9 to 7'-8	94	26 Var.	1'-9 to 6'-8	73	22 Var.	1'-9 to 5'-8	54	18 Var.	1'-9 to 4'-8	39	4c5
5c6	Wingwall, B.F.V.		12 Var.	2 Each 2'-8 to 4'-4	44	12 Var.	2 Each 2'-8 to 4'-4	44	12 Var.	2 Each 2'-8 to 4'-4	44	12 Var.	2 Each 2'-8 to 4'-4	44	12 Var.	2 Each 2'-8 to 4'-4	44	12 Var.	2 Each 2'-8 to 4'-4	44	12 Var.	2 Each 2'-8 to 4'-4	44	5c6
5c7	Wingwall, B.F.V.		52 Var.	2 Each 8'-8 to 16'-9	689	46 Var.	2 Each 8'-8 to 15'-9	586	40 Var.	2 Each 8'-8 to 14'-9	488	34 Var.	2 Each 8'-8 to 13'-10	399	28 Var.	2 Each 8'-8 to 12'-10	314	20 Var.	2 Each 8'-8 to 11'-7	211	14 Var.	2 Each 8'-8 to 10'-7	141	5c7
5c8	Wingwall, B.F.V.		38	10'-6	416	32	10'-6	350	26	10'-6	285	20	10'-6	219	14	10'-6	153	--	--	--	--	--	--	5c8
5c9	Wingwall, B.F.V.		2	15'-7	33	2	14'-7	30	2	13'-7	28	2	12'-7	26	2	11'-7	24	4	10'-7	44	4	9'-7	40	5c9
4d1	Apron, Longit., Bott.		11	23'-11	176	11	21'-11	161	11	19'-11	146	11	17'-11	132	11	15'-11	117	11	13'-11	102	11	11'-11	88	4d1
4d2	Apron, Longit., Bott.		6	30'-1	121	6	27'-0	108	6	23'-11	96	6	20'-10	84	6	17'-8	71	6	14'-7	58	6	11'-6	46	4d2
6f1	Apron, Longit., Top		16	23'-11	575	16	21'-11	527	16	19'-11	479	16	17'-11	431	16	15'-11	383	16	13'-11	334	16	11'-11	286	6f1
6f2	Apron, Longit., Top		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	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	35'-1	105	2	32'-0	96	2	28'-11	87	2	25'-9	77	2	22'-8	68	2	19'-7	59	2	16'-6	50	6f3
4i1	Parapet, Vertical		33	6'-1	134	33	6'-1	134	33	6'-1	134	33	6'-1	134	33	6'-1	134	33	6'-1	134	33	6'-1	134	4i1
7j1	Parapet, Horizontal		4	18'-2	149	4	18'-2	149	4	18'-2	149	4	17'-11	146	4	17'-11	146	4	17'-11	146	4	17'-11	146	7j1
6m1	Apron, Trans., Top		29 Var.	18'-4 to 28'-10	1027	26 Var.	18'-4 to 27'-9	900	23 Var.	18'-4 to 26'-7	776	21 Var.	18'-1 to 25'-7	689	18 Var.	18'-1 to 24'-6	576	15 Var.	18'-1 to 23'-4	467	13 Var.	18'-1 to 22'-7	397	6m1
6m2	Apron, Trans., Bott.		20 Var.	12'-7 to 22'-1	521	18 Var.	12'-7 to 21'-1	455	16 Var.	12'-7 to 20'-1	393	14 Var.	12'-6 to 19'-0	331	12 Var.	12'-6 to 18'-0	275	10 Var.	12'-6 to 17'-0	222	8 Var.	12'-6 to 16'-0	171	6m2
6p1	Curtain, Horizontal		4	17'-1	103	4	17'-1	103	4	17'-1	103	4	17'-0	102	4	17'-0	102	4	17'-0	102	4	17'-0	102	6p1
6p2	Curtain, Horizontal		8	16'-1	193	8	14'-10	178	8	13'-7	163	8	12'-4	148	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	4	7'-8	46	4	7'-8	46	4	7'-8	46	4	7'-8	46	6s1
6s2	Wing Slope, Both F.		4	30'-7	184	4	27'-4	164	4	24'-1	145	4	20'-10	125	4	17'-7	106	4	14'-4	86	4	11'-1	67	6s2
6s3	Wing Slope, F.F.		2	36'-8	110	2	33'-5	100	2	30'-2	91	2	26'-11	81	2	23'-8	71	2	20'-5	61	2	17'-2	52	6s3
6s4	Interior Wall, Both F.		2	25'-9	77	2	23'-6	71	2	21'-4	64	2	19'-1	57	2	16'-10	51	2	14'-7	44	2	12'-4	37	6s4
5t1	Curtain, Vertical		31	7'-6	242	29	7'-3	219	27	7'-0	197	25	6'-9	176	23	6'-6	156	21	6'-6	142	19	6'-6	129	5t1
	Estimated Quantities One Headwall	Reinf. Steel		6941 LB			6064 LB			5153 LB			4445 LB			3745 LB			2996 LB			2481 LB		
		Concrete	Parapet Δ	2.0	53.7 CY	2.0	45.1 CY		2.0	37.9 CY		1.9	30.5 CY		1.9	26.1 CY		1.9	21.6 CY		1.9	17.6 CY		
			Wingwalls	16.9		14.0			11.4			8.1			6.2			4.5			3.1			
			Apron ✳	34.8		29.1			24.5			20.5			18.0			15.2			12.6			

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.

Bent Bar Details



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

Headwall Notes:

1. See Sheet TWFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. This headwall is based on a 3:1 slope normal to centerline of roadway.
3. The sides of the apron are to be formed to ensure correct line and grade.
4. 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.
5. 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.
6. Concrete quantities are estimated from back of parapet.
7. 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.
8. Dimensions are in feet and inches unless otherwise noted.

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWA DOT Highway Administration

Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
8'-0" Span
0° Skew

TWFWH
0-6-21

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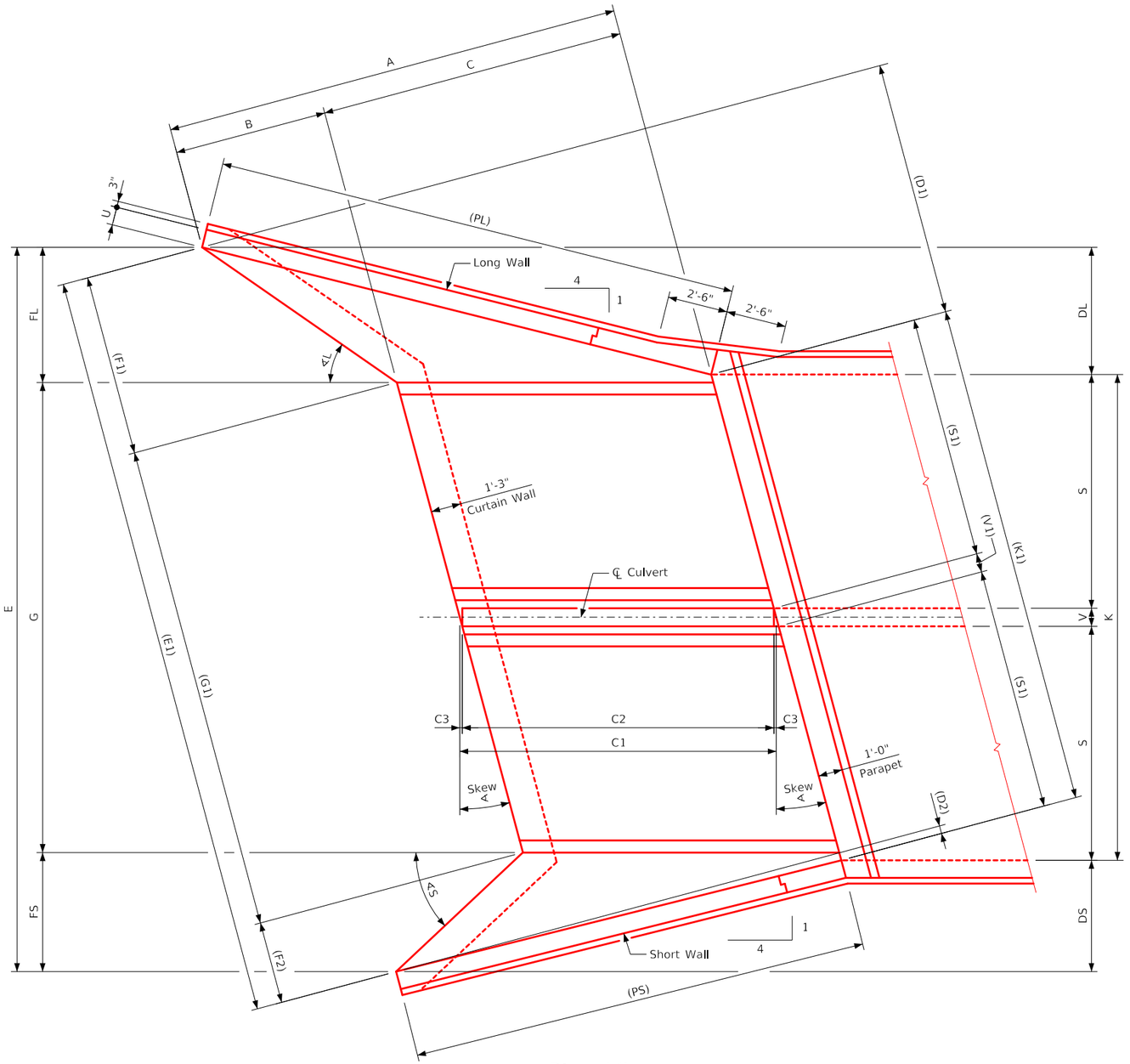

Plan View

Notes:

1. See Sheet TWFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. See Sheet TWFWH 15-2-21 for dimensions table.
3. See Sheet TWFWH 15-4-21 for Angle L & Angle S.

LATEST REVISION DATE

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IOWADOT Highway Administration

Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Dimension Plan 15° Skew	TWFWH 15-1-21

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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'	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	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	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	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	20'-8	18'-8	16'-8	14'-8	12'-8	10'-8	8'-8	C
C1	25'-6½	23'-5⅝	21'-4¾	19'-3⅞	17'-3	15'-2¼	13'-1⅜	11'-0½	8'-11⅝	25'-6½	23'-5⅝	21'-4¾	19'-3⅞	17'-3	15'-2¼	13'-1⅜	11'-0½	8'-11⅝	21'-4¾	19'-3⅞	17'-3	15'-2¼	13'-1⅜	11'-0½	8'-11⅝	C1
C2	25'-3¼	23'-2⅝	21'-2⅛	19'-1¼	17'-0⅜	14'-11¾	12'-11	10'-10⅛	8'-9¼	25'-3¼	23'-2⅝	21'-2⅛	19'-1¼	17'-0⅜	14'-11¾	12'-11	10'-10⅛	8'-9¼	21'-2⅛	19'-1¼	17'-0⅜	14'-11¾	12'-11	10'-10⅛	8'-9¼	C2
C3	1⅜	1½	1⅜	1⅜	1⅜	1¼	1¼	1¼	1¼	1⅜	1½	1⅜	1⅜	1⅜	1¼	1¼	1¼	1¼	1⅜	1⅜	1⅜	1¼	1¼	1¼	1¼	C3
DL	10'-3⅛	9'-5⅛	8'-7¼	7'-9¼	6'-11¼	6'-1¼	5'-3¼	4'-5¼	3'-7¼	10'-3⅛	9'-5⅛	8'-7¼	7'-9¼	6'-11¼	6'-1¼	5'-3¼	4'-5¼	3'-7¼	8'-7¼	7'-9¼	6'-11¼	6'-1¼	5'-3¼	4'-5¼	3'-7¼	DL
DS	8'-11¾	8'-3	7'-6¼	6'-9½	6'-0¾	5'-4	4'-7¼	3'-10⅝	3'-1⅞	8'-11¾	8'-3	7'-6¼	6'-9½	6'-0¾	5'-4	4'-7¼	3'-10⅝	3'-1⅞	7'-6¼	6'-9½	6'-0¾	5'-4	4'-7¼	3'-10⅝	3'-1⅞	DS
D1	20'-6½	18'-10½	17'-2½	15'-6½	13'-10½	12'-2½	10'-6⅝	8'-10⅝	7'-2⅝	20'-6½	18'-10½	17'-2½	15'-6½	13'-10½	12'-2½	10'-6⅝	8'-10⅝	7'-2⅝	17'-2½	15'-6½	13'-10½	12'-2½	10'-6⅝	8'-10⅝	7'-2⅝	D1
D2	7½	6⅞	6¼	5⅝	5	4½	3⅜	3¼	2⅜	7½	6⅞	6¼	5⅝	5	4½	3⅜	3¼	2⅜	6¼	5⅝	5	4½	3⅜	3¼	2⅜	D2
E	44'-2⅞	42'-7⅛	40'-11⅜	39'-4¾	37'-10	36'-2¼	34'-7½	33'-0⅞	31'-6⅛	40'-2⅞	38'-7⅛	36'-11⅜	35'-4¾	33'-10	32'-2¼	30'-7½	29'-0⅞	27'-6⅛	32'-11⅜	31'-4¾	29'-10	28'-2¼	26'-7½	25'-0⅞	23'-6⅛	E
E1	45'-9⅝	44'-1⅛	42'-4¾	40'-9⅜	39'-2	37'-5⅝	35'-10¼	34'-2⅞	32'-7½	41'-7⅞	39'-11½	38'-3⅛	36'-7¾	35'-0⅜	33'-3⅞	31'-8½	30'-1⅛	28'-5¾	34'-1⅜	32'-6	30'-10⅝	29'-2¼	27'-6⅞	25'-11½	24'-4⅛	E1
FL	10'-7⅛	9'-9⅛	8'-11¼	8'-1¼	7'-3¼	6'-5¼	5'-7¼	4'-9¼	3'-11¼	10'-7⅛	9'-9⅛	8'-11¼	8'-1¼	7'-3¼	6'-5¼	4'-9¼	3'-11¼	8'-11¼	8'-1¼	7'-3¼	6'-5¼	5'-7¼	4'-9¼	3'-11¼	FL
FS	9'-3¾	8'-7	7'-10¼	7'-1½	6'-4¾	5'-8	4'-11¼	4'-2⅝	3'-5⅞	9'-3¾	8'-7	7'-10¼	7'-1½	6'-4¾	5'-8	4'-11¼	4'-2⅝	3'-5⅞	7'-10¼	7'-1½	6'-4¾	5'-8	4'-11¼	4'-2⅝	3'-5⅞	FS
F1	14'-3¼	13'-1¾	12'-0¼	10'-10⅝	9'-9⅛	8'-7½	7'-6	6'-4⅜	5'-2⅞	14'-3¼	13'-1¾	12'-0¼	10'-10⅝	9'-9⅛	8'-7½	7'-6	6'-4⅜	5'-2⅞	12'-0¼	10'-10⅝	9'-9⅛	8'-7½	7'-6	6'-4⅜	5'-2⅞	F1
F2	6'-4	5'-10⅛	5'-4⅜	4'-10½	4'-4⅜	3'-10⅞	3'-5	2'-11¼	2'-5⅜	6'-4	5'-10⅛	5'-4⅜	4'-10½	4'-4⅜	3'-10⅞	3'-5	2'-11¼	2'-5⅜	5'-4⅜	4'-10½	4'-4⅜	3'-10⅞	3'-5	2'-11¼	2'-5⅜	F2
G	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	20'-1	20'-1	20'-1	16'-2	16'-2	16'-2	16'-1	16'-1	16'-1	16'-1	G
G1	25'-2¼	25'-1¼	25'-0¼	25'-0¼	25'-0¼	24'-11¼	24'-11¼	24'-11¼	24'-11¼	21'-0⅝	20'-11⅝	20'-10½	20'-10½	20'-10½	20'-9½	20'-9½	20'-9½	20'-9½	16'-8⅞	16'-8⅞	16'-8⅞	16'-7¾	16'-7¾	16'-7¾	16'-7¾	G1
G2	26'-5	26'-4	26'-2⅞	26'-2⅞	26'-2⅞	26'-1¾	26'-1⅝	26'-1½	26'-1⅜	22'-3⅜	22'-2¼	22'-1¼	22'-1⅛	22'-1⅛	22'-0	21'-11⅞	21'-11⅞	21'-11⅝	17'-11½	17'-11½	17'-11⅜	17'-10⅜	17'-10¼	17'-10⅛	17'-10	G2
G3	18'-10⅜	17'-4¼	15'-10⅛	14'-4⅛	12'-10	11'-3⅞	9'-9¾	8'-3⅝	6'-9⅝	18'-10⅜	17'-4¼	15'-10⅛	14'-4⅛	12'-10	11'-3⅞	9'-9¾	8'-3⅝	6'-9⅝	15'-10⅛	14'-4⅛	12'-10	11'-3⅞	9'-9¾	8'-3⅝	6'-9⅝	G3
G4	19'-6⅝	17'-9⅝	16'-0⅝	14'-6⅝	13'-0½	11'-3⅝	9'-9⅝	8'-3½	6'-9⅝	19'-6⅝	17'-9⅝	16'-0⅝	14'-6⅝	13'-0½	11'-3⅝	9'-9⅝	8'-3½	6'-9⅝	16'-0⅝	14'-6⅝	13'-0½	11'-3⅝	9'-9⅝	8'-3½	6'-9⅝	G4
G5	13'-10⅜	12'-9	11'-7¾	10'-6⅜	9'-5	8'-3¾	7'-2⅜	6'-1	4'-11¾	13'-10⅜	12'-9	11'-7¾	10'-6⅜	9'-5	8'-3¾	7'-2⅜	6'-1	4'-11¾	11'-7¾	10'-6⅜	9'-5	8'-3¾	7'-2⅜	6'-1	4'-11¾	G5
G6	14'-11¼	13'-7⅞	12'-4⅜	11'-3⅛	10'-1⅞	8'-10⅜	7'-9⅛	6'-7⅞	5'-6⅝	14'-11¼	13'-7⅞	12'-4⅜	11'-3⅛	10'-1⅞	8'-10⅜	7'-9⅛	6'-7⅞	5'-6⅝	12'-4⅜	11'-3⅛	10'-1¾	8'-10⅜	7'-9⅛	6'-7⅞	5'-6⅝	G6
G7	2⅝	5⅜	8⅛	8⅛	8⅛	10¾	10⅝	10⅝	10½	2⅝	5⅜	8⅛	8⅛	8⅛	10¾	10⅝	10⅝	10½	8⅛	8⅛	8⅛	10¾	10⅝	10⅝	10½	G7
G8	3¾	5⅝	7½	7½	7½	9¼	9¼	9¼	9⅛	3¾	5⅝	7½	7½	7½	9¼	9¼	9¼	9⅛	7½	7½	7½	9¼	9¼	9¼	9⅛	G8
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	20'-9	20'-9	20'-9	16'-10	16'-10	16'-10	16'-9	16'-9	16'-9	16'-9	K
K1	25'-10⅝	25'-9½	25'-8½	25'-8½	25'-8½	25'-7½	25'-7½	25'-7½	25'-7½	21'-8⅞	21'-7⅞	21'-6⅞	21'-6⅞	21'-6⅞	21'-5¾	21'-5¾	21'-5¾	21'-5¾	17'-5⅛	17'-5⅛	17'-5⅛	17'-4⅛	17'-4⅛	17'-4⅛	17'-4⅛	K1
PL	42'-3⅞	38'-10⅝	35'-5½	32'-0¼	28'-7⅛	25'-2	21'-8¾	18'-3⅝	14'-10⅜	42'-3⅞	38'-10⅝	35'-5½	32'-0¼	28'-7⅛	25'-2	21'-8¾	18'-3⅝	14'-10⅜	35'-5½	32'-0¼	28'-7⅛	25'-2	21'-8¾	18'-3⅝	14'-10⅜	PL
PS	37'-0⅛	34'-0	31'-0	28'-0	25'-0	22'-0	19'-0	16'-0	13'-0	37'-0⅛	34'-0	31'-0	28'-0	25'-0	22'-0	19'-0	16'-0	13'-0	31'-0	28'-0	25'-0	22'-0	19'-0	16'-0	13'-0	PS
RL	44'-1	40'-6⅛	36'-11⅞	33'-4¼	29'-9⅜	26'-2½	22'-7⅝	19'-0¾	15'-5⅞	44'-1	40'-6⅛	36'-11⅞	33'-4¼	29'-9⅜	26'-2½	22'-7⅝	19'-0¾	15'-5⅞	36'-11⅞	33'-4¼	29'-9⅜	26'-2½	22'-7⅝	19'-0¾	15'-5⅞	RL
RS	39'-0⅛	35'-10⅛	32'-8⅛	29'-6¼	26'-4¼	23'-2⅜	20'-0⅜	16'-10⅜	13'-8½	39'-0⅛	35'-10⅛	32'-8⅛	29'-6¼	26'-4¼	23'-2⅜	20'-0⅜	16'-10⅜	13'-8½	32'-8⅛	29'-6¼	26'-4¼	23'-2⅜	20'-0⅜	16'-10⅜	13'-8½	RS
R1	27'-6¾	25'-3⅜	23'-0⅛	20'-8½	18'-5	16'-1⅝	13'-10⅝	11'-6⅝	9'-3¼	27'-6¾	25'-3⅜	23'-0⅛	20'-8½	18'-5	16'-1⅝	13'-10⅝	11'-6⅝	9'-3¼	23'-0⅛	20'-8½	18'-5	16'-1⅝	13'-10⅝	11'-6⅝	9'-3¼	R1
S1	12'-5⅛	12'-5⅛	12'-5⅛	12'-5⅛	12'-5⅛	12'-5⅛	12'-5⅛	12'-5⅛	12'-5⅛	10'-4¼	10'-4¼	10'-4¼	10'-4¼	10'-4¼	10'-4¼	10'-4¼	10'-4¼	10'-4¼	8'-3⅜	8'-3⅜	8'-3⅜	8'-3⅜	8'-3⅜	8'-3⅜	8'-3⅜	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	1'-0	1'-0	1'-0	1'-0	1'-0	1'-0	1'-0	T
U	1'-0	11	10	10	10	9	9	9	9	1'-0	11	10	10	10	9	9	9	9	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	10	10	10	9	9	9	9	V
V1	1'-0⅜	11⅜	10⅜	10⅜	10⅜	9⅜	9⅜	9⅜	9⅜	1'-0⅜	11⅜	10⅜	10⅜	10⅜	9⅜	9⅜	9⅜	9⅜	10⅜	10⅜	10⅜	9⅜	9⅜	9⅜	9⅜	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	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 15-1-21 and sheets TWFWH 15-3-21 thru TWFWH 15-5-21 for location of certain dimensions tabulated.
3. Dimensions are in feet and inches unless otherwise noted.

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWADOT Highway Administration

Standard Design - Twin Reinforced Concrete Box Culverts

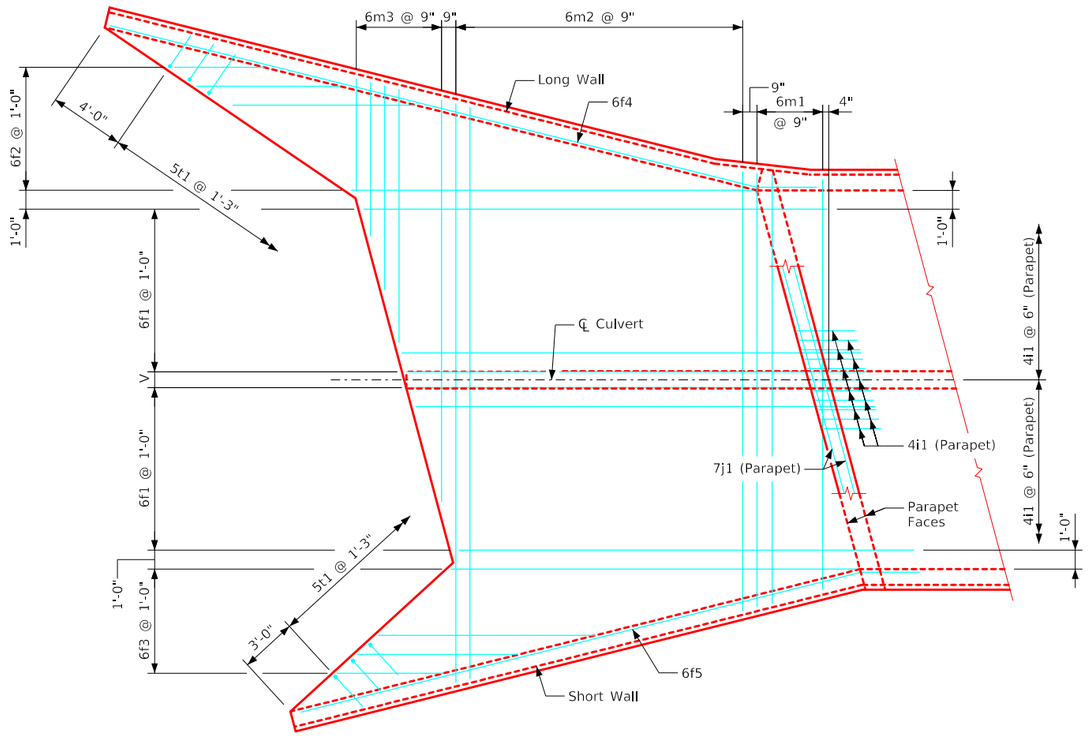
Flared Wing Headwalls

February, 2021

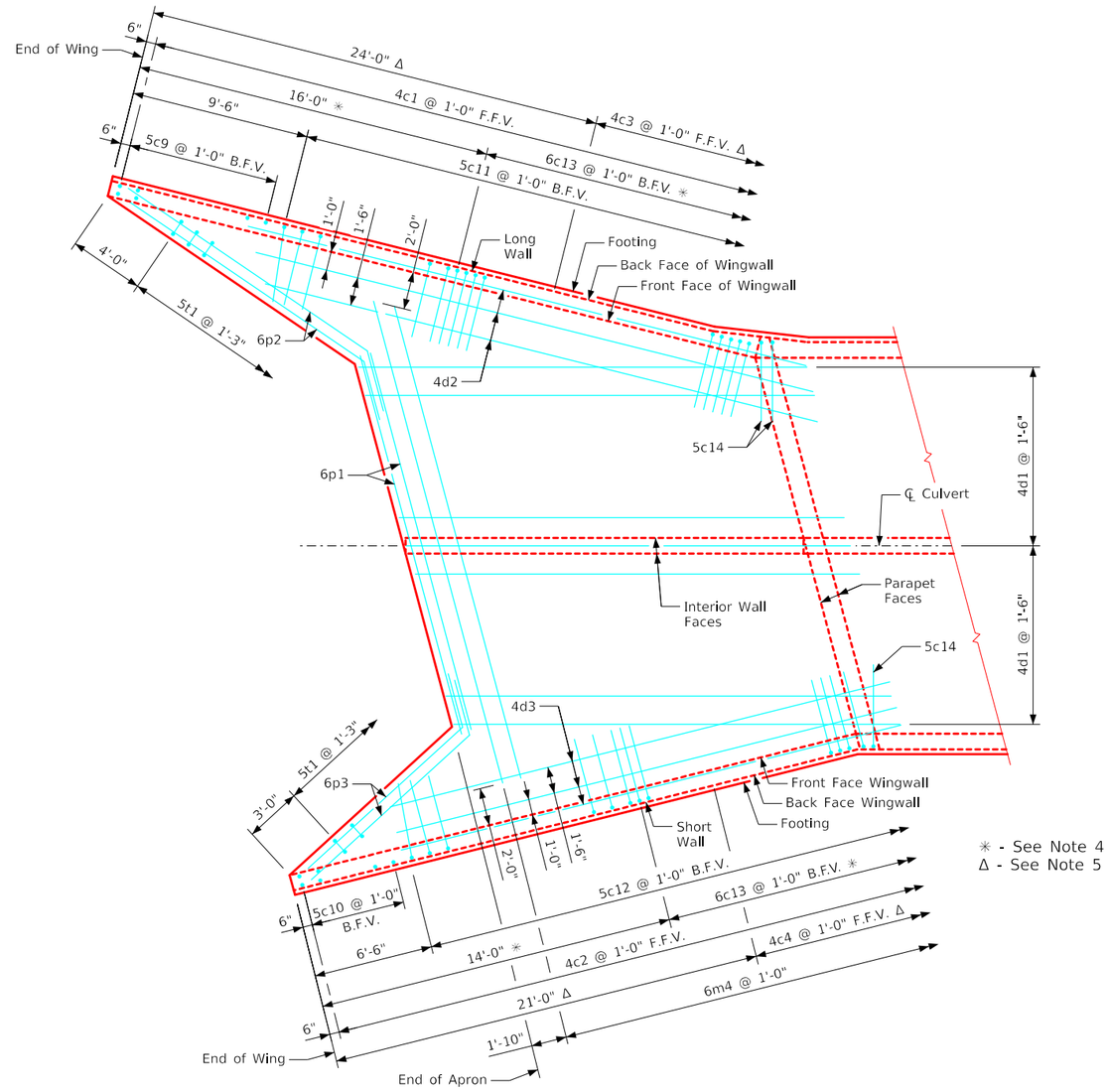
Dimension Table
15° Skew

TWFWH
15-2-21

ENGLISHLRFDSIGNEDTWINCULVERTSFWH.DGN - TWFWH 15-2-21 - THIS SHEET ISSUED 02-2021.



Plan View - Top of Apron Reinforcing



✳ - See Note 4
Δ - See Note 5

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. Top transverse floor bars are referenced approximately 4" from the back of the parapet for all headwalls.
4. There are no 6c13 bars in the 4' & 5' height headwalls.
5. 4c3 & 4c4 bars used only in the 9', 10', 11' & 12' height headwalls.
6. For dimension table see Sheet TWFWH 15-2-21.
7. For reinforcing in curtain wall see Curtain Wall Details on Sheet TWFWH 15-4-21.

LATEST REVISION DATE

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Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Apron Details 15° Skew	TWFWH 15-3-21

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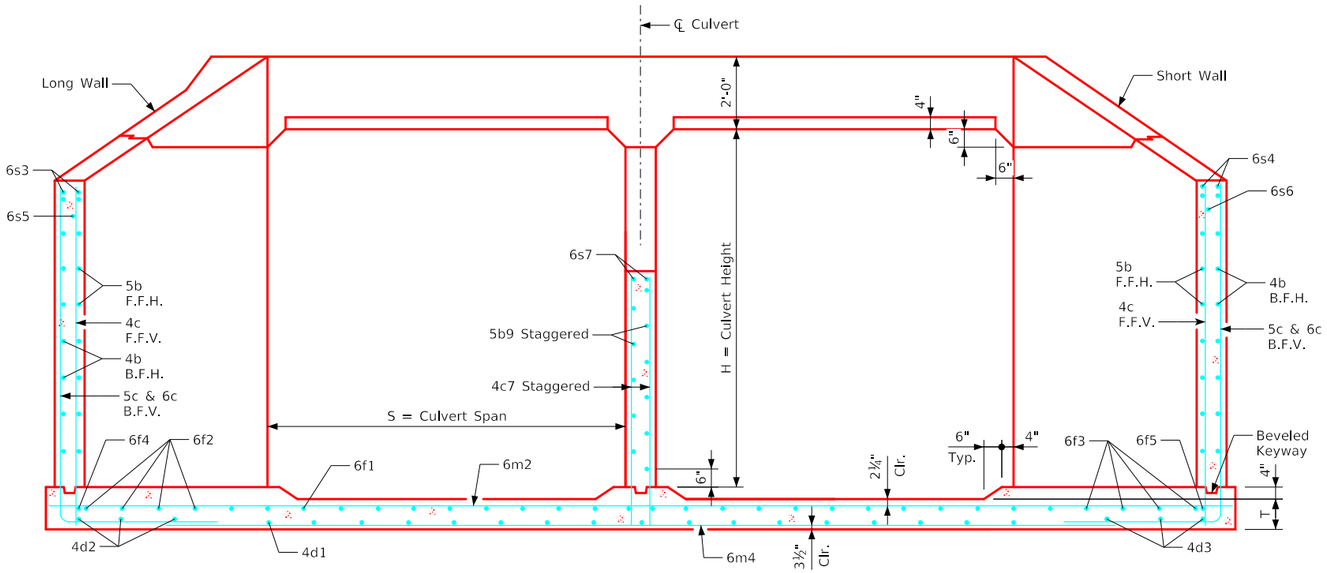
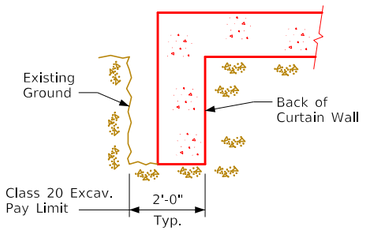
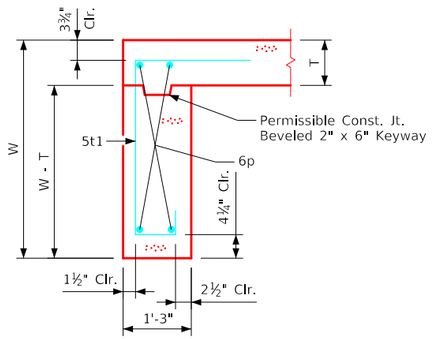


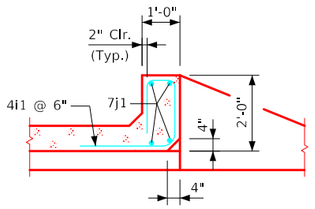
Typical Section - Near Center of Apron



Curtain Wall
Class 20 Excavation

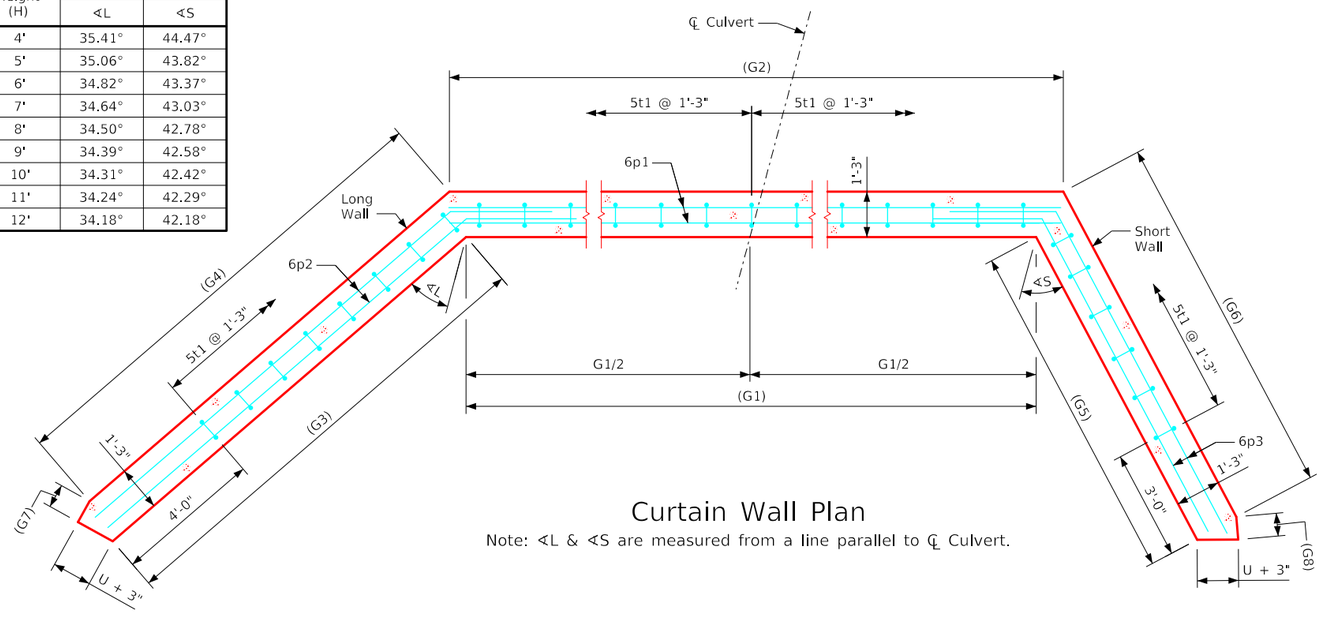


Section thru Curtain Wall



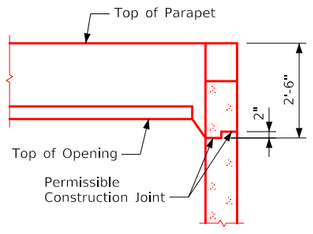
Section thru Parapet

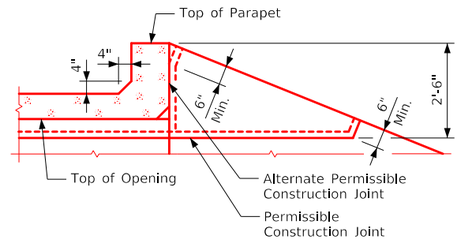
Culvert Height (H)	Angle	
	∢L	∢S
4'	35.41°	44.47°
5'	35.06°	43.82°
6'	34.82°	43.37°
7'	34.64°	43.03°
8'	34.50°	42.78°
9'	34.39°	42.58°
10'	34.31°	42.42°
11'	34.24°	42.29°
12'	34.18°	42.18°



Curtain Wall Plan

Note: ∢L & ∢S are measured from a line parallel to ℄ Culvert.





Top of Wingwall Details

Notes:

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

LATEST REVISION DATE

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IOWADOT Highway Administration

Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Parapet & Curtain Wall Details 15° Skew

TWFWH 15-4-21

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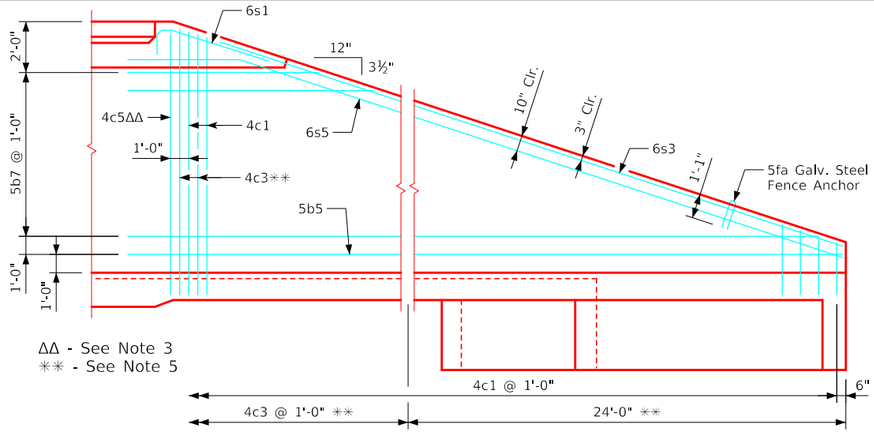
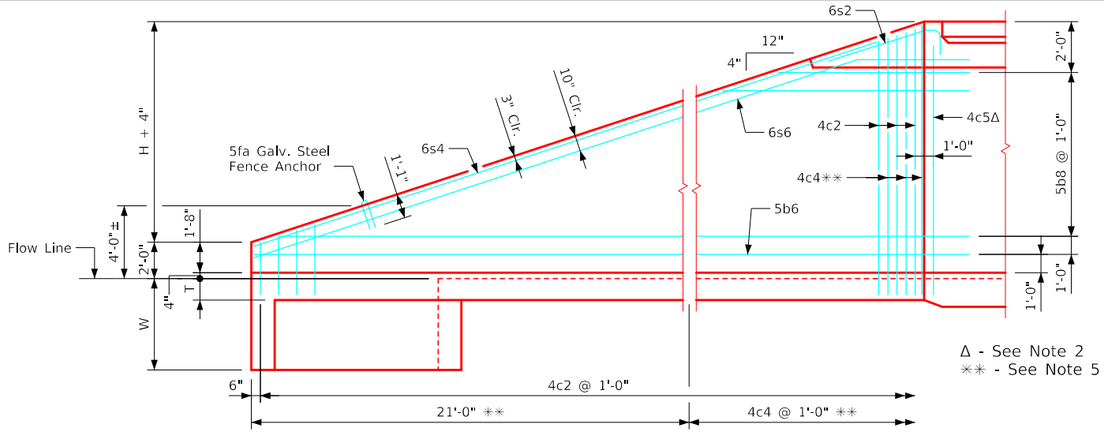
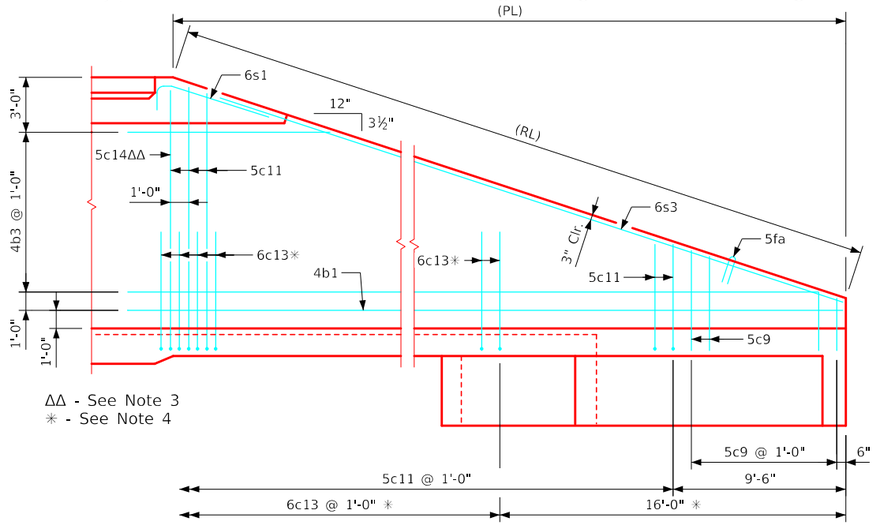


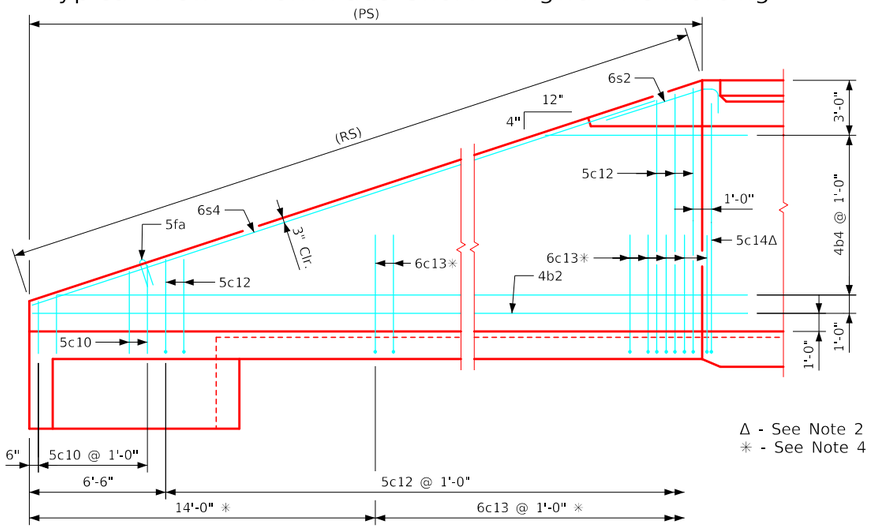
Typical View - Front Face Long Wingwall Reinforcing



Typical View - Front Face Short Wingwall Reinforcing

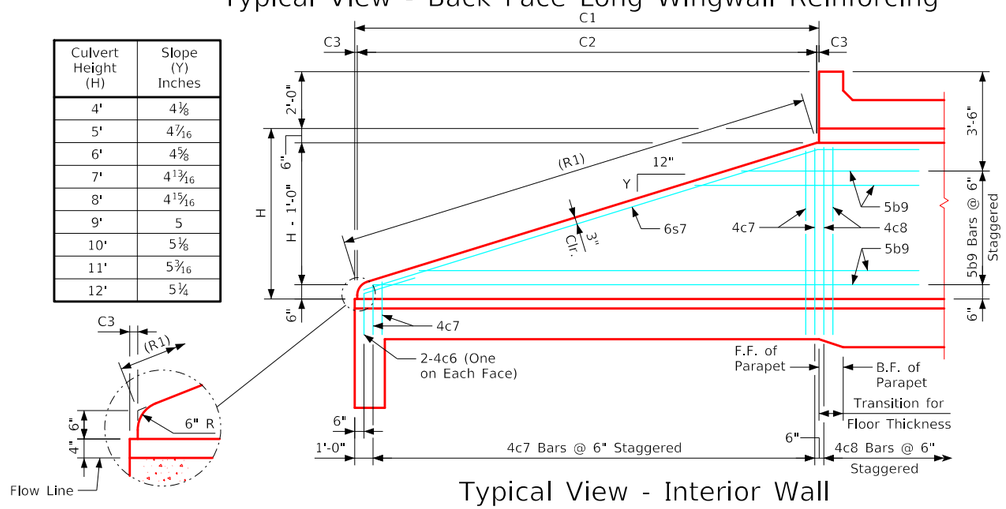


Typical View - Back Face Long Wingwall Reinforcing



Typical View - Back Face Short Wingwall Reinforcing

Culvert Height (H)	Slope (Y) Inches
4'	4⅜
5'	4⅞16
6'	4⅝
7'	4¹³⁄₁₆
8'	4¹⁵⁄₁₆
9'	5
10'	5⅛
11'	5³⁄₁₆
12'	5¼



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 all headwalls.
3. Two 4c5 & two 5c14 for 5', 7', 9', 10' & 12' height headwalls. One 4c5 & one 5c14 bar for 4', 6', 8' & 11' 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 TWFWH 15-2-21.
7. Top of wall slope may be rounded in some instances.

LATEST REVISION DATE

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IOWADOT Highway Administration

Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Wingwall Details 15° Skew

TWFWH 15-5-21

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

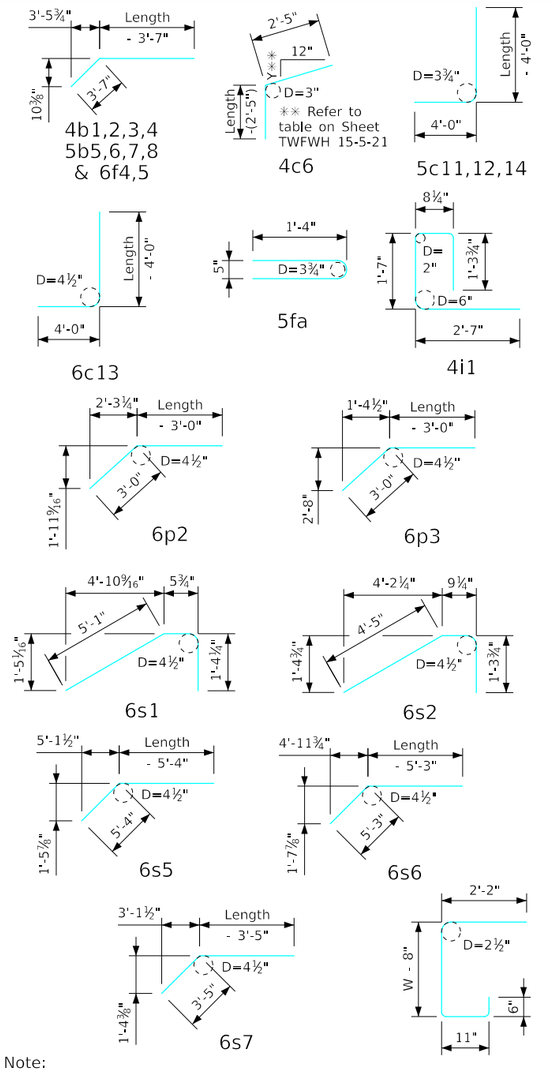
Bar	Location	Shape	12' x 12' No.	12' x 12' Length	12' x 12' Wt.	12' x 11' No.	12' x 11' Length	12' x 11' Wt.	12' x 10' No.	12' x 10' Length	12' x 10' Wt.	12' x 9' No.	12' x 9' Length	12' x 9' Wt.	12' x 8' No.	12' x 8' Length	12' x 8' Wt.	Bar
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	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.		21 Var.	5'-6 to 28'-6	372	19 Var.	5'-6 to 26'-5	316	17 Var.	5'-6 to 24'-4	264	15 Var.	5'-7 to 22'-3	218	13 Var.	5'-7 to 20'-2	175	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.		2	4'-2	6	2	4'-2	6	2	4'-2	6	2	4'-2	6	2	4'-2	6	4c6
4c7	Interior Wall, Both F.V.		49 Var.	2'-0 to 12'-5	236	45 Var.	1'-11 to 11'-5	200	41 Var.	1'-11 to 10'-5	169	37 Var.	1'-11 to 9'-6	141	33 Var.	1'-11 to 8'-6	115	4c7
4c8	Interior Wall, Both F.V.		2	12'-7	17	2	11'-7	15	2	10'-7	14	2	9'-7	13	2	8'-7	11	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.		17	28'-10	327	17	26'-9	304	17	24'-9	281	17	22'-8	257	17	20'-7	234	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		24	28'-10	1039	24	26'-9	964	24	24'-9	892	24	22'-8	817	24	20'-7	742	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		51	6'-2	210	49	6'-2	202	49	6'-2	202	49	6'-2	202	49	6'-2	202	4i1
7j1	Parapet, Horizontal		4	27'-7	226	4	27'-4	223	4	27'-1	221	4	27'-1	221	4	27'-1	221	7j1
6m1	Apron, Trans., Top		6 Var.	27'-10 to 28'-9	255	6 Var.	27'-7 to 28'-6	253	6 Var.	27'-4 to 28'-3	250	6 Var.	27'-4 to 28'-3	250	6 Var.	27'-4 to 28'-3	250	6m1
6m2	Apron, Trans., Top		25 Var.	29'-1 to 38'-1	1261	22 Var.	28'-10 to 36'-9	1084	19 Var.	28'-7 to 35'-4	912	17 Var.	28'-7 to 34'-7	806	14 Var.	28'-7 to 33'-5	652	6m2
6m3	Apron, Trans., Top		9 Var.	8'-0 to 28'-11	250	9 Var.	8'-0 to 28'-10	249	9 Var.	7'-11 to 28'-10	248	9 Var.	5'-5 to 26'-4	215	9 Var.	5'-7 to 26'-5	216	6m3
6m4	Apron, Trans., Bott.		24 Var.	21'-6 to 33'-10	997	22 Var.	21'-4 to 32'-8	892	20 Var.	21'-3 to 31'-6	792	18 Var.	21'-3 to 30'-5	698	16 Var.	21'-3 to 29'-4	608	6m4
6p1	Curtain, Horizontal		4	26'-2	157	4	26'-1	157	4	25'-11	156	4	25'-11	156	4	25'-11	156	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.		2	30'-9	92	2	28'-6	86	2	26'-3	79	2	23'-11	72	2	21'-8	65	6s7
5t1	Curtain, Vertical		42	7'-11	347	40	7'-8	320	38	7'-5	294	37	7'-2	277	35	6'-11	252	5t1
	Estimated Quantities One Headwall	Reinf. Steel		10,924 LB			9731 LB			8610 LB			7628 LB			6557 LB		
		Concrete Parapet Δ	2.9	92.4 CY		2.8	79.4 CY		2.8	67.9 CY		2.8	59.4 CY		2.8	51.4 CY		
		Concrete Wingwalls	29.5			23.2			17.9			14.8			12.1			
		Concrete Apron ✳	60.0			53.4			47.2			41.8			36.5			

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

Bent Bar Details



Note:
All dimensions are out to out. D = pin diameter. 5t1

Headwall Notes:

1. See Sheet TWFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. This headwall is based on a 3:1 slope normal to centerline of roadway.
3. The sides of the apron are to be formed to ensure correct line and grade.
4. 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.
5. 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.
6. Concrete quantities are estimated from back of parapet.
7. 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.
8. Dimensions are in feet and inches unless otherwise noted.

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWADOT Highway Administration

Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
12'-0" Span
15° Skew

TWFWH
15-6-21
Sheet 1 of 2

ENGLISHLRFDSIGNEDTWINCULVERTSFWH.DGN - TWFWH 15-6-21 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.		11 Var.	5'-8 to 18'-2	137	9 Var.	5'-9 to 16'-1	102	7 Var.	5'-10 to 14'-0	72	5 Var.	6'-0 to 11'-10	47	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.		2	4'-2	6	2	4'-2	6	2	4'-2	6	2	4'-1	5	4c6
4c7	Interior Wall, Both F.V.		28 Var.	1'-11 to 7'-4	87	24 Var.	1'-11 to 6'-4	66	20 Var.	1'-11 to 5'-5	49	16 Var.	1'-10 to 4'-5	33	4c7
4c8	Interior Wall, Both F.V.		2	7'-7	10	2	6'-7	9	2	5'-7	7	2	4'-7	6	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.		17	18'-6	210	17	16'-5	186	17	14'-4	163	17	12'-4	140	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		24	18'-6	667	24	16'-5	592	24	14'-4	517	24	12'-4	445	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		49	6'-2	202	49	6'-2	202	49	6'-2	202	49	6'-2	202	4i1
7j1	Parapet, Horizontal		4	26'-9	219	4	26'-9	219	4	26'-9	219	4	26'-9	219	7j1
6m1	Apron, Trans., Top		6 Var.	27'-1 to 28'-0	248	6 Var.	27'-1 to 28'-0	248	6 Var.	27'-1 to 28'-0	248	6 Var.	27'-1 to 28'-0	248	6m1
6m2	Apron, Trans., Top		11 Var.	28'-4 to 32'-1	499	8 Var.	28'-4 to 30'-11	356	6 Var.	28'-4 to 30'-2	264	3 Var.	28'-4 to 29'-1	129	6m2
6m3	Apron, Trans., Top		9 Var.	5'-7 to 26'-5	216	9 Var.	5'-8 to 26'-7	218	8 Var.	5'-9 to 24'-0	179	9 Var.	3'-3 to 24'-2	185	6m3
6m4	Apron, Trans., Bott.		14 Var.	21'-2 to 28'-2	519	12 Var.	21'-2 to 27'-2	436	10 Var.	21'-2 to 26'-1	355	8 Var.	21'-2 to 25'-0	277	6m4
6p1	Curtain, Horizontal		4	25'-10	155	4	25'-10	155	4	25'-10	155	4	25'-10	155	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'-6	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.		2	19'-4	58	2	17'-1	51	2	14'-9	44	2	12'-6	38	6s7
5t1	Curtain, Vertical		30	6'-8	209	28	6'-5	187	26	6'-5	174	24	6'-5	161	5t1
	Estimated Quantities One Headwall	Reinf. Steel		5619 LB			4776 LB			3879 LB			3221 LB		
		Concrete Parapet Δ	2.7	42.5 CY		2.7	35.8 CY		2.7	30.1 CY		2.7	24.7 CY		
		Concrete Wingwalls	6.6			6.6			4.9			3.3			
		Concrete Apron ✳	31.2			26.5			22.5			18.7			

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.

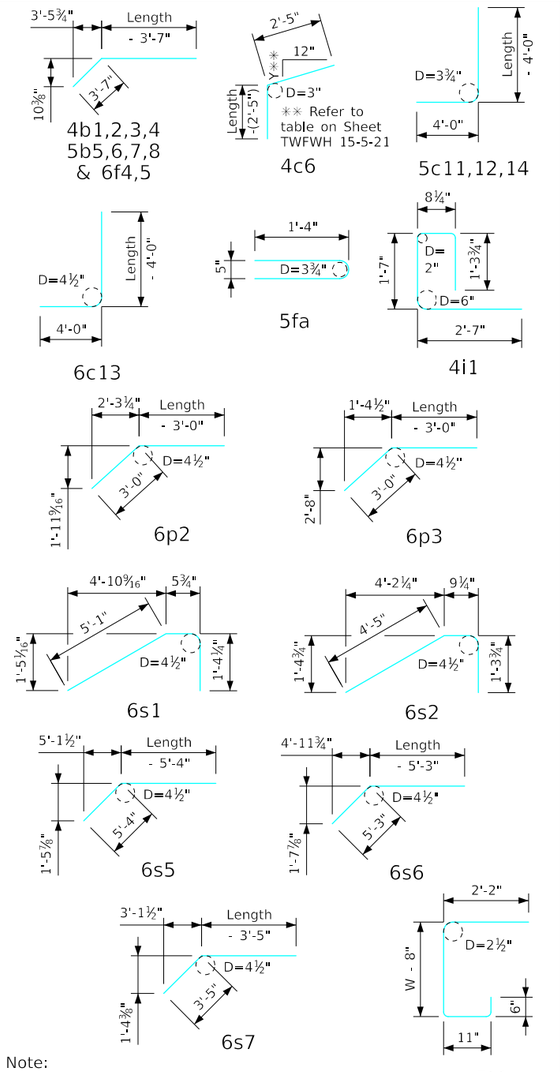
Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

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

Headwall Notes:

1. See Sheet TWFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. This headwall is based on a 3:1 slope normal to centerline of roadway.
3. The sides of the apron are to be formed to ensure correct line and grade.
4. 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.
5. 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.
6. Concrete quantities are estimated from back of parapet.
7. 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.
8. Dimensions are in feet and inches unless otherwise noted.

Bent Bar Details



Note:
All dimensions are out to out. D = pin diameter. 5t1

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWADOT Highway Administration

Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
12'-0" Span
15° Skew

TWFWH
15-6-21
Sheet 2 of 2

ENGLISHLRFDSIGNEDTWINCULVERTSFWH.DGN - TWFWH 15-6-21 S2 - THIS SHEET ISSUED 02-2021.

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

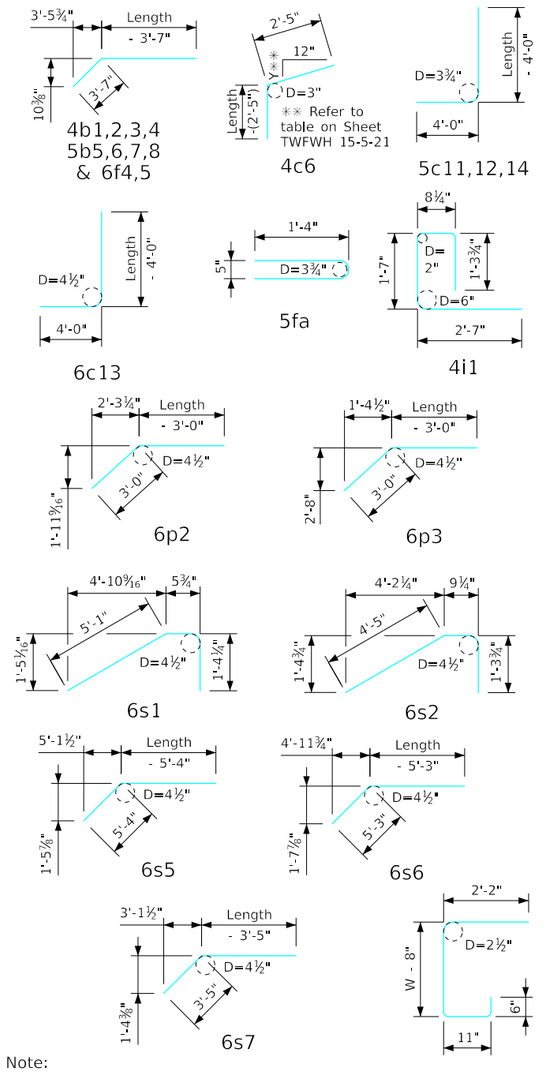
Bar	Location	Shape	10' x 12' No.	10' x 12' Length	10' x 12' Wt.	10' x 11' No.	10' x 11' Length	10' x 11' Wt.	10' x 10' No.	10' x 10' Length	10' x 10' Wt.	10' x 9' No.	10' x 9' Length	10' x 9' Wt.	10' x 8' No.	10' x 8' Length	10' x 8' Wt.	Bar
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	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.		21 Var.	5'-6 to 28'-6	372	19 Var.	5'-6 to 26'-5	316	17 Var.	5'-6 to 24'-4	264	15 Var.	5'-7 to 22'-3	218	13 Var.	5'-7 to 20'-2	175	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.		2	4'-1	5	2	4'-1	5	2	4'-1	5	2	4'-1	5	2	4'-1	5	4c6
4c7	Interior Wall, Both F.V.		49 Var.	1'-11 to 12'-4	233	45 Var.	1'-10 to 11'-4	198	41 Var.	1'-10 to 10'-4	167	37 Var.	1'-10 to 9'-5	139	33 Var.	1'-10 to 8'-5	113	4c7
4c8	Interior Wall, Both F.V.		2	12'-6	17	2	11'-6	15	2	10'-6	14	2	9'-6	13	2	8'-6	11	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.		15	28'-10	289	13	26'-9	232	13	24'-9	215	13	22'-8	197	13	20'-7	179	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		20	28'-10	866	20	26'-9	804	20	24'-9	743	20	22'-8	681	20	20'-7	618	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		43	6'-2	177	41	6'-2	169	41	6'-2	169	41	6'-2	169	41	6'-2	169	4i1
7j1	Parapet, Horizontal		4	23'-5	191	4	23'-2	189	4	22'-11	187	4	22'-11	187	4	22'-11	187	7j1
6m1	Apron, Trans., Top		5 Var.	23'-8 to 24'-5	181	5 Var.	23'-5 to 24'-2	179	5 Var.	23'-2 to 23'-11	177	5 Var.	23'-2 to 23'-11	177	5 Var.	23'-2 to 23'-11	177	6m1
6m2	Apron, Trans., Top		27 Var.	24'-9 to 34'-6	1201	24 Var.	24'-6 to 33'-1	1038	21 Var.	24'-2 to 31'-8	881	18 Var.	24'-2 to 30'-7	740	16 Var.	24'-2 to 29'-10	649	6m2
6m3	Apron, Trans., Top		7 Var.	8'-9 to 24'-5	174	7 Var.	8'-9 to 24'-5	174	8 Var.	6'-1 to 24'-4	183	8 Var.	6'-2 to 24'-6	184	7 Var.	6'-4 to 22'-0	149	6m3
6m4	Apron, Trans., Bott.		24 Var.	17'-4 to 29'-8	847	22 Var.	17'-3 to 28'-6	756	20 Var.	17'-2 to 27'-5	670	18 Var.	17'-2 to 26'-4	588	16 Var.	17'-2 to 25'-3	510	6m4
6p1	Curtain, Horizontal		4	22'-0	132	4	21'-11	132	4	21'-10	131	4	21'-10	131	4	21'-10	131	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.		2	30'-9	92	2	28'-6	86	2	26'-3	79	2	23'-11	72	2	21'-8	65	6s7
5t1	Curtain, Vertical		38	7'-11	314	36	7'-8	288	34	7'-5	263	33	7'-2	247	31	6'-11	224	5t1
	Estimated Quantities One Headwall	Reinf. Steel		10,209 LB			9027 LB			7966 LB			7017 LB			6004 LB		
		Concrete Parapet Δ	2.6	84.1 CY		2.5	71.9 CY		2.5	61.1 CY		2.5	53.2 CY		2.5	45.9 CY		
		Concrete Wingwalls	29.5			23.2			17.9			14.8			12.1			
		Concrete Apron ✳	52.0			46.2			40.7			35.9			31.3			

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

Bent Bar Details



Note:
All dimensions are out to out. D = pin diameter. 5t1

Headwall Notes:

1. See Sheet TWFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. This headwall is based on a 3:1 slope normal to centerline of roadway.
3. The sides of the apron are to be formed to ensure correct line and grade.
4. 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.
5. 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.
6. Concrete quantities are estimated from back of parapet.
7. 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.
8. Dimensions are in feet and inches unless otherwise noted.

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWADOT Highway Administration

Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
10'-0" Span
15° Skew

TWFWH
15-7-21
Sheet 1 of 2

ENGLISHLRFDSIGNEDTWINCULVERTSFWH.DGN - TWFWH 15-7-21 S1 - THIS SHEET ISSUED 02-2021.

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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.		11 Var.	5'-8 to 18'-2	137	9 Var.	5'-9 to 16'-1	102	7 Var.	5'-10 to 14'-0	72	5 Var.	6'-0 to 11'-10	47	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.		2	4'-1	5	2	4'-1	5	2	4'-1	5	2	4'-0	5	4c6
4c7	Interior Wall, Both F.V.		28 Var.	1'-10 to 7'-3	85	24 Var.	1'-10 to 6'-3	65	20 Var.	1'-10 to 5'-4	48	16 Var.	1'-9 to 4'-4	33	4c7
4c8	Interior Wall, Both F.V.		2	7'-6	10	2	6'-6	9	2	5'-6	7	2	4'-6	6	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.		13	18'-6	161	13	16'-5	143	13	14'-4	124	13	12'-4	107	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		20	18'-6	556	20	16'-5	493	20	14'-4	431	20	12'-4	370	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		41	6'-2	169	41	6'-2	169	41	6'-2	169	41	6'-2	169	4i1
7j1	Parapet, Horizontal		4	22'-8	185	4	22'-8	185	4	22'-8	185	4	22'-8	185	7j1
6m1	Apron, Trans., Top		5 Var.	22'-11 to 23'-8	175	5 Var.	22'-11 to 23'-8	175	5 Var.	22'-11 to 23'-8	175	5 Var.	22'-11 to 23'-8	175	6m1
6m2	Apron, Trans., Top		13 Var.	23'-11 to 28'-5	511	10 Var.	23'-11 to 27'-4	385	7 Var.	23'-11 to 26'-2	263	5 Var.	23'-11 to 25'-5	185	6m2
6m3	Apron, Trans., Top		7 Var.	6'-3 to 21'-11	148	8 Var.	3'-9 to 22'-1	155	8 Var.	3'-11 to 22'-2	157	7 Var.	4'-0 to 19'-8	124	6m3
6m4	Apron, Trans., Bott.		14 Var.	17'-1 to 24'-1	433	12 Var.	17'-1 to 23'-0	361	10 Var.	17'-1 to 21'-11	293	8 Var.	17'-1 to 20'-10	228	6m4
6p1	Curtain, Horizontal		4	21'-9	131	4	21'-8	130	4	21'-8	130	4	21'-8	130	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'-6	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.		2	19'-4	58	2	17'-1	51	2	14'-9	44	2	12'-6	38	6s7
5t1	Curtain, Vertical		28	6'-8	195	26	6'-5	174	24	6'-5	161	22	6'-5	147	5t1
	Estimated Quantities One Headwall	Reinf. Steel		5126 LB			4337 LB			3483 LB			2874 LB		
		Concrete Parapet Δ	2.4	37.6 CY		2.4	31.5 CY		2.4	26.4 CY		2.4	21.5 CY		
		Concrete Wingwalls	8.6			6.6			4.9			3.3			
		Concrete Apron ✳	26.6			22.5			19.1			15.8			

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.

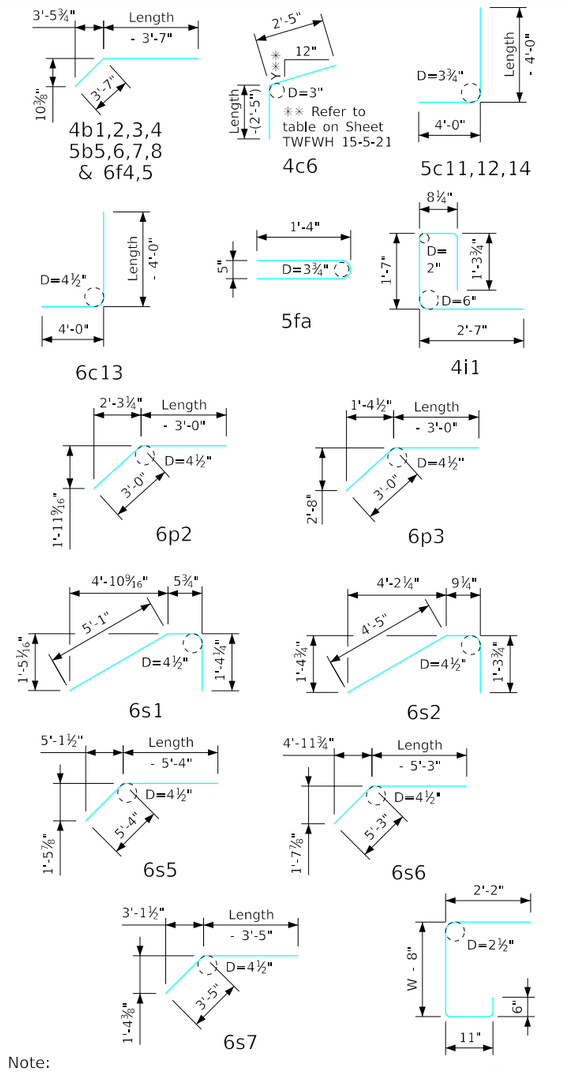
Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

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

Headwall Notes:

1. See Sheet TWFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. This headwall is based on a 3:1 slope normal to centerline of roadway.
3. The sides of the apron are to be formed to ensure correct line and grade.
4. 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.
5. 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.
6. Concrete quantities are estimated from back of parapet.
7. 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.
8. Dimensions are in feet and inches unless otherwise noted.

Bent Bar Details



Note:
All dimensions are out to out. D = pin diameter. 5t1

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LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWADOT Highway Administration

Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
10'-0" Span
15° Skew

TWFWH
15-7-21
Sheet 2 of 2

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

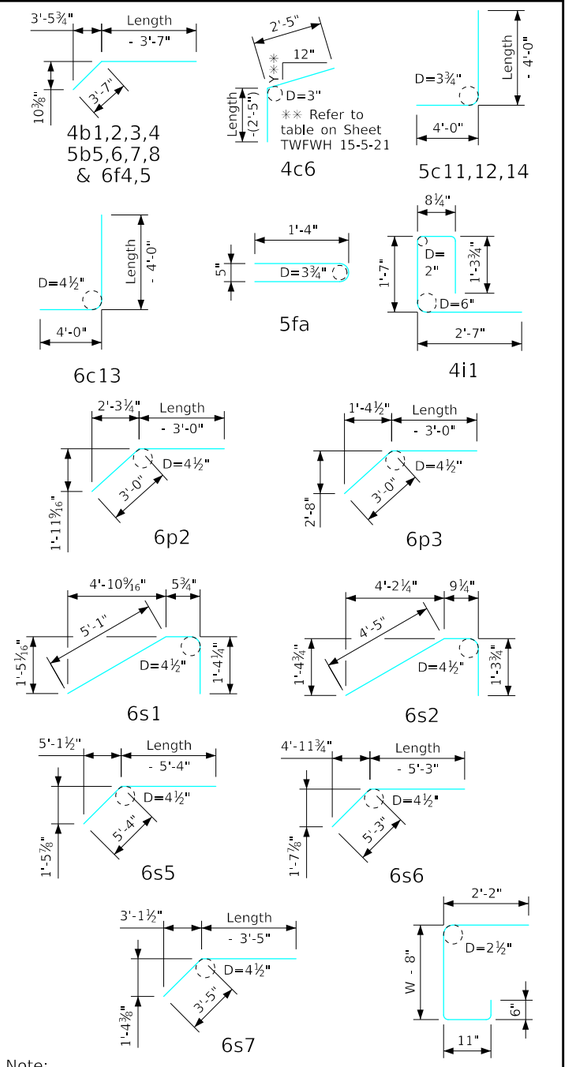
Bar	Location	Shape	8' x 10' No.	8' x 10' Length	8' x 10' Wt.	8' x 9' No.	8' x 9' Length	8' x 9' Wt.	8' x 8' No.	8' x 8' Length	8' x 8' Wt.	8' x 7' No.	8' x 7' Length	8' x 7' Wt.	Bar
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	5fa
4b1	Wingwall, B.F.H. Long		1	38'-9	26	1	35'-4	24	1	31'-11	21	1	28'-6	19	4b1
4b2	Wingwall, B.F.H. Short		1	34'-4	23	1	31'-4	21	1	28'-4	19	1	25'-4	17	4b2
4b3	Wingwall, B.F.H. Long		8 Var.	13'-2 to 37'-2	134	7 Var.	13'-2 to 33'-9	110	6 Var.	13'-2 to 30'-4	87	5 Var.	13'-2 to 26'-11	67	4b3
4b4	Wingwall, B.F.H. Short		8 Var.	11'-11 to 32'-11	120	7 Var.	11'-11 to 29'-11	98	6 Var.	11'-11 to 26'-11	78	5 Var.	11'-11 to 23'-11	60	4b4
5b5	Wingwall, F.F.H. Long		1	38'-10	41	1	35'-5	37	1	31'-11	33	1	28'-6	30	5b5
5b6	Wingwall, F.F.H. Short		1	34'-4	36	1	31'-4	33	1	28'-4	30	1	25'-4	26	5b6
5b7	Wingwall, F.F.H. Long		9 Var.	9'-10 to 37'-3	221	8 Var.	9'-10 to 33'-10	182	7 Var.	9'-10 to 30'-5	147	6 Var.	9'-10 to 26'-11	115	5b7
5b8	Wingwall, F.F.H. Short		9 Var.	9'-0 to 33'-0	197	8 Var.	9'-0 to 30'-0	163	7 Var.	9'-0 to 27'-0	131	6 Var.	9'-0 to 24'-0	103	5b8
5b9	Interior Wall, Both F.H.		17 Var.	5'-6 to 24'-4	264	15 Var.	5'-7 to 22'-3	218	13 Var.	5'-7 to 20'-2	175	11 Var.	5'-8 to 18'-2	137	5b9
4c1	Wingwall, F.F.V. Long		35 Var.	2'-8 to 12'-7	178	32 Var.	2'-8 to 11'-9	154	29 Var.	2'-8 to 10'-10	131	25 Var.	2'-8 to 9'-8	103	4c1
4c2	Wingwall, F.F.V. Short		31 Var.	2'-8 to 12'-8	159	28 Var.	2'-8 to 11'-8	134	25 Var.	2'-8 to 10'-8	111	22 Var.	2'-8 to 9'-8	91	4c2
4c3	Wingwall, F.F.V. Long		12 Var.	9'-6 to 12'-9	89	9 Var.	9'-6 to 11'-10	64	--	--	--	--	--	--	4c3
4c4	Wingwall, F.F.V. Short		11 Var.	9'-6 to 12'-10	82	8 Var.	9'-6 to 11'-10	57	--	--	--	--	--	--	4c4
4c5	Wingwall, F.F.V. Long		2	11'-7	15	2	10'-7	14	1	9'-7	6	2	8'-7	11	4c5
4c5	Wingwall, F.F.V. Short		2	11'-7	15	2	10'-7	14	2	9'-7	13	2	8'-7	11	4c5
4c6	Interior Wall, Both F.V.		2	4'-0	5	2	4'-0	5	2	4'-0	5	2	4'-0	5	4c6
4c7	Interior Wall, Both F.V.		41 Var.	1'-9 to 10'-3	164	37 Var.	1'-9 to 9'-4	137	33 Var.	1'-9 to 8'-4	111	28 Var.	1'-9 to 7'-2	83	4c7
4c8	Interior Wall, Both F.V.		2	10'-5	14	2	9'-5	13	2	8'-5	11	2	7'-5	10	4c8
5c9	Wingwall, B.F.V. Long		9 Var.	2'-8 to 5'-0	36	9 Var.	2'-8 to 5'-0	36	9 Var.	2'-8 to 5'-0	36	9 Var.	2'-8 to 5'-0	36	5c9
5c10	Wingwall, B.F.V. Short		6 Var.	2'-8 to 4'-4	22	6 Var.	2'-8 to 4'-4	22	6 Var.	2'-8 to 4'-4	22	6 Var.	2'-8 to 4'-4	22	5c10
5c11	Wingwall, B.F.V. Long		26 Var.	9'-4 to 16'-7	351	23 Var.	9'-4 to 15'-9	301	20 Var.	9'-4 to 14'-10	252	16 Var.	9'-4 to 13'-8	192	5c11
5c12	Wingwall, B.F.V. Short		25 Var.	8'-8 to 16'-8	330	22 Var.	8'-8 to 15'-8	279	19 Var.	8'-8 to 14'-8	231	16 Var.	8'-8 to 13'-8	186	5c12
6c13	Wingwall, B.F.V. Long		20	10'-6	315	17	10'-6	268	14	10'-6	221	10	10'-6	158	6c13
6c13	Wingwall, B.F.V. Short		18	10'-6	284	15	10'-6	237	12	10'-6	189	9	10'-6	142	6c13
5c14	Wingwall, B.F.V. Long		2	15'-7	33	2	14'-7	30	1	13'-7	14	2	12'-7	26	5c14
5c14	Wingwall, B.F.V. Short		2	15'-7	33	2	14'-7	30	2	13'-7	28	2	12'-7	26	5c14
4d1	Apron, Longit., Bott.		11	24'-9	182	11	22'-8	167	11	20'-7	151	11	18'-6	136	4d1
4d2	Apron, Longit., Bott. Long		3	33'-5	67	3	30'-0	60	3	26'-7	53	3	23'-1	46	4d2
4d3	Apron, Longit., Bott. Short		3	29'-5	59	3	26'-5	53	3	23'-5	47	3	20'-5	41	4d3
6f1	Apron, Longit., Top		16	24'-9	595	16	22'-8	545	16	20'-7	495	16	18'-6	445	6f1
6f2	Apron, Longit., Top Long		7 Var.	6'-3 to 21'-5	145	6 Var.	6'-8 to 19'-5	118	5 Var.	7'-2 to 17'-4	92	4 Var.	7'-7 to 15'-3	69	6f2
6f3	Apron, Longit., Top Short		6 Var.	7'-0 to 21'-7	129	6 Var.	4'-11 to 19'-6	110	5 Var.	5'-9 to 17'-5	87	4 Var.	6'-7 to 15'-4	66	6f3
6f4	Apron, Longit., Top Long		1	38'-10	58	1	35'-5	53	1	31'-11	48	1	28'-6	43	6f4
6f5	Apron, Longit., Top Short		1	34'-4	52	1	31'-4	47	1	28'-4	43	1	25'-4	38	6f5
4i1	Parapet, Vertical		33	6'-2	136	33	6'-2	136	33	6'-2	136	33	6'-2	136	4i1
7j1	Parapet, Horizontal		4	18'-9	153	4	18'-9	153	4	18'-9	153	4	18'-6	151	7j1
6m1	Apron, Trans., Top		4 Var.	19'-0 to 19'-7	116	4 Var.	19'-0 to 19'-7	116	4 Var.	19'-0 to 19'-7	116	4 Var.	18'-9 to 19'-4	114	6m1
6m2	Apron, Trans., Top		23 Var.	19'-10 to 28'-1	828	20 Var.	19'-10 to 26'-11	702	17 Var.	19'-10 to 25'-10	583	15 Var.	19'-7 to 24'-10	500	6m2
6m3	Apron, Trans., Top		6 Var.	6'-10 to 19'-11	121	6 Var.	6'-11 to 20'-0	121	6 Var.	7'-1 to 20'-1	122	6 Var.	4'-5 to 17'-6	99	6m3
6m4	Apron, Trans., Bott.		20 Var.	13'-0 to 23'-3	544	18 Var.	13'-0 to 22'-2	475	16 Var.	13'-0 to 21'-1	410	14 Var.	12'-11 to 19'-11	345	6m4
6p1	Curtain, Horizontal		4	17'-8	106	4	17'-8	106	4	17'-8	106	4	17'-7	106	6p1
6p2	Curtain, Horizontal, Long		4	18'-9	113	4	17'-3	104	4	15'-9	95	4	14'-2	85	6p2
6p3	Curtain, Horizontal, Short		4	14'-7	88	4	13'-6	81	4	12'-5	75	4	11'-3	68	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	34'-2	103	2	30'-7	92	2	27'-0	81	2	23'-5	70	6s3
6s4	Wing Slope, Both F., Short		2	30'-7	92	2	27'-5	82	2	24'-3	73	2	21'-1	63	6s4
6s5	Wing Slope, F.F. Long		1	39'-3	59	1	35'-8	54	1	32'-1	48	1	28'-6	43	6s5
6s6	Wing Slope, F.F. Short		1	35'-4	53	1	32'-2	48	1	29'-0	44	1	25'-10	39	6s6
6s7	Interior Wall, Both F.H.		2	26'-3	79	2	23'-11	72	2	21'-8	65	2	19'-4	58	6s7
5t1	Curtain, Vertical		30	7'-5	232	29	7'-2	217	27	6'-11	195	24	6'-8	167	5t1
	Estimated Quantities One Headwall	Reinf. Steel		7344 LB			6440 LB			5467 LB			4651 LB		
		Concrete Parapet Δ	2.1	54.7 CY		2.1	47.3 CY		2.1	40.6 CY		2.1	33.1 CY		
		Concrete Wingwalls	17.9			14.8			12.1			8.6			
		Concrete Apron ✳	34.7			30.4			26.4			22.4			

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

Bent Bar Details



Note:
All dimensions are out to out. D = pin diameter. 5t1

Headwall Notes:

1. See Sheet TWFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. This headwall is based on a 3:1 slope normal to centerline of roadway.
3. The sides of the apron are to be formed to ensure correct line and grade.
4. 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.
5. 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.
6. Concrete quantities are estimated from back of parapet.
7. 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.
8. Dimensions are in feet and inches unless otherwise noted.

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWADOT Highway Administration

Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
8'-0" Span
15° Skew

TWFWH
15-8-21
Sheet 1 of 2

ENGLISHLRFDSIGNEDTWINCULVERTSFWH.DGN - TWFWH 15-8-21 S1 - THIS SHEET ISSUED 02-2021.

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

Bar	Location	Shape	8' x 6' No.	8' x 6' Length	8' x 6' Wt.	8' x 5' No.	8' x 5' Length	8' x 5' Wt.	8' x 4' No.	8' x 4' Length	8' x 4' Wt.	Bar
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	5fa
4b1	Wingwall, B.F.H. Long		1	25'-1	17	1	21'-7	14	1	18'-2	12	4b1
4b2	Wingwall, B.F.H. Short		1	22'-4	15	1	19'-4	13	1	16'-4	11	4b2
4b3	Wingwall, B.F.H. Long		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		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	25'-1	26	1	21'-8	23	1	18'-3	19	5b5
5b6	Wingwall, F.F.H. Short		1	22'-4	23	1	19'-4	20	1	16'-4	17	5b6
5b7	Wingwall, F.F.H. Long		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		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.		9 Var.	5'-9 to 16'-1	102	7 Var.	5'-10 to 14'-0	72	5 Var.	6'-0 to 11'-10	47	5b9
4c1	Wingwall, F.F.V. Long		22 Var.	2'-8 to 8'-10	85	18 Var.	2'-8 to 7'-8	62	15 Var.	2'-8 to 6'-9	47	4c1
4c2	Wingwall, F.F.V. Short		19 Var.	2'-8 to 8'-8	72	16 Var.	2'-8 to 7'-8	55	13 Var.	2'-8 to 6'-8	41	4c2
4c3	Wingwall, F.F.V. Long		--	--	--	--	--	--	--	--	--	4c3
4c4	Wingwall, F.F.V. Short		--	--	--	--	--	--	--	--	--	4c4
4c5	Wingwall, F.F.V. Long		1	7'-7	5	2	6'-7	9	1	5'-7	4	4c5
4c5	Wingwall, F.F.V. Short		2	7'-7	10	2	6'-7	9	2	5'-7	7	4c5
4c6	Interior Wall, Both F.V.		2	4'-0	5	2	4'-0	5	2	3'-11	5	4c6
4c7	Interior Wall, Both F.V.		24 Var.	1'-9 to 6'-2	63	20 Var.	1'-9 to 5'-3	47	16 Var.	1'-8 to 4'-3	32	4c7
4c8	Interior Wall, Both F.V.		2	6'-5	9	2	5'-5	7	2	4'-5	6	4c8
5c9	Wingwall, B.F.V. Long		9 Var.	2'-8 to 5'-0	36	9 Var.	2'-8 to 5'-0	36	9 Var.	2'-8 to 5'-0	36	5c9
5c10	Wingwall, B.F.V. Short		6 Var.	2'-8 to 4'-4	22	6 Var.	2'-8 to 4'-4	22	6 Var.	2'-8 to 4'-4	22	5c10
5c11	Wingwall, B.F.V. Long		13 Var.	9'-4 to 12'-10	150	9 Var.	9'-4 to 11'-8	99	6 Var.	9'-4 to 10'-9	63	5c11
5c12	Wingwall, B.F.V. Short		13 Var.	8'-8 to 12'-8	145	10 Var.	8'-8 to 11'-8	106	7 Var.	8'-8 to 10'-8	71	5c12
6c13	Wingwall, B.F.V. Long		7	10'-6	110	--	--	--	--	--	--	6c13
6c13	Wingwall, B.F.V. Short		6	10'-6	95	--	--	--	--	--	--	6c13
5c14	Wingwall, B.F.V. Long		1	11'-7	12	2	10'-7	22	1	9'-7	10	5c14
5c14	Wingwall, B.F.V. Short		2	11'-7	24	2	10'-7	22	2	9'-7	20	5c14
4d1	Apron, Longit., Bott.		11	16'-5	121	11	14'-4	105	11	12'-4	91	4d1
4d2	Apron, Longit., Bott. Long		3	19'-8	39	3	16'-3	33	3	12'-10	26	4d2
4d3	Apron, Longit., Bott. Short		3	17'-5	35	3	14'-5	29	3	11'-5	23	4d3
6f1	Apron, Longit., Top		16	16'-5	395	16	14'-4	344	16	12'-4	296	6f1
6f2	Apron, Longit., Top Long		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.	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	25'-1	38	1	21'-8	33	1	18'-3	27	6f4
6f5	Apron, Longit., Top Short		1	22'-4	34	1	19'-4	29	1	16'-4	25	6f5
4i1	Parapet, Vertical		33	6'-2	136	33	6'-2	136	33	6'-2	136	4i1
7j1	Parapet, Horizontal		4	18'-6	151	4	18'-6	151	4	18'-6	151	7j1
6m1	Apron, Trans., Top		4 Var.	18'-9 to 19'-4	114	4 Var.	18'-9 to 19'-4	114	4 Var.	18'-9 to 19'-4	114	6m1
6m2	Apron, Trans., Top		12 Var.	19'-7 to 23'-8	390	9 Var.	19'-7 to 22'-7	285	6 Var.	19'-7 to 21'-5	185	6m2
6m3	Apron, Trans., Top		6 Var.	4'-6 to 17'-7	100	6 Var.	4'-8 to 17'-8	101	6 Var.	4'-9 to 17'-10	102	6m3
6m4	Apron, Trans., Bott.		12 Var.	12'-11 to 18'-10	286	10 Var.	12'-11 to 17'-9	230	8 Var.	12'-11 to 16'-8	178	6m4
6p1	Curtain, Horizontal		4	17'-7	106	4	17'-7	106	4	17'-7	106	6p1
6p2	Curtain, Horizontal, Long		4	12'-8	76	4	11'-2	67	4	9'-8	58	6p2
6p3	Curtain, Horizontal, Short		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	6s1
6s2	Wing Slope, Both F., Short		2	6'-6	20	2	6'-6	20	2	6'-6	20	6s2
6s3	Wing Slope, Both F., Long		2	19'-10	60	2	16'-3	49	2	12'-8	38	6s3
6s4	Wing Slope, Both F., Short		2	17'-11	54	2	14'-9	44	2	11'-7	35	6s4
6s5	Wing Slope, F.F. Long		1	25'-0	38	1	21'-5	32	1	17'-10	27	6s5
6s6	Wing Slope, F.F. Short		1	22'-8	34	1	19'-6	29	1	16'-4	25	6s6
6s7	Interior Wall, Both F.H.		2	17'-1	51	2	14'-9	44	2	12'-6	38	6s7
5t1	Curtain, Vertical		22	6'-5	147	20	6'-5	134	18	6'-5	120	5t1
	Estimated Quantities One Headwall	Reinf. Steel		3906 LB			3096 LB			2529 LB		
		Concrete Parapet Δ	2.1			2.1			2.1			
		Concrete Wingwalls	6.6	27.5 CY		4.9	22.9 CY		3.3	18.5 CY		
		Concrete Apron ✳	18.8			15.9			13.1			

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.

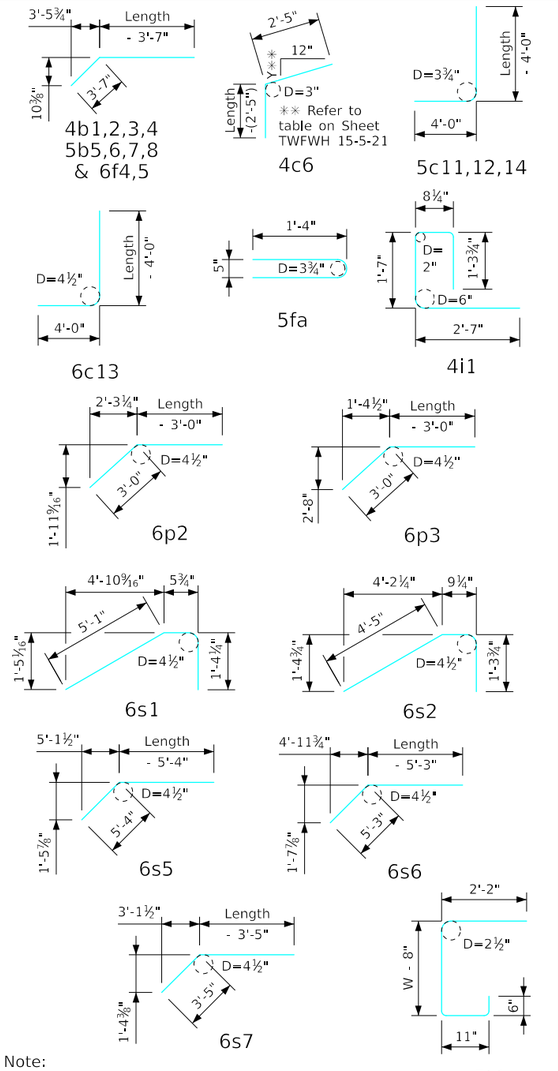
Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

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

Headwall Notes:

1. See Sheet TWFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. This headwall is based on a 3:1 slope normal to centerline of roadway.
3. The sides of the apron are to be formed to ensure correct line and grade.
4. 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.
5. 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.
6. Concrete quantities are estimated from back of parapet.
7. 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.
8. Dimensions are in feet and inches unless otherwise noted.

Bent Bar Details



Note:
All dimensions are out to out. D = pin diameter. 5t1

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWADOT Highway Administration

Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
8'-0" Span
15° Skew

TWFWH
15-8-21
Sheet 2 of 2

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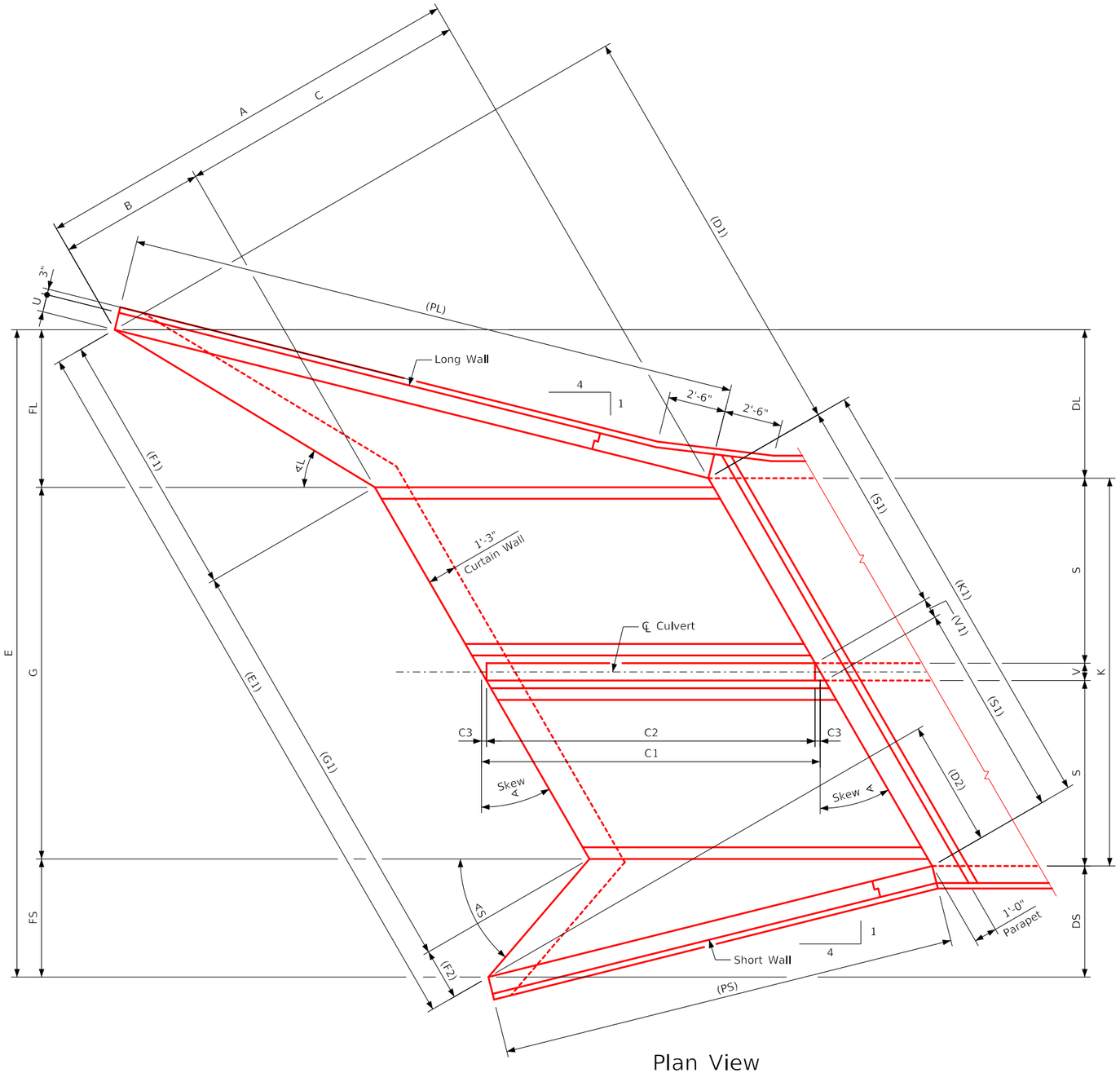

Plan View

Notes:

1. See Sheet TWFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. See Sheet TWFWH 30-2-21 for dimensions table.
3. See Sheet TWFWH 30-4-21 for Angle L & Angle S.

LATEST REVISION DATE

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IOWADOT Highway Administration

Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Dimension Plan 30° Skew	TWFWH 30-1-21

ENGLISHLRFDSIGNEDTWINCULVERTSFWH.DGN - TWFWH 30-1-21 - 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'	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	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	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	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	20'-8	18'-8	16'-8	14'-8	12'-8	10'-8	8'-8	C
C1	28'-5¾	26'-2⅛	23'-10⅜	21'-6⅝	19'-3	16'-11¼	14'-7½	12'-3¾	10'-0⅛	28'-5¾	26'-2⅛	23'-10⅜	21'-6⅝	19'-3	16'-11¼	14'-7½	12'-3¾	10'-0⅛	23'-10⅜	21'-6⅝	19'-3	16'-11¼	14'-7½	12'-3¾	10'-0⅛	C1
C2	27'-10⅞	25'-7¾	23'-4⅝	21'-0⅞	18'-9⅛	16'-6	14'-2⅜	11'-10⅝	9'-6⅞	27'-10⅞	25'-7¾	23'-4⅝	21'-0⅞	18'-9⅛	16'-6	14'-2⅜	11'-10⅝	9'-6⅞	23'-4⅝	21'-0⅞	18'-9⅛	16'-6	14'-2⅜	11'-10⅝	9'-6⅞	C2
C3	3½	3⅛	2⅞	2⅞	2⅞	2⅝	2⅝	2⅝	2⅝	3½	3⅛	2⅞	2⅞	2⅞	2⅝	2⅝	2⅝	2⅝	2⅞	2⅞	2⅞	2⅝	2⅝	2⅝	2⅝	C3
DL	12'-5¾	11'-5⅝	10'-5½	9'-5⅜	8'-5¼	7'-5⅛	6'-4⅞	5'-4¾	4'-4⅝	12'-5¾	11'-5⅝	10'-5½	9'-5⅜	8'-5¼	7'-5⅛	6'-4⅞	5'-4¾	4'-4⅝	10'-5½	9'-5⅜	8'-5¼	7'-5⅛	6'-4⅞	5'-4¾	4'-4⅝	DL
DS	9'-4	8'-6⅞	7'-9⅞	7'-0¾	6'-3⅝	5'-6⅝	4'-9½	4'-0⅜	3'-3⅜	9'-4	8'-6⅞	7'-9⅞	7'-0¾	6'-3⅝	5'-6⅜	4'-9½	4'-0⅜	3'-3⅜	7'-9⅞	7'-0¾	6'-3⅝	5'-6⅜	4'-9½	4'-0⅜	3'-3⅜	DS
D1	35'-9¼	32'-10½	29'-11¾	27'-0⅞	24'-2⅛	21'-3¼	18'-4½	15'-5⅝	12'-6⅞	35'-9¼	32'-10½	29'-11¾	27'-0⅞	24'-2⅛	21'-3¼	18'-4½	15'-5⅝	12'-6⅞	29'-11¾	27'-0⅞	24'-2⅛	21'-3¼	18'-4½	15'-5⅝	12'-6⅞	D1
D2	10'-7	9'-8¾	8'-10⅜	8'-0⅛	7'-1⅞	6'-3½	5'-5¼	4'-6⅞	3'-8⅝	10'-7	9'-8¾	8'-10⅜	8'-0⅛	7'-1⅞	6'-3½	5'-5¼	4'-6⅞	3'-8⅝	8'-10⅜	8'-0⅛	7'-1⅞	6'-3½	5'-5¼	4'-6⅞	3'-8⅝	D2
E	46'-9¾	44'-11⅞	43'-1⅜	41'-4⅛	39'-6⅞	37'-8⅝	35'-11⅜	34'-2¼	32'-5	42'-9¾	40'-11⅞	39'-1⅜	37'-4⅛	35'-6⅞	33'-8⅝	31'-11⅜	30'-2¼	28'-5	35'-1⅜	33'-4⅛	31'-6⅞	29'-8⅝	27'-11⅜	26'-2¼	24'-5	E
E1	54'-0¾	51'-11	49'-9⅜	47'-8⅞	45'-8⅜	43'-6¾	41'-6⅛	39'-5⅝	37'-5⅛	49'-5¼	47'-3⅝	45'-2	43'-1½	41'-0⅞	38'-11¼	36'-10⅜	34'-10⅛	32'-9⅞	40'-6½	38'-6	36'-5½	34'-3⅞	32'-3⅜	30'-2⅝	28'-2¼	E1
FL	12'-9¾	11'-9⅝	10'-9½	9'-9⅜	8'-9¼	7'-9⅛	6'-8⅞	5'-8¾	4'-8⅝	12'-9¾	11'-9⅝	10'-9½	9'-9⅜	8'-9¼	7'-9⅛	6'-8⅞	5'-8¾	4'-8⅝	10'-9½	9'-9⅜	8'-9¼	7'-9⅛	6'-8⅞	5'-8¾	4'-8⅝	FL
FS	9'-8	8'-10⅞	8'-1⅞	7'-4¾	6'-7⅝	5'-10⅝	5'-1½	4'-4⅜	3'-7⅜	9'-8	8'-10⅞	8'-1⅞	7'-4¾	6'-7⅝	5'-10⅝	5'-1½	4'-4⅜	3'-7⅜	8'-1⅞	7'-4¾	6'-7⅝	5'-10⅝	5'-1½	4'-4⅜	3'-7⅜	FS
F1	21'-11	20'-2⅛	18'-5⅜	16'-8⅝	14'-11¼	13'-2¼	11'-5⅜	9'-8⅜	7'-11⅜	21'-11	20'-2⅛	18'-5⅜	16'-8⅝	14'-11¼	13'-2¼	11'-5⅜	9'-8⅜	7'-11⅜	18'-5⅜	16'-8⅝	14'-11¼	13'-2¼	11'-5⅜	9'-8⅜	7'-11⅜	F1
F2	4'-0½	3'-9	3'-5⅜	3'-1⅞	2'-10¼	2'-6¾	2'-3⅛	1'-11⅝	1'-8	4'-0½	3'-9	3'-5⅜	3'-1⅞	2'-10¼	2'-6¾	2'-3⅛	1'-11⅝	1'-8	3'-5⅜	3'-1⅞	2'-10¼	2'-6¾	2'-3⅛	1'-11⅝	1'-8	F2
G	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	20'-1	20'-1	20'-1	16'-2	16'-2	16'-2	16'-1	16'-1	16'-1	16'-1	G
G1	28'-1⅛	28'-0	27'-10⅞	27'-10⅞	27'-10⅞	27'-9¾	27'-9¾	27'-9¾	27'-9¾	23'-5¾	23'-4⅝	23'-3½	23'-3½	23'-3½	23'-2¼	23'-2¼	23'-2¼	23'-2¼	18'-8	18'-8	18'-8	18'-6⅞	18'-6⅞	18'-6⅞	18'-6⅞	G1
G2	29'-4	29'-2¾	29'-1⅝	29'-1½	29'-1½	29'-0¼	29'-0⅛	29'-0	28'-11⅞	24'-8½	24'-7⅜	24'-6⅛	24'-6⅛	24'-6	24'-4⅞	24'-4¾	24'-4⅝	24'-4⅜	19'-10¾	19'-10¾	19'-10⅝	19'-9⅜	19'-9¼	19'-9⅛	19'-9	G2
G3	25'-1¾	23'-1⅝	21'-1½	19'-1⅜	17'-1¼	15'-1⅛	13'-1	11'-0¾	9'-0⅝	25'-1¾	23'-1⅝	21'-1½	19'-1⅜	17'-1¼	15'-1⅛	13'-1	11'-0¾	9'-0⅝	21'-1½	19'-1⅜	17'-1¼	15'-1⅛	13'-1	11'-0¾	9'-0⅝	G3
G4	25'-7⅞	23'-4¼	21'-0⅝	19'-0½	17'-0⅜	14'-8⅞	12'-8¾	10'-8¾	8'-8¾	25'-7⅞	23'-4¼	21'-0⅝	19'-0½	17'-0⅜	14'-8⅞	12'-8¾	10'-8¾	8'-8¾	21'-0⅝	19'-0½	17'-0⅜	14'-8⅞	12'-8¾	10'-8¾	8'-8¾	G4
G5	12'-11¾	11'-11¼	10'-10¾	9'-10¼	8'-9¾	7'-9¼	6'-8¾	5'-8¼	4'-7¾	12'-11¾	11'-11¼	10'-10¾	9'-10¼	8'-9¾	7'-9¼	6'-8¾	5'-8¼	4'-7¾	10'-10¾	9'-10¼	8'-9¾	7'-9¼	6'-8¾	5'-8¼	4'-7¾	G5
G6	14'-3¼	13'-0⅞	11'-10⅝	10'-10⅛	9'-9⅝	8'-7⅜	7'-7	6'-6½	5'-6⅛	14'-3¼	13'-0⅞	11'-10⅝	10'-10⅛	9'-9⅝	8'-7⅜	7'-7	6'-6½	5'-6⅛	11'-10⅝	10'-10⅛	9'-9⅝	8'-7⅜	7'-7	6'-6½	5'-6⅛	G6
G7	2¼	5½	8⅞	8⅞	8⅞	1'-0⅛	1'-0	1'-0	11⅞	2¼	5½	8⅞	8⅞	8⅞	1'-0⅛	1'-0	1'-0	11⅞	8⅞	8⅞	8⅞	1'-0⅛	1'-0	1'-0	11⅞	G7
G8	4⅝	6⅛	7⅝	7⅝	7⅝	9	9	9	9	4⅝	6⅛	7⅝	7⅝	7⅝	9	9	9	9	7⅝	7⅝	7⅝	9	9	9	9	G8
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	20'-9	20'-9	20'-9	16'-10	16'-10	16'-10	16'-9	16'-9	16'-9	16'-9	K
K1	28'-10⅜	28'-9¼	28'-8⅛	28'-8⅛	28'-8⅛	28'-7	28'-7	28'-7	28'-7	24'-3	24'-1⅞	24'-0⅝	24'-0⅝	24'-0⅝	23'-11½	23'-11½	23'-11½	23'-11½	19'-5¼	19'-5¼	19'-5¼	19'-4⅛	19'-4⅛	19'-4⅛	19'-4⅛	K1
PL	51'-5⅝	47'-3½	43'-1½	38'-11⅜	34'-9¼	30'-7⅛	26'-5⅛	22'-3⅜	18'-1	51'-5⅝	47'-3½	43'-1½	38'-11⅜	34'-9¼	30'-7⅛	26'-5⅛	22'-3⅜	18'-1	43'-1½	38'-11⅜	34'-9¼	30'-7⅛	26'-5⅛	22'-3⅜	18'-1	PL
PS	38'-5¾	35'-4⅜	32'-2⅞	29'-1½	26'-0	22'-10⅝	19'-9⅛	16'-7¾	13'-6¼	38'-5¾	35'-4⅜	32'-2⅞	29'-1½	26'-0	22'-10⅝	19'-9⅛	16'-7¾	13'-6¼	32'-2⅞	29'-1½	26'-0	22'-10⅝	19'-9⅛	16'-7¾	13'-6¼	PS
RL	52'-11⅛	48'-7⅝	44'-4⅛	40'-0⅝	35'-9⅛	31'-5⅝	27'-2⅛	22'-10⅝	18'-7⅛	52'-11⅛	48'-7⅝	44'-4⅛	40'-0⅝	35'-9⅛	31'-5⅝	27'-2⅛	22'-10⅝	18'-7⅛	44'-4⅛	40'-0⅝	35'-9⅛	31'-5⅝	27'-2⅛	22'-10⅝	18'-7⅛	RL
RS	40'-5	37'-1⅜	33'-10¼	30'-7	27'-3⅝	24'-0⅜	20'-9	17'-5¾	14'-2⅜	40'-5	37'-1⅜	33'-10¼	30'-7	27'-3⅝	24'-0⅜	20'-9	17'-5¾	14'-2⅜	33'-10¼	30'-7	27'-3⅝	24'-0⅜	20'-9	17'-5¾	14'-2⅜	RS
R1	30'-0	27'-6¼	25'-0⅝	22'-6½	20'-0⅜	17'-6¾	15'-0⅝	12'-6½	10'-0⅜	30'-0	27'-6¼	25'-0⅝	22'-6½	20'-0⅜	17'-6¾	15'-0⅝	12'-6½	10'-0⅜	25'-0⅝	22'-6½	20'-0⅜	17'-6¾	15'-0⅝	12'-6½	10'-0⅜	R1
S1	13'-10¼	13'-10¼	13'-10¼	13'-10¼	13'-10¼	13'-10¼	13'-10¼	13'-10¼	13'-10¼	11'-6⅝	11'-6⅝	11'-6⅝	11'-6⅝	11'-6⅝	11'-6⅝	11'-6⅝	11'-6⅝	11'-6⅝	9'-2⅞	9'-2⅞	9'-2⅞	9'-2⅞	9'-2⅞	9'-2⅞	9'-2⅞	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	1'-0	1'-0	1'-0	1'-0	1'-0	1'-0	1'-0	T
U	1'-0	11	10	10	10	9	9	9	9	1'-0	11	10	10	10	9	9	9	9	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	10	10	10	9	9	9	9	V
V1	1'-1⅞	1'-0¾	11½	11½	11½	10⅜	10⅜	10⅜	10⅜	1'-1⅞	1'-0¾	11½	11½	11½	10⅜	10⅜	10⅜	10⅜	11½	11½	11½	10⅜	10⅜	10⅜	10⅜	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	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 30-1-21 and sheets TWFWH 30-3-21 thru 30-5-21 for location of certain dimensions tabulated.
3. Dimensions are in feet and inches unless otherwise noted.

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWADOT Highway Administration

Standard Design - Twin Reinforced Concrete Box Culverts

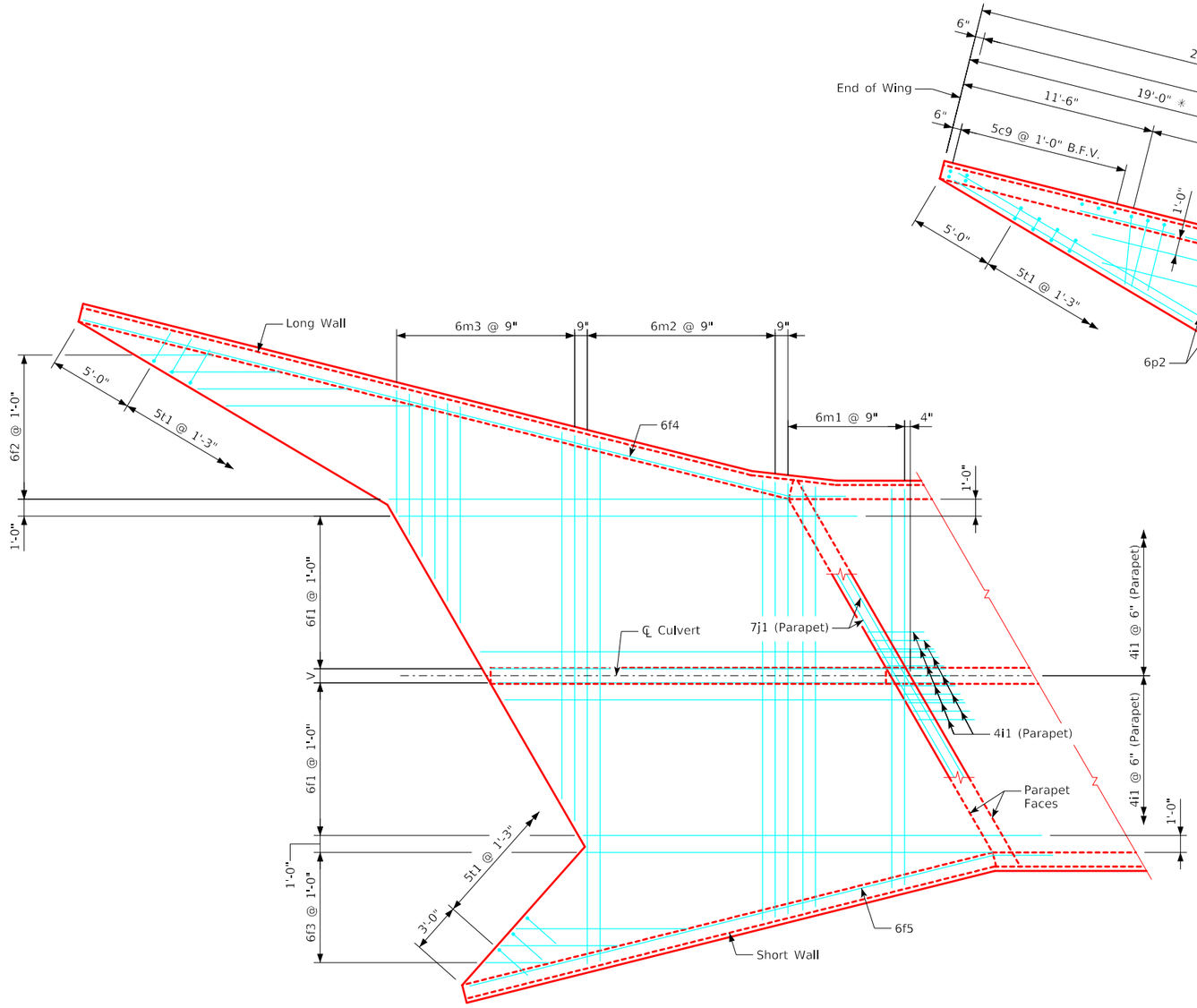
Flared Wing Headwalls

February, 2021

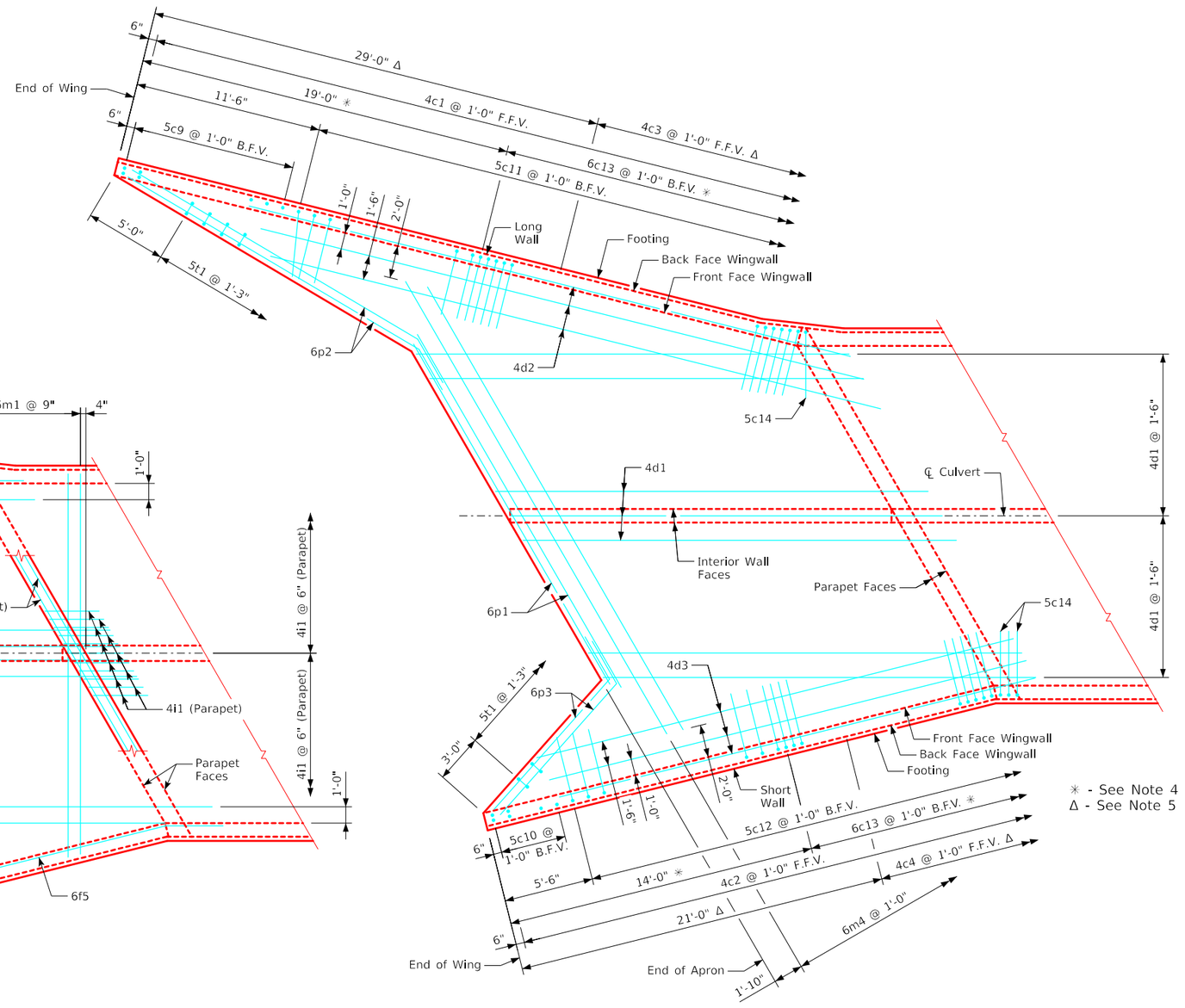
Dimension Table
30° Skew

TWFWH
30-2-21

ENGLISHLRFDSIGNEDTWINCULVERTSFWH.DGN - TWFWH 30-2-21 - THIS SHEET ISSUED 02-2021.



Plan View - Top of Apron Reinforcing



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. Top transverse floor bars are referenced approximately 4" from the back of the parapet for all headwalls.
4. There are no 6c13 bars in the 4' & 5' height headwalls.
5. 4c3 & 4c4 bars used only in the 9', 10', 11' & 12' height headwalls.
6. For dimension table see Sheet TWFWH 30-2-21.
7. For reinforcing in curtain wall see Curtain Wall Details on Sheet TWFWH 30-4-21.

LATEST REVISION DATE

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IOWADOT Highway Administration

Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Apron Details 30° Skew	TWFWH 30-3-21

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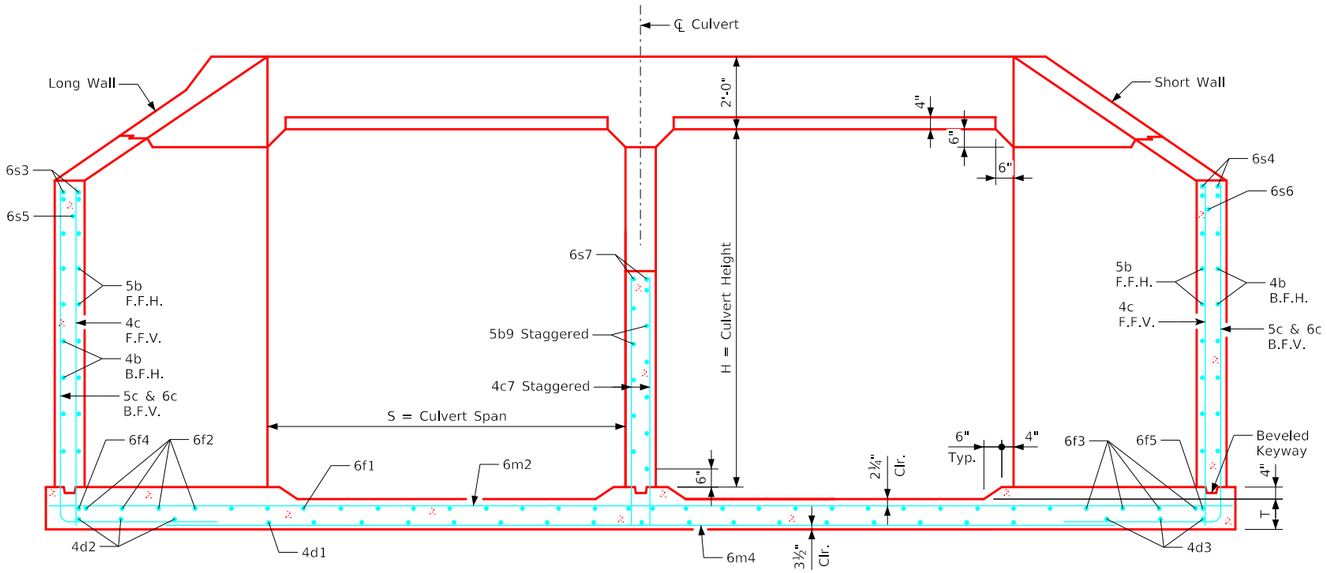
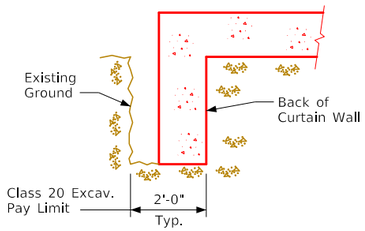
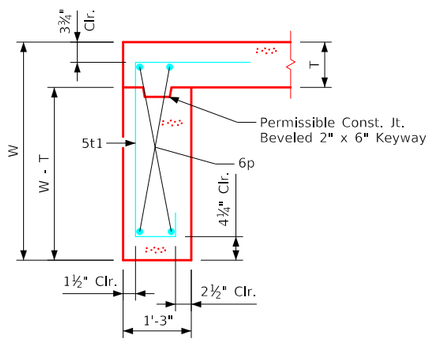


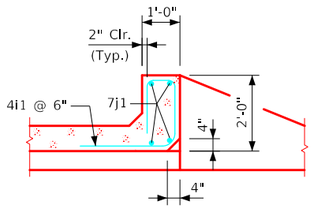
Typical Section - Near Center of Apron



Curtain Wall
Class 20 Excavation

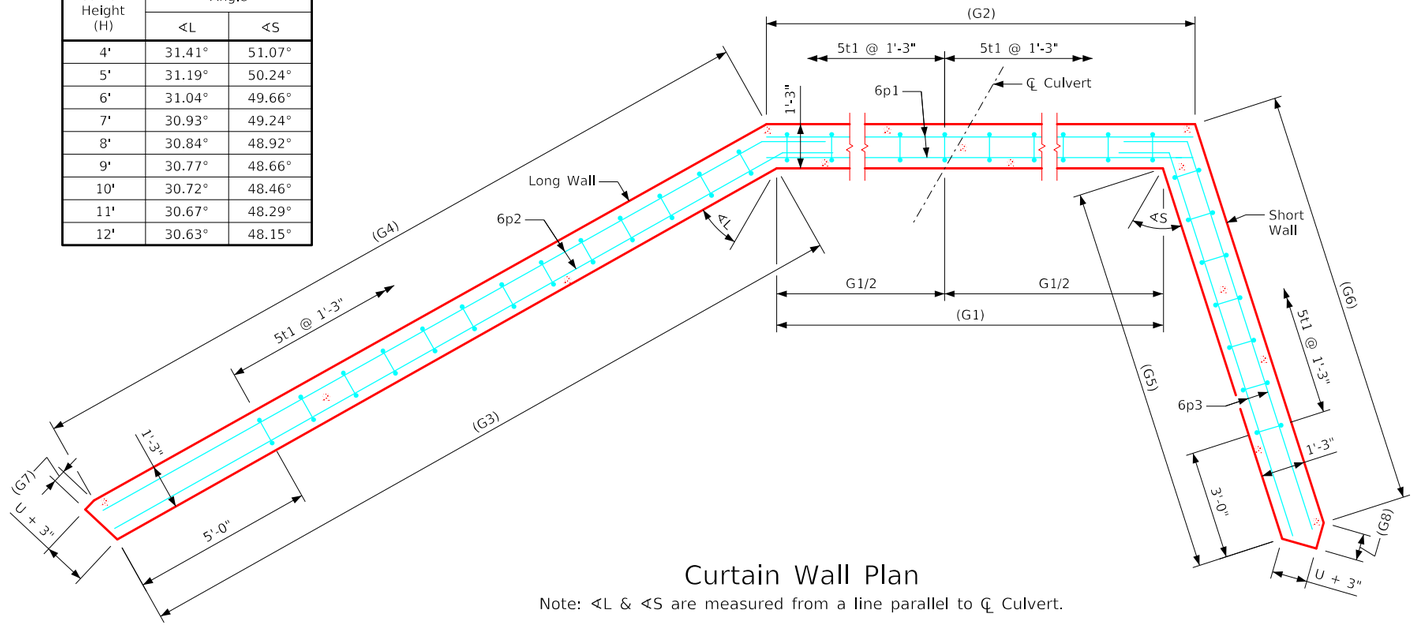


Section thru Curtain Wall



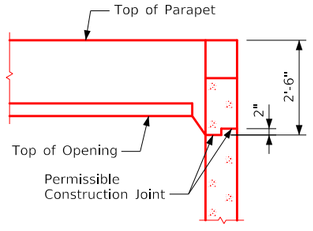
Section thru Parapet

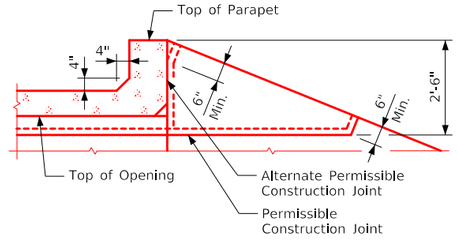
Culvert Height (H)	Angle	
	∢L	∢S
4'	31.41°	51.07°
5'	31.19°	50.24°
6'	31.04°	49.66°
7'	30.93°	49.24°
8'	30.84°	48.92°
9'	30.77°	48.66°
10'	30.72°	48.46°
11'	30.67°	48.29°
12'	30.63°	48.15°



Curtain Wall Plan

Note: ∢L & ∢S are measured from a line parallel to ℄ Culvert.





Top of Wingwall Details

Notes:

1. See Sheet TWFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. For dimension table see Sheet TWFWH 30-2-21.

LATEST REVISION DATE

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IOWA DOT Highway Administration

Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Parapet & Curtain Wall Details 30° Skew

TWFWH 30-4-21

ENGLISHLRFDSIGNEDTWINCULVERTSFWH.DGN - TWFWH 30-4-21 - THIS SHEET ISSUED 02-2021.

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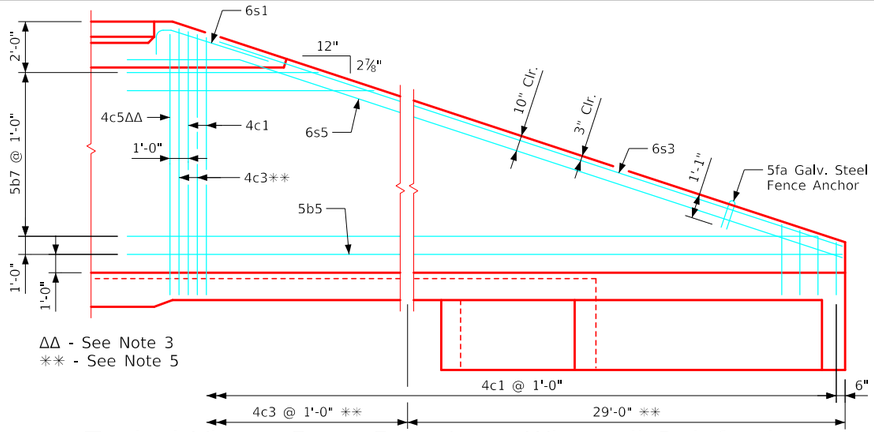
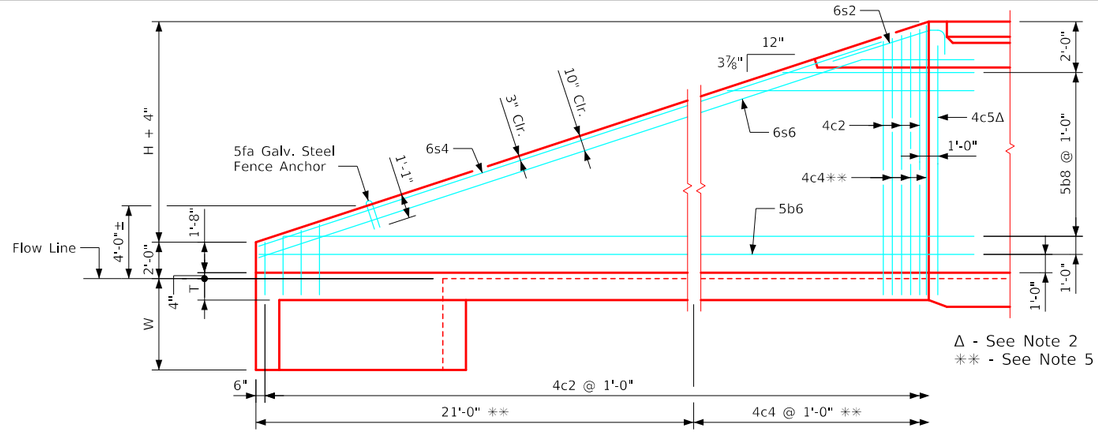
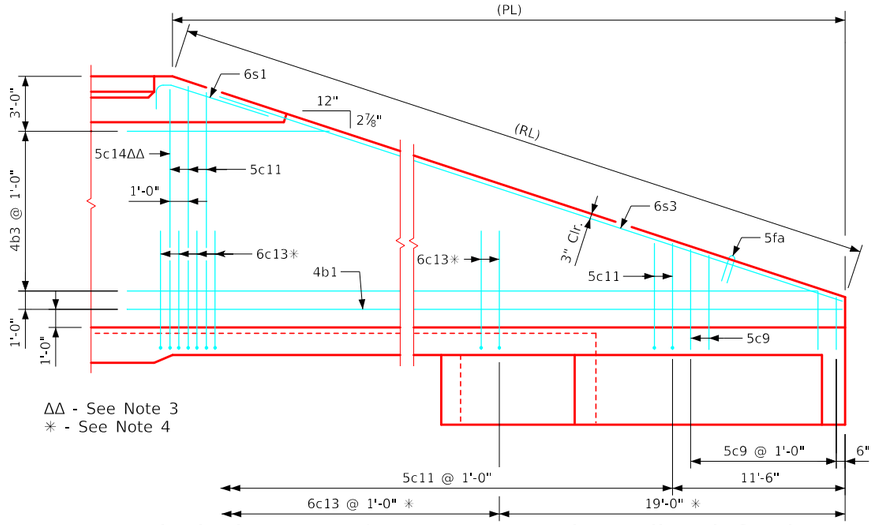


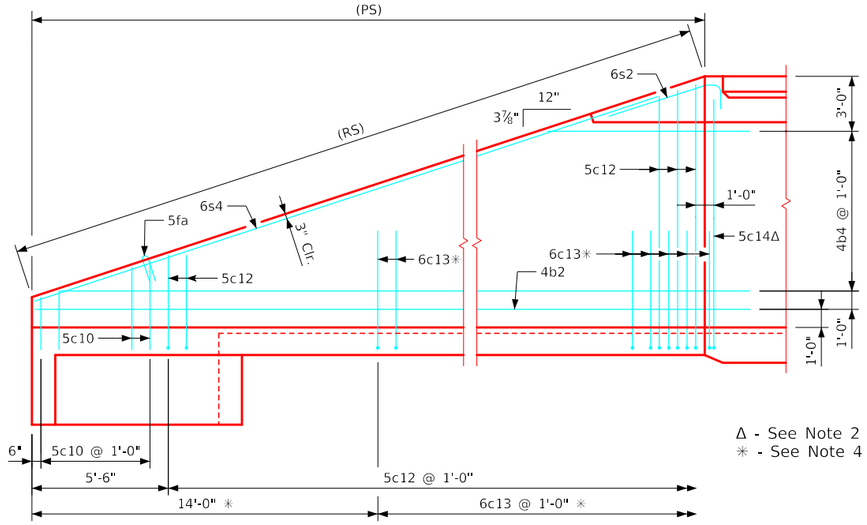
Typical View - Front Face Long Wingwall Reinforcing



Typical View - Front Face Short Wingwall Reinforcing

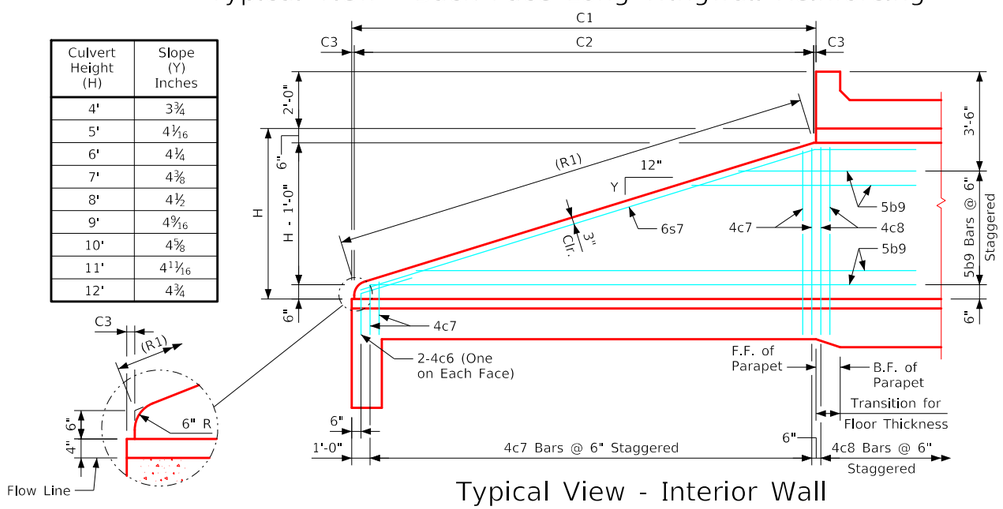


Typical View - Back Face Long Wingwall Reinforcing



Typical View - Back Face Short Wingwall Reinforcing

Culvert Height (H)	Slope (Y) Inches
4'	3¾
5'	4 1/16
6'	4¼
7'	4⅜
8'	4½
9'	4 9/16
10'	4⅝
11'	4 11/16
12'	4¾



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 TWFWH 30-2-21.
7. Top of wall slope may be rounded in some instances.

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWADOT Highway Administration

Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Wingwall Details 30° Skew

TWFWH 30-5-21

ENGLISHLRFDSIGNEDTWINCULVERTSFWH.DGN - TWFWH 30-5-21 - THIS SHEET ISSUED 02-2021.

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

Bar	Location	Shape	12' x 12' No.	12' x 12' Length	12' x 12' Wt.	12' x 11' No.	12' x 11' Length	12' x 11' Wt.	12' x 10' No.	12' x 10' Length	12' x 10' Wt.	12' x 9' No.	12' x 9' Length	12' x 9' Wt.	12' x 8' No.	12' x 8' Length	12' x 8' Wt.	Bar
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.		21 Var.	6'-0 to 31'-4	409	19 Var.	6'-0 to 29'-1	348	17 Var.	6'-0 to 26'-9	290	15 Var.	6'-0 to 24'-5	238	13 Var.	6'-1 to 22'-2	192	5b9
4c1	Wingwall, F.F.V. Long		51 Var.	2'-10 to 14'-10	301	47 Var.	2'-10 to 13'-10	262	43 Var.	2'-10 to 12'-11	226	39 Var.	2'-10 to 11'-11	192	35 Var.	2'-10 to 11'-0	162	4c1
4c2	Wingwall, F.F.V. Short		38 Var.	2'-10 to 14'-9	223	35 Var.	2'-10 to 13'-9	194	32 Var.	2'-10 to 12'-10	167	29 Var.	2'-10 to 11'-10	142	26 Var.	2'-10 to 10'-10	119	4c2
4c3	Wingwall, F.F.V. Long		23 Var.	9'-8 to 14'-11	189	19 Var.	9'-8 to 14'-0	150	15 Var.	9'-8 to 13'-0	114	11 Var.	9'-8 to 12'-1	80	--	--	--	4c3
4c4	Wingwall, F.F.V. Short		18 Var.	9'-5 to 14'-11	146	15 Var.	9'-5 to 13'-11	117	12 Var.	9'-5 to 12'-11	90	9 Var.	9'-5 to 12'-0	64	--	--	--	4c4
4c5	Wingwall, F.F.V. Long		2	13'-9	18	2	12'-9	17	2	11'-9	16	1	10'-9	7	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.		2	4'-2	6	2	4'-2	6	2	4'-2	6	2	4'-2	6	2	4'-2	6	4c6
4c7	Interior Wall, Both F.V.		54 Var.	1'-11 to 12'-4	257	50 Var.	1'-11 to 11'-6	224	45 Var.	1'-11 to 10'-5	185	41 Var.	1'-11 to 9'-6	156	36 Var.	1'-11 to 8'-5	124	4c7
4c8	Interior Wall, Both F.V.		2	12'-7	17	2	11'-7	15	2	10'-7	14	2	9'-7	13	2	8'-7	11	4c8
5c9	Wingwall, B.F.V. Long		11 Var.	2'-10 to 5'-3	46	11 Var.	2'-10 to 5'-3	46	11 Var.	2'-10 to 5'-3	46	11 Var.	2'-10 to 5'-3	46	11 Var.	2'-10 to 5'-3	46	5c9
5c10	Wingwall, B.F.V. Short		5 Var.	2'-10 to 4'-2	18	5 Var.	2'-10 to 4'-2	18	5 Var.	2'-10 to 4'-2	18	5 Var.	2'-10 to 4'-2	18	5 Var.	2'-10 to 4'-2	18	5c10
5c11	Wingwall, B.F.V. Long		40 Var.	9'-6 to 18'-10	591	36 Var.	9'-6 to 17'-10	513	32 Var.	9'-6 to 16'-11	441	28 Var.	9'-6 to 15'-11	371	24 Var.	9'-6 to 15'-0	307	5c11
5c12	Wingwall, B.F.V. Short		33 Var.	8'-6 to 18'-9	469	30 Var.	8'-6 to 17'-9	411	27 Var.	8'-6 to 16'-10	357	24 Var.	8'-6 to 15'-10	305	21 Var.	8'-6 to 14'-10	256	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'-9	37	2	16'-9	35	2	15'-9	33	1	14'-9	15	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.		17	31'-11	362	17	29'-7	336	17	27'-3	309	17	25'-0	284	17	22'-8	257	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		24	31'-11	1151	24	29'-7	1066	24	27'-3	982	24	25'-0	901	24	22'-8	817	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		51	6'-4	216	49	6'-4	207	49	6'-4	207	49	6'-4	207	49	6'-4	207	4i1
7j1	Parapet, Horizontal		4	30'-9	251	4	30'-6	249	4	30'-2	247	4	30'-2	247	4	30'-2	247	7j1
6m1	Apron, Trans., Top		11 Var.	28'-9 to 30'-8	491	11 Var.	28'-6 to 30'-4	486	11 Var.	28'-3 to 30'-1	482	11 Var.	28'-3 to 30'-1	482	11 Var.	28'-3 to 30'-1	482	6m1
6m2	Apron, Trans., Top		19 Var.	30'-11 to 37'-8	979	16 Var.	30'-8 to 36'-3	804	13 Var.	30'-5 to 34'-11	638	10 Var.	30'-5 to 33'-9	482	7 Var.	30'-5 to 32'-8	332	6m2
6m3	Apron, Trans., Top		19 Var.	8'-8 to 28'-8	533	19 Var.	7'-10 to 27'-10	509	19 Var.	7'-1 to 27'-1	488	19 Var.	6'-5 to 26'-5	468	19 Var.	5'-9 to 25'-9	449	6m3
6m4	Apron, Trans., Bott.		24 Var.	23'-10 to 39'-6	1142	22 Var.	23'-9 to 38'-1	1022	20 Var.	23'-8 to 36'-7	905	18 Var.	23'-8 to 35'-3	796	16 Var.	23'-8 to 33'-10	691	6m4
6p1	Curtain, Horizontal		4	29'-1	175	4	28'-11	174	4	28'-10	173	4	28'-10	173	4	28'-10	173	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.		2	33'-3	100	2	30'-10	93	2	28'-4	85	2	25'-10	78	2	23'-4	70	6s7
5t1	Curtain, Vertical		48	7'-11	396	46	7'-8	368	43	7'-5	333	41	7'-2	306	38	6'-11	274	5t1
	Estimated Quantities One Headwall	Reinf. Steel		12,319 LB			11,012 LB			9768 LB			8572 LB			7354 LB		
		Concrete Parapet Δ	3.3	105.9 CY		2.2	90.0 CY		3.1	77.6 CY		3.1	67.8 CY		3.1	58.5 CY		
		Concrete Wingwalls	33.3			26.2			20.1			16.7			13.6			
		Concrete Apron ✳	69.3			61.6			54.4			48.0			41.8			

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.

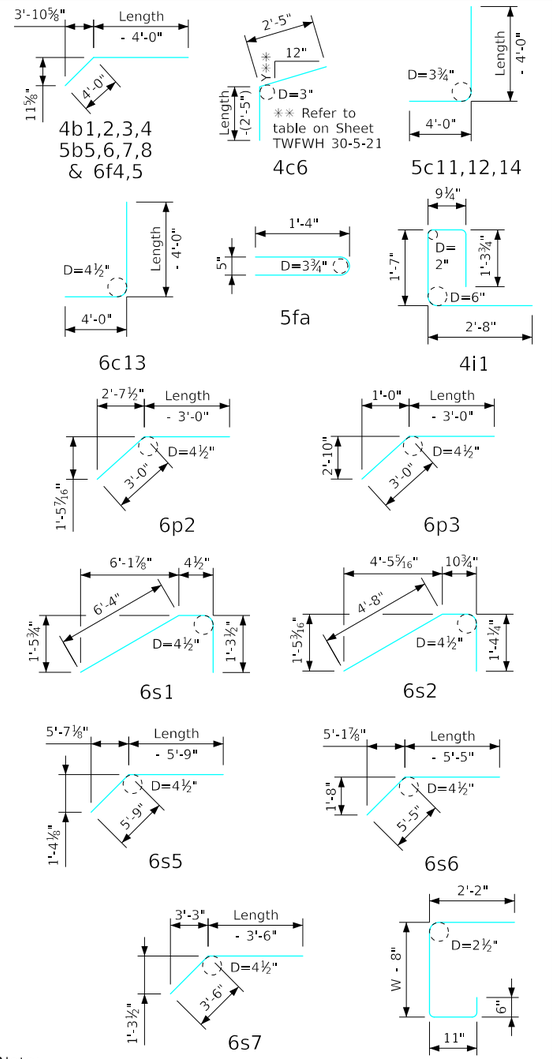
Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

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

Headwall Notes:

1. See Sheet TWFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. This headwall is based on a 3:1 slope normal to centerline of roadway.
3. The sides of the apron are to be formed to ensure correct line and grade.
4. 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.
5. 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.
6. Concrete quantities are estimated from back of parapet.
7. 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.
8. Dimensions are in feet and inches unless otherwise noted.

Bent Bar Details



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

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWADOT Highway Administration

Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
12'-0" Span
30° Skew

TWFWH
30-6-21
Sheet 1 of 2

ENGLISHLRFDSIGNEDTWINCULVERTSFWH.DGN - TWFWH 30-6-21 S1 - THIS SHEET ISSUED 02-2021.

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Bill of Reinforcing for One Headwall 30° 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	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.		11 Var.	6'-1 to 19'-10	149	9 Var.	6'-2 to 17'-6	111	7 Var.	6'-3 to 15'-2	78	5 Var.	6'-6 to 12'-10	50	5b9
4c1	Wingwall, F.F.V. Long		31 Var.	2'-10 to 10'-0	133	26 Var.	2'-10 to 8'-10	101	22 Var.	2'-10 to 7'-10	78	18 Var.	2'-10 to 6'-11	59	4c1
4c2	Wingwall, F.F.V. Short		23 Var.	2'-10 to 9'-11	98	20 Var.	2'-10 to 8'-11	78	17 Var.	2'-10 to 8'-0	62	14 Var.	2'-10 to 7'-0	46	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	2	7'-9	10	2	6'-9	9	2	5'-9	8	4c5
4c5	Wingwall, F.F.V. Short		1	8'-9	6	1	7'-9	5	1	6'-9	5	1	5'-9	4	4c5
4c6	Interior Wall, Both F.V.		2	4'-2	6	2	4'-1	5	2	4'-1	5	2	4'-1	5	4c6
4c7	Interior Wall, Both F.V.		32 Var.	1'-11 to 7'-6	101	27 Var.	1'-11 to 6'-6	76	22 Var.	1'-10 to 5'-5	53	18 Var.	1'-10 to 4'-6	38	4c7
4c8	Interior Wall, Both F.V.		2	7'-7	10	2	6'-7	9	2	5'-7	7	2	4'-7	6	4c8
5c9	Wingwall, B.F.V. Long		11 Var.	2'-10 to 5'-3	46	11 Var.	2'-10 to 5'-3	46	11 Var.	2'-10 to 5'-3	46	11 Var.	2'-10 to 5'-3	46	5c9
5c10	Wingwall, B.F.V. Short		5 Var.	2'-10 to 4'-2	18	5 Var.	2'-10 to 4'-2	18	5 Var.	2'-10 to 4'-2	18	5 Var.	2'-10 to 4'-2	18	5c10
5c11	Wingwall, B.F.V. Long		20 Var.	9'-6 to 14'-0	245	15 Var.	9'-6 to 12'-10	175	11 Var.	9'-6 to 11'-10	122	7 Var.	9'-6 to 10'-11	75	5c11
5c12	Wingwall, B.F.V. Short		18 Var.	8'-6 to 13'-11	210	15 Var.	8'-6 to 12'-11	168	12 Var.	8'-6 to 12'-0	128	9 Var.	8'-6 to 11'-0	92	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'-9	13	2	11'-9	25	2	10'-9	22	2	9'-9	20	5c14
5c14	Wingwall, B.F.V. Short		1	12'-9	13	1	11'-9	12	1	10'-9	11	1	9'-9	10	5c14
4d1	Apron, Longit., Bott.		17	20'-4	231	17	18'-1	205	17	15'-9	179	17	13'-5	152	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		24	20'-4	733	24	18'-1	652	24	15'-9	568	24	13'-5	484	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		49	6'-4	207	49	6'-4	207	49	6'-4	207	49	6'-4	207	4i1
7j1	Parapet, Horizontal		4	29'-11	245	4	29'-11	245	4	29'-11	245	4	29'-11	245	7j1
6m1	Apron, Trans., Top		11 Var.	28'-0 to 29'-10	478	11 Var.	28'-0 to 29'-10	478	9 Var.	28'-0 to 29'-6	389	6 Var.	28'-0 to 28'-11	256	6m1
6m2	Apron, Trans., Top		4 Var.	30'-2 to 31'-3	184	1 Var.	30'-2 to 30'-2	45	2 Var.	22'-7 to 23'-11	70	5 Var.	18'-7 to 23'-10	159	6m2
6m3	Apron, Trans., Top		18 Var.	6'-1 to 24'-11	419	18 Var.	5'-5 to 24'-3	401	16 Var.	4'-9 to 21'-5	314	13 Var.	4'-1 to 17'-5	210	6m3
6m4	Apron, Trans., Bott.		14 Var.	23'-7 to 32'-5	589	12 Var.	23'-7 to 31'-1	493	10 Var.	23'-7 to 29'-8	400	8 Var.	23'-7 to 28'-4	312	6m4
6p1	Curtain, Horizontal		4	28'-9	173	4	28'-9	173	4	28'-9	173	4	28'-8	172	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.		2	20'-10	63	2	18'-4	55	2	15'-10	48	2	13'-4	40	6s7
5t1	Curtain, Vertical		36	6'-8	250	33	6'-5	221	31	6'-5	207	29	6'-5	194	5t1
	Estimated Quantities One Headwall	Reinf. Steel		6313 LB			5345 LB			4322 LB			3589 LB		
		Concrete Parapet Δ	3.0	48.4 CY		3.0	40.7 CY		3.0	34.1 CY		3.0	27.9 CY		
		Concrete Wingwalls	9.7			7.5			5.5			3.7			
		Concrete Apron ✳	35.7			30.2			25.6			21.2			

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.

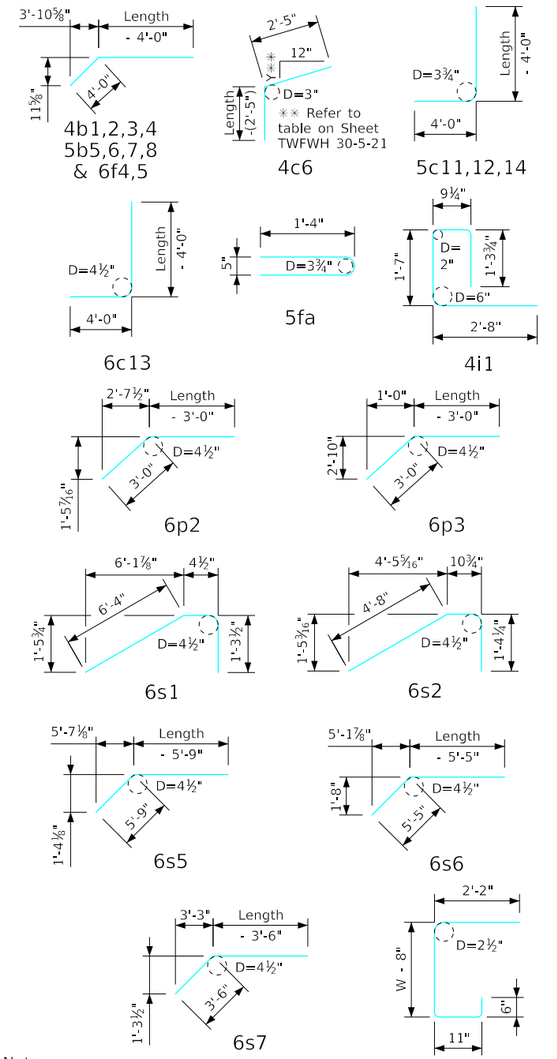
Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

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

Headwall Notes:

1. See Sheet TWFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. This headwall is based on a 3:1 slope normal to centerline of roadway.
3. The sides of the apron are to be formed to ensure correct line and grade.
4. 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.
5. 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.
6. Concrete quantities are estimated from back of parapet.
7. 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.
8. Dimensions are in feet and inches unless otherwise noted.

Bent Bar Details



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

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWADOT Highway Administration

Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
12'-0" Span
30° Skew

TWFWH
30-6-21
Sheet 2 of 2

ENGLISHLRFDSIGNEDTWINCULVERTSFWH.DGN - TWFWH 30-6-21 S2 - THIS SHEET ISSUED 02-2021.

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

Bar	Location	Shape	10' x 12' No.	10' x 12' Length	10' x 12' Wt.	10' x 11' No.	10' x 11' Length	10' x 11' Wt.	10' x 10' No.	10' x 10' Length	10' x 10' Wt.	10' x 9' No.	10' x 9' Length	10' x 9' Wt.	10' x 8' No.	10' x 8' Length	10' x 8' Wt.	Bar
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.		21 Var.	6'-0 to 31'-4	409	19 Var.	6'-0 to 29'-1	348	17 Var.	6'-0 to 26'-9	290	15 Var.	6'-0 to 24'-5	238	13 Var.	6'-1 to 22'-2	192	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.		2	4'-1	5	2	4'-1	5	2	4'-1	5	2	4'-1	5	2	4'-1	5	4c6
4c7	Interior Wall, Both F.V.		54 Var.	1'-10 to 12'-3	254	50 Var.	1'-10 to 11'-5	221	45 Var.	1'-10 to 10'-4	183	41 Var.	1'-10 to 9'-5	154	36 Var.	1'-10 to 8'-4	122	4c7
4c8	Interior Wall, Both F.V.		2	12'-6	17	2	11'-6	15	2	10'-6	14	2	9'-6	13	2	8'-6	11	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.		15	31'-11	320	13	29'-7	257	13	27'-3	237	13	25'-0	217	13	22'-8	197	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		20	31'-11	959	20	29'-7	889	20	27'-3	819	20	25'-0	751	20	22'-8	681	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		43	6'-4	182	41	6'-4	173	41	6'-4	173	41	6'-4	173	41	6'-4	173	4i1
7j1	Parapet, Horizontal		4	26'-2	214	4	25'-10	211	4	25'-7	209	4	25'-7	209	4	25'-7	209	7j1
6m1	Apron, Trans., Top		10 Var.	24'-6 to 26'-2	381	10 Var.	24'-3 to 25'-11	377	10 Var.	23'-11 to 25'-8	372	10 Var.	23'-11 to 25'-8	372	10 Var.	23'-11 to 25'-8	372	6m1
6m2	Apron, Trans., Top		22 Var.	26'-6 to 34'-5	1006	19 Var.	26'-3 to 33'-0	845	15 Var.	26'-0 to 31'-3	645	12 Var.	26'-0 to 30'-2	506	9 Var.	26'-0 to 29'-0	372	6m2
6m3	Apron, Trans., Top		15 Var.	9'-2 to 24'-8	381	15 Var.	8'-4 to 23'-11	363	16 Var.	7'-7 to 24'-3	383	16 Var.	6'-11 to 23'-7	366	16 Var.	6'-3 to 22'-11	350	6m3
6m4	Apron, Trans., Bott.		24 Var.	19'-3 to 34'-11	976	22 Var.	19'-2 to 33'-5	869	20 Var.	19'-1 to 32'-0	767	18 Var.	19'-1 to 30'-7	671	16 Var.	19'-0 to 29'-3	580	6m4
6p1	Curtain, Horizontal		4	24'-5	147	4	24'-4	146	4	24'-3	146	4	24'-3	146	4	24'-3	146	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.		2	33'-3	100	2	30'-10	93	2	28'-4	85	2	25'-10	78	2	23'-4	70	6s7
5t1	Curtain, Vertical		44	7'-11	363	42	7'-8	336	39	7'-5	302	37	7'-2	277	34	6'-11	245	5t1
	Estimated Quantities One Headwall	Reinf. Steel		11,534 LB			10,239 LB			9042 LB			7900 LB			6737 LB		
		Concrete Parapet Δ	2.9	96.5 CY		2.8	82.5 CY		2.7	69.8 CY		2.7	60.7 CY		2.7	52.2 CY		
		Concrete Wingwalls	33.3			26.2			20.1			16.7			13.6			
		Concrete Apron ✳	60.3			53.5			47.0			41.3			35.9			

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.

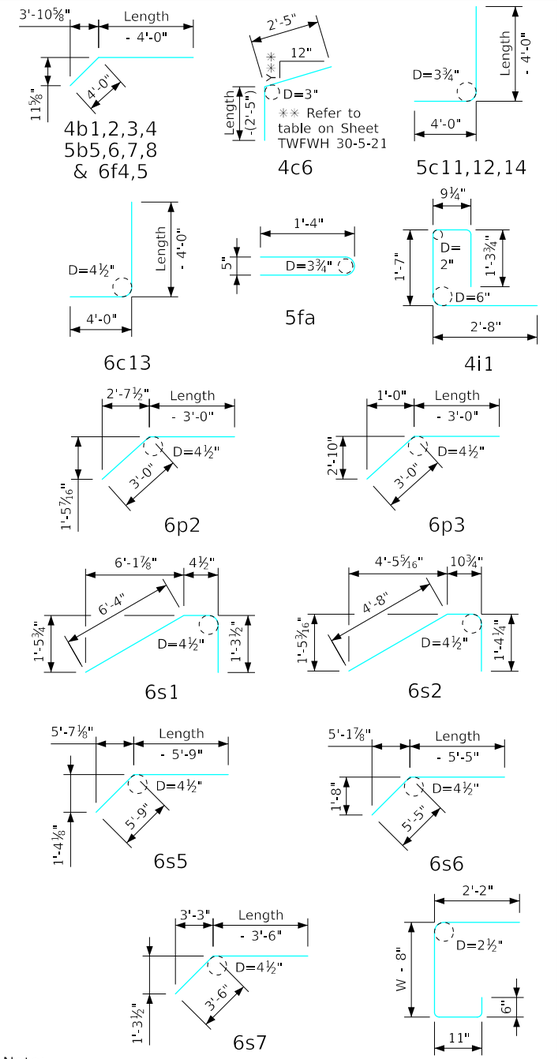
Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

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

Headwall Notes:

1. See Sheet TWFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. This headwall is based on a 3:1 slope normal to centerline of roadway.
3. The sides of the apron are to be formed to ensure correct line and grade.
4. 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.
5. 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.
6. Concrete quantities are estimated from back of parapet.
7. 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.
8. Dimensions are in feet and inches unless otherwise noted.

Bent Bar Details



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

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWADOT Highway Administration

Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
10'-0" Span
30° Skew

TWFWH
30-7-21
Sheet 1 of 2

ENGLISHLRFDSIGNEDTWINCULVERTSFWH.DGN - TWFWH 30-7-21 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.		11 Var.	6'-1 to 19'-10	149	9 Var.	6'-2 to 17'-6	111	7 Var.	6'-3 to 15'-2	78	5 Var.	6'-6 to 12'-10	50	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.		2	4'-1	5	2	4'-0	5	2	4'-0	5	2	4'-0	5	4c6
4c7	Interior Wall, Both F.V.		32 Var.	1'-10 to 7'-5	99	27 Var.	1'-10 to 6'-5	74	22 Var.	1'-9 to 5'-4	52	18 Var.	1'-9 to 4'-5	37	4c7
4c8	Interior Wall, Both F.V.		2	7'-6	10	2	6'-6	9	2	5'-6	7	2	4'-6	6	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.		13	20'-4	177	13	18'-1	157	13	15'-9	137	13	13'-5	117	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		20	20'-4	611	20	18'-1	543	20	15'-9	473	20	13'-5	403	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		41	6'-4	173	41	6'-4	173	41	6'-4	173	41	6'-4	173	4i1
7j1	Parapet, Horizontal		4	25'-3	206	4	25'-3	206	4	25'-3	206	4	25'-3	206	7j1
6m1	Apron, Trans., Top		10 Var.	23'-8 to 25'-5	369	10 Var.	23'-8 to 25'-5	369	9 Var.	23'-8 to 25'-2	330	7 Var.	23'-8 to 24'-10	255	6m1
6m2	Apron, Trans., Top		6 Var.	25'-9 to 27'-8	241	3 Var.	25'-9 to 26'-6	118	1	25'-5	38	3 Var.	17'-11 to 20'-6	87	6m2
6m3	Apron, Trans., Top		16 Var.	5'-5 to 22'-2	331	16 Var.	4'-9 to 21'-6	315	16 Var.	4'-1 to 20'-10	299	13 Var.	3'-5 to 16'-10	198	6m3
6m4	Apron, Trans., Bott.		14 Var.	18'-11 to 27'-10	492	12 Var.	18'-11 to 26'-5	409	10 Var.	18'-11 to 25'-1	330	8 Var.	18'-11 to 23'-9	256	6m4
6p1	Curtain, Horizontal		4	24'-1	145	4	24'-1	145	4	24'-1	145	4	24'-1	145	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.		2	20'-10	63	2	18'-4	55	2	15'-10	48	2	13'-4	40	6s7
5t1	Curtain, Vertical		32	6'-8	223	29	6'-5	194	27	6'-5	181	25	6'-5	167	5t1
	Estimated Quantities One Headwall	Reinf. Steel		5762 LB			4844 LB			3875 LB			3199 LB		
		Concrete Parapet Δ	2.6	42.8 CY		2.6	35.8 CY		2.6	29.8 CY		2.6	24.2 CY		
		Concrete Wingwalls	9.7			7.5			5.5			3.7			
		Concrete Apron ✳	30.5			25.7			21.7			17.9			

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.

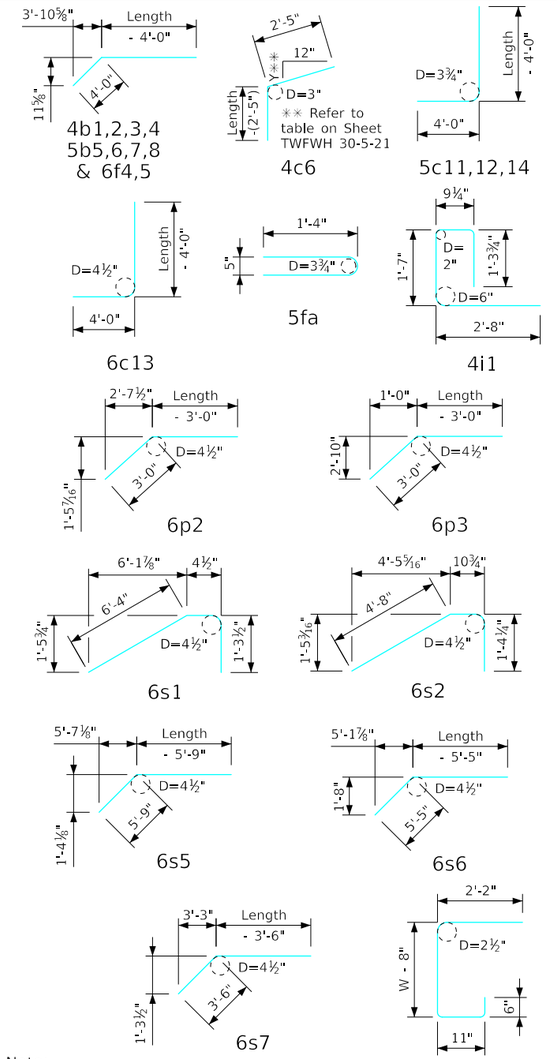
Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

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

Headwall Notes:

1. See Sheet TWFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. This headwall is based on a 3:1 slope normal to centerline of roadway.
3. The sides of the apron are to be formed to ensure correct line and grade.
4. 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.
5. 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.
6. Concrete quantities are estimated from back of parapet.
7. 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.
8. Dimensions are in feet and inches unless otherwise noted.

Bent Bar Details



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

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWADOT Highway Administration

Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
10'-0" Span
30° Skew

TWFWH
30-7-21
Sheet 2 of 2

ENGLISHLRFDSIGNEDTWINCULVERTSFWH.DGN - TWFWH 30-7-21 S2 - THIS SHEET ISSUED 02-2021.

3/2/2021 5:53:40 PM bkloss W:\Highway\Bridge\Standards\Culverts\LRFD\EnglishLRFDSignedTwinCulvertsFWH.dgn TWFWH 30-7-21 S2 11x17_pdf.pltcfg

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

Bar	Location	Shape	8' x 10'			8' x 9'			8' x 8'			8' x 7'			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	46'-10	33	1	42'-8	30	1	38'-6	26	1	34'-4	23	4b1
4b2	Wingwall, B.F.H. Short		1	36'-0	24	1	32'-10	22	1	29'-9	20	1	26'-7	18	4b2
4b3	Wingwall, B.F.H. Long		8 Var.	15'-8 to 44'-11	165	7 Var.	15'-8 to 40'-9	134	6 Var.	15'-8 to 36'-7	105	5 Var.	15'-8 to 32'-5	80	4b3
4b4	Wingwall, B.F.H. Short		8 Var.	12'-11 to 34'-7	127	7 Var.	12'-10 to 31'-5	103	6 Var.	12'-10 to 28'-4	82	5 Var.	12'-10 to 25'-3	64	4b4
5b5	Wingwall, F.F.H. Long		1	46'-11	51	1	42'-9	47	1	38'-7	40	1	34'-5	36	5b5
5b6	Wingwall, F.F.H. Short		1	36'-0	38	1	32'-11	34	1	29'-9	31	1	26'-8	28	5b6
5b7	Wingwall, F.F.H. Long		9 Var.	11'-7 to 44'-11	270	8 Var.	11'-7 to 40'-9	221	7 Var.	11'-7 to 36'-7	176	6 Var.	11'-7 to 32'-5	138	5b7
5b8	Wingwall, F.F.H. Short		9 Var.	9'-10 to 34'-7	208	8 Var.	9'-10 to 31'-6	172	7 Var.	9'-9 to 28'-4	139	6 Var.	9'-9 to 25'-3	110	5b8
5b9	Interior Wall, Both F.H.		17 Var.	6'-0 to 26'-9	290	15 Var.	6'-0 to 24'-5	238	13 Var.	6'-1 to 22'-2	192	11 Var.	6'-1 to 19'-10	149	5b9
4c1	Wingwall, F.F.V. Long		43 Var.	2'-8 to 12'-9	221	39 Var.	2'-8 to 11'-9	188	35 Var.	2'-8 to 10'-10	158	31 Var.	2'-8 to 9'-10	129	4c1
4c2	Wingwall, F.F.V. Short		32 Var.	2'-8 to 12'-8	164	29 Var.	2'-8 to 11'-8	139	26 Var.	2'-8 to 10'-8	116	23 Var.	2'-8 to 9'-9	95	4c2
4c3	Wingwall, F.F.V. Long		15 Var.	9'-6 to 12'-10	112	11 Var.	9'-6 to 11'-11	79	--	--	--	--	--	--	4c3
4c4	Wingwall, F.F.V. Short		12 Var.	9'-3 to 12'-9	88	9 Var.	9'-3 to 11'-10	63	--	--	--	--	--	--	4c4
4c5	Wingwall, F.F.V. Long		2	11'-7	15	1	10'-7	7	1	9'-7	6	1	8'-7	6	4c5
4c5	Wingwall, F.F.V. Short		2	11'-7	15	2	10'-7	14	2	9'-7	13	1	8'-7	6	4c5
4c6	Interior Wall, Both F.V.		2	4'-0	5	2	4'-0	5	2	4'-0	5	2	4'-0	5	4c6
4c7	Interior Wall, Both F.V.		45 Var.	1'-9 to 10'-3	180	41 Var.	1'-9 to 9'-4	152	36 Var.	1'-9 to 8'-3	120	32 Var.	1'-9 to 7'-4	97	4c7
4c8	Interior Wall, Both F.V.		2	10'-5	14	2	9'-5	13	2	8'-5	11	2	7'-5	10	4c8
5c9	Wingwall, B.F.V. Long		11 Var.	2'-8 to 5'-1	44	11 Var.	2'-8 to 5'-1	44	11 Var.	2'-8 to 5'-1	44	11 Var.	2'-8 to 5'-1	44	5c9
5c10	Wingwall, B.F.V. Short		5 Var.	2'-8 to 4'-0	17	5 Var.	2'-8 to 4'-0	17	5 Var.	2'-8 to 4'-0	17	5 Var.	2'-8 to 4'-0	17	5c10
5c11	Wingwall, B.F.V. Long		32 Var.	9'-4 to 16'-9	435	28 Var.	9'-4 to 15'-9	366	24 Var.	9'-4 to 14'-10	302	20 Var.	9'-4 to 13'-10	242	5c11
5c12	Wingwall, B.F.V. Short		27 Var.	8'-4 to 16'-8	352	24 Var.	8'-4 to 15'-8	300	21 Var.	8'-4 to 14'-8	252	18 Var.	8'-4 to 13'-9	207	5c12
6c13	Wingwall, B.F.V. Long		25	10'-6	394	21	10'-6	331	17	10'-6	268	13	10'-6	205	6c13
6c13	Wingwall, B.F.V. Short		19	10'-6	300	16	10'-6	252	13	10'-6	205	10	10'-6	158	6c13
5c14	Wingwall, B.F.V. Long		2	15'-7	33	1	14'-7	15	1	13'-7	14	1	12'-7	13	5c14
5c14	Wingwall, B.F.V. Short		2	15'-7	33	2	14'-7	30	2	13'-7	28	1	12'-7	13	5c14
4d1	Apron, Longit., Bott.		11	27'-3	200	11	25'-0	184	11	22'-8	167	11	20'-4	149	4d1
4d2	Apron, Longit., Bott. Long		3	40'-5	86	3	36'-3	73	3	32'-1	64	3	27'-11	56	4d2
4d3	Apron, Longit., Bott. Short		3	31'-0	62	3	27'-11	56	3	24'-9	50	3	21'-8	43	4d3
6f1	Apron, Longit., Top		16	27'-3	655	16	25'-0	601	16	22'-8	545	16	20'-4	489	6f1
6f2	Apron, Longit., Top Long		9 Var.	5'-4 to 23'-10	197	8 Var.	5'-4 to 21'-7	162	7 Var.	5'-3 to 19'-3	129	6 Var.	5'-3 to 16'-11	100	6f2
6f3	Apron, Longit., Top Short		7 Var.	5'-5 to 24'-1	155	6 Var.	6'-2 to 21'-9	126	5 Var.	6'-11 to 19'-6	99	4 Var.	7'-9 to 17'-2	75	6f3
6f4	Apron, Longit., Top Long		1	46'-11	74	1	42'-9	68	1	38'-7	58	1	34'-5	52	6f4
6f5	Apron, Longit., Top Short		1	36'-0	54	1	32'-11	49	1	29'-9	45	1	26'-8	40	6f5
4i1	Parapet, Vertical		33	6'-4	140	33	6'-4	140	33	6'-4	140	33	6'-4	140	4i1
7j1	Parapet, Horizontal		4	20'-11	171	4	20'-11	171	4	20'-11	171	4	20'-8	169	7j1
6m1	Apron, Trans., Top		8 Var.	19'-8 to 21'-0	244	8 Var.	19'-8 to 21'-0	244	8 Var.	19'-8 to 21'-0	244	8 Var.	19'-5 to 20'-9	241	6m1
6m2	Apron, Trans., Top		19 Var.	21'-3 to 28'-0	703	16 Var.	21'-3 to 26'-11	579	13 Var.	21'-3 to 25'-9	459	10 Var.	21'-0 to 24'-5	341	6m2
6m3	Apron, Trans., Top		13 Var.	7'-0 to 20'-4	267	13 Var.	6'-4 to 19'-8	254	12 Var.	6'-9 to 19'-0	232	12 Var.	6'-0 to 18'-2	218	6m3
6m4	Apron, Trans., Bott.		20 Var.	14'-5 to 27'-4	627	18 Var.	14'-5 to 26'-0	546	16 Var.	14'-5 to 24'-8	470	14 Var.	14'-4 to 23'-2	394	6m4
6p1	Curtain, Horizontal		4	19'-7	118	4	19'-7	118	4	19'-7	118	4	19'-6	117	6p1
6p2	Curtain, Horizontal, Long		4	24'-0	144	4	22'-0	132	4	20'-0	120	4	18'-0	108	6p2
6p3	Curtain, Horizontal, Short		4	13'-10	83	4	12'-10	77	4	11'-9	71	4	10'-9	65	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	40'-4	128	2	36'-0	108	2	31'-9	95	2	27'-5	82	6s3
6s4	Wing Slope, Both F., Short		2	31'-6	95	2	28'-2	85	2	24'-11	75	2	21'-8	65	6s4
6s5	Wing Slope, F.F. Long		1	46'-5	73	1	42'-2	67	1	37'-10	57	1	33'-7	50	6s5
6s6	Wing Slope, F.F. Short		1	36'-9	55	1	33'-6	50	1	30'-3	45	1	26'-11	40	6s6
6s7	Interior Wall, Both F.H.		2	28'-4	85	2	25'-10	78	2	23'-4	70	2	20'-10	63	6s7
5t1	Curtain, Vertical		35	7'-5	271	33	7'-2	247	30	6'-11	216	28	6'-8	195	5t1
	Estimated Quantities One Headwall	Reinf. Steel		8366 LB			7282 LB			6161 LB			5236 LB		
		Concrete Parapet Δ	2.4	64.8 CY		2.4	54.3 CY		2.4	48.0 CY		2.3	37.7 CY		
		Concrete Wingwalls	20.1			16.7			13.6			9.7			
		Concrete Apron ✳	42.3			35.2			32.0			25.7			

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.

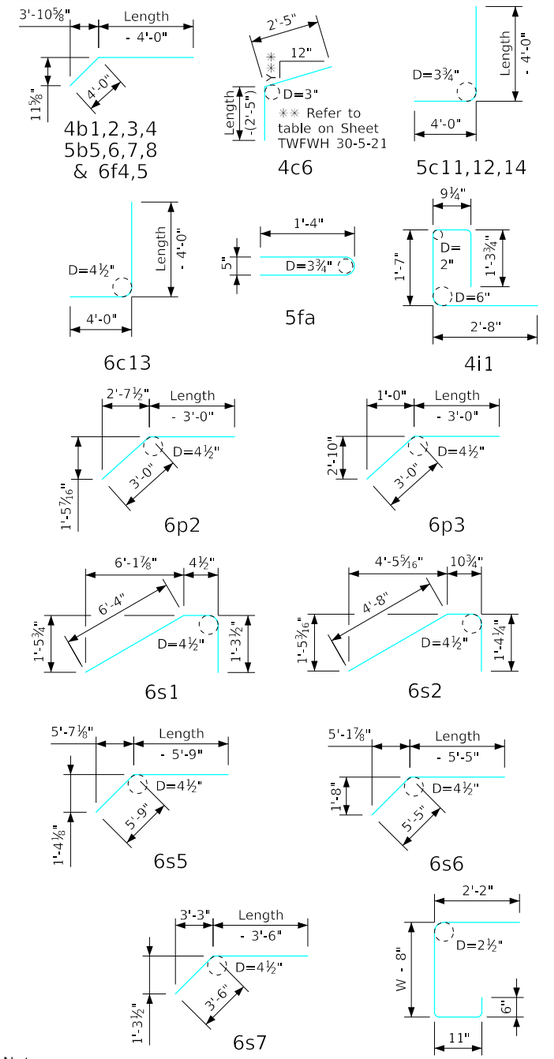
Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

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

Headwall Notes:

1. See Sheet TWFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. This headwall is based on a 3:1 slope normal to centerline of roadway.
3. The sides of the apron are to be formed to ensure correct line and grade.
4. 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.
5. 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.
6. Concrete quantities are estimated from back of parapet.
7. 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.
8. Dimensions are in feet and inches unless otherwise noted.

Bent Bar Details



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

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWADOT Highway Administration

Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
8'-0" Span
30° Skew

TWFWH
30-8-21
Sheet 1 of 2

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

Bar	Location	Shape	8' x 6' No.	8' x 6' Length	8' x 6' Wt.	8' x 5' No.	8' x 5' Length	8' x 5' Wt.	8' x 4' No.	8' x 4' Length	8' x 4' Wt.	Bar
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	5fa
4b1	Wingwall, B.F.H. Long		1	30'-2	20	1	26'-0	17	1	21'-10	15	4b1
4b2	Wingwall, B.F.H. Short		1	23'-6	16	1	20'-5	14	1	17'-3	12	4b2
4b3	Wingwall, B.F.H. Long		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		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	30'-2	31	1	26'-0	27	1	21'-10	23	5b5
5b6	Wingwall, F.F.H. Short		1	23'-6	25	1	20'-5	21	1	17'-4	18	5b6
5b7	Wingwall, F.F.H. Long		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		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.		9 Var.	6'-2 to 17'-6	111	7 Var.	6'-3 to 15'-2	78	5 Var.	6'-6 to 12'-10	50	5b9
4c1	Wingwall, F.F.V. Long		26 Var.	2'-8 to 8'-8	98	22 Var.	2'-8 to 7'-8	76	18 Var.	2'-8 to 6'-9	57	4c1
4c2	Wingwall, F.F.V. Short		20 Var.	2'-8 to 8'-9	76	17 Var.	2'-8 to 7'-10	60	14 Var.	2'-8 to 6'-10	44	4c2
4c3	Wingwall, F.F.V. Long		--	--	--	--	--	--	--	--	--	4c3
4c4	Wingwall, F.F.V. Short		--	--	--	--	--	--	--	--	--	4c4
4c5	Wingwall, F.F.V. Long		2	7'-7	10	2	6'-7	9	2	5'-7	7	4c5
4c5	Wingwall, F.F.V. Short		1	7'-7	5	1	6'-7	4	1	5'-7	4	4c5
4c6	Interior Wall, Both F.V.		2	3'-11	5	2	3'-11	5	2	3'-11	5	4c6
4c7	Interior Wall, Both F.V.		27 Var.	1'-9 to 6'-4	73	22 Var.	1'-8 to 5'-3	51	18 Var.	1'-8 to 4'-4	36	4c7
4c8	Interior Wall, Both F.V.		2	6'-5	9	2	5'-5	7	2	4'-5	6	4c8
5c9	Wingwall, B.F.V. Long		11 Var.	2'-8 to 5'-1	44	11 Var.	2'-8 to 5'-1	44	11 Var.	2'-8 to 5'-1	44	5c9
5c10	Wingwall, B.F.V. Short		5 Var.	2'-8 to 4'-0	17	5 Var.	2'-8 to 4'-0	17	5 Var.	2'-8 to 4'-0	17	5c10
5c11	Wingwall, B.F.V. Long		15 Var.	9'-4 to 12'-8	172	11 Var.	9'-4 to 11'-8	120	7 Var.	9'-4 to 10'-9	73	5c11
5c12	Wingwall, B.F.V. Short		15 Var.	8'-4 to 12'-9	165	12 Var.	8'-4 to 11'-10	126	9 Var.	8'-4 to 10'-10	90	5c12
6c13	Wingwall, B.F.V. Long		8	10'-6	126	--	--	--	--	--	--	6c13
6c13	Wingwall, B.F.V. Short		7	10'-6	110	--	--	--	--	--	--	6c13
5c14	Wingwall, B.F.V. Long		2	11'-7	24	2	10'-7	22	2	9'-7	20	5c14
5c14	Wingwall, B.F.V. Short		1	11'-7	12	1	10'-7	11	1	9'-7	10	5c14
4d1	Apron, Longit., Bott.		11	18'-1	133	11	15'-9	116	11	13'-5	99	4d1
4d2	Apron, Longit., Bott. Long		3	23'-9	48	3	19'-7	39	3	15'-4	31	4d2
4d3	Apron, Longit., Bott. Short		3	18'-7	37	3	15'-5	31	3	12'-4	25	4d3
6f1	Apron, Longit., Top		16	18'-1	435	16	15'-9	379	16	13'-5	322	6f1
6f2	Apron, Longit., Top Long		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.	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	30'-2	45	1	26'-0	39	1	21'-10	33	6f4
6f5	Apron, Longit., Top Short		1	23'-6	35	1	20'-5	31	1	17'-4	26	6f5
4i1	Parapet, Vertical		33	6'-4	140	33	6'-4	140	33	6'-4	140	4i1
7j1	Parapet, Horizontal		4	20'-8	169	4	20'-8	169	4	20'-8	169	7j1
6m1	Apron, Trans., Top		8 Var.	19'-5 to 20'-9	241	8 Var.	19'-5 to 20'-9	241	8 Var.	19'-5 to 20'-9	241	6m1
6m2	Apron, Trans., Top		7 Var.	21'-0 to 23'-3	233	4 Var.	21'-0 to 22'-2	130	1	21'-0	32	6m2
6m3	Apron, Trans., Top		12 Var.	5'-4 to 17'-6	206	12 Var.	4'-8 to 16'-10	194	12 Var.	4'-0 to 16'-2	182	6m3
6m4	Apron, Trans., Bott.		12 Var.	14'-4 to 21'-10	326	10 Var.	14'-4 to 20'-5	261	8 Var.	14'-4 to 19'-1	201	6m4
6p1	Curtain, Horizontal		4	19'-6	117	4	19'-6	117	4	19'-6	117	6p1
6p2	Curtain, Horizontal, Long		4	16'-0	96	4	13'-11	84	4	11'-11	72	6p2
6p3	Curtain, Horizontal, Short		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	6s1
6s2	Wing Slope, Both F., Short		2	6'-11	21	2	6'-11	21	2	6'-11	21	6s2
6s3	Wing Slope, Both F., Long		2	23'-2	70	2	18'-10	57	2	14'-7	44	6s3
6s4	Wing Slope, Both F., Short		2	18'-4	55	2	15'-1	45	2	11'-10	36	6s4
6s5	Wing Slope, F.F. Long		1	29'-3	44	1	25'-0	38	1	20'-8	31	6s5
6s6	Wing Slope, F.F. Short		1	23'-8	36	1	20'-5	31	1	17'-1	26	6s6
6s7	Interior Wall, Both F.H.		2	18'-4	55	2	15'-10	48	2	13'-4	40	6s7
5t1	Curtain, Vertical		25	6'-5	167	23	6'-5	154	21	6'-5	141	5t1
	Estimated Quantities One Headwall	Reinf. Steel		4374 LB			3457 LB			2828 LB		
		Concrete Parapet Δ	2.3			2.3			2.3			
		Concrete Wingwalls	7.5	31.4 CY		5.5	26.0 CY		3.7	20.9 CY		
		Concrete Apron ✳	21.6			18.2			14.9			

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.

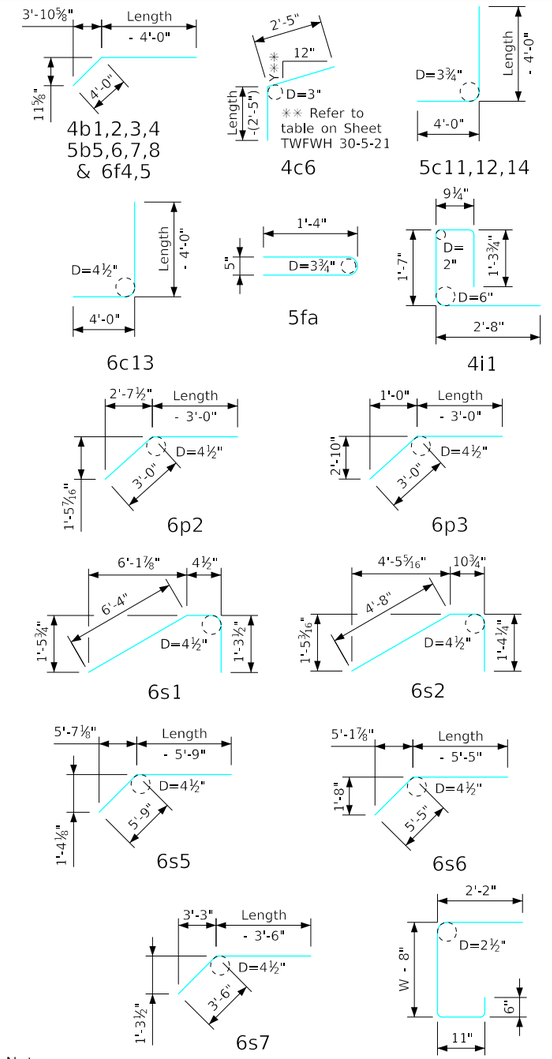
Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

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

Headwall Notes:

1. See Sheet TWFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. This headwall is based on a 3:1 slope normal to centerline of roadway.
3. The sides of the apron are to be formed to ensure correct line and grade.
4. 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.
5. 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.
6. Concrete quantities are estimated from back of parapet.
7. 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.
8. Dimensions are in feet and inches unless otherwise noted.

Bent Bar Details



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

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IOWADOT Highway Administration

Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
8'-0" Span
30° Skew

TWFWH
30-8-21
Sheet 2 of 2

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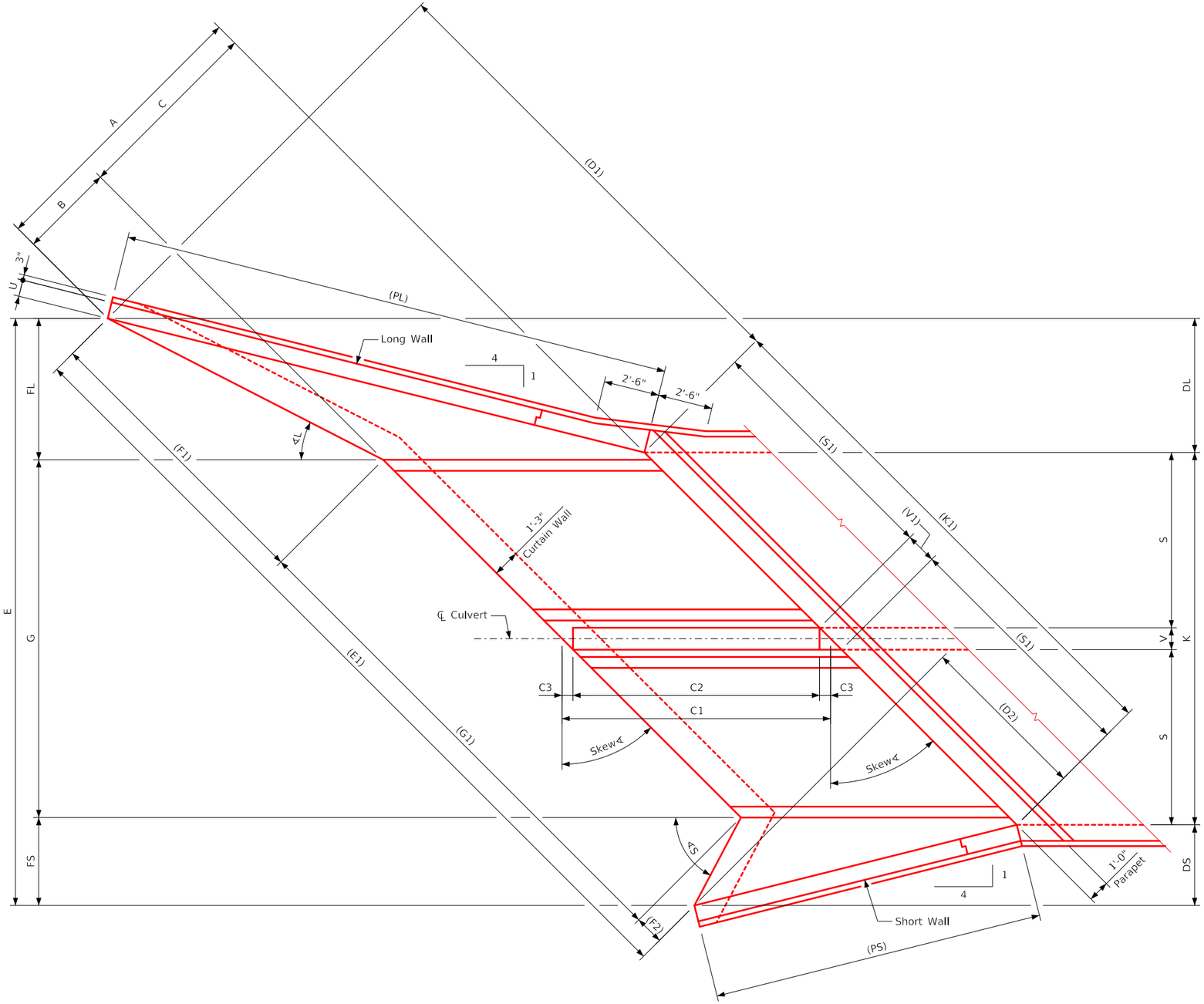

Plan View

Notes:

1. See Sheet TWFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. See Sheet TWFWH 45-2-21 for dimensions table.
3. See Sheet TWFWH 45-5-21 for Angle L & Angle S.

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Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Dimension Plan 45° Skew	TWFWH 45-1-21

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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'	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	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	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	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	20'-8	18'-8	16'-8	14'-8	12'-8	10'-8	8'-8	C
C1	34'-10⅝	32'-0⅝	29'-2¾	26'-4¾	23'-6⅞	20'-8⅞	17'-11	15'-1	12'-3⅛	34'-10⅝	32'-0⅝	29'-2¾	26'-4¾	23'-6⅞	20'-8⅞	17'-11	15'-1	12'-3⅛	29'-2¾	26'-4¾	23'-6⅞	20'-8⅞	17'-11	15'-1	12'-3⅛	C1
C2	33'-10⅝	31'-1⅝	28'-4¾	25'-6¾	22'-8⅞	19'-11⅞	17'-2	14'-4	11'-6⅛	33'-10⅝	31'-1⅝	28'-4¾	25'-6¾	22'-8⅞	19'-11⅞	17'-2	14'-4	11'-6⅛	28'-4¾	25'-6¾	22'-8⅞	19'-11⅞	17'-2	14'-4	11'-6⅛	C2
C3	6	5½	5	5	5	4½	4½	4½	4½	6	5½	5	5	5	4½	4½	4½	4½	5	5	5	4½	4½	4½	4½	C3
DL	17'-5¼	16'-0⅜	14'-7⅜	13'-2⅜	11'-9⅜	10'-4½	8'-11½	7'-6½	6'-1½	17'-5¼	16'-0⅜	14'-7⅜	13'-2⅜	11'-9⅜	10'-4½	8'-11½	7'-6½	6'-1½	14'-7⅜	13'-2⅜	11'-9⅜	10'-4½	8'-11½	7'-6½	6'-1½	DL
DS	10'-5⅜	9'-7⅜	8'-9¼	7'-11	7'-0⅞	6'-2⅝	5'-4½	4'-6¼	3'-8⅛	10'-5⅜	9'-7⅜	8'-9¼	7'-11	7'-0⅞	6'-2⅝	5'-4½	4'-6¼	3'-8⅛	8'-9¼	7'-11	7'-0⅞	6'-2⅝	5'-4½	4'-6¼	3'-8⅛	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	51'-8	46'-8	41'-8	36'-8	31'-8	26'-8	21'-8	D1
D2	22'-2⅜	20'-4¾	18'-7⅛	16'-9⅝	15'-0	13'-2⅜	11'-4¾	9'-7¼	7'-9⅝	22'-2⅜	20'-4¾	18'-7⅛	16'-9⅝	15'-0	13'-2⅜	11'-4¾	9'-7¼	7'-9⅝	18'-7¼	16'-9⅝	15'-0	13'-2⅜	11'-4¾	9'-7¼	7'-9⅝	D2
E	52'-10⅞	50'-6¾	48'-2⅝	45'-11⅜	43'-8¼	41'-4⅛	39'-1	36'-9⅞	34'-6⅝	48'-10⅞	46'-6¾	44'-2⅝	41'-11⅜	39'-8¼	37'-4⅛	35'-1	32'-9⅞	30'-6⅝	40'-2⅝	37'-11⅜	35'-8¼	33'-4⅛	31'-1	28'-9⅞	26'-6⅝	E
E1	74'-9⅞	71'-6	68'-2¼	64'-11⅞	61'-9⅜	58'-5⅝	55'-3¼	52'-0⅞	48'-10⅜	69'-2	65'-10⅛	62'-6⅜	59'-4	56'-1½	52'-9¾	49'-7⅜	46'-5	43'-2½	56'-10½	53'-8⅛	50'-5⅜	47'-1⅞	43'-11½	40'-9	37'-6⅜	E1
FL	17'-9¼	16'-4⅜	14'-11⅜	13'-6⅜	12'-1⅜	10'-8½	9'-3½	7'-10½	6'-5½	17'-9¼	16'-4⅜	14'-11⅜	13'-6⅜	12'-1⅜	10'-8½	9'-3½	7'-10½	6'-5½	14'-11⅜	13'-6⅜	12'-1⅜	10'-8½	9'-3½	7'-10½	6'-5½	FL
FS	10'-9⅝	9'-11⅜	9'-1¼	8'-3	7'-4⅞	6'-6⅝	5'-8½	4'-10¼	4'-0⅛	10'-9⅝	9'-11⅜	9'-1¼	8'-3	7'-4⅞	6'-6⅝	5'-8½	4'-10¼	4'-0⅛	9'-1¼	8'-3	7'-4⅞	6'-6⅝	5'-8½	4'-10¼	4'-0⅛	FS
F1	37'-5⅝	34'-5⅝	31'-5⅝	28'-5⅝	25'-5⅝	22'-5⅝	19'-5⅝	16'-5⅝	13'-5⅝	37'-5⅝	34'-5⅝	31'-5⅝	28'-5⅝	25'-5⅝	22'-5⅝	19'-5⅝	16'-5⅝	13'-5⅝	31'-5⅝	28'-5⅝	25'-5⅝	22'-5⅝	19'-5⅝	16'-5⅝	13'-5⅝	F1
F2	2'-11¼	2'-8⅞	2'-6½	2'-4	2'-1⅜	1'-11¼	1'-8⅞	1'-6½	1'-4	2'-11¼	2'-8⅞	2'-6½	2'-4	2'-1⅜	1'-11¼	1'-8⅞	1'-6½	1'-4	2'-6½	2'-4	2'-1⅜	1'-11¼	1'-8⅞	1'-6½	1'-4	F2
G	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	20'-1	20'-1	20'-1	16'-2	16'-2	16'-2	16'-1	16'-1	16'-1	16'-1	G
G1	34'-5	34'-3½	34'-2⅛	34'-2⅛	34'-2⅛	34'-0¾	34'-0¾	34'-0¾	34'-0¾	28'-9⅛	28'-7⅝	28'-6¼	28'-6¼	28'-6¼	28'-4⅞	28'-4⅞	28'-4⅞	28'-4⅞	22'-10⅜	22'-10⅜	22'-10⅜	22'-9	22'-9	22'-9	22'-9	G1
G2	35'-7¼	35'-5¾	35'-4¼	35'-4¼	35'-4⅛	35'-2⅝	35'-2½	35'-2⅜	35'-2⅛	29'-11⅜	29'-9⅞	29'-8⅜	29'-8⅜	29'-8¼	29'-6¾	29'-6⅝	29'-6½	29'-6¼	24'-0½	24'-0½	24'-0⅜	23'-10⅞	23'-10¾	23'-10⅝	23'-10⅜	G2
G3	39'-5⅜	36'-3½	33'-1½	29'-11½	26'-9⅝	23'-7⅞	20'-5¾	17'-3¾	14'-1⅞	39'-5⅜	36'-3½	33'-1½	29'-11½	26'-9⅝	23'-7⅞	20'-5¾	17'-3¾	14'-1⅞	33'-1½	29'-11½	26'-9⅝	23'-7⅝	20'-5¾	17'-3¾	14'-1⅞	G3
G4	39'-9½	36'-3	32'-8½	29'-6⅝	26'-4⅝	22'-10¼	19'-8⅜	16'-6½	13'-4¾	39'-9½	36'-3	32'-8½	29'-6⅝	26'-4⅝	22'-10¼	19'-8⅜	16'-6½	13'-4¾	32'-8½	29'-6⅝	26'-4⅝	22'-10¼	19'-8⅜	16'-6½	13'-4¾	G4
G5	12'-8⅛	11'-7⅞	10'-7⅝	9'-7½	8'-7¼	7'-7	6'-6¾	5'-6⅝	4'-6⅜	12'-8⅛	11'-7⅞	10'-7⅝	9'-7½	8'-7¼	7'-7	6'-6¾	5'-6⅝	4'-6⅜	10'-7⅝	9'-7½	8'-7¼	7'-7	6'-6¾	5'-6⅝	4'-6⅜	G5
G6	14'-2⅛	13'-0½	11'-10¾	10'-10½	9'-10⅜	8'-8¾	7'-8½	6'-8⅜	5'-8⅛	14'-2⅛	13'-0½	11'-10¾	10'-10½	9'-10⅜	8'-8¾	7'-8½	6'-8⅜	5'-8⅛	11'-10¾	10'-10½	9'-10⅜	8'-8¾	7'-8½	6'-8⅜	5'-8⅛	G6
G7	1⅝	6⅛	10½	10½	10½	1'-2¾	1'-2¾	1'-2⅝	1'-2⅝	1⅝	6⅛	10½	10½	10½	1'-2¾	1'-2¾	1'-2⅝	1'-2⅝	10½	10½	10½	1'-2¾	1'-2¾	1'-2⅝	1'-2⅝	G7
G8	6⅛	7⅛	8¼	8¼	8¼	9¼	9¼	9⅜	9⅜	6⅛	7⅛	8¼	8¼	8¼	9¼	9¼	9⅜	9⅜	8¼	8¼	8¼	9¼	9¼	9⅜	9⅜	G8
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	20'-9	20'-9	20'-9	16'-10	16'-10	16'-10	16'-9	16'-9	16'-9	16'-9	K
K1	35'-4¼	35'-2⅞	35'-1⅜	35'-1⅜	35'-1⅜	35'-0	35'-0	35'-0	35'-0	29'-8⅜	29'-7	29'-5½	29'-5½	29'-5½	29'-4⅛	29'-4⅛	29'-4⅛	29'-4⅛	23'-9⅝	23'-9⅝	23'-9⅝	23'-8¼	23'-8¼	23'-8¼	23'-8¼	K1
PL	71'-11	66'-1	60'-3	54'-5⅛	48'-7⅛	42'-9⅛	36'-11⅛	31'-1⅛	25'-3¼	71'-11	66'-1	60'-3	54'-5⅛	48'-7⅛	42'-9⅛	36'-11⅛	31'-1⅛	25'-3¼	60'-3	54'-5⅛	48'-7⅛	42'-9⅛	36'-11⅛	31'-1⅛	25'-3¼	PL
PS	43'-1¾	39'-7¾	36'-1⅞	32'-7⅞	29'-1⅞	25'-7⅞	22'-1⅞	18'-7⅞	15'-1⅞	43'-1¾	39'-7¾	36'-1⅞	32'-7⅞	29'-1⅞	25'-7⅞	22'-1⅞	18'-7⅞	15'-1⅞	36'-1⅞	32'-7⅞	29'-1⅞	25'-7⅞	22'-1⅞	18'-7⅞	15'-1⅞	PS
RL	72'-11⅝	67'-0⅝	61'-1⅝	55'-2⅝	49'-3⅝	43'-4⅝	37'-5⅝	31'-6⅝	25'-7⅝	72'-11⅝	67'-0⅝	61'-1⅝	55'-2⅝	49'-3⅝	43'-4⅝	37'-5⅝	31'-6⅝	25'-7⅝	61'-1⅝	55'-2⅝	49'-3⅝	43'-4⅝	37'-5⅝	31'-6⅝	25'-7⅝	RL
RS	44'-10½	41'-2⅞	37'-7¼	33'-11½	30'-3⅞	26'-8¼	23'-0½	19'-4⅞	15'-9¼	44'-10½	41'-2⅞	37'-7¼	33'-11½	30'-3⅞	26'-8¼	23'-0½	19'-4⅞	15'-9¼	37'-7¼	33'-11½	30'-3⅞	26'-8¼	23'-0½	19'-4⅞	15'-9¼	RS
R1	35'-7½	32'-8½	29'-9⅜	26'-9½	23'-9½	20'-10½	17'-10½	14'-10⅝	11'-10¾	35'-7½	32'-8½	29'-9⅜	26'-9½	23'-9½	20'-10½	17'-10½	14'-10⅝	11'-10¾	29'-9⅜	26'-9½	23'-9½	20'-10½	17'-10½	14'-10⅝	11'-10¾	R1
S1	16'-11⅝	16'-11⅝	16'-11⅝	16'-11⅝	16'-11⅝	16'-11⅝	16'-11⅝	16'-11⅝	16'-11⅝	14'-1¾	14'-1¾	14'-1¾	14'-1¾	14'-1¾	14'-1¾	14'-1¾	14'-1¾	14'-1¾	11'-3¾	11'-3¾	11'-3¾	11'-3¾	11'-3¾	11'-3¾	11'-3¾	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	1'-0	1'-0	1'-0	1'-0	1'-0	1'-0	1'-0	T
U	1'-0	11	10	10	10	9	9	9	9	1'-0	11	10	10	10	9	9	9	9	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	10	10	10	9	9	9	9	V
V1	1'-5	1'-3½	1'-2⅛	1'-2⅛	1'-2⅛	1'-0¾	1'-0¾	1'-0¾	1'-0¾	1'-5	1'-3½	1'-2⅛	1'-2⅛	1'-2⅛	1'-0¾	1'-0¾	1'-0¾	1'-0¾	1'-2⅛	1'-2⅛	1'-2⅛	1'-0¾	1'-0¾	1'-0¾	1'-0¾	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	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 45-1-21 and sheets TWFWH 45-3-21 thru 45-6-21 for location of certain dimensions tabulated.
3. Dimensions are in feet and inches unless otherwise noted.

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Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Dimension Table
45° Skew

TWFWH
45-2-21

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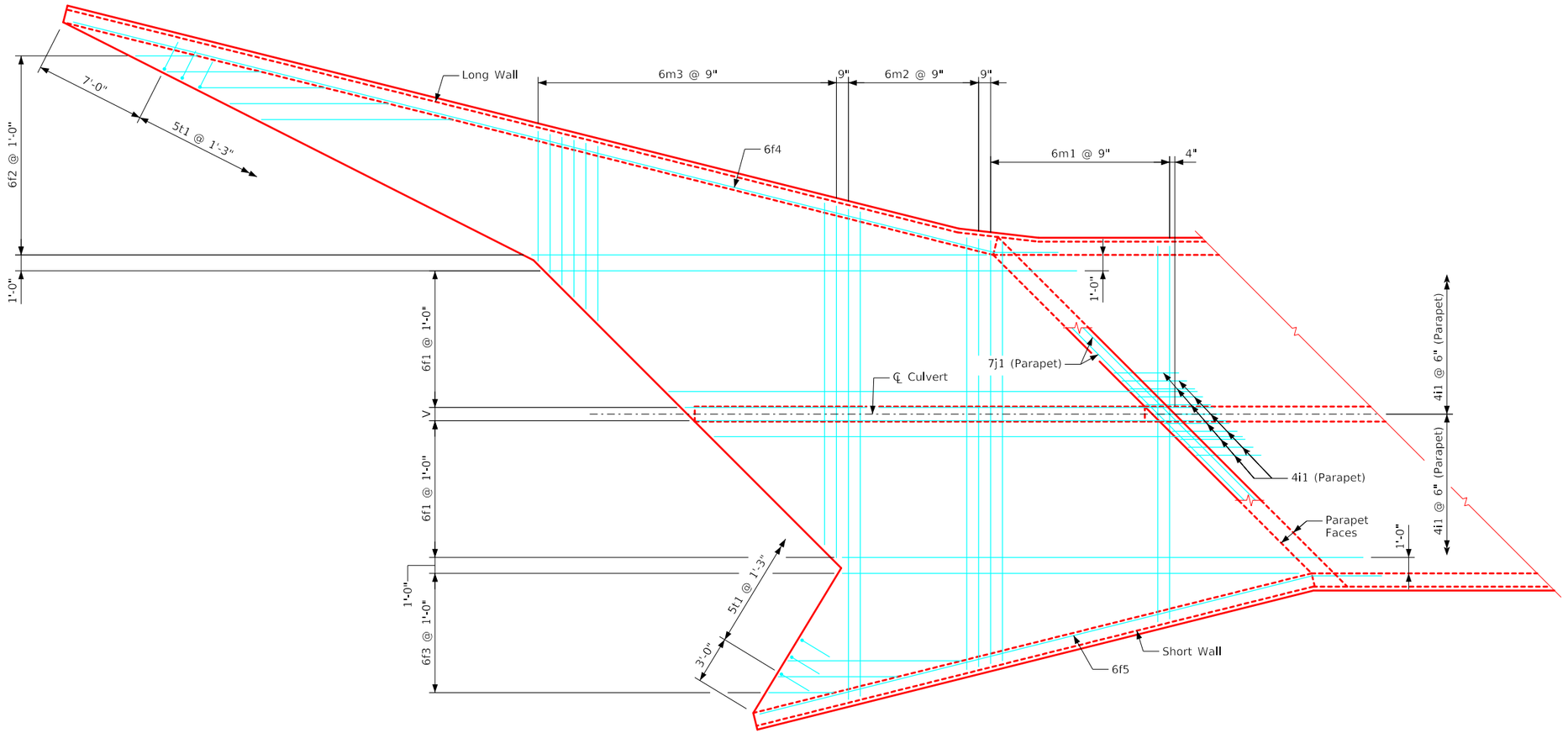

Plan View - Top of Apron Reinforcing

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 TWFWH 45-2-21.
4. For reinforcing in curtain wall see Curtain Wall Details on Sheet TWFWH 45-5-21.

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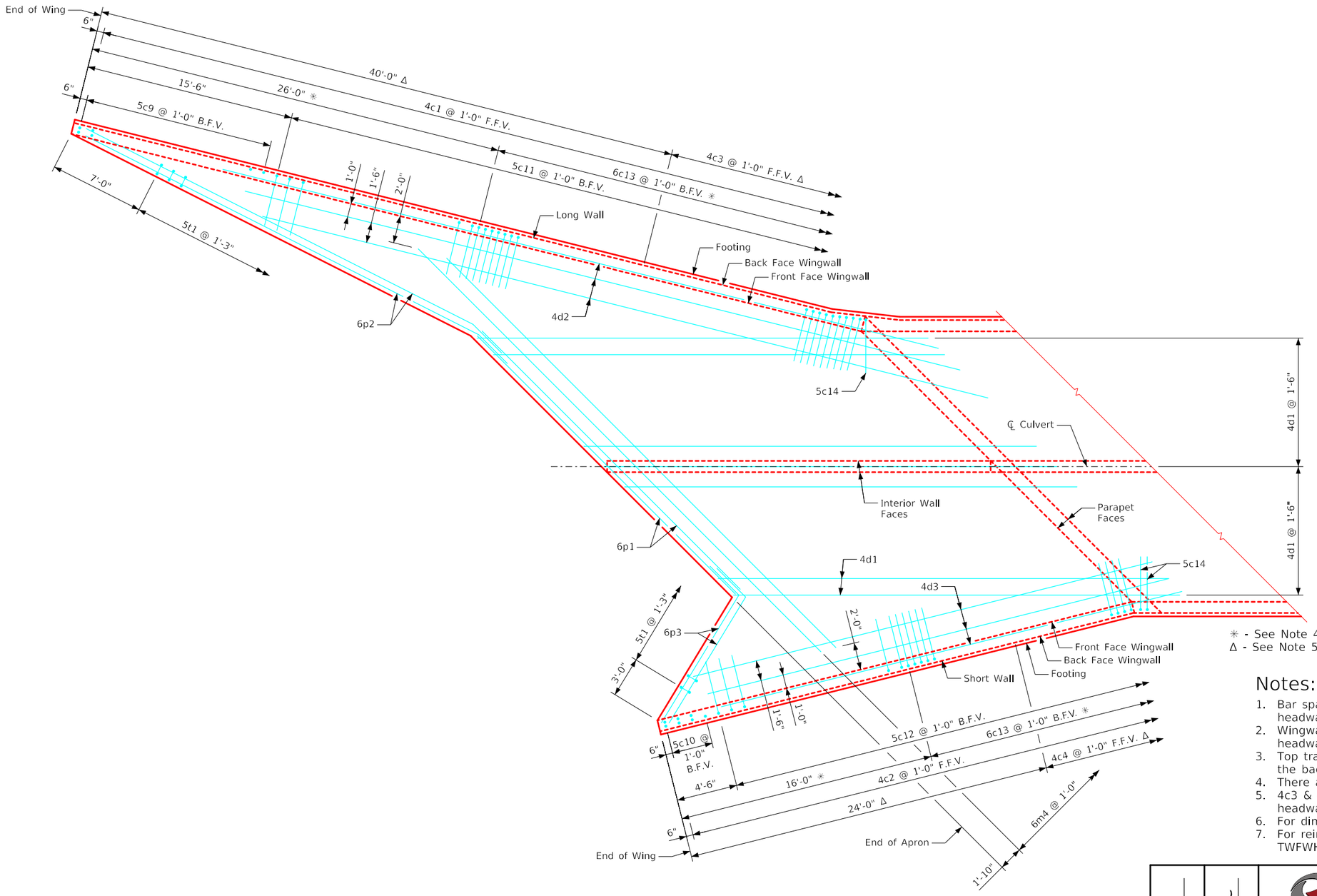
Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Top Apron Detail
45° Skew

TWFWH
45-3-21



✳ - See Note 4
Δ - See Note 5

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 6c13 bars in the 4' & 5' height headwalls.
5. 4c3 & 4c4 bars used only in the 9', 10', 11' & 12' height headwalls.
6. For dimension table see Sheet TWFWH 45-2-21.
7. For reinforcing in curtain wall see Curtain Wall Details on Sheet TWFWH 45-5-21.

Plan View - Bottom of Apron Reinforcing

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Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Bottom Apron Detail 45° Skew	TWFWH 45-4-21

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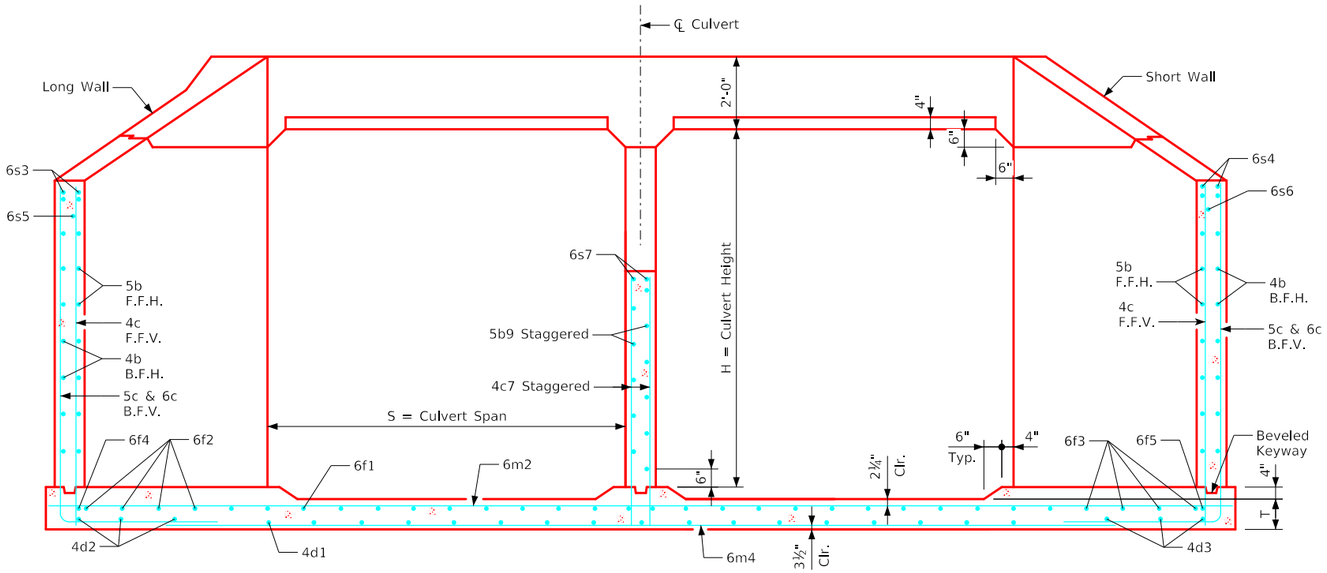
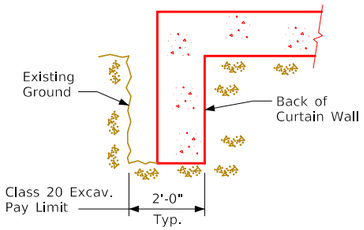
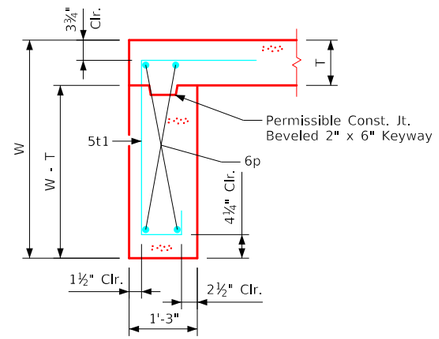


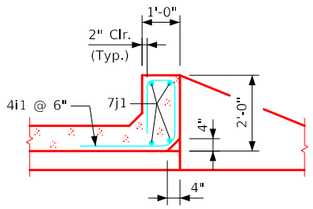
Typical Section - Near Center of Apron



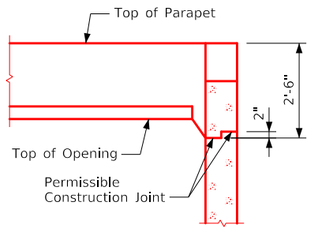
Curtain Wall
Class 20 Excavation

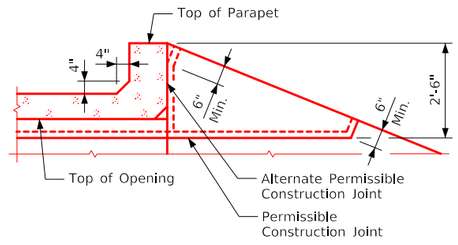


Section thru Curtain Wall



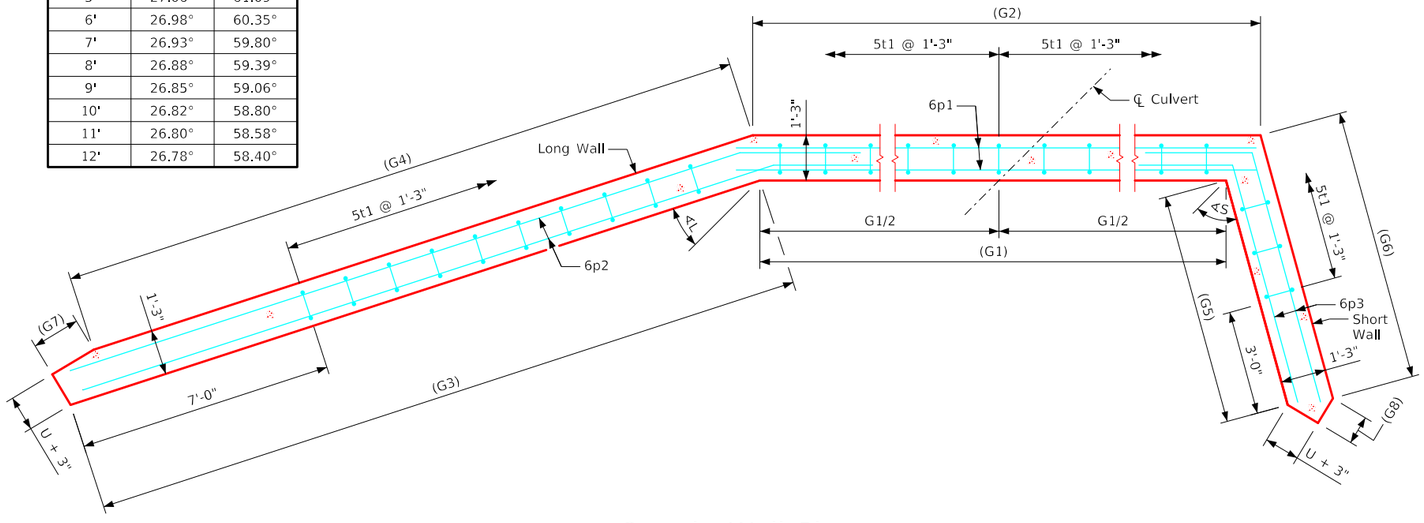
Section thru Parapet





Top of Wingwall Details

Culvert Height (H)	Angle	
	∢L	∢S
4'	27.17°	62.16°
5'	27.06°	61.09°
6'	26.98°	60.35°
7'	26.93°	59.80°
8'	26.88°	59.39°
9'	26.85°	59.06°
10'	26.82°	58.80°
11'	26.80°	58.58°
12'	26.78°	58.40°



Curtain Wall Plan

Note: ∢L & ∢S are measured from a line parallel to ℄ Culvert.

Notes:

1. See Sheet TWFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. For dimension table see Sheet TWFWH 45-2-21.

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWADOT Highway Administration

Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Parapet & Curtain Wall Details 45° Skew

TWFWH 45-5-21

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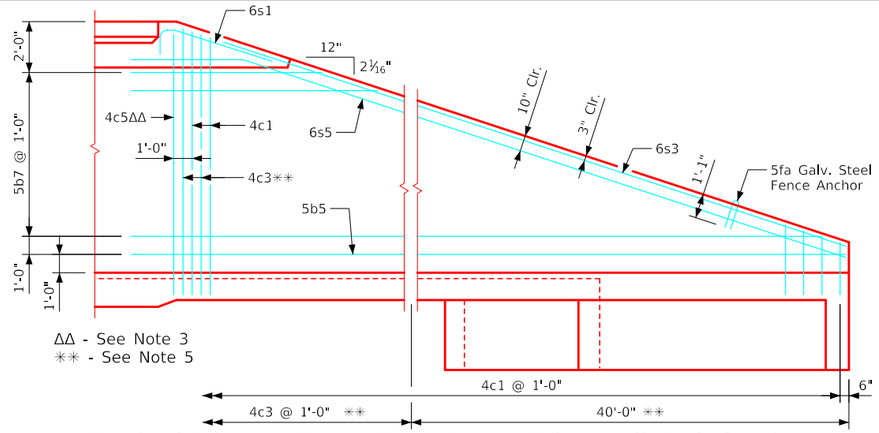
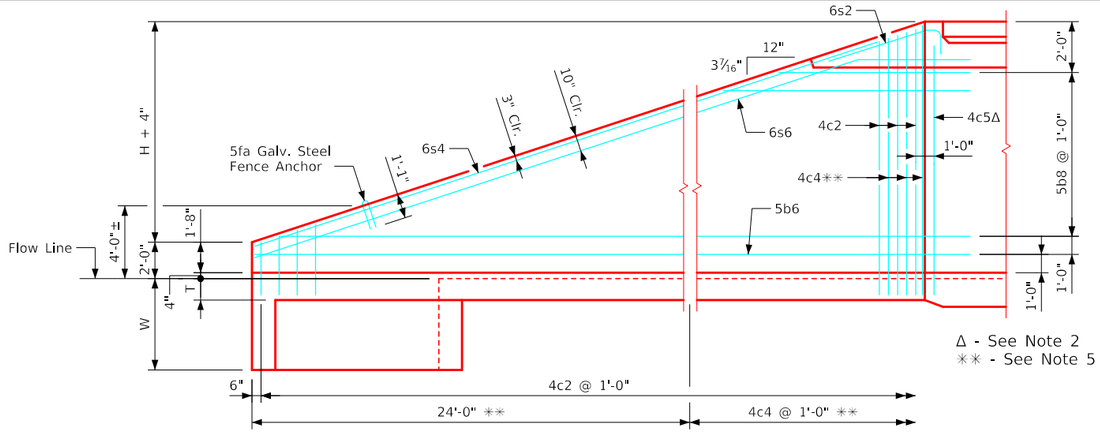
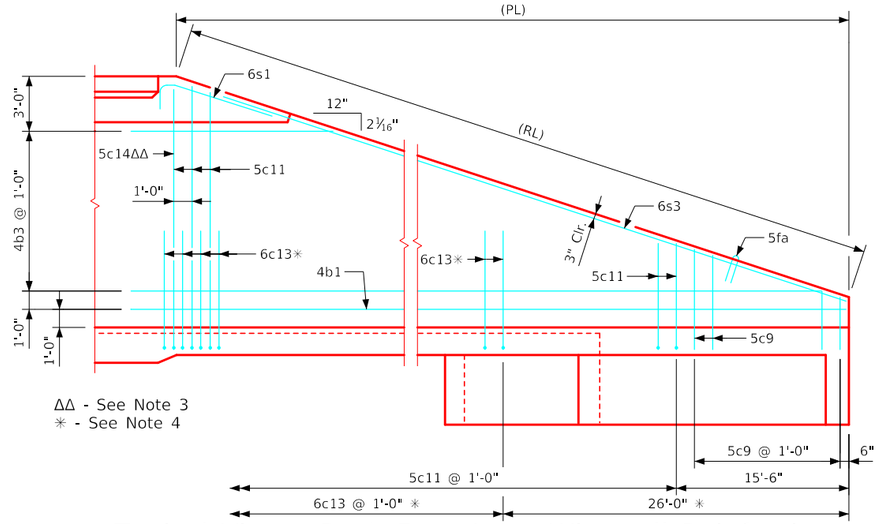


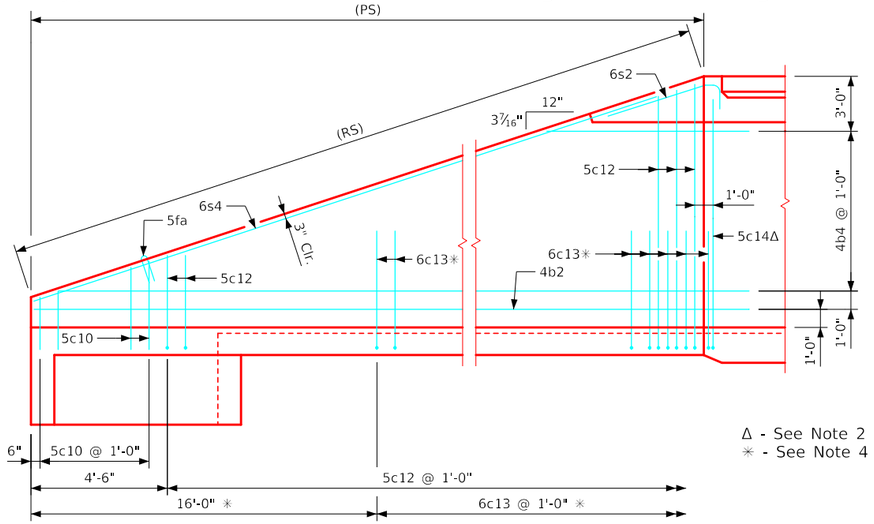
Typical View - Front Face Long Wingwall Reinforcing



Typical View - Front Face Short Wingwall Reinforcing

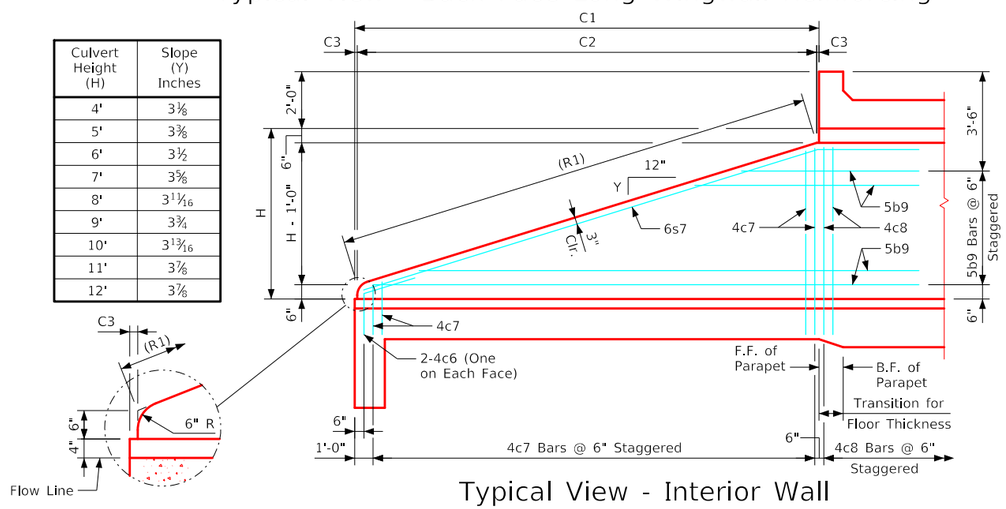


Typical View - Back Face Long Wingwall Reinforcing



Typical View - Back Face Short Wingwall Reinforcing

Culvert Height (H)	Slope (Y) Inches
4'	3⅜
5'	3⅜
6'	3½
7'	3⅝
8'	3 11/16
9'	3¾
10'	3 13/16
11'	3⅞
12'	3⅞



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 TWFWH 45-2-21.
7. Top of wall slope may be rounded in some instances.

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWADOT Highway Administration

Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Wingwall Details 45° Skew

TWFWH 45-6-21

ENGLISHLRFDSIGNEDTWINCULVERTSFWH.DGN - TWFWH 45-6-21 - THIS SHEET ISSUED 02-2021.

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

Bar	Location	Shape	12' x 12' No.	12' x 12' Length	12' x 12' Wt.	12' x 11' No.	12' x 11' Length	12' x 11' Wt.	12' x 10' No.	12' x 10' Length	12' x 10' Wt.	12' x 9' No.	12' x 9' Length	12' x 9' Wt.	12' x 8' No.	12' x 8' Length	12' x 8' Wt.	Bar
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.		21 Var.	6'-11 to 37'-9	489	19 Var.	6'-11 to 34'-11	415	17 Var.	6'-11 to 32'-2	346	15 Var.	6'-11 to 29'-4	284	13 Var.	7'-0 to 26'-6	227	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.		2	4'-1	5	2	4'-1	5	2	4'-1	5	2	4'-1	5	2	4'-1	5	4c6
4c7	Interior Wall, Both F.V.		66 Var.	1'-10 to 12'-5	314	61 Var.	1'-10 to 11'-6	272	55 Var.	1'-10 to 10'-5	225	50 Var.	1'-10 to 9'-6	189	44 Var.	1'-10 to 8'-6	152	4c7
4c8	Interior Wall, Both F.V.		3	12'-7	25	3	11'-7	23	3	10'-7	21	3	9'-7	19	3	8'-7	17	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.		17	38'-6	437	17	35'-8	405	17	32'-10	373	17	30'-0	341	17	27'-2	309	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		24	38'-6	1388	24	35'-8	1286	24	32'-10	1184	24	30'-0	1081	24	27'-2	979	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		51	6'-8	227	49	6'-8	218	49	6'-8	218	49	6'-8	218	49	6'-8	218	4i1
7j1	Parapet, Horizontal		4	37'-8	308	4	37'-4	305	4	37'-0	303	4	37'-0	303	4	37'-0	303	7j1
6m1	Apron, Trans., Top		19 Var.	30'-0 to 33'-5	905	18 Var.	29'-9 to 32'-11	847	18 Var.	29'-6 to 32'-8	840	18 Var.	29'-6 to 32'-8	840	17 Var.	29'-6 to 32'-6	792	6m1
6m2	Apron, Trans., Top		13 Var.	33'-9 to 38'-3	703	10 Var.	33'-2 to 36'-6	523	7 Var.	32'-11 to 35'-2	358	3 Var.	32'-11 to 33'-8	150	1 Var.	24'-11 to 24'-11	37	6m2
6m3	Apron, Trans., Top		33 Var.	9'-11 to 27'-11	938	33 Var.	9'-3 to 27'-3	905	32 Var.	8'-6 to 25'-11	827	32 Var.	7'-11 to 25'-5	801	31 Var.	7'-4 to 24'-3	735	6m3
6m4	Apron, Trans., Bott.		24 Var.	28'-11 to 53'-5	1531	22 Var.	28'-10 to 51'-2	1362	20 Var.	28'-8 to 48'-11	1198	18 Var.	28'-8 to 46'-10	1046	16 Var.	28'-8 to 44'-8	899	6m4
6p1	Curtain, Horizontal		4	35'-4	212	4	35'-2	211	4	35'-1	211	4	35'-1	211	4	35'-1	211	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.		2	39'-1	117	2	36'-2	109	2	33'-3	100	2	30'-3	91	2	27'-3	82	6s7
5t1	Curtain, Vertical		61	7'-11	504	58	7'-8	464	55	7'-5	425	52	7'-2	389	48	6'-11	346	5t1
	Reinf. Steel			15,699 LB			13,973 LB			12,336 LB			10,793 LB			9217 LB		
	Estimated Quantities One Headwall — Concrete	Parapet Δ	4.0	138.1 CY		3.9	118.5 CY		3.8	100.8 CY		3.8	87.8 CY		3.8	75.6 CY		
		Wingwalls	42.1			33.1			25.4			21.1			17.2			
		Apron ✳	92.0			81.5			71.6			62.9			54.6			

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.

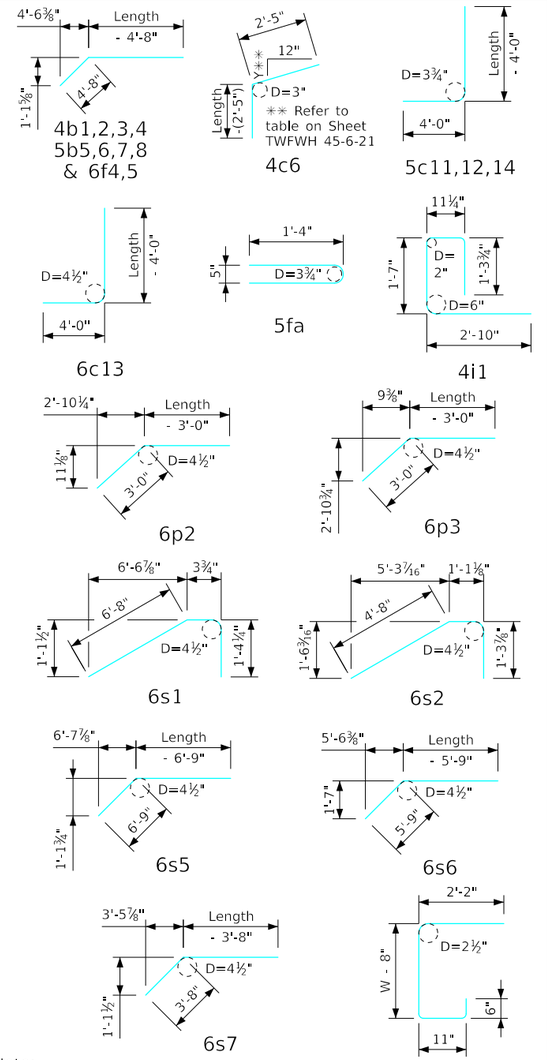
Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap.
Lengths shown for bars over 40'-0" long do not include lap.

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

Headwall Notes:

1. See Sheet TWFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. This headwall is based on a 3:1 slope normal to centerline of roadway.
3. The sides of the apron are to be formed to ensure correct line and grade.
4. 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.
5. 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.
6. Concrete quantities are estimated from back of parapet.
7. 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.
8. Dimensions are in feet and inches unless otherwise noted.

Bent Bar Details



Note:
All dimensions are out to out. D = pin diameter. 5t1

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWADOT Highway Administration

Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
12'-0" Span
45° Skew

TWFWH
45-7-21
Sheet 1 of 2

ENGLISHLRFDSIGNEDTWINCULVERTSFWH.DGN - TWFWH 45-7-21 S1 - THIS SHEET ISSUED 02-2021.

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

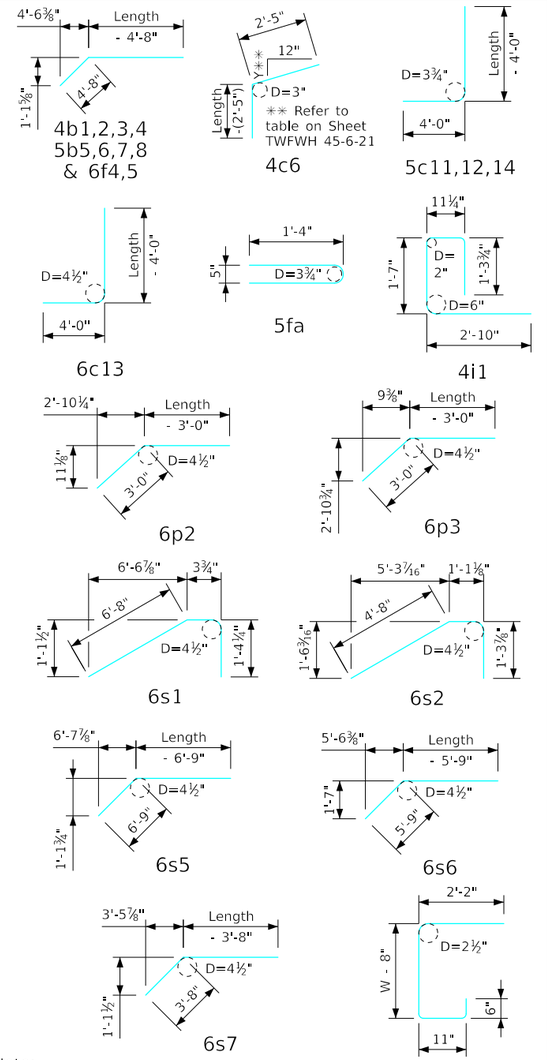
Bar	Location	Shape	12' x 7'			12' x 6'			12' x 5'			12' x 4'			Bar
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	5fa
4b1	Wingwall, B.F.H. Long		1	47'-2	33	1	41'-4	29	1	35'-6	24	1	29'-8	20	4b1
4b2	Wingwall, B.F.H. Short		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.		11 Var.	7'-0 to 23'-8	176	9 Var.	7'-1 to 20'-10	131	7 Var.	7'-3 to 18'-0	92	5 Var.	7'-5 to 15'-1	59	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.		2	4'-1	5	2	4'-1	5	2	4'-1	5	2	4'-1	5	4c6
4c7	Interior Wall, Both F.V.		38 Var.	1'-10 to 7'-5	117	33 Var.	1'-10 to 6'-6	92	27 Var.	1'-10 to 5'-5	65	22 Var.	1'-10 to 4'-6	47	4c7
4c8	Interior Wall, Both F.V.		3	7'-7	15	3	6'-7	13	3	5'-7	11	3	4'-7	9	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.		17	24'-5	277	17	21'-7	245	17	18'-9	213	17	15'-11	181	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		24	24'-5	880	24	21'-7	778	24	18'-9	676	24	15'-11	574	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		49	6'-8	218	49	6'-8	218	49	6'-8	218	49	6'-8	218	4i1
7j1	Parapet, Horizontal		4	36'-7	299	4	36'-7	299	4	36'-7	299	4	36'-7	299	7j1
6m1	Apron, Trans., Top		13 Var.	29'-3 to 31'-6	593	10 Var.	29'-3 to 30'-11	452	6 Var.	29'-3 to 30'-2	268	2 Var.	29'-3 to 29'-5	88	6m1
6m2	Apron, Trans., Top		5 Var.	22'-0 to 25'-0	176	8 Var.	19'-2 to 24'-5	262	12 Var.	16'-4 to 24'-7	369	16 Var.	13'-6 to 24'-9	460	6m2
6m3	Apron, Trans., Top		28 Var.	6'-1 to 21'-3	575	24 Var.	5'-6 to 18'-6	433	20 Var.	4'-11 to 15'-8	309	16 Var.	4'-4 to 12'-10	206	6m3
6m4	Apron, Trans., Bott.		14 Var.	28'-7 to 42'-5	757	12 Var.	28'-7 to 40'-4	625	10 Var.	28'-7 to 38'-2	501	8 Var.	28'-7 to 36'-0	388	6m4
6p1	Curtain, Horizontal		4	34'-11	210	4	34'-11	210	4	34'-11	210	4	34'-11	210	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.		2	24'-4	73	2	21'-4	64	2	18'-4	55	2	15'-4	46	6s7
5t1	Curtain, Vertical		45	6'-8	313	41	6'-5	274	39	6'-5	261	35	6'-5	234	5t1
	Estimated Quantities One Headwall	Reinf. Steel		7873 LB			6627 LB			5302 LB			4356 LB		
		Concrete Parapet Δ	3.7	62.3 CY		3.7	52.0 CY		3.7	43.3 CY		3.7	35.3 CY		
		Concrete Wingwalls	12.3			9.4			6.9			4.7			
		Concrete Apron ✳	46.3			38.9			32.7			26.9			

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

Bent Bar Details



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

Headwall Notes:

1. See Sheet TWFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. This headwall is based on a 3:1 slope normal to centerline of roadway.
3. The sides of the apron are to be formed to ensure correct line and grade.
4. 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.
5. 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.
6. Concrete quantities are estimated from back of parapet.
7. 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.
8. Dimensions are in feet and inches unless otherwise noted.

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWA DOT Highway Administration

Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
12'-0" Span
45° Skew

TWFWH
45-7-21
Sheet 2 of 2

ENGLISHLRFDSIGNEDTWINCULVERTSFWH.DGN - TWFWH 45-7-21 S2 - THIS SHEET ISSUED 02-2021.

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

Bar	Location	Shape	10' x 12' No.	10' x 12' Length	10' x 12' Wt.	10' x 11' No.	10' x 11' Length	10' x 11' Wt.	10' x 10' No.	10' x 10' Length	10' x 10' Wt.	10' x 9' No.	10' x 9' Length	10' x 9' Wt.	10' x 8' No.	10' x 8' Length	10' x 8' Wt.	Bar
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.		21 Var.	6'-11 to 37'-9	489	19 Var.	6'-11 to 34'-11	415	17 Var.	6'-11 to 32'-2	346	15 Var.	6'-11 to 29'-4	284	13 Var.	7'-0 to 26'-6	227	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.		2	4'-0	5	2	4'-0	5	2	4'-0	5	2	4'-0	5	2	4'-0	5	4c6
4c7	Interior Wall, Both F.V.		66 Var.	1'-9 to 12'-4	310	61 Var.	1'-9 to 11'-5	268	55 Var.	1'-9 to 10'-4	222	50 Var.	1'-9 to 9'-5	186	44 Var.	1'-9 to 8'-5	149	4c7
4c8	Interior Wall, Both F.V.		3	12'-6	25	3	11'-6	23	3	10'-6	21	3	9'-6	19	3	8'-6	17	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.		15	38'-6	386	13	35'-8	310	13	32'-10	285	13	30'-0	261	13	27'-2	236	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		20	38'-6	1157	20	35'-8	1071	20	32'-10	986	20	30'-0	901	20	27'-2	816	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		43	6'-8	191	41	6'-8	183	41	6'-8	183	41	6'-8	183	41	6'-8	183	4i1
7j1	Parapet, Horizontal		4	32'-0	262	4	31'-8	259	4	31'-4	256	4	31'-4	256	4	31'-4	256	7j1
6m1	Apron, Trans., Top		16 Var.	25'-6 to 28'-4	647	16 Var.	25'-3 to 28'-1	641	16 Var.	25'-0 to 27'-10	635	16 Var.	25'-0 to 27'-10	635	16 Var.	25'-0 to 27'-10	635	6m1
6m2	Apron, Trans., Top		19 Var.	28'-8 to 35'-5	914	15 Var.	28'-5 to 33'-8	699	11 Var.	28'-2 to 31'-11	496	7 Var.	28'-2 to 30'-5	308	4 Var.	28'-2 to 29'-3	172	6m2
6m3	Apron, Trans., Top		27 Var.	10'-1 to 24'-9	706	27 Var.	9'-5 to 24'-0	678	27 Var.	8'-8 to 23'-4	649	28 Var.	7'-7 to 22'-9	638	27 Var.	7'-0 to 21'-7	580	6m3
6m4	Apron, Trans., Bott.		24 Var.	23'-3 to 47'-10	1310	22 Var.	23'-2 to 45'-6	1156	20 Var.	23'-0 to 43'-4	1011	18 Var.	23'-0 to 41'-2	875	16 Var.	23'-0 to 39'-0	745	6m4
6p1	Curtain, Horizontal		4	29'-8	178	4	29'-6	177	4	29'-5	177	4	29'-5	177	4	29'-5	177	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.		2	39'-1	117	2	36'-2	109	2	33'-3	100	2	30'-3	91	2	27'-3	82	6s7
5t1	Curtain, Vertical		57	7'-11	471	54	7'-8	432	51	7'-5	395	48	7'-2	359	44	6'-11	317	5t1
	Estimated Quantities One Headwall	Reinf. Steel		14,742 LB			13,030 LB			11,454 LB			9989 LB			8490 LB		
		Concrete Parapet Δ	3.6	126.4 CY		3.5	107.8 CY		3.4	91.2 CY		3.4	79.1 CY		3.4	67.8 CY		
		Concrete Wingwalls	42.1			33.1			25.4			21.1			17.2			
		Concrete Apron ✳	80.7			71.2			62.4			54.6			47.2			

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.

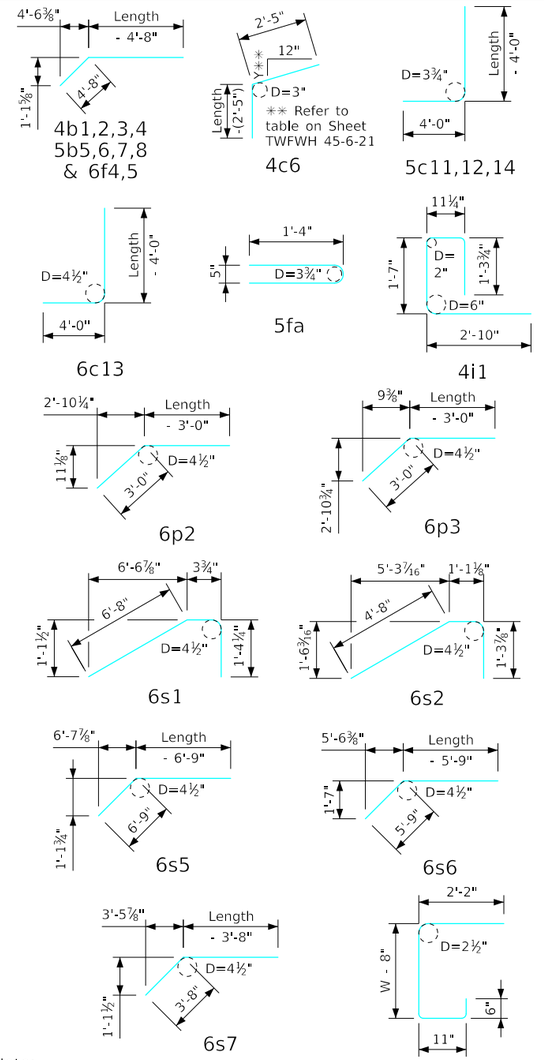
Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

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

Headwall Notes:

1. See Sheet TWFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. This headwall is based on a 3:1 slope normal to centerline of roadway.
3. The sides of the apron are to be formed to ensure correct line and grade.
4. 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.
5. 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.
6. Concrete quantities are estimated from back of parapet.
7. 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.
8. Dimensions are in feet and inches unless otherwise noted.

Bent Bar Details



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

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWADOT Highway Administration

Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
10'-0" Span
45° Skew

TWFWH
45-8-21
Sheet 1 of 2

ENGLISHLRFDSIGNEDTWINCULVERTSFWH.DGN - TWFWH 45-8-21 S1 - THIS SHEET ISSUED 02-2021.

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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.		11 Var.	7'-0 to 23'-8	176	9 Var.	7'-1 to 20'-10	131	7 Var.	7'-3 to 18'-0	92	5 Var.	7'-5 to 15'-1	59	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.		2	4'-0	5	2	4'-0	5	2	4'-0	5	2	4'-0	5	4c6
4c7	Interior Wall, Both F.V.		38 Var.	1'-9 to 7'-4	115	33 Var.	1'-9 to 6'-5	90	27 Var.	1'-9 to 5'-4	64	22 Var.	1'-9 to 4'-5	45	4c7
4c8	Interior Wall, Both F.V.		3	7'-6	15	3	6'-6	13	3	5'-6	11	3	4'-6	9	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.		13	24'-5	212	13	21'-7	187	13	18'-9	163	13	15'-11	138	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		20	24'-5	733	20	21'-7	648	20	18'-9	563	20	15'-11	478	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		41	6'-8	183	41	6'-8	183	41	6'-8	183	41	6'-8	183	4i1
7j1	Parapet, Horizontal		4	30'-11	253	4	30'-11	253	4	30'-11	253	4	30'-11	253	7j1
6m1	Apron, Trans., Top		15 Var.	24'-9 to 27'-4	587	12 Var.	24'-9 to 26'-9	464	8 Var.	24'-9 to 26'-0	305	5 Var.	24'-9 to 25'-6	189	6m1
6m2	Apron, Trans., Top		1 Var.	27'-6 to 27'-6	41	4 Var.	18'-8 to 20'-11	119	7 Var.	16'-7 to 21'-1	198	11 Var.	13'-0 to 20'-6	277	6m2
6m3	Apron, Trans., Top		27 Var.	6'-3 to 20'-11	551	23 Var.	5'-9 to 18'-1	412	20 Var.	5'-2 to 15'-10	315	16 Var.	4'-0 to 12'-5	197	6m3
6m4	Apron, Trans., Bott.		14 Var.	22'-11 to 36'-9	627	12 Var.	22'-11 to 34'-8	519	10 Var.	22'-11 to 32'-6	416	8 Var.	22'-11 to 30'-4	320	6m4
6p1	Curtain, Horizontal		4	29'-3	176	4	29'-3	176	4	29'-3	176	4	29'-3	176	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.		2	24'-4	73	2	21'-4	64	2	18'-4	55	2	15'-4	46	6s7
5t1	Curtain, Vertical		41	6'-8	285	37	6'-5	248	35	6'-5	234	31	6'-5	207	5t1
	Estimated Quantities One Headwall	Reinf. Steel		7211 LB			6028 LB			4776 LB			3908 LB		
		Concrete Parapet Δ	3.3	55.4 CY		3.3	46.1 CY		3.3	38.2 CY		3.3	30.9 CY		
		Concrete Wingwalls	12.3			9.4			6.9			4.7			
		Concrete Apron ✳	39.8			33.4			28.0			22.9			

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.

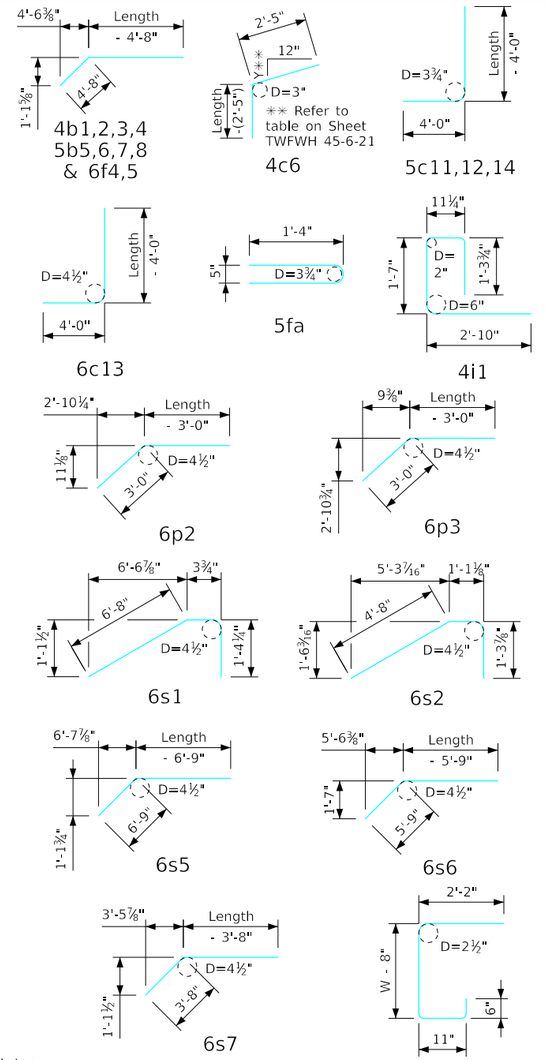
Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

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

Headwall Notes:

1. See Sheet TWFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. This headwall is based on a 3:1 slope normal to centerline of roadway.
3. The sides of the apron are to be formed to ensure correct line and grade.
4. 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.
5. 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.
6. Concrete quantities are estimated from back of parapet.
7. 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.
8. Dimensions are in feet and inches unless otherwise noted.

Bent Bar Details



Note:
All dimensions are out to out. D = pin diameter. 5t1

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWADOT Highway Administration

Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
10'-0" Span
45° Skew

TWFWH
45-8-21
Sheet 2 of 2

ENGLISHLRFDSIGNEDTWINCULVERTSFWH.DGN - TWFWH 45-8-21 S2 - THIS SHEET ISSUED 02-2021.

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

Bar	Location	Shape	8' x 10'			8' x 9'			8' x 8'			8' x 7'			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	64'-8	45	1	58'-10	41	1	53'-0	37	1	47'-2	33	4b1
4b2	Wingwall, B.F.H. Short		1	40'-7	29	1	37'-1	25	1	33'-7	22	1	30'-1	20	4b2
4b3	Wingwall, B.F.H. Long		8 Var.	21'-2 to 61'-11	228	7 Var.	21'-2 to 56'-1	185	6 Var.	21'-2 to 50'-3	146	5 Var.	21'-2 to 44'-5	111	4b3
4b4	Wingwall, B.F.H. Short		8 Var.	14'-6 to 38'-11	143	7 Var.	14'-6 to 35'-5	117	6 Var.	14'-6 to 31'-11	93	5 Var.	14'-6 to 28'-5	72	4b4
5b5	Wingwall, F.F.H. Long		1	64'-8	70	1	58'-10	64	1	53'-0	58	1	47'-2	52	5b5
5b6	Wingwall, F.F.H. Short		1	40'-7	45	1	37'-1	39	1	33'-7	35	1	30'-1	31	5b6
5b7	Wingwall, F.F.H. Long		9 Var.	15'-5 to 61'-11	373	8 Var.	15'-5 to 56'-1	306	7 Var.	15'-4 to 50'-3	244	6 Var.	15'-4 to 44'-5	189	5b7
5b8	Wingwall, F.F.H. Short		9 Var.	11'-1 to 39'-0	235	8 Var.	11'-1 to 35'-6	194	7 Var.	11'-1 to 32'-0	157	6 Var.	11'-0 to 28'-6	124	5b8
5b9	Interior Wall, Both F.H.		17 Var.	6'-11 to 32'-2	346	15 Var.	6'-11 to 29'-4	284	13 Var.	7'-0 to 26'-6	227	11 Var.	7'-0 to 23'-8	176	5b9
4c1	Wingwall, F.F.V. Long		60 Var.	2'-7 to 12'-9	307	54 Var.	2'-7 to 11'-9	259	49 Var.	2'-7 to 10'-10	220	43 Var.	2'-7 to 9'-10	178	4c1
4c2	Wingwall, F.F.V. Short		36 Var.	2'-8 to 12'-8	184	33 Var.	2'-8 to 11'-10	160	29 Var.	2'-8 to 10'-8	129	26 Var.	2'-8 to 9'-10	109	4c2
4c3	Wingwall, F.F.V. Long		21 Var.	9'-5 to 12'-10	156	15 Var.	9'-5 to 11'-10	106	--	--	--	--	--	--	4c3
4c4	Wingwall, F.F.V. Short		13 Var.	9'-5 to 12'-10	97	10 Var.	9'-5 to 11'-11	71	--	--	--	--	--	--	4c4
4c5	Wingwall, F.F.V. Long		2	11'-7	15	2	10'-7	14	1	9'-7	6	1	8'-7	6	4c5
4c5	Wingwall, F.F.V. Short		2	11'-7	15	1	10'-7	7	2	9'-7	13	1	8'-7	6	4c5
4c6	Interior Wall, Both F.V.		2	3'-11	5	2	3'-11	5	2	3'-11	5	2	3'-11	5	4c6
4c7	Interior Wall, Both F.V.		55 Var.	1'-8 to 10'-3	219	50 Var.	1'-8 to 9'-4	184	44 Var.	1'-8 to 8'-4	147	38 Var.	1'-8 to 7'-3	113	4c7
4c8	Interior Wall, Both F.V.		3	10'-5	21	3	9'-5	19	3	8'-5	17	3	7'-5	15	4c8
5c9	Wingwall, B.F.V. Long		15 Var.	2'-7 to 5'-0	59	15 Var.	2'-7 to 5'-0	59	15 Var.	2'-7 to 5'-0	59	15 Var.	2'-7 to 5'-0	59	5c9
5c10	Wingwall, B.F.V. Short		4 Var.	2'-8 to 3'-6	13	4 Var.	2'-8 to 3'-6	13	4 Var.	2'-8 to 3'-6	13	4 Var.	2'-8 to 3'-6	13	5c10
5c11	Wingwall, B.F.V. Long		45 Var.	9'-2 to 16'-9	608	39 Var.	9'-2 to 15'-9	507	34 Var.	9'-2 to 14'-10	426	28 Var.	9'-2 to 13'-10	336	5c11
5c12	Wingwall, B.F.V. Short		32 Var.	7'-10 to 16'-8	409	29 Var.	7'-10 to 15'-10	358	25 Var.	7'-10 to 14'-8	293	22 Var.	7'-10 to 13'-10	249	5c12
6c13	Wingwall, B.F.V. Long		35	10'-6	552	29	10'-6	457	24	10'-6	379	18	10'-6	284	6c13
6c13	Wingwall, B.F.V. Short		21	10'-6	331	18	10'-6	284	14	10'-6	221	11	10'-6	173	6c13
5c14	Wingwall, B.F.V. Long		2	15'-7	33	2	14'-7	30	1	13'-7	14	1	12'-7	13	5c14
5c14	Wingwall, B.F.V. Short		2	15'-7	33	1	14'-7	15	2	13'-7	28	1	12'-7	13	5c14
4d1	Apron, Longit., Bott.		11	32'-10	241	11	30'-0	220	11	27'-2	200	11	24'-5	179	4d1
4d2	Apron, Longit., Bott. Long		3	57'-2	119	3	51'-5	108	3	45'-7	96	3	39'-9	80	4d2
4d3	Apron, Longit., Bott. Short		3	35'-7	71	3	32'-1	64	3	28'-7	57	3	25'-1	50	4d3
6f1	Apron, Longit., Top		16	32'-10	789	16	30'-0	721	16	27'-2	653	16	24'-5	587	6f1
6f2	Apron, Longit., Top Long		12 Var.	6'-11 to 29'-2	325	11 Var.	6'-1 to 26'-4	268	9 Var.	7'-3 to 23'-6	208	8 Var.	6'-5 to 20'-8	163	6f2
6f3	Apron, Longit., Top Short		8 Var.	5'-9 to 29'-6	212	7 Var.	6'-4 to 26'-8	173	6 Var.	6'-10 to 23'-10	138	5 Var.	7'-4 to 21'-0	106	6f3
6f4	Apron, Longit., Top Long		1	64'-8	101	1	58'-10	92	1	53'-0	83	1	47'-2	74	6f4
6f5	Apron, Longit., Top Short		1	40'-7	65	1	37'-1	56	1	33'-7	50	1	30'-1	45	6f5
4i1	Parapet, Vertical		33	6'-8	147	33	6'-8	147	33	6'-8	147	33	6'-8	147	4i1
7j1	Parapet, Horizontal		4	25'-8	210	4	25'-8	210	4	25'-8	210	4	25'-4	207	7j1
6m1	Apron, Trans., Top		13 Var.	20'-6 to 22'-9	422	13 Var.	20'-6 to 22'-9	422	13 Var.	20'-6 to 22'-9	422	13 Var.	20'-3 to 22'-6	417	6m1
6m2	Apron, Trans., Top		17 Var.	23'-0 to 29'-0	664	13 Var.	23'-0 to 27'-6	493	9 Var.	23'-0 to 26'-0	331	6 Var.	22'-9 to 24'-8	214	6m2
6m3	Apron, Trans., Top		22 Var.	8'-4 to 20'-2	471	22 Var.	7'-9 to 19'-7	452	22 Var.	7'-2 to 19'-0	432	21 Var.	6'-6 to 17'-9	382	6m3
6m4	Apron, Trans., Bott.		20 Var.	17'-4 to 37'-8	826	18 Var.	17'-4 to 35'-6	714	16 Var.	17'-4 to 33'-4	609	14 Var.	17'-3 to 31'-1	508	6m4
6p1	Curtain, Horizontal		4	23'-9	143	4	23'-9	143	4	23'-9	143	4	23'-7	142	6p1
6p2	Curtain, Horizontal, Long		4	36'-0	216	4	32'-10	197	4	29'-8	178	4	26'-6	159	6p2
6p3	Curtain, Horizontal, Short		4	13'-7	82	4	12'-7	76	4	11'-7	70	4	10'-7	64	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	56'-9	178	2	50'-10	160	2	44'-11	142	2	39'-0	117	6s3
6s4	Wing Slope, Both F., Short		2	34'-5	103	2	30'-9	92	2	27'-1	81	2	23'-6	71	6s4
6s5	Wing Slope, F.F. Long		1	62'-10	98	1	56'-11	89	1	51'-0	80	1	45'-1	71	6s5
6s6	Wing Slope, F.F. Short		1	40'-4	64	1	36'-9	55	1	33'-1	50	1	29'-5	44	6s6
6s7	Interior Wall, Both F.H.		2	33'-3	100	2	30'-3	91	2	27'-3	82	2	24'-4	73	6s7
5t1	Curtain, Vertical		47	7'-5	364	44	7'-2	329	40	6'-11	289	37	6'-8	257	5t1
	Estimated Quantities One Headwall	Reinf. Steel		10,637 LB			9230 LB			7795 LB			6592 LB		
		Concrete Parapet Δ	3.0	82.2 CY		3.0	71.0 CY		3.0	60.6 CY		2.8	49.0 CY		
		Concrete Wingwalls	25.4			21.1			17.2			12.3			
		Concrete Apron ✳	53.8			46.9			40.4			33.9			

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.

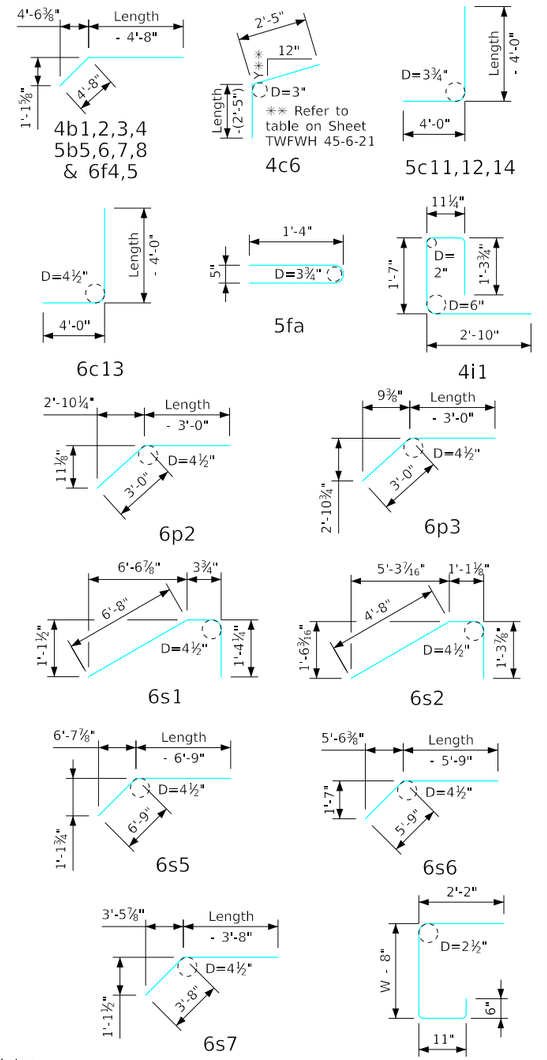
Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

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

Headwall Notes:

1. See Sheet TWFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. This headwall is based on a 3:1 slope normal to centerline of roadway.
3. The sides of the apron are to be formed to ensure correct line and grade.
4. 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.
5. 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.
6. Concrete quantities are estimated from back of parapet.
7. 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.
8. Dimensions are in feet and inches unless otherwise noted.

Bent Bar Details



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

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWA DOT Highway Administration

Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
8'-0" Span
45° Skew

TWFWH
45-9-21
Sheet 1 of 2

ENGLISHLRFDSIGNEDTWINCULVERTSFWH.DGN - TWFWH 45-9-21 S1 - THIS SHEET ISSUED 02-2021.

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

Bar	Location	Shape	8' x 6' No.	8' x 6' Length	8' x 6' Wt.	8' x 5' No.	8' x 5' Length	8' x 5' Wt.	8' x 4' No.	8' x 4' Length	8' x 4' Wt.	Bar
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	5fa
4b1	Wingwall, B.F.H. Long		1	41'-4	29	1	35'-6	24	1	29'-8	20	4b1
4b2	Wingwall, B.F.H. Short		1	26'-7	18	1	23'-1	15	1	19'-7	13	4b2
4b3	Wingwall, B.F.H. Long		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		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	41'-4	46	1	35'-6	37	1	29'-9	31	5b5
5b6	Wingwall, F.F.H. Short		1	26'-7	28	1	23'-1	24	1	19'-7	20	5b6
5b7	Wingwall, F.F.H. Long		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		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.		9 Var.	7'-1 to 20'-10	131	7 Var.	7'-3 to 18'-0	92	5 Var.	7'-5 to 15'-1	59	5b9
4c1	Wingwall, F.F.V. Long		37 Var.	2'-7 to 8'-10	141	31 Var.	2'-7 to 7'-9	107	25 Var.	2'-7 to 6'-9	78	4c1
4c2	Wingwall, F.F.V. Short		22 Var.	2'-8 to 8'-8	83	19 Var.	2'-8 to 7'-10	67	15 Var.	2'-8 to 6'-8	47	4c2
4c3	Wingwall, F.F.V. Long		--	--	--	--	--	--	--	--	--	4c3
4c4	Wingwall, F.F.V. Short		--	--	--	--	--	--	--	--	--	4c4
4c5	Wingwall, F.F.V. Long		1	7'-7	5	2	6'-7	9	2	5'-7	7	4c5
4c5	Wingwall, F.F.V. Short		2	7'-7	10	1	6'-7	4	2	5'-7	7	4c5
4c6	Interior Wall, Both F.V.		2	3'-11	5	2	3'-11	5	2	3'-11	5	4c6
4c7	Interior Wall, Both F.V.		33 Var.	1'-8 to 6'-4	88	27 Var.	1'-8 to 5'-3	62	22 Var.	1'-8 to 4'-4	44	4c7
4c8	Interior Wall, Both F.V.		3	6'-5	13	3	5'-5	11	3	4'-5	9	4c8
5c9	Wingwall, B.F.V. Long		15 Var.	2'-7 to 5'-0	59	15 Var.	2'-7 to 5'-0	59	15 Var.	2'-7 to 5'-0	59	5c9
5c10	Wingwall, B.F.V. Short		4 Var.	2'-8 to 3'-6	13	4 Var.	2'-8 to 3'-6	13	4 Var.	2'-8 to 3'-6	13	5c10
5c11	Wingwall, B.F.V. Long		22 Var.	9'-2 to 12'-10	252	16 Var.	9'-2 to 11'-9	175	10 Var.	9'-2 to 10'-9	104	5c11
5c12	Wingwall, B.F.V. Short		18 Var.	7'-10 to 12'-8	192	15 Var.	7'-10 to 11'-10	154	11 Var.	7'-10 to 10'-8	106	5c12
6c13	Wingwall, B.F.V. Long		12	10'-6	189	--	--	--	--	--	--	6c13
6c13	Wingwall, B.F.V. Short		7	10'-6	110	--	--	--	--	--	--	6c13
5c14	Wingwall, B.F.V. Long		1	11'-7	12	2	10'-7	22	2	9'-7	20	5c14
5c14	Wingwall, B.F.V. Short		2	11'-7	24	1	10'-7	11	2	9'-7	20	5c14
4d1	Apron, Longit., Bott.		11	21'-7	159	11	18'-9	138	11	15'-11	117	4d1
4d2	Apron, Longit., Bott. Long		3	33'-11	68	3	28'-1	56	3	22'-3	45	4d2
4d3	Apron, Longit., Bott. Short		3	21'-7	43	3	18'-1	36	3	14'-7	29	4d3
6f1	Apron, Longit., Top		16	21'-7	519	16	18'-9	451	16	15'-11	383	6f1
6f2	Apron, Longit., Top Long		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		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	41'-4	66	1	35'-6	53	1	29'-9	45	6f4
6f5	Apron, Longit., Top Short		1	26'-7	40	1	23'-1	35	1	19'-7	29	6f5
4i1	Parapet, Vertical		33	6'-8	147	33	6'-8	147	33	6'-8	147	4i1
7j1	Parapet, Horizontal		4	25'-4	207	4	25'-4	207	4	25'-4	207	7j1
6m1	Apron, Trans., Top		13 Var.	20'-3 to 22'-6	417	11 Var.	20'-3 to 22'-1	350	7 Var.	20'-3 to 21'-4	219	6m1
6m2	Apron, Trans., Top		2 Var.	22'-9 to 23'-2	69	2 Var.	16'-1 to 16'-10	49	6 Var.	13'-3 to 17'-0	136	6m2
6m3	Apron, Trans., Top		22 Var.	5'-4 to 17'-2	372	20 Var.	4'-9 to 15'-5	303	16 Var.	4'-2 to 12'-7	201	6m3
6m4	Apron, Trans., Bott.		12 Var.	17'-3 to 29'-0	417	10 Var.	17'-3 to 26'-10	331	8 Var.	17'-3 to 24'-9	252	6m4
6p1	Curtain, Horizontal		4	23'-7	142	4	23'-7	142	4	23'-7	142	6p1
6p2	Curtain, Horizontal, Long		4	23'-4	140	4	20'-2	121	4	17'-0	102	6p2
6p3	Curtain, Horizontal, Short		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	6s1
6s2	Wing Slope, Both F., Short		2	7'-11	24	2	7'-11	24	2	7'-11	24	6s2
6s3	Wing Slope, Both F., Long		2	33'-1	99	2	27'-2	82	2	21'-3	64	6s3
6s4	Wing Slope, Both F., Short		2	19'-10	60	2	16'-2	49	2	12'-7	38	6s4
6s5	Wing Slope, F.F. Long		1	39'-2	59	1	33'-3	50	1	27'-5	41	6s5
6s6	Wing Slope, F.F. Short		1	25'-10	39	1	22'-2	33	1	18'-6	28	6s6
6s7	Interior Wall, Both F.H.		2	21'-4	64	2	18'-4	55	2	15'-4	46	6s7
5t1	Curtain, Vertical		33	6'-5	221	31	6'-5	207	27	6'-5	181	5t1
	Estimated Quantities One Headwall	Reinf. Steel		5477 LB			4286 LB			3466 LB		
		Concrete Parapet Δ	2.8			2.8			2.8			
		Concrete Wingwalls	9.4	40.4 CY		6.9	33.3		4.7	27.6 CY		
		Concrete Apron ✳	28.2			23.6			20.1			

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.

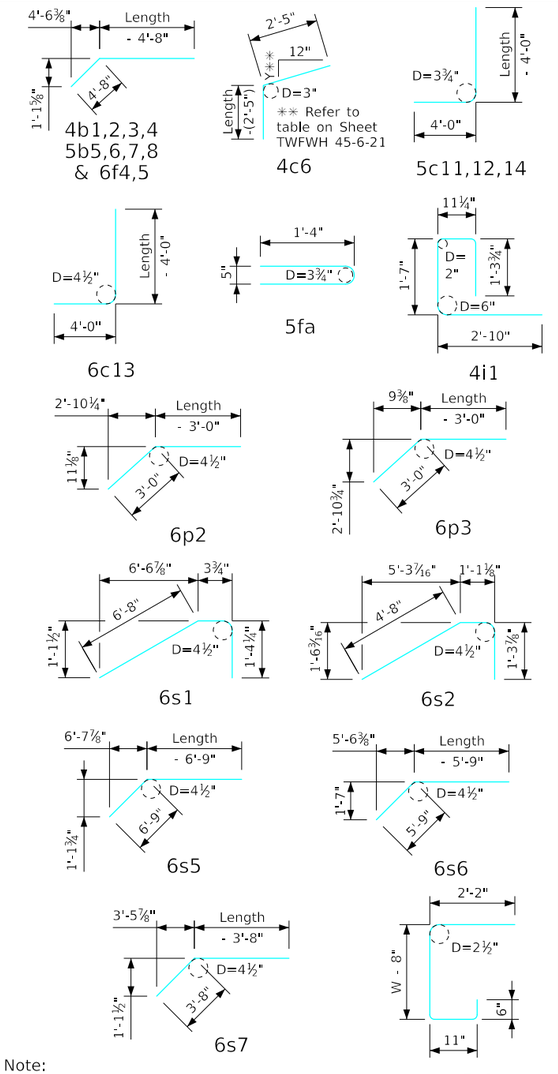
Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

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

Headwall Notes:

1. See Sheet TWFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. This headwall is based on a 3:1 slope normal to centerline of roadway.
3. The sides of the apron are to be formed to ensure correct line and grade.
4. 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.
5. 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.
6. Concrete quantities are estimated from back of parapet.
7. 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.
8. Dimensions are in feet and inches unless otherwise noted.

Bent Bar Details



Note:
All dimensions are out to out. D = pin diameter. 5t1

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWADOT Highway Administration

Standard Design - Twin Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
8'-0" Span
45° Skew

TWFWH
45-9-21
Sheet 2 of 2