IOWA DOT
Highway Division

Single Reinforced Concrete Box Culvert Standards - Flared Wing Headwalls

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LATEST REVISION DATE

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IOWA DOT

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Index of Sheets

FWH G1-21

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Single 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 Single Reinforced Concrete Box Culvert Stardards (RCB).

Specifications:

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

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

Design Stresses:

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

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Standard Design - Single Reinforced Concrete Box Culverts

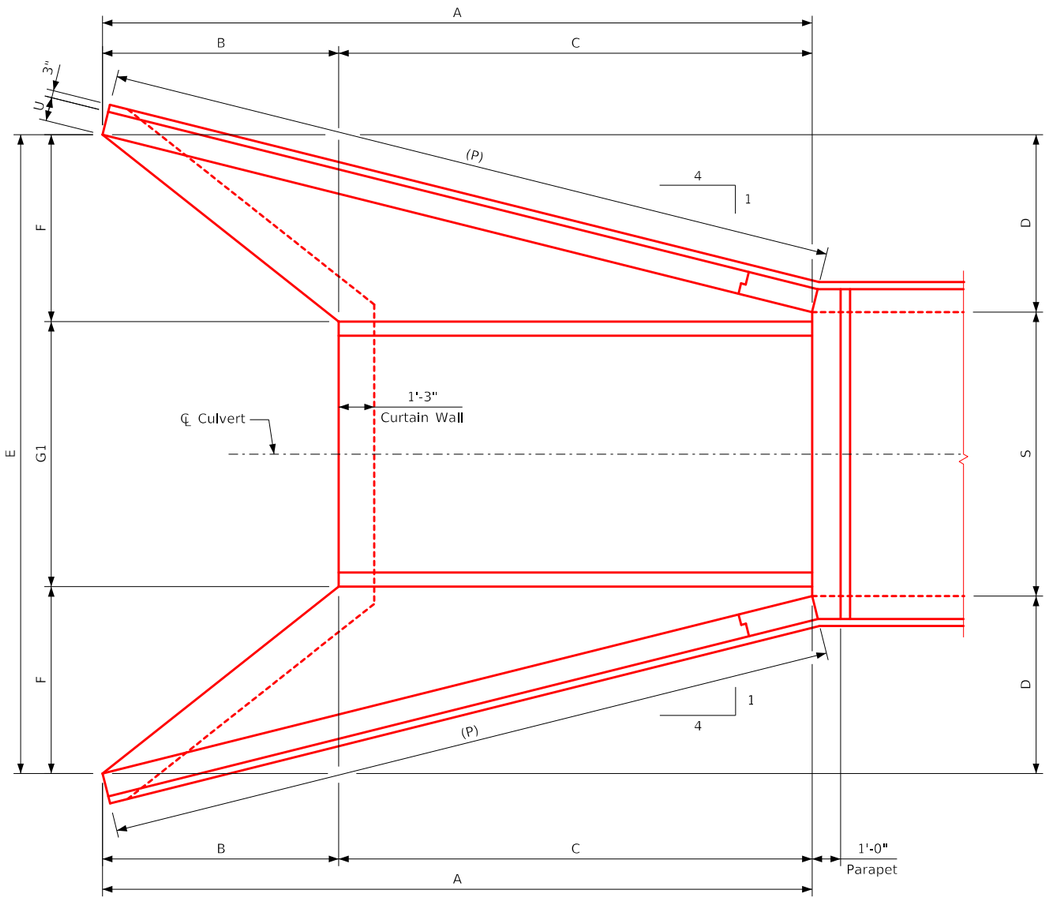
Flared Wing Headwalls

February, 2021

General Notes & Specifications

FWH G2-21

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Plan View

Notes:

1. See Sheet FWH G2-21 for General Notes, Specifications, and Design Stresses.
2. See Sheet FWH 0-2-21 for dimensions table.

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Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Dimension Plan 0° Skew

FWH 0-1-21

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Dimension Table

S x H	16' x 14'	16' x 13'	16' x 12'	16' x 11'	16' x 10'	16' x 9'	16' x 8'	16' x 7'	16' x 6'	16' x 5'	16' x 4'	14' x 14'	14' x 13'	14' x 12'	14' x 11'	14' x 10'	14' x 9'	14' x 8'	14' x 7'	14' x 6'	14' x 5'	14' x 4'	12' x 12'	12' x 11'	12' x 10'	12' x 9'	12' x 8'	12' x 7'	12' x 6'	12' x 5'	12' x 4'	S x H
A	43'-0	40'-0	37'-0	34'-0	31'-0	28'-0	25'-0	22'-0	19'-0	16'-0	13'-0	43'-0	40'-0	37'-0	34'-0	31'-0	28'-0	25'-0	22'-0	19'-0	16'-0	13'-0	37'-0	34'-0	31'-0	28'-0	25'-0	22'-0	19'-0	16'-0	13'-0	A
B	14'-4	13'-4	12'-4	11'-4	10'-4	9'-4	8'-4	7'-4	6'-4	5'-4	4'-4	14'-4	13'-4	12'-4	11'-4	10'-4	9'-4	8'-4	7'-4	6'-4	5'-4	4'-4	12'-4	11'-4	10'-4	9'-4	8'-4	7'-4	6'-4	5'-4	4'-4	B
C	28'-8	26'-8	24'-8	22'-8	20'-8	18'-8	16'-8	14'-8	12'-8	10'-8	8'-8	28'-8	26'-8	24'-8	22'-8	20'-8	18'-8	16'-8	14'-8	12'-8	10'-8	8'-8	24'-8	22'-8	20'-8	18'-8	16'-8	14'-8	12'-8	10'-8	8'-8	C
D	10'-9	10'-0	9'-3	8'-6	7'-9	7'-0	6'-3	5'-6	4'-9	4'-0	3'-3	10'-9	10'-0	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	4'-9	4'-0	3'-3	D
E	37'-6	36'-0	34'-6	33'-0	31'-6	30'-0	28'-6	27'-0	25'-6	24'-0	22'-6	35'-6	34'-0	32'-6	31'-0	29'-6	28'-0	26'-6	25'-0	23'-6	22'-0	20'-6	30'-6	29'-0	27'-6	26'-0	24'-6	23'-0	21'-6	20'-0	18'-6	E
F	11'-1	10'-4	9'-7	8'-10	8'-1	7'-4	6'-7	5'-10	5'-1	4'-4	3'-7	11'-1	10'-4	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	5'-1	4'-4	3'-7	F
G1	15'-4	15'-4	15'-4	15'-4	15'-4	15'-4	15'-4	15'-4	15'-4	15'-4	15'-4	13'-4	13'-4	13'-4	13'-4	13'-4	13'-4	13'-4	13'-4	13'-4	13'-4	13'-4	11'-4	11'-4	11'-4	11'-4	11'-4	11'-4	11'-4	11'-4	11'-4	G1
G2	16'-6¾	16'-6¾	16'-6⅜	16'-6⅜	16'-6⅜	16'-6⅜	16'-6½	16'-6½	16'-6⅜	16'-6¼	16'-6⅛	14'-6¾	14'-6¾	14'-6⅜	14'-6⅜	14'-6⅜	14'-6⅜	14'-6½	14'-6½	14'-6⅜	14'-6¼	14'-6⅛	12'-6⅜	12'-6⅜	12'-6⅜	12'-6⅜	12'-6½	12'-6½	12'-6⅜	12'-6¼	12'-6⅛	G2
G3	18'-1⅜	16'-10⅜	15'-7⅜	14'-4⅜	13'-1⅜	11'-10⅜	10'-7½	9'-4½	8'-1½	6'-10½	5'-7½	18'-1⅜	16'-10⅜	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	8'-1½	6'-10½	5'-7½	G3
G4	19'-3⅜	17'-8⅞	16'-5⅞	15'-0½	13'-7	12'-4	11'-1⅛	9'-7¾	8'-4¾	7'-1⅞	5'-11	19'-3⅜	17'-8⅞	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	8'-4¾	7'-1⅞	5'-11	G4
G5	--	3⅛	3⅛	5⅜	7⅜	7⅜	7⅜	9⅛	9¾	9¾	9⅝	--	3⅛	3⅛	5⅜	7⅜	7⅜	7⅜	9⅛	9¾	9⅝	3⅛	5⅜	7⅜	7⅜	7⅜	9⅛	9¾	9¾	9⅝	9⅝	G5
P	44'-3⅞	41'-2¾	38'-1⅝	35'-0½	31'-11½	28'-10⅜	25'-9¼	22'-8⅛	19'-7	16'-5⅞	13'-4¾	44'-3⅞	41'-2¾	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	19'-7	16'-5⅞	13'-4¾	P
R	46'-7	43'-4	40'-1	36'-10	33'-7	30'-4	27'-1	23'-10	20'-7	17'-4	14'-1	46'-7	43'-4	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	20'-7	17'-4	14'-1	R
T	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	T
U	1'-2	1'-0	1'-0	11	10	10	10	9	9	9	9	1'-2	1'-0	1'-0	11	10	10	10	9	9	9	9	1'-0	11	10	10	10	9	9	9	9	U
W	5'-6	5'-3	5'-0	4'-9	4'-6	4'-3	4'-0	3'-9	3'-6	3'-6	3'-6	5'-6	5'-3	5'-0	4'-9	4'-6	4'-3	4'-0	3'-9	3'-6	3'-6	3'-6	5'-0	4'-9	4'-6	4'-3	4'-0	3'-9	3'-6	3'-6	3'-6	W

Dimension Table

S x H	10' x 12'	10' x 11'	10' x 10'	10' x 9'	10' x 8'	10' x 7'	10' x 6'	10' x 5'	10' x 4'	8' x 10'	8' x 9'	8' x 8'	8' x 7'	8' x 6'	8' x 5'	8' x 4'	6' x 8'	6' x 7'	6' x 6'	6' x 5'	6' x 4'	6' x 3'	5' x 6'	5' x 5'	5' x 4'	5' x 3'	4' x 4'	3' x 3'	S x H
A	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	25'-0	22'-0	19'-0	16'-0	13'-0	10'-0	19'-0	16'-0	13'-0	10'-0	13'-0	10'-0	A
B	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	8'-4	7'-4	6'-4	5'-4	4'-4	3'-4	6'-4	5'-4	4'-4	3'-4	4'-4	3'-4	B
C	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	16'-8	14'-8	12'-8	10'-8	8'-8	6'-8	12'-8	10'-8	8'-8	6'-8	8'-8	6'-8	C
D	9'-3	8'-6	7'-9	7'-0	6'-3	5'-6	4'-9	4'-0	3'-3	7'-9	7'-0	6'-3	5'-6	4'-9	4'-0	3'-3	6'-3	5'-6	4'-9	4'-0	3'-3	2'-6	4'-9	4'-0	3'-3	2'-6	3'-3	2'-6	D
E	28'-6	27'-0	25'-6	24'-0	22'-6	21'-0	19'-6	18'-0	16'-6	23'-6	22'-0	20'-6	19'-0	17'-6	16'-0	14'-6	18'-6	17'-0	15'-6	14'-0	12'-6	11'-0	14'-6	13'-0	11'-6	10'-0	10'-6	8'-0	E
F	9'-7	8'-10	8'-1	7'-4	6'-7	5'-10	5'-1	4'-4	3'-7	8'-1	7'-4	6'-7	5'-10	5'-1	4'-4	3'-7	6'-7	5'-10	5'-1	4'-4	3'-7	2'-10	5'-1	4'-4	3'-7	2'-10	3'-7	2'-10	F
G1	9'-4	9'-4	9'-4	9'-4	9'-4	9'-4	9'-4	9'-4	9'-4	7'-4	7'-4	7'-4	7'-4	7'-4	7'-4	7'-4	5'-4	5'-4	5'-4	5'-4	5'-4	5'-4	4'-4	4'-4	4'-4	4'-4	3'-4	2'-4	G1
G2	10'-6⅝	10'-6⅝	10'-6⅝	10'-6⅝	10'-6½	10'-6½	10'-6⅜	10'-6¼	10'-6⅛	8'-6⅝	8'-6⅝	8'-6½	8'-6½	8'-6⅜	8'-6¼	8'-6⅛	6'-6½	6'-6½	6'-6⅜	6'-6¼	6'-6⅛	6'-5⅞	5'-6⅜	5'-6¼	5'-6⅛	5'-5⅞	4'-6⅛	3'-5⅞	G2
G3	15'-7⅜	14'-4⅜	13'-1⅜	11'-10⅜	10'-7½	9'-4½	8'-1½	6'-10½	5'-7½	13'-1⅜	11'-10⅜	10'-7½	9'-4½	8'-1½	6'-10½	5'-7½	10'-7½	9'-4½	8'-1½	6'-10½	5'-7½	4'-4½	8'-1½	6'-10½	5'-7½	4'-4½	5'-7½	4'-4½	G3
G4	16'-5⅞	15'-0½	13'-7	12'-4	11'-1⅛	9'-7¾	8'-4¾	7'-1⅞	5'-11	13'-7	12'-4	11'-1⅛	9'-7¾	8'-4¾	7'-1⅞	5'-11	11'-1⅛	9'-7¾	8'-4¾	7'-1⅞	5'-11	4'-8⅛	8'-4¾	7'-1⅞	5'-11	4'-8⅛	5'-11	4'-8⅛	G4
G5	3⅛	5⅜	7⅜	7⅜	7⅜	9⅛	9¾	9¾	9⅝	7⅜	7⅜	9⅛	9¾	9¾	9⅝	7⅜	7⅜	9⅛	9¾	9¾	9⅝	9⅝	9¾	9¾	9⅝	9⅝	9⅝	9⅝	G5
P	38'-1⅝	35'-0½	31'-11½	28'-10⅜	25'-9¼	22'-8⅛	19'-7	16'-5⅞	13'-4¾	31'-11½	28'-10⅜	25'-9¼	22'-8⅛	19'-7	16'-5⅞	13'-4¾	25'-9¼	22'-8⅛	19'-7	16'-5⅞	13'-4¾	10'-3¾	19'-7	16'-5⅞	13'-4¾	10'-3¾	13'-4¾	10'-3¾	P
R	40'-1	36'-10	33'-7	30'-4	27'-1	23'-10	20'-7	17'-4	14'-1	33'-7	30'-4	27'-1	23'-10	20'-7	17'-4	14'-1	27'-1	23'-10	20'-7	17'-4	14'-1	10'-10	20'-7	17'-4	14'-1	10'-10	14'-1	10'-10	R
T	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	1'-0	1'-0	1'-0	1'-0	1'-0	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	10	10	10	9	9	9	9	10	9	9	9	9	9	9	9	9	9	9	9	U
W	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	4'-0	3'-9	3'-6	3'-6	3'-6	3'-6	3'-6	3'-6	3'-6	3'-6	3'-6	3'-6	W

Notes:

1. See Sheet FWH G2-21 for General Notes, Specifications, and Design Stresses.
2. See Sheet FWH 0-1-21 and sheets FWH 0-3-21 & 0-4-21 for location of certain dimensions tabulated.
3. Dimensions are in feet and inches unless otherwise noted.

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWA DOT

Standard Design - Single Reinforced Concrete Box Culverts

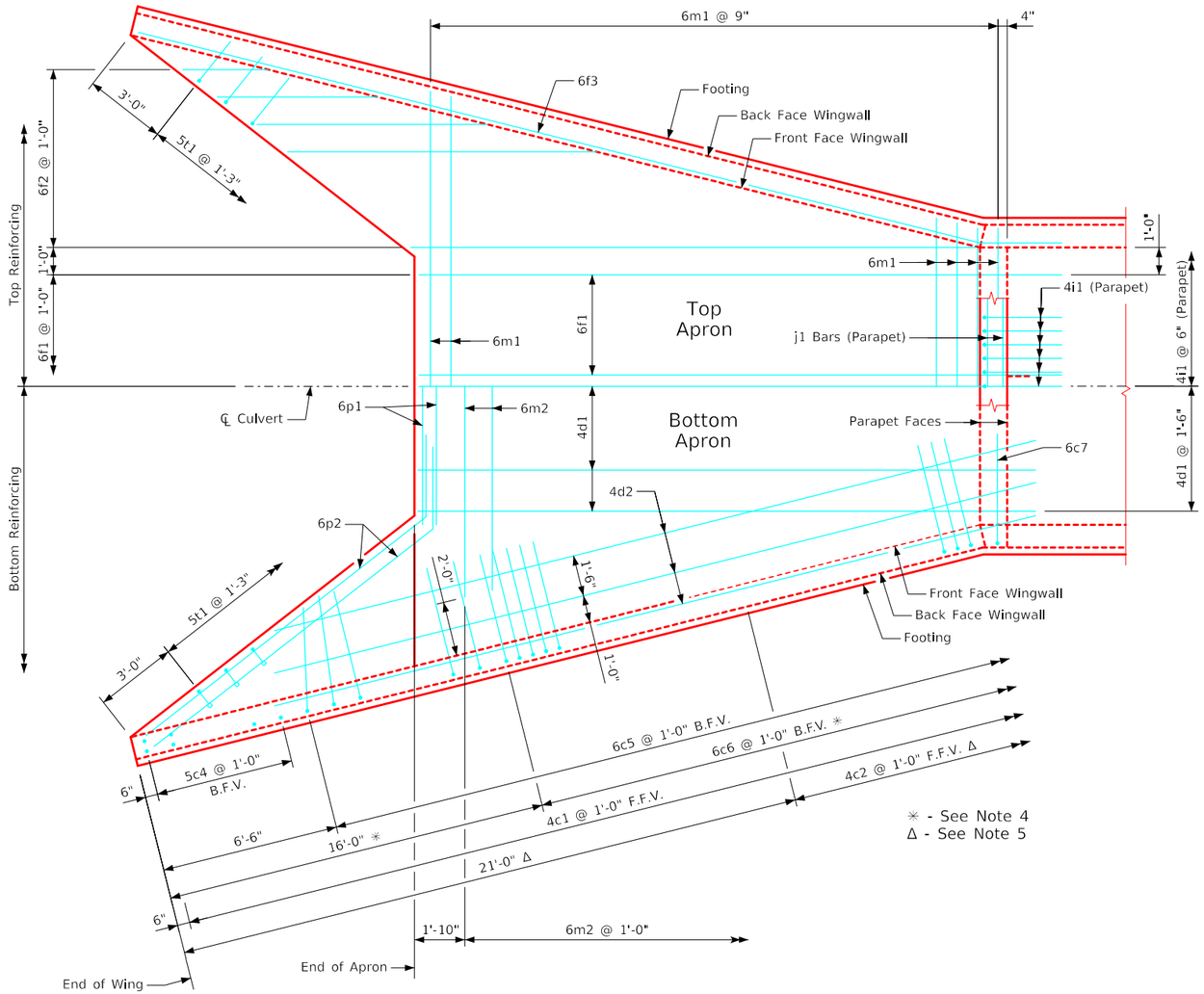
Flared Wing Headwalls

February, 2021

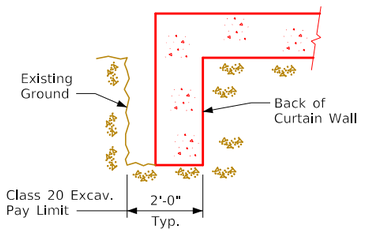
Dimension Table
0° Skew

FWH 0-2-21

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 0-2-21 - THIS SHEET ISSUED 02-2021.

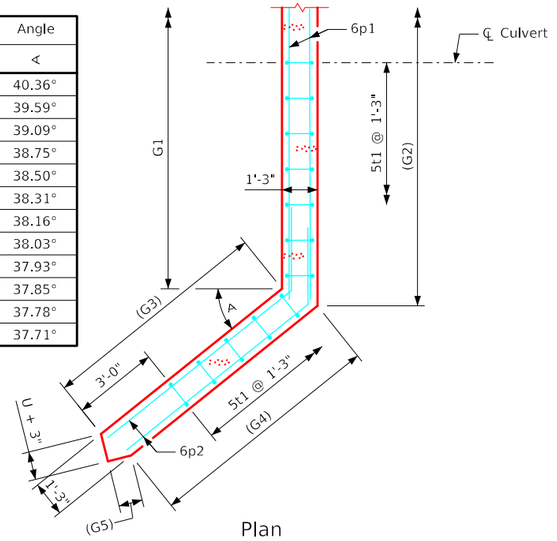


Plan View - Top & Bottom of Apron Reinforcing

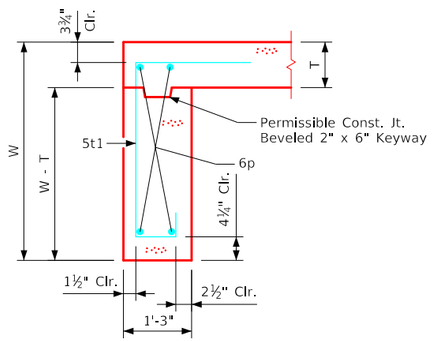


Curtain Wall
Class 20 Excavation

Culvert Height (H)	Angle A
3'	40.36°
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°
13'	37.78°
14'	37.71°



Plan



Section

Curtain Wall Details

Notes:

1. Bar spacings and positions shown are similar for all sizes of headwalls in this standard.
2. Wingwall bars consistently referenced from end of wing for all headwalls.
3. Top transverse floor bars are referenced approximately 4" from the back of the parapet for all headwalls.
4. There are no 6c6 bars in the 3' thru 6' height headwalls.
5. 4c2 bars used only in the 9' thru 14' height headwalls.
6. For dimension table see Sheet FWH 0-2-21.
7. For reinforcing in curtain wall see Curtain Wall Details this sheet.

LATEST REVISION DATE

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Standard Design - Single Reinforced Concrete Box Culverts

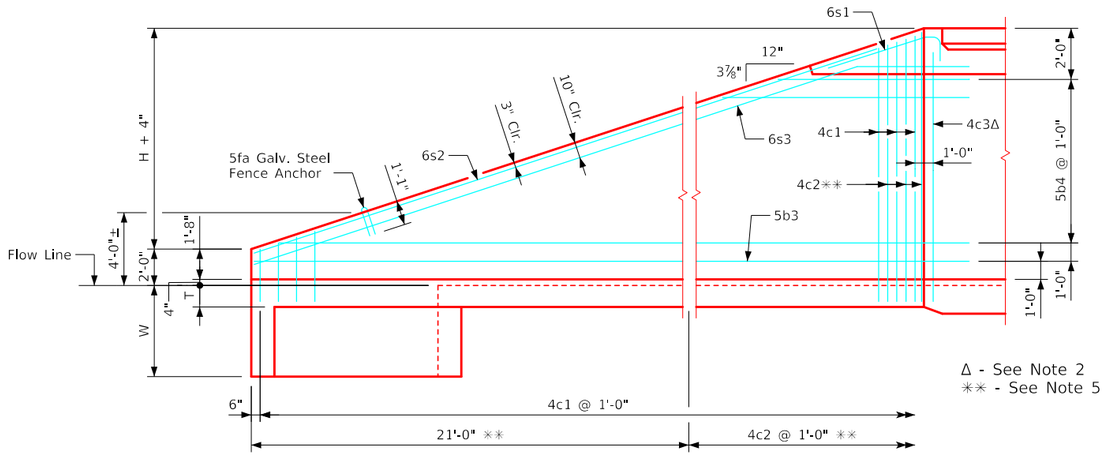
Flared Wing Headwalls

February, 2021

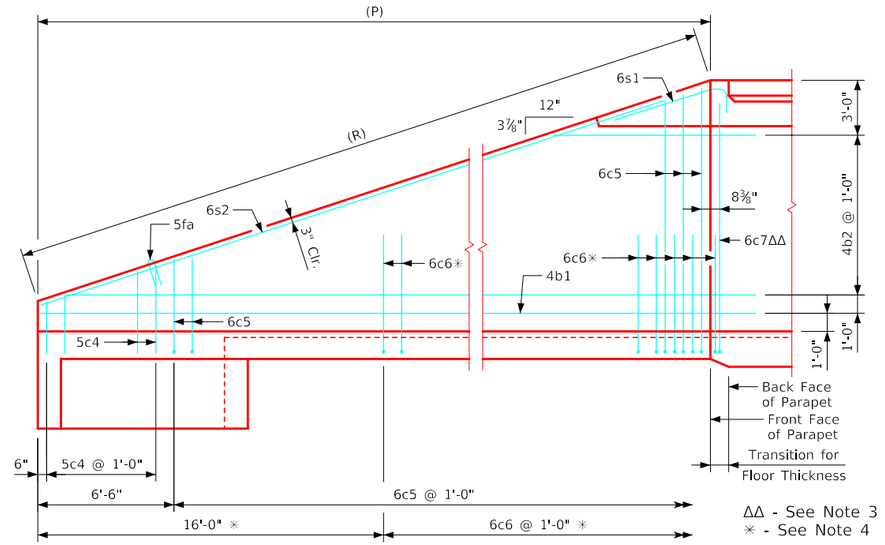
Apron & Curtain Wall Details 0° Skew

FWH 0-3-21

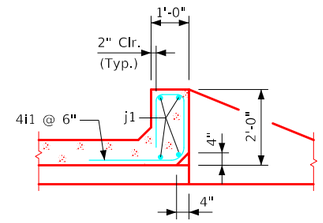
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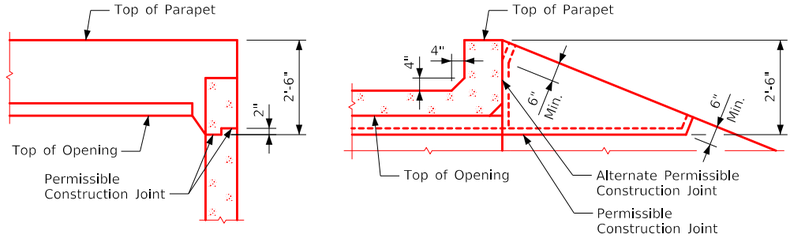
Typical View - Front Face Wingwall Reinforcing



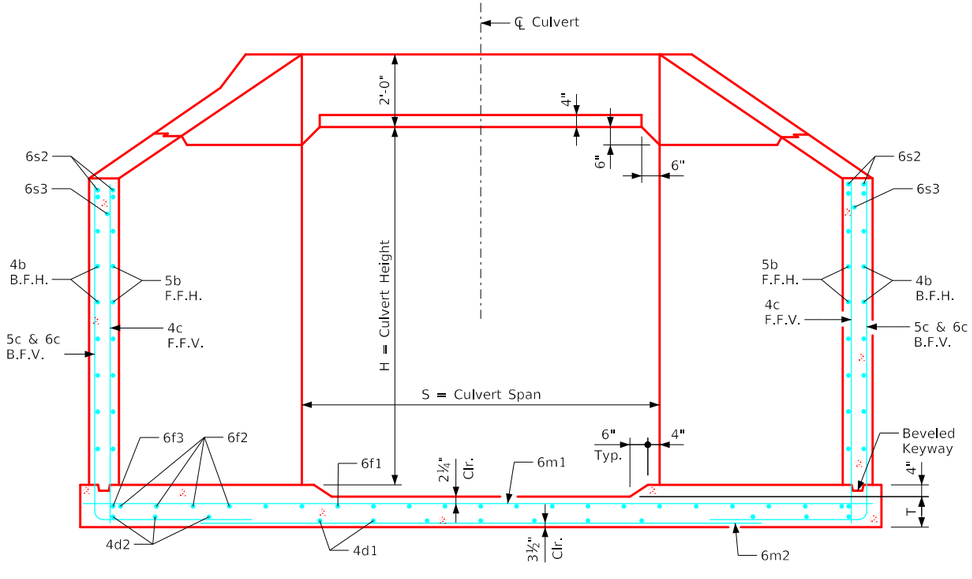
Typical View - Back Face Wingwall Reinforcing



Section thru Parapet



Top of Wingwall Details



Typical Section - Near Center of Apron

Notes:

1. Bar spacings and positions shown are similar for all sizes of headwalls in this standard.
2. Two 4c3 bars for 3' thru 5' & 11' thru 14' height headwalls. One 4c3 bar for 6' thru 10' height headwalls.
3. Two 6c7 bars for 3' thru 5' & 11' thru 14' headwalls. One 6c7 bar for 6' thru 10' height headalls.
4. Not applicable for 3' thru 6' height headwalls.
5. Not applicable for 3' thru 8' height headwalls.
6. For dimension table, see sheet FWH 0-2-21.
7. Top of wall slope may be rounded in some instances.

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

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Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Wingwall & Parapet Details 0° Skew

FWH 0-4-21

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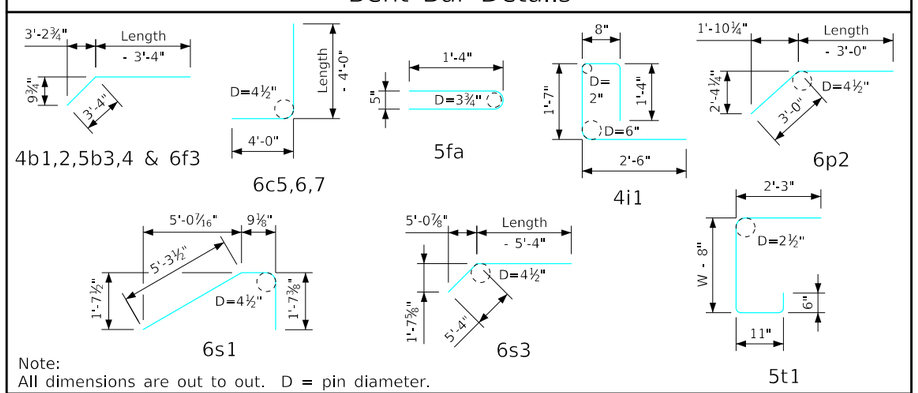
Bill of Reinforcing for One Headwall 0° Skew Span x Culvert Height

Bar	Location	Shape	16' x 14'			16' x 13'			16' x 12'			16' x 11'			16' x 10'			16' x 9'			16' x 8'			Bar
			No.	Length	Wt.	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	2	2'-10	6	5fa
4b1	Wingwall, B.F.H.		2	47'-4	66	2	44'-3	62	2	41'-2	58	2	38'-1	51	2	35'-0	47	2	31'-11	43	2	28'-10	39	4b1
4b2	Wingwall, B.F.H.		24 Var.	2 Each 11'-10 to 45'-11	469	22 Var.	2 Each 11'-11 to 42'-10	406	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	4b2
5b3	Wingwall, F.F.H.		2	47'-5	104	2	44'-4	98	2	41'-3	91	2	38'-2	80	2	35'-1	73	2	32'-0	67	2	28'-11	60	5b3
5b4	Wingwall, F.F.H.		26 Var.	2 Each 8'-10 to 46'-0	754	24 Var.	2 Each 8'-10 to 42'-11	653	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	5b4
4c1	Wingwall, F.F.V.		88 Var.	2 Each 2'-10 to 16'-9	576	82 Var.	2 Each 2'-10 to 15'-10	511	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	4c1
4c2	Wingwall, F.F.V.		48 Var.	2 Each 9'-6 to 16'-11	424	42 Var.	2 Each 9'-6 to 16'-0	358	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	15'-9	42	4	14'-9	39	4	13'-9	37	4	12'-9	34	2	11'-9	16	2	10'-9	14	2	9'-9	13	4c3
5c4	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	12 Var.	2 Each 2'-10 to 4'-6	46	5c4
6c5	Wingwall, B.F.V.		76 Var.	2 Each 8'-10 to 20'-9	1688	70 Var.	2 Each 8'-10 to 19'-10	1507	64 Var.	2 Each 8'-10 to 18'-10	1330	58 Var.	2 Each 8'-10 to 17'-10	1162	52 Var.	2 Each 8'-10 to 16'-11	1006	46 Var.	2 Each 8'-10 to 15'-11	855	40 Var.	2 Each 8'-10 to 14'-11	713	6c5
6c6	Wingwall, B.F.V.		58	10'-6	915	52	10'-6	820	46	10'-6	725	40	10'-6	631	34	10'-6	536	28	10'-6	442	22	10'-6	347	6c6
6c7	Wingwall, B.F.V.		4	19'-9	119	4	18'-9	113	4	17'-9	107	4	16'-9	101	2	15'-9	47	2	14'-9	44	2	13'-9	41	6c7
4d1	Apron, Longit., Bott.		11	31'-11	235	11	29'-11	220	11	27'-11	205	11	25'-11	190	11	23'-11	176	11	21'-11	161	11	19'-11	146	4d1
4d2	Apron, Longit., Bott.		6	42'-5	180	6	39'-4	158	6	36'-3	145	6	33'-2	133	6	30'-1	121	6	27'-0	108	6	23'-11	96	4d2
6f1	Apron, Longit., Top		15	31'-11	719	15	29'-11	674	15	27'-11	629	15	25'-11	584	15	23'-11	539	15	21'-11	494	15	19'-11	449	6f1
6f2	Apron, Longit., Top		20 Var.	2 Each 4'-6 to 28'-10	501	18 Var.	2 Each 5'-2 to 26'-10	433	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	6f2
6f3	Apron, Longit., Top		2	47'-5	150	2	44'-4	140	2	41'-3	131	2	38'-2	115	2	35'-1	105	2	32'-0	96	2	28'-11	87	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
9j1	Parapet, Horizontal		4	18'-0	245	4	17'-8	240	4	17'-8	240	4	17'-6	238	4	17'-4	236	4	17'-4	236	4	17'-4	236	9j1
6m1	Apron, Trans., Top		39 Var.	18'-2 to 32'-5	1482	37 Var.	17'-10 to 31'-4	1366	34 Var.	17'-10 to 30'-3	1228	31 Var.	17'-8 to 28'-11	1085	29 Var.	17'-6 to 28'-0	991	26 Var.	17'-6 to 26'-11	867	23 Var.	17'-6 to 25'-9	747	6m1
6m2	Apron, Trans., Bott.		28 Var.	11'-9 to 25'-3	778	26 Var.	11'-9 to 24'-3	703	24 Var.	11'-9 to 23'-3	631	22 Var.	11'-9 to 22'-3	562	20 Var.	11'-9 to 21'-3	496	18 Var.	11'-9 to 20'-3	433	16 Var.	11'-9 to 19'-3	372	6m2
6p1	Curtain, Horizontal		4	16'-3	98	4	16'-3	98	4	16'-3	98	4	16'-3	98	4	16'-3	98	4	16'-3	98	4	16'-3	98	6p1
6p2	Curtain, Horizontal		8	21'-1	253	8	19'-10	238	8	18'-7	223	8	17'-4	208	8	16'-1	193	8	14'-10	178	8	13'-7	163	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	43'-7	276	4	40'-4	257	4	37'-1	223	4	33'-10	203	4	30'-7	184	4	27'-4	164	4	24'-1	145	6s2
6s3	Wing Slope, F.F.		2	49'-8	156	2	46'-5	147	2	43'-2	137	2	39'-11	120	2	36'-8	110	2	33'-5	100	2	30'-2	91	6s3
5t1	Curtain, Vertical		39	8'-6	346	37	8'-3	318	35	8'-0	292	33	7'-9	267	31	7'-6	242	29	7'-3	219	27	7'-0	197	5t1
	Estimated Quantities One Headwall	Reinf. Steel		10,808 LB			9791 LB			8776 LB			7806 LB			6875 LB			6012 LB			5106 LB		
		Concrete Parapet Δ	2.2			2.1			2.1			2.0			1.9			1.9			1.9			
		Concrete Wingwalls	34.0	92.3 CY		25.5	77.6 CY		22.2	69.3 CY		17.4	59.3 CY		13.4	50.3 CY		11.2	43.8 CY		9.1	37.6 CY		
		Concrete Apron ✳	56.1			50.0			45.0			39.9			35.0			30.7			26.6			

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 FWH G2-21 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

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Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
16'-0" Span
0° Skew

FWH 0-5-21

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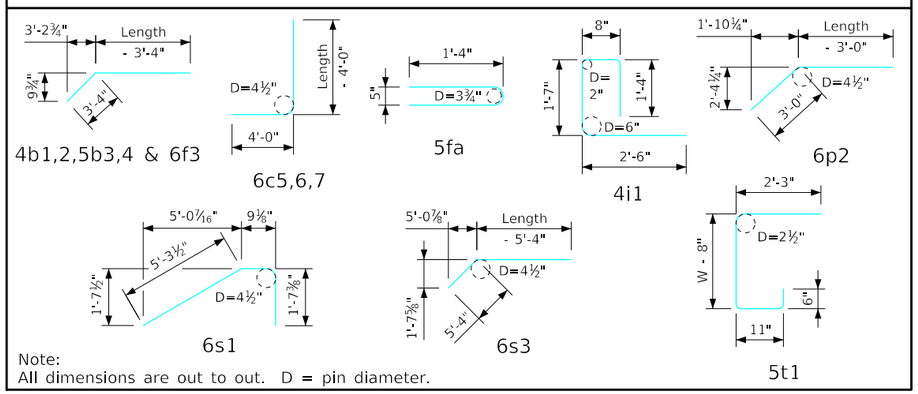
Bill of Reinforcing for One Headwall 0° Skew Span x Culvert Height

Bar	Location	Shape	16' x 7' No.	16' x 7' Length	16' x 7' Wt.	16' x 6' No.	16' x 6' Length	16' x 6' Wt.	16' x 5' No.	16' x 5' Length	16' x 5' Wt.	16' x 4' No.	16' x 4' Length	16' x 4' 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.		2	25'-9	34	2	22'-8	30	2	19'-7	26	2	16'-6	22	4b1
4b2	Wingwall, B.F.H.		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	25'-9	54	2	22'-8	47	2	19'-7	41	2	16'-6	34	5b3
5b4	Wingwall, F.F.H.		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
4c1	Wingwall, F.F.V.		46 Var.	2 Each 2'-10 to 10'-0	197	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	8'-9	12	2	7'-9	10	4	6'-9	18	4	5'-9	15	4c3
5c4	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	5c4
6c5	Wingwall, B.F.V.		34 Var.	2 Each 8'-10 to 14'-0	583	28 Var.	2 Each 8'-10 to 13'-0	459	20 Var.	2 Each 8'-10 to 11'-9	309	14 Var.	2 Each 8'-10 to 10'-9	206	6c5
6c6	Wingwall, B.F.V.		16	10'-6	252	--	--	--	--	--	--	--	--	--	6c6
6c7	Wingwall, B.F.V.		2	12'-9	38	2	11'-9	35	4	10'-9	65	4	9'-9	59	6c7
4d1	Apron, Longit., Bott.		11	17'-11	132	11	15'-11	117	11	13'-11	102	11	11'-11	88	4d1
4d2	Apron, Longit., Bott.		6	20'-10	84	6	17'-8	71	6	14'-7	58	6	11'-6	46	4d2
6f1	Apron, Longit., Top		15	17'-11	404	15	15'-11	359	15	13'-11	314	15	11'-11	268	6f1
6f2	Apron, Longit., Top		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	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	4i1
9j1	Parapet, Horizontal		4	17'-2	233	4	17'-2	233	4	17'-2	233	4	17'-2	233	9j1
6m1	Apron, Trans., Top		21 Var.	17'-4 to 24'-10	665	18 Var.	17'-4 to 23'-9	555	15 Var.	17'-4 to 22'-7	450	13 Var.	17'-4 to 21'-10	382	6m1
6m2	Apron, Trans., Bott.		14 Var.	11'-9 to 18'-3	315	12 Var.	11'-9 to 17'-3	261	10 Var.	11'-9 to 16'-3	210	8 Var.	11'-9 to 15'-3	162	6m2
6p1	Curtain, Horizontal		4	16'-3	98	4	16'-3	98	4	16'-3	98	4	16'-3	98	6p1
6p2	Curtain, Horizontal		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	6s1
6s2	Wing Slope, Both F.		4	20'-10	125	4	17'-7	106	4	14'-4	86	4	11'-1	67	6s2
6s3	Wing Slope, F.F.		2	26'-11	81	2	23'-8	71	2	20'-5	61	2	17'-2	52	6s3
5t1	Curtain, Vertical		25	6'-9	176	23	6'-6	156	21	6'-6	142	19	6'-6	129	5t1
	Estimated Quantities One Headwall	Reinf. Steel		4410 LB			3550 LB			2981 LB			2485 LB		
		Concrete: Parapet Δ	1.9	30.9 CY		1.9	25.9 CY		1.9	21.5 CY		1.9	17.5 CY		
		Concrete: Wingwalls	6.5			5.0			3.7			2.5			
		Concrete: Apron ✳	22.5			19.0			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.

Bent Bar Details



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

Headwall Notes:

1. See Sheet FWH G2-21 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

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
16'-0" Span
0° Skew

FWH 0-5-21
Sheet 2 of 2

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 0-5-21 S2 - THIS SHEET ISSUED 02-2021.

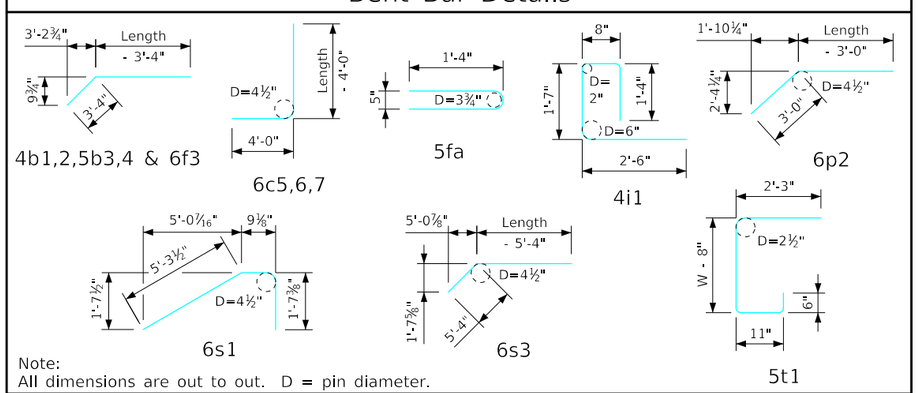
Bill of Reinforcing for One Headwall 0° Skew Span x Culvert Height

Bar	Location	Shape	14' x 14' No.	14' x 14' Length	14' x 14' Wt.	14' x 13' No.	14' x 13' Length	14' x 13' Wt.	14' x 12' No.	14' x 12' Length	14' x 12' Wt.	14' x 11' No.	14' x 11' Length	14' x 11' Wt.	14' x 10' No.	14' x 10' Length	14' x 10' Wt.	14' x 9' No.	14' x 9' Length	14' x 9' Wt.	14' x 8' No.	14' x 8' Length	14' 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	2	2'-10	6	2	2'-10	6	5fa
4b1	Wingwall, B.F.H.		2	47'-4	66	2	44'-3	62	2	41'-2	58	2	38'-1	51	2	35'-0	47	2	31'-11	43	2	28'-10	39	4b1
4b2	Wingwall, B.F.H.		24 Var.	2 Each 11'-10 to 45'-11	469	22 Var.	2 Each 11'-11 to 42'-10	406	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	4b2
5b3	Wingwall, F.F.H.		2	47'-5	104	2	44'-4	98	2	41'-3	91	2	38'-2	80	2	35'-1	73	2	32'-0	67	2	28'-11	60	5b3
5b4	Wingwall, F.F.H.		26 Var.	2 Each 8'-10 to 46'-0	754	24 Var.	2 Each 8'-10 to 42'-11	653	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	5b4
4c1	Wingwall, F.F.V.		88 Var.	2 Each 2'-10 to 16'-9	576	82 Var.	2 Each 2'-10 to 15'-10	511	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	4c1
4c2	Wingwall, F.F.V.		48 Var.	2 Each 9'-6 to 16'-11	424	42 Var.	2 Each 9'-6 to 16'-0	358	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	15'-9	42	4	14'-9	39	4	13'-9	37	4	12'-9	34	2	11'-9	16	2	10'-9	14	2	9'-9	13	4c3
5c4	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	12 Var.	2 Each 2'-10 to 4'-6	46	5c4
6c5	Wingwall, B.F.V.		76 Var.	2 Each 8'-10 to 20'-9	1688	70 Var.	2 Each 8'-10 to 19'-10	1507	64 Var.	2 Each 8'-10 to 18'-10	1330	58 Var.	2 Each 8'-10 to 17'-10	1162	52 Var.	2 Each 8'-10 to 16'-11	1006	46 Var.	2 Each 8'-10 to 15'-11	855	40 Var.	2 Each 8'-10 to 14'-11	713	6c5
6c6	Wingwall, B.F.V.		58	10'-6	915	52	10'-6	820	46	10'-6	725	40	10'-6	631	34	10'-6	536	28	10'-6	442	22	10'-6	347	6c6
6c7	Wingwall, B.F.V.		4	19'-9	119	4	18'-9	113	4	17'-9	107	4	16'-9	101	2	15'-9	47	2	14'-9	44	2	13'-9	41	6c7
4d1	Apron, Longit., Bott.		9	31'-11	192	9	29'-11	180	9	27'-11	168	9	25'-11	156	9	23'-11	144	9	21'-11	132	9	19'-11	120	4d1
4d2	Apron, Longit., Bott.		6	42'-5	180	6	39'-4	158	6	36'-3	145	6	33'-2	133	6	30'-1	121	6	27'-0	108	6	23'-11	96	4d2
6f1	Apron, Longit., Top		13	31'-11	623	13	29'-11	584	13	27'-11	545	13	25'-11	506	13	23'-11	467	13	21'-11	428	13	19'-11	389	6f1
6f2	Apron, Longit., Top		20 Var.	2 Each 4'-6 to 28'-10	501	18 Var.	2 Each 5'-2 to 26'-10	433	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	6f2
6f3	Apron, Longit., Top		2	47'-5	150	2	44'-4	140	2	41'-3	131	2	38'-2	115	2	35'-1	105	2	32'-0	96	2	28'-11	87	6f3
4i1	Parapet, Vertical		29	6'-1	118	29	6'-1	118	29	6'-1	118	29	6'-1	118	29	6'-1	118	29	6'-1	118	29	6'-1	118	4i1
9j1	Parapet, Horizontal		4	16'-0	218	4	15'-8	213	4	15'-8	213	4	15'-6	211	4	15'-4	209	4	15'-4	209	4	15'-4	209	9j1
6m1	Apron, Trans., Top		39 Var.	16'-2 to 30'-5	1364	37 Var.	15'-10 to 29'-4	1255	34 Var.	15'-10 to 28'-3	1126	31 Var.	15'-8 to 26'-11	991	29 Var.	15'-6 to 26'-0	904	26 Var.	15'-6 to 24'-11	789	23 Var.	15'-6 to 23'-9	678	6m1
6m2	Apron, Trans., Bott.		28 Var.	9'-9 to 23'-3	694	26 Var.	9'-9 to 22'-3	625	24 Var.	9'-9 to 21'-3	559	22 Var.	9'-9 to 20'-3	496	20 Var.	9'-9 to 19'-3	436	18 Var.	9'-9 to 18'-3	379	16 Var.	9'-9 to 17'-3	324	6m2
6p1	Curtain, Horizontal		4	14'-3	86	4	14'-3	86	4	14'-3	86	4	14'-3	86	4	14'-3	86	4	14'-3	86	4	14'-3	86	6p1
6p2	Curtain, Horizontal		8	21'-1	253	8	19'-10	238	8	18'-7	223	8	17'-4	208	8	16'-1	193	8	14'-10	178	8	13'-7	163	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	43'-7	276	4	40'-4	257	4	37'-1	223	4	33'-10	203	4	30'-7	184	4	27'-4	164	4	24'-1	145	6s2
6s3	Wing Slope, F.F.		2	49'-8	156	2	46'-5	147	2	43'-2	137	2	39'-11	120	2	36'-8	110	2	33'-5	100	2	30'-2	91	6s3
5t1	Curtain, Vertical		37	8'-6	328	35	8'-3	301	33	8'-0	275	31	7'-9	251	29	7'-6	227	27	7'-3	204	25	7'-0	183	5t1
	Estimated Quantities One Headwall	Reinf. Steel		10,394 LB			9400 LB			8409 LB			7463 LB			6554 LB			5715 LB			4834 LB		
		Concrete Parapet Δ	2.1			1.9			1.9			1.9			1.8			1.8			1.8			
		Concrete Wingwalls	34.0	89.3 CY		25.5	74.7 CY		22.2	66.5 CY		17.4	56.8 CY		13.4	48.0 CY		11.2	41.7 CY		9.1	35.7 CY		
		Concrete Apron ✳	53.2			47.3			42.4			37.5			32.8			28.7			24.8			

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.

Bent Bar Details



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

Headwall Notes:

1. See Sheet FWH G2-21 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

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
14'-0" Span
0° Skew

FWH 0-6-21

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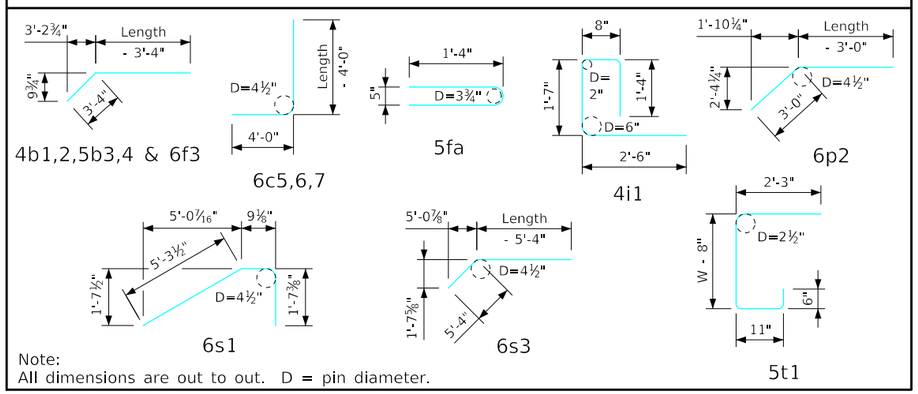
Bill of Reinforcing for One Headwall 0° Skew Span x Culvert Height

Bar	Location	Shape	14' x 7' No.	14' x 7' Length	14' x 7' Wt.	14' x 6' No.	14' x 6' Length	14' x 6' Wt.	14' x 5' No.	14' x 5' Length	14' x 5' Wt.	14' x 4' No.	14' x 4' Length	14' x 4' 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.		2	25'-9	34	2	22'-8	30	2	19'-7	26	2	16'-6	22	4b1
4b2	Wingwall, B.F.H.		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	25'-9	54	2	22'-8	47	2	19'-7	41	2	16'-6	34	5b3
5b4	Wingwall, F.F.H.		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
4c1	Wingwall, F.F.V.		46 Var.	2 Each 2'-10 to 10'-0	197	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	8'-9	12	2	7'-9	10	4	6'-9	18	4	5'-9	15	4c3
5c4	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	5c4
6c5	Wingwall, B.F.V.		34 Var.	2 Each 8'-10 to 14'-0	583	28 Var.	2 Each 8'-10 to 13'-0	459	20 Var.	2 Each 8'-10 to 11'-9	309	14 Var.	2 Each 8'-10 to 10'-9	206	6c5
6c6	Wingwall, B.F.V.		16	10'-6	252	--	--	--	--	--	--	--	--	--	6c6
6c7	Wingwall, B.F.V.		2	12'-9	38	2	11'-9	35	4	10'-9	65	4	9'-9	59	6c7
4d1	Apron, Longit., Bott.		9	17'-11	108	9	15'-11	96	9	13'-11	84	9	11'-11	72	4d1
4d2	Apron, Longit., Bott.		6	20'-10	84	6	17'-8	71	6	14'-7	58	6	11'-6	46	4d2
6f1	Apron, Longit., Top		13	17'-11	350	13	15'-11	311	13	13'-11	272	13	11'-11	233	6f1
6f2	Apron, Longit., Top		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	25'-9	77	2	22'-8	68	2	19'-7	59	2	16'-6	50	6f3
4i1	Parapet, Vertical		29	6'-1	118	29	6'-1	118	29	6'-1	118	29	6'-1	118	4i1
9j1	Parapet, Horizontal		4	15'-2	206	4	15'-2	206	4	15'-2	206	4	15'-2	206	9j1
6m1	Apron, Trans., Top		21 Var.	15'-4 to 22'-10	602	18 Var.	15'-4 to 21'-9	501	15 Var.	15'-4 to 20'-7	405	13 Var.	15'-4 to 19'-10	343	6m1
6m2	Apron, Trans., Bott.		14 Var.	9'-9 to 16'-3	273	12 Var.	9'-9 to 15'-3	225	10 Var.	9'-9 to 14'-3	180	8 Var.	9'-9 to 13'-3	138	6m2
6p1	Curtain, Horizontal		4	14'-3	86	4	14'-3	86	4	14'-3	86	4	14'-3	86	6p1
6p2	Curtain, Horizontal		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	6s1
6s2	Wing Slope, Both F.		4	20'-10	125	4	17'-7	106	4	14'-4	86	4	11'-1	67	6s2
6s3	Wing Slope, F.F.		2	26'-11	81	2	23'-8	71	2	20'-5	61	2	17'-2	52	6s3
5t1	Curtain, Vertical		23	6'-9	162	21	6'-6	142	19	6'-6	129	17	6'-6	115	5t1
	Estimated Quantities One Headwall	Reinf. Steel		4158 LB			3322 LB			2778 LB			2302 LB		
		Concrete: Parapet Δ	1.7	29.2 CY		1.7	24.3 CY		1.7	20.1 CY		1.7	16.2 CY		
		Concrete: Wingwalls	6.5			5.0			3.7			2.5			
		Concrete: Apron ✳	21.0			17.6			14.7			12.0			

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

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

Bent Bar Details



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

Headwall Notes:

1. See Sheet FWH G2-21 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

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
14'-0" Span
0° Skew

FWH 0-6-21
Sheet 2 of 2

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 0-6-21 S2 - THIS SHEET ISSUED 02-2021.

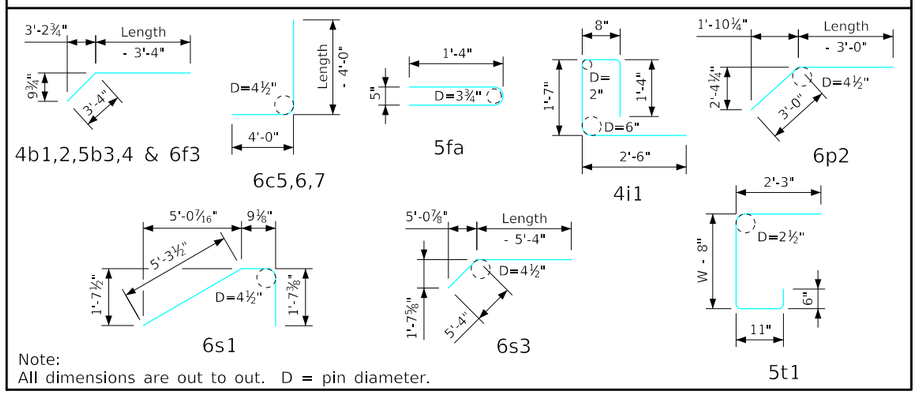
Bill of Reinforcing for One Headwall 0° Skew Span x Culvert Height

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
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
5c4	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	5c4
6c5	Wingwall, B.F.V.		64 Var.	2 Each 8'-10 to 18'-10	1330	58 Var.	2 Each 8'-10 to 17'-10	1162	52 Var.	2 Each 8'-10 to 16'-11	1006	46 Var.	2 Each 8'-10 to 15'-11	855	40 Var.	2 Each 8'-10 to 14'-11	713	34 Var.	2 Each 8'-10 to 14'-0	583	6c5
6c6	Wingwall, B.F.V.		46	10'-6	725	40	10'-6	631	34	10'-6	536	28	10'-6	442	22	10'-6	347	16	10'-6	252	6c6
6c7	Wingwall, B.F.V.		4	17'-9	107	4	16'-9	101	2	15'-9	47	2	14'-9	44	2	13'-9	41	2	12'-9	38	6c7
4d1	Apron, Longit., Bott.		9	27'-11	168	9	25'-11	156	9	23'-11	144	9	21'-11	132	9	19'-11	120	9	17'-11	108	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		11	27'-11	461	11	25'-11	428	11	23'-11	395	11	21'-11	362	11	19'-11	329	11	17'-11	296	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		25	6'-1	102	25	6'-1	102	25	6'-1	102	25	6'-1	102	25	6'-1	102	25	6'-1	102	4i1
7j1	Parapet, Horizontal		4	13'-8	112	4	13'-6	110	4	13'-4	109	4	13'-4	109	4	13'-4	109	4	13'-2	108	7j1
6m1	Apron, Trans., Top		34 Var.	13'-10 to 26'-3	1023	31 Var.	13'-8 to 24'-11	898	29 Var.	13'-6 to 24'-0	817	26 Var.	13'-6 to 22'-11	711	23 Var.	13'-6 to 21'-9	609	21 Var.	13'-4 to 20'-10	539	6m1
6m2	Apron, Trans., Bott.		24 Var.	7'-9 to 19'-3	487	22 Var.	7'-9 to 18'-3	430	20 Var.	7'-9 to 17'-3	376	18 Var.	7'-9 to 16'-3	324	16 Var.	7'-9 to 15'-3	276	14 Var.	7'-9 to 14'-3	231	6m2
6p1	Curtain, Horizontal		4	12'-3	74	4	12'-3	74	4	12'-3	74	4	12'-3	74	4	12'-3	74	4	12'-3	74	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
5t1	Curtain, Vertical		31	8'-0	259	29	7'-9	234	27	7'-6	211	25	7'-3	189	23	7'-0	168	21	6'-9	148	5t1
	Estimated Quantities One Headwall	Reinf. Steel		8005 LB			7080 LB			6191 LB			5373 LB			4514 LB			3859 LB		
		Concrete Parapet Δ	1.8	63.9 CY		1.7	54.2 CY		1.6	45.6 CY		1.6	39.5 CY		1.6	33.7 CY		1.6	27.5 CY		
		Concrete Wingwalls	22.2			17.4			13.4			11.2			9.1			6.5			
		Concrete Apron ✳	39.9			35.1			30.6			26.7			23.0			19.4			

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 FWH G2-21 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

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
12'-0" Span
0° Skew

FWH 0-7-21

Sheet 1 of 2

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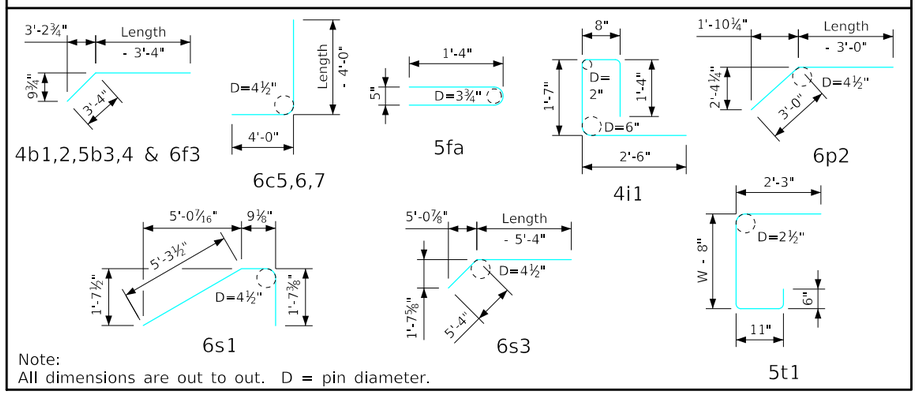
Bill of Reinforcing for One Headwall 0° Skew Span x Culvert Height

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
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
5c4	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	5c4
6c5	Wingwall, B.F.V.		28 Var.	2 Each 8'-10 to 13'-0	459	20 Var.	2 Each 8'-10 to 11'-9	309	14 Var.	2 Each 8'-10 to 10'-9	206	6c5
6c6	Wingwall, B.F.V.		--	--	--	--	--	--	--	--	--	6c6
6c7	Wingwall, B.F.V.		2	11'-9	35	4	10'-9	65	4	9'-9	59	6c7
4d1	Apron, Longit., Bott.		9	15'-11	96	9	13'-11	84	9	11'-11	72	4d1
4d2	Apron, Longit., Bott.		6	17'-8	71	6	14'-7	58	6	11'-6	46	4d2
6f1	Apron, Longit., Top		11	15'-11	263	11	13'-11	230	11	11'-11	197	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		25	6'-1	102	25	6'-1	102	25	6'-1	102	4i1
7j1	Parapet, Horizontal		4	13'-2	108	4	13'-2	108	4	13'-2	108	7j1
6m1	Apron, Trans., Top		18 Var.	13'-4 to 19'-9	447	15 Var.	13'-4 to 18'-7	360	13 Var.	13'-4 to 17'-10	304	6m1
6m2	Apron, Trans., Bott.		12 Var.	7'-9 to 13'-3	189	10 Var.	7'-9 to 12'-3	150	8 Var.	7'-9 to 11'-3	114	6m2
6p1	Curtain, Horizontal		4	12'-3	74	4	12'-3	74	4	12'-3	74	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
5t1	Curtain, Vertical		19	6'-6	129	17	6'-6	115	15	6'-6	102	5t1
	Estimated Quantities One Headwall	Reinf. Steel		3045 LB			2521 LB			2064 LB		
		Concrete Parapet Δ	1.6	22.8 CY		1.6	18.8 CY		1.6	15.1 CY		
		Concrete Wingwalls	5.0			3.7			2.5			
		Concrete Apron ✳	16.2			13.5			11.0			

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

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

Bent Bar Details



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

Headwall Notes:

1. See Sheet FWH G2-21 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

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
12'-0" Span
0° Skew

FWH 0-7-21
Sheet 2 of 2

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 0-7-21 S2 - THIS SHEET ISSUED 02-2021.

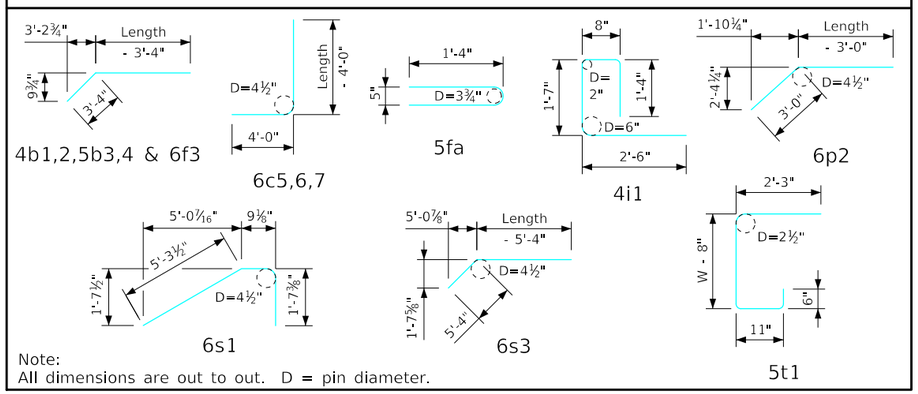
Bill of Reinforcing for One Headwall 0° Skew Span x Culvert Height

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
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
5c4	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	5c4
6c5	Wingwall, B.F.V.		64 Var.	2 Each 8'-9 to 18'-9	1322	58 Var.	2 Each 8'-9 to 17'-9	1154	52 Var.	2 Each 8'-9 to 16'-10	999	46 Var.	2 Each 8'-9 to 15'-10	849	40 Var.	2 Each 8'-9 to 14'-10	708	34 Var.	2 Each 8'-9 to 13'-11	579	6c5
6c6	Wingwall, B.F.V.		46	10'-6	725	40	10'-6	631	34	10'-6	536	28	10'-6	442	22	10'-6	347	16	10'-6	252	6c6
6c7	Wingwall, B.F.V.		4	17'-8	106	4	16'-8	100	2	15'-8	47	2	14'-8	44	2	13'-8	41	2	12'-8	38	6c7
4d1	Apron, Longit., Bott.		7	27'-11	131	7	25'-11	121	7	23'-11	112	7	21'-11	102	7	19'-11	93	7	17'-11	84	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		9	27'-11	377	9	25'-11	350	9	23'-11	323	9	21'-11	296	9	19'-11	269	9	17'-11	242	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		21	6'-1	85	21	6'-1	85	21	6'-1	85	21	6'-1	85	21	6'-1	85	21	6'-1	85	4i1
7j1	Parapet, Horizontal		4	11'-8	95	4	11'-6	94	4	11'-4	93	4	11'-4	93	4	11'-4	93	4	11'-2	91	7j1
6m1	Apron, Trans., Top		34 Var.	11'-10 to 24'-3	921	31 Var.	11'-8 to 22'-11	805	29 Var.	11'-6 to 22'-0	730	26 Var.	11'-6 to 20'-11	633	23 Var.	11'-6 to 19'-9	540	21 Var.	11'-4 to 18'-10	476	6m1
6m2	Apron, Trans., Bott.		24 Var.	5'-9 to 17'-3	415	22 Var.	5'-9 to 16'-3	363	20 Var.	5'-9 to 15'-3	315	18 Var.	5'-9 to 14'-3	270	16 Var.	5'-9 to 13'-3	228	14 Var.	5'-9 to 12'-3	189	6m2
6p1	Curtain, Horizontal		4	10'-3	62	4	10'-3	62	4	10'-3	62	4	10'-3	62	4	10'-3	62	4	10'-3	62	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
5t1	Curtain, Vertical		29	8'-0	242	27	7'-9	218	25	7'-6	196	23	7'-3	174	21	7'-0	153	19	6'-9	134	5t1
	Estimated Quantities One Headwall	Reinf. Steel		7631 LB			6731 LB			5866 LB			5074 LB			4241 LB			3609 LB		
		Concrete Parapet Δ	1.6			1.6			1.5			1.5			1.5			1.4			
		Concrete Wingwalls	22.2	59.4 CY		17.4	50.3 CY		13.4	42.1 CY		11.2	36.4 CY		9.1	30.9 CY		6.5	24.9 CY		
		Concrete Apron ✳	35.6			31.3			27.2			23.7			20.3			17.0			

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

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

Bent Bar Details



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

Headwall Notes:

1. See Sheet FWH G2-21 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

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
10'-0" Span
0° Skew

FWH 0-8-21

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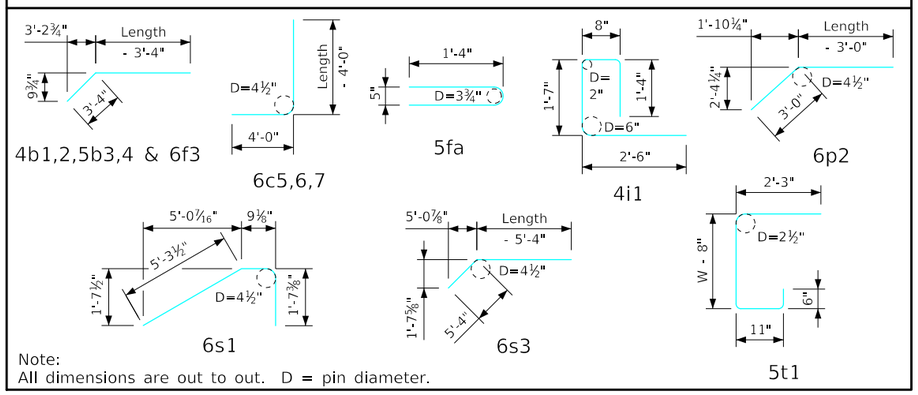
Bill of Reinforcing for One Headwall 0° Skew Span x Culvert Height

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
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
5c4	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	5c4
6c5	Wingwall, B.F.V.		28 Var.	2 Each 8'-9 to 12'-11	456	20 Var.	2 Each 8'-9 to 11'-8	307	14 Var.	2 Each 8'-9 to 10'-8	204	6c5
6c6	Wingwall, B.F.V.		--	--	--	--	--	--	--	--	--	6c6
6c7	Wingwall, B.F.V.		2	11'-8	35	4	10'-8	64	4	9'-8	58	6c7
4d1	Apron, Longit., Bott.		7	15'-11	74	7	13'-11	65	7	11'-11	56	4d1
4d2	Apron, Longit., Bott.		6	17'-8	71	6	14'-7	58	6	11'-6	46	4d2
6f1	Apron, Longit., Top		9	15'-11	215	9	13'-11	188	9	11'-11	161	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		21	6'-1	85	21	6'-1	85	21	6'-1	85	4i1
7j1	Parapet, Horizontal		4	11'-2	91	4	11'-2	91	4	11'-2	91	7j1
6m1	Apron, Trans., Top		18 Var.	11'-4 to 17'-9	393	15 Var.	11'-4 to 16'-7	314	13 Var.	11'-4 to 15'-10	265	6m1
6m2	Apron, Trans., Bott.		12 Var.	5'-9 to 11'-3	153	10 Var.	5'-9 to 10'-3	120	8 Var.	5'-9 to 9'-3	90	6m2
6p1	Curtain, Horizontal		4	10'-3	62	4	10'-3	62	4	10'-3	62	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
5t1	Curtain, Vertical		17	6'-6	115	15	6'-6	102	13	6'-6	88	5t1
	Estimated Quantities One Headwall	Reinf. Steel		2819 LB			2319 LB			1884 LB		
		Concrete Parapet Δ	1.4	20.5 CY		1.4	16.9 CY		1.4	13.4 CY		
		Concrete Wingwalls	5.0			3.7			2.5			
		Concrete Apron ✳	14.1			11.8			9.5			

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.

Bent Bar Details



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

Headwall Notes:

1. See Sheet FWH G2-21 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

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
10'-0" Span
0° Skew

FWH 0-8-21

Sheet 2 of 2

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 0-8-21 S2 - THIS SHEET ISSUED 02-2021.

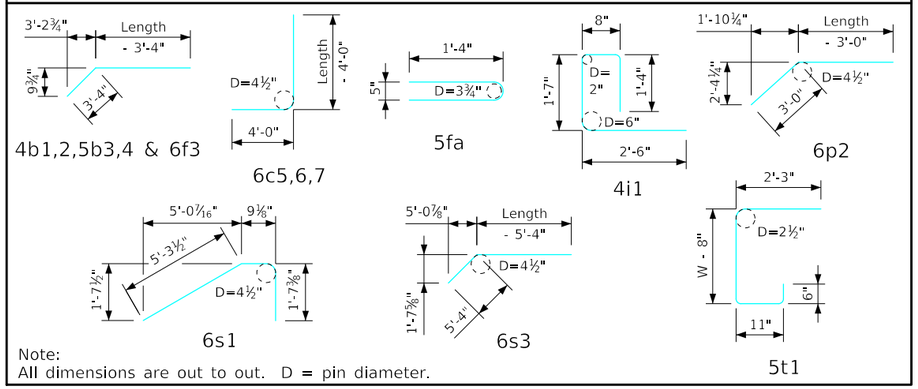
Bill of Reinforcing for One Headwall 0° Skew Span x Culvert Height

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
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
5c4	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	5c4
6c5	Wingwall, B.F.V.		52 Var.	2 Each 8'-8 to 16'-9	993	46 Var.	2 Each 8'-8 to 15'-9	843	40 Var.	2 Each 8'-8 to 14'-9	703	34 Var.	2 Each 8'-8 to 13'-10	575	28 Var.	2 Each 8'-8 to 12'-10	452	20 Var.	2 Each 8'-8 to 11'-7	304	14 Var.	2 Each 8'-8 to 10'-7	202	6c5
6c6	Wingwall, B.F.V.		34	10'-6	536	28	10'-6	442	22	10'-6	347	16	10'-6	252	--	--	--	--	--	--	--	--	--	6c6
6c7	Wingwall, B.F.V.		2	15'-7	47	2	14'-7	44	2	13'-7	41	2	12'-7	38	2	11'-7	35	4	10'-7	64	4	9'-7	58	6c7
4d1	Apron, Longit., Bott.		5	23'-11	80	5	21'-11	73	5	19'-11	67	5	17'-11	60	5	15'-11	53	5	13'-11	46	5	11'-11	40	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		7	23'-11	251	7	21'-11	230	7	19'-11	209	7	17'-11	188	7	15'-11	167	7	13'-11	146	7	11'-11	125	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		17	6'-1	69	17	6'-1	69	17	6'-1	69	17	6'-1	69	17	6'-1	69	17	6'-1	69	17	6'-1	69	4i1
7j1	Parapet, Horizontal		4	9'-4	76	4	9'-4	76	4	9'-4	76	4	9'-2	75	4	9'-2	75	4	9'-2	75	4	9'-2	75	7j1
6m1	Apron, Trans., Top		29 Var.	9'-6 to 20'-0	642	26 Var.	9'-6 to 18'-11	555	23 Var.	9'-6 to 17'-9	471	21 Var.	9'-4 to 16'-10	413	18 Var.	9'-4 to 15'-9	339	15 Var.	9'-4 to 14'-7	269	13 Var.	9'-4 to 13'-10	226	6m1
6m2	Apron, Trans., Bott.		20 Var.	3'-9 to 13'-3	255	18 Var.	3'-9 to 12'-3	216	16 Var.	3'-9 to 11'-3	180	14 Var.	3'-9 to 10'-3	147	12 Var.	3'-9 to 9'-3	117	10 Var.	3'-9 to 8'-3	90	8 Var.	3'-9 to 7'-3	66	6m2
6p1	Curtain, Horizontal		4	8'-3	50	4	8'-3	50	4	8'-3	50	4	8'-3	50	4	8'-3	50	4	8'-3	50	4	8'-3	50	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
5t1	Curtain, Vertical		23	7'-6	180	21	7'-3	159	19	7'-0	139	17	6'-9	120	15	6'-6	102	13	6'-6	88	11	6'-6	75	5t1
	Estimated Quantities One Headwall	Reinf. Steel		5540 LB			4775 LB			3970 LB			3359 LB			2596 LB			2120 LB			1707 LB		
		Concrete Parapet Δ	1.3	38.7 CY		1.3	33.3 CY		1.3	28.2 CY		1.3	22.6 CY		1.3	18.5 CY		1.3	15.2 CY		1.3	12.0 CY		
		Concrete Wingwalls	13.4			11.2			9.1			6.5			5.0			3.7			2.5			
		Concrete Apron ✳	24.0			20.8			17.8			14.8			12.2			10.2			8.2			

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.

Bent Bar Details



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

Headwall Notes:

1. See Sheet FWH G2-21 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

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
8'-0" Span
0° Skew

FWH 0-9-21

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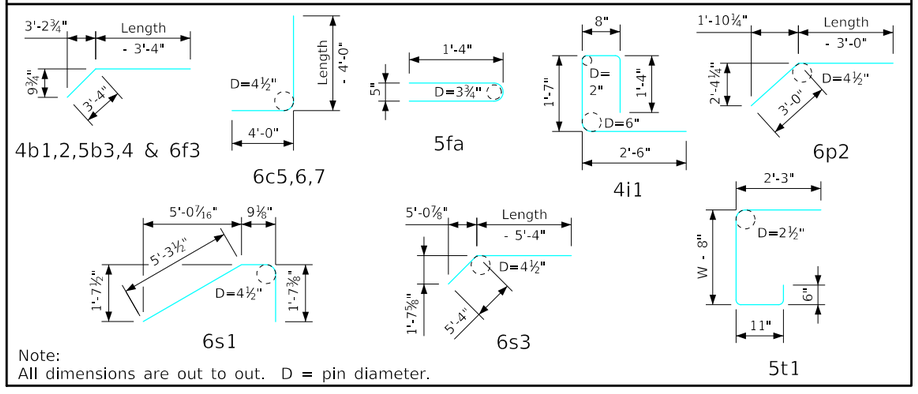
Bill of Reinforcing for One Headwall 0° Skew Span x Culvert Height

Bar	Location	Shape	6' x 8'			6' x 7'			6' x 6'			6' x 5'			6' x 4'			6' x 3'			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	28'-10	39	2	25'-9	34	2	22'-8	30	2	19'-7	26	2	16'-6	22	2	13'-5	18	4b1
4b2	Wingwall, B.F.H.		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	2	12'-0	16	4b2
5b3	Wingwall, F.F.H.		2	28'-11	60	2	25'-9	54	2	22'-8	47	2	19'-7	41	2	16'-6	34	2	13'-5	28	5b3
5b4	Wingwall, F.F.H.		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	4 Var.	2 Each 8'-11 to 12'-0	44	5b4
4c1	Wingwall, F.F.V.		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	20 Var.	2 Each 2'-8 to 5'-7	55	4c1
4c2	Wingwall, F.F.V.		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4c2
4c3	Wingwall, F.F.V.		2	9'-7	13	2	8'-7	11	2	7'-7	10	4	6'-7	18	4	5'-7	15	4	4'-7	12	4c3
5c4	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	5c4
6c5	Wingwall, B.F.V.		40 Var.	2 Each 8'-8 to 14'-9	703	34 Var.	2 Each 8'-8 to 13'-10	575	28 Var.	2 Each 8'-8 to 12'-10	452	20 Var.	2 Each 8'-8 to 11'-7	304	14 Var.	2 Each 8'-8 to 10'-7	202	8 Var.	2 Each 8'-8 to 9'-7	110	6c5
6c6	Wingwall, B.F.V.		22	10'-6	347	16	10'-6	252	--	--	--	--	--	--	--	--	--	--	--	--	6c6
6c7	Wingwall, B.F.V.		2	13'-7	41	2	12'-7	38	2	11'-7	35	4	10'-7	64	4	9'-7	58	4	8'-7	52	6c7
4d1	Apron, Longit., Bott.		5	19'-11	67	5	17'-11	60	5	15'-11	53	5	13'-11	46	5	11'-11	40	5	9'-11	33	4d1
4d2	Apron, Longit., Bott.		6	23'-11	96	6	20'-10	84	6	17'-8	71	6	14'-7	58	6	11'-6	46	6	8'-5	34	4d2
6f1	Apron, Longit., Top		5	19'-11	150	5	17'-11	135	5	15'-11	120	5	13'-11	105	5	11'-11	89	5	9'-11	74	6f1
6f2	Apron, Longit., Top		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	4 Var.	2 Each 4'-0 to 6'-10	33	6f2
6f3	Apron, Longit., Top		2	28'-11	87	2	25'-9	77	2	22'-8	68	2	19'-7	59	2	16'-6	50	2	13'-5	40	6f3
4i1	Parapet, Vertical		13	6'-1	53	13	6'-1	53	13	6'-1	53	13	6'-1	53	13	6'-1	53	13	6'-1	53	4i1
7j1	Parapet, Horizontal		4	7'-4	60	4	7'-2	59	4	7'-2	59	4	7'-2	59	4	7'-2	59	4	7'-2	59	7j1
6m1	Apron, Trans., Top		23 Var.	7'-6 to 15'-9	402	21 Var.	7'-4 to 14'-10	350	18 Var.	7'-4 to 13'-9	285	15 Var.	7'-4 to 12'-7	224	13 Var.	7'-4 to 11'-10	187	10 Var.	7'-4 to 10'-9	136	6m1
6m2	Apron, Trans., Bott.		15 Var.	2'-3 to 9'-3	130	13 Var.	2'-3 to 8'-3	103	11 Var.	2'-3 to 7'-3	78	9 Var.	2'-3 to 6'-3	57	7 Var.	2'-3 to 5'-3	39	5 Var.	2'-3 to 4'-3	24	6m2
6p1	Curtain, Horizontal		4	6'-3	38	4	6'-3	38	4	6'-3	38	4	6'-3	38	4	6'-3	38	4	6'-2	37	6p1
6p2	Curtain, Horizontal		8	13'-7	163	8	12'-4	148	8	11'-1	133	8	9'-10	118	8	8'-7	103	8	7'-4	88	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	24'-1	145	4	20'-10	125	4	17'-7	106	4	14'-4	86	4	11'-1	67	4	7'-10	47	6s2
6s3	Wing Slope, F.F.		2	30'-2	91	2	26'-11	81	2	23'-8	71	2	20'-5	61	2	17'-2	52	2	13'-11	42	6s3
5t1	Curtain, Vertical		19	7'-0	139	17	6'-9	120	15	6'-6	102	13	6'-6	88	11	6'-6	75	9	6'-6	61	5t1
	Estimated Quantities One Headwall	Reinf. Steel		3748 LB			3155 LB			2412 LB			1957 LB			1561 LB			1192 LB		
		Concrete Parapet Δ	1.2	26.5 CY		1.1	21.0 CY		1.1	17.1 CY		1.1	13.9 CY		1.1	10.9 CY		1.1	8.2 CY		
		Concrete Wingwalls	9.1			6.5			5.0			3.7			2.5			1.5			
		Concrete Apron ✳	16.2			13.4			11.0			9.1			7.3			5.6			

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 FWH G2-21 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

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
6'-0" Span
0° Skew

FWH 0-10-21

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 0-10-21 - THIS SHEET ISSUED 02-2021.

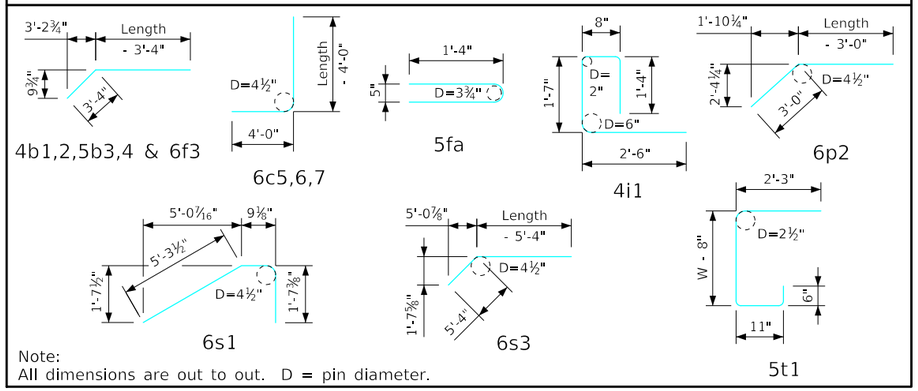
Bill of Reinforcing for One Headwall 0° Skew Span x Culvert Height

Bar	Location	Shape	5' x 6'			5' x 5'			5' x 4'			5' x 3'			4' x 4'			3' x 3'			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	22'-8	30	2	19'-7	26	2	16'-6	22	2	13'-5	18	2	16'-6	22	2	13'-5	18	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	2	12'-0	16	4 Var.	2 Each 11'-11 to 15'-1	36	2	12'-0	16	4b2
5b3	Wingwall, F.F.H.		2	22'-8	47	2	19'-7	41	2	16'-6	34	2	13'-5	28	2	16'-6	34	2	13'-5	28	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	4 Var.	2 Each 8'-11 to 12'-0	44	6 Var.	2 Each 8'-11 to 15'-1	75	4 Var.	2 Each 8'-11 to 12'-0	44	5b4
4c1	Wingwall, F.F.V.		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	20 Var.	2 Each 2'-8 to 5'-7	55	26 Var.	2 Each 2'-8 to 6'-7	80	20 Var.	2 Each 2'-8 to 5'-7	55	4c1
4c2	Wingwall, F.F.V.		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4c2
4c3	Wingwall, F.F.V.		2	7'-7	10	4	6'-7	18	4	5'-7	15	4	4'-7	12	4	5'-7	15	4	4'-7	12	4c3
5c4	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	5c4
6c5	Wingwall, B.F.V.		28 Var.	2 Each 8'-8 to 12'-10	452	20 Var.	2 Each 8'-8 to 11'-7	304	14 Var.	2 Each 8'-8 to 10'-7	202	8 Var.	2 Each 8'-8 to 9'-7	110	14 Var.	2 Each 8'-8 to 10'-7	202	8 Var.	2 Each 8'-8 to 9'-7	110	6c5
6c6	Wingwall, B.F.V.		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6c6
6c7	Wingwall, B.F.V.		2	11'-7	35	4	10'-7	64	4	9'-7	58	4	8'-7	52	4	9'-7	58	4	8'-7	52	6c7
4d1	Apron, Longit., Bott.		3	15'-11	32	3	13'-11	28	3	11'-11	24	3	9'-11	20	3	11'-11	24	3	9'-11	20	4d1
4d2	Apron, Longit., Bott.		6	17'-8	71	6	14'-7	58	6	11'-6	46	6	8'-5	34	6	11'-6	46	6	8'-5	34	4d2
6f1	Apron, Longit., Top		4	15'-11	96	4	13'-11	84	4	11'-11	72	4	9'-11	60	3	11'-11	54	2	9'-11	30	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	4 Var.	2 Each 4'-0 to 6'-10	33	4 Var.	2 Each 6'-1 to 8'-10	45	4 Var.	2 Each 4'-0 to 6'-10	33	6f2
6f3	Apron, Longit., Top		2	22'-8	68	2	19'-7	59	2	16'-6	50	2	13'-5	40	2	16'-6	50	2	13'-5	40	6f3
4i1	Parapet, Vertical		11	6'-1	45	11	6'-1	45	11	6'-1	45	11	6'-1	45	9	6'-1	37	7	6'-1	28	4i1
7j1	Parapet, Horizontal		4	6'-2	50	4	6'-2	50	4	6'-2	50	4	6'-2	50	4	5'-2	42	4	4'-2	34	7j1
6m1	Apron, Trans., Top		18 Var.	6'-4 to 12'-9	258	15 Var.	6'-4 to 11'-7	202	13 Var.	6'-4 to 10'-10	168	10 Var.	6'-4 to 9'-9	121	13 Var.	5'-4 to 9'-10	148	10 Var.	4'-4 to 7'-9	91	6m1
6m2	Apron, Trans., Bott.		9 Var.	2'-3 to 6'-3	57	7 Var.	2'-3 to 5'-3	39	5 Var.	2'-3 to 4'-3	24	3 Var.	2'-3 to 3'-3	12	--	--	--	--	--	--	6m2
6p1	Curtain, Horizontal		4	5'-3	32	4	5'-3	32	4	5'-3	32	4	5'-2	31	4	4'-3	26	4	3'-2	19	6p1
6p2	Curtain, Horizontal		8	11'-1	133	8	9'-10	118	8	8'-7	103	8	7'-4	88	8	8'-7	103	8	7'-4	88	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	17'-7	106	4	14'-4	86	4	11'-1	67	4	7'-10	47	4	11'-1	67	4	7'-10	47	6s2
6s3	Wing Slope, F.F.		2	23'-8	71	2	20'-5	61	2	17'-2	52	2	13'-11	42	2	17'-2	52	2	13'-11	42	6s3
5t1	Curtain, Vertical		13	6'-6	88	11	6'-6	75	9	6'-6	61	7	6'-6	47	9	6'-6	61	7	6'-6	47	5t1
	Estimated Quantities One Headwall	Reinf. Steel	2282 LB			1842 LB			1457 LB			1101 LB			1373 LB			984 LB			
		Concrete Parapet Δ	1.0	16.4 CY		1.0	13.2 CY		1.0	10.3 CY		1.0	7.7 CY		1.0	9.8 CY		0.9	6.8 CY		
		Concrete Wingwalls	5.0			3.7			2.5			1.5			2.5			1.5			
		Concrete Apron ✳	10.4			8.5			6.8			5.2			6.3			4.4			

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 FWH G2-21 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.

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IOWA DOT

Standard Design - Single Reinforced Concrete Box Culverts

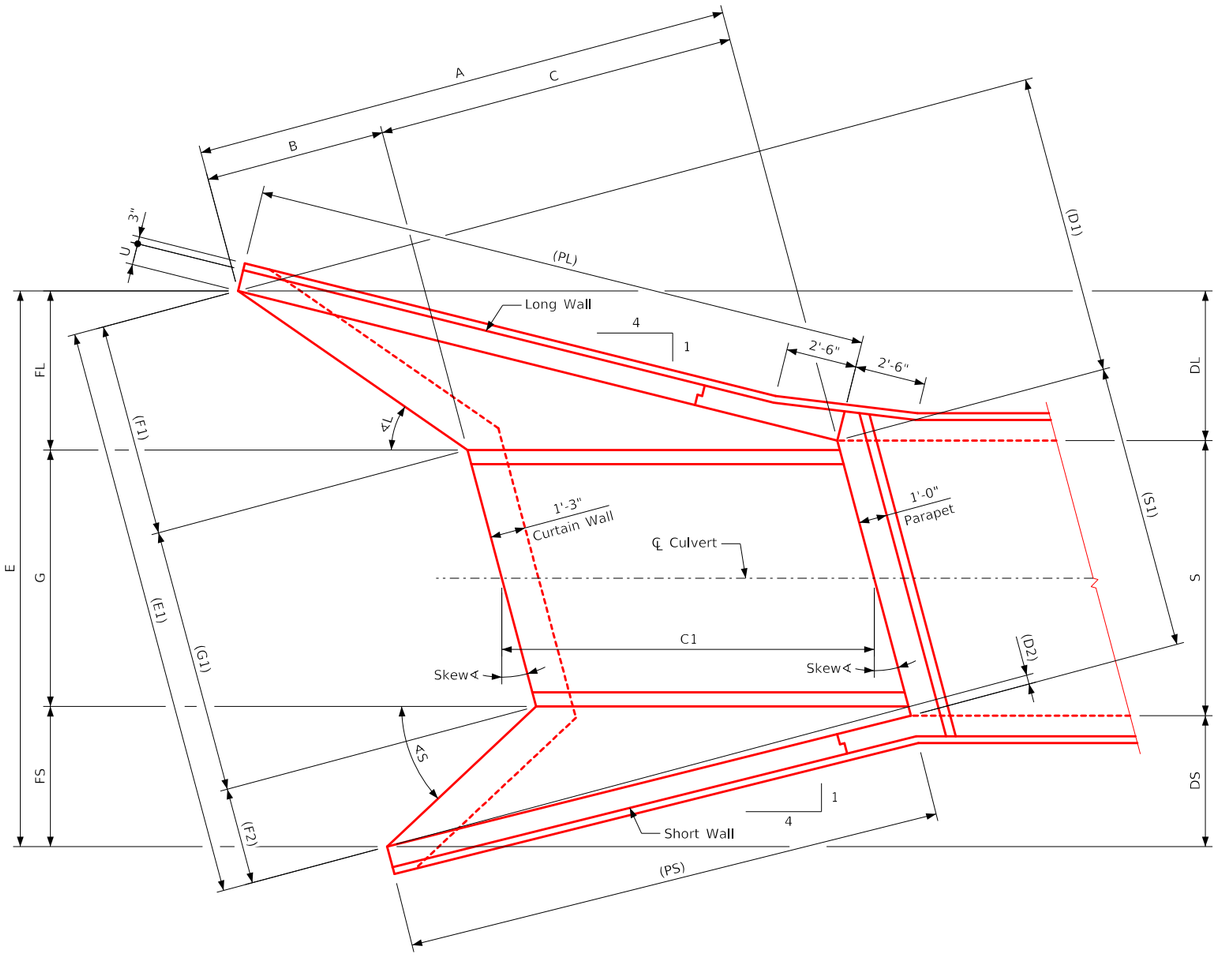
Flared Wing Headwalls

February, 2021

Quantity Tabulation
5'-0", 4'-0" & 3'-0" Spans
0° Skew

FWH 0-11-21

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 0-11-21 - THIS SHEET ISSUED 02-2021.



Plan View

Notes:

1. See Sheet FWH G2-21 for General Notes, Specifications, and Design Stresses.
2. See Sheet FWH 15-2-21 for dimensions table.
3. See Sheet FWH 15-4-21 for Angle L & Angle S.

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWADOT

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Dimension Plan 15° Skew

FWH 15-1-21

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Dimension Table

S x H	16' x 14'	16' x 13'	16' x 12'	16' x 11'	16' x 10'	16' x 9'	16' x 8'	16' x 7'	16' x 6'	16' x 5'	16' x 4'	14' x 14'	14' x 13'	14' x 12'	14' x 11'	14' x 10'	14' x 9'	14' x 8'	14' x 7'	14' x 6'	14' x 5'	14' x 4'	12' x 12'	12' x 11'	12' x 10'	12' x 9'	12' x 8'	12' x 7'	12' x 6'	12' x 5'	12' x 4'	S x H
A	43'-0	40'-0	37'-0	34'-0	31'-0	28'-0	25'-0	22'-0	19'-0	16'-0	13'-0	43'-0	40'-0	37'-0	34'-0	31'-0	28'-0	25'-0	22'-0	19'-0	16'-0	13'-0	37'-0	34'-0	31'-0	28'-0	25'-0	22'-0	19'-0	16'-0	13'-0	A
B	14'-4	13'-4	12'-4	11'-4	10'-4	9'-4	8'-4	7'-4	6'-4	5'-4	4'-4	14'-4	13'-4	12'-4	11'-4	10'-4	9'-4	8'-4	7'-4	6'-4	5'-4	4'-4	12'-4	11'-4	10'-4	9'-4	8'-4	7'-4	6'-4	5'-4	4'-4	B
C	28'-8	26'-8	24'-8	22'-8	20'-8	18'-8	16'-8	14'-8	12'-8	10'-8	8'-8	28'-8	26'-8	24'-8	22'-8	20'-8	18'-8	16'-8	14'-8	12'-8	10'-8	8'-8	24'-8	22'-8	20'-8	18'-8	16'-8	14'-8	12'-8	10'-8	8'-8	C
C1	29'-8⅛	27'-7¼	25'-6½	23'-5⅝	21'-4¾	19'-3⅞	17'-3	15'-2¼	13'-1⅜	11'-0½	8'-11⅝	29'-8⅛	27'-7¼	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	C1
DL	11'-11⅛	11'-1⅛	10'-3⅛	9'-5⅛	8'-7¼	7'-9¼	6'-11¼	6'-1¼	5'-3¼	4'-5¼	3'-7¼	11'-11⅛	11'-1⅛	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	DL
DS	10'-5⅛	9'-8⅜	8'-11⅜	8'-3	7'-6¼	6'-9½	6'-0¾	5'-4	4'-7¼	3'-10⅝	3'-1⅞	10'-5⅛	9'-8⅜	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	DS
D1	23'-10½	22'-2½	20'-6½	18'-10½	17'-2½	15'-6½	13'-10½	12'-2½	10'-6⅝	8'-10⅝	7'-2⅜	23'-10½	22'-2½	20'-6½	18'-10½	17'-2½	15'-6½	13'-10½	12'-2½	10'-6⅜	8'-10⅜	7'-2⅜	20'-6½	18'-10½	17'-2½	15'-6½	13'-10½	12'-2½	10'-6⅜	8'-10⅜	7'-2⅜	D1
D2	8⅜	8⅛	7½	6⅞	6¼	5⅝	5	4½	3⅞	3¼	2⅝	8⅜	8⅛	7½	6⅞	6¼	5⅝	5	4½	3⅞	3¼	2⅝	7½	6⅞	6¼	5⅝	5	4½	3⅞	3¼	2⅝	D2
E	38'-4¼	36'-9⅝	35'-2⅞	33'-8⅛	32'-1⅜	30'-6¾	29'-0	27'-5¼	25'-10½	24'-3⅞	22'-9⅛	36'-4¼	34'-9⅝	33'-2⅛	31'-8⅜	30'-1⅜	28'-6¾	27'-0	25'-5¼	23'-10½	22'-3⅞	20'-9⅛	31'-2⅞	29'-8⅛	28'-1⅜	26'-6¾	25'-0	23'-5¼	21'-10½	20'-3⅞	18'-9⅛	E
E1	39'-8½	38'-1⅛	36'-5¾	34'-10⅜	33'-3	31'-7⅝	30'-0¼	28'-4⅞	26'-9½	25'-2⅛	23'-6¾	37'-7¾	36'-0⅜	34'-5	32'-9½	31'-2⅛	29'-6¾	27'-11⅜	26'-4	24'-8⅝	23'-1¼	21'-5⅞	32'-4⅛	30'-8¾	29'-1⅜	27'-6	25'-10⅝	24'-3¼	22'-7⅞	21'-0⅜	19'-5	E1
FL	12'-3⅛	11'-5⅛	10'-7⅛	9'-9⅛	8'-11¼	8'-1¼	7'-3¼	6'-5¼	5'-7¼	4'-9¼	3'-11¼	12'-3⅛	11'-5⅛	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	5'-7¼	4'-9¼	3'-11¼	FL
FS	10'-9⅛	10'-0⅜	9'-3¾	8'-7	7'-10¼	7'-1½	6'-4¾	5'-8	4'-11¼	4'-2⅝	3'-5⅞	10'-9⅛	10'-0⅜	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	FS
F1	16'-6⅜	15'-4⅞	14'-3¼	13'-1¾	12'-0¼	10'-10⅝	9'-9⅛	8'-7½	7'-6	6'-4⅜	5'-2⅞	16'-6⅜	15'-4⅞	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	F1
F2	7'-3⅝	6'-9¾	6'-4	5'-10⅛	5'-4⅜	4'-10½	4'-4⅝	3'-10⅞	3'-5	2'-11¼	2'-5⅜	7'-3⅝	6'-9¾	6'-4	5'-10⅛	5'-4⅜	4'-10½	4'-4⅝	3'-10⅞	3'-5	2'-11¼	2'-5⅜	6'-4	5'-10⅛	5'-4⅜	4'-10½	4'-4⅝	3'-10⅞	3'-5	2'-11¼	2'-5⅜	F2
G	15'-4	15'-4	15'-4	15'-4	15'-4	15'-4	15'-4	15'-4	15'-4	15'-4	15'-4	13'-4	13'-4	13'-4	13'-4	13'-4	13'-4	13'-4	13'-4	13'-4	13'-4	13'-4	11'-4	11'-4	11'-4	11'-4	11'-4	11'-4	11'-4	11'-4	11'-4	G
G1	15'-10½	15'-10½	15'-10½	15'-10½	15'-10½	15'-10½	15'-10½	15'-10½	15'-10½	15'-10½	15'-10½	13'-9⅜	13'-9⅜	13'-9⅜	13'-9⅜	13'-9⅜	13'-9⅜	13'-9⅜	13'-9⅜	13'-9⅜	13'-9⅜	13'-9⅜	11'-8¾	11'-8¾	11'-8¾	11'-8¾	11'-8¾	11'-8¾	11'-8¾	11'-8¾	11'-8¾	G1
G2	17'-1¼	17'-1¼	17'-1¼	17'-1¼	17'-1⅛	17'-1⅛	17'-1⅛	17'-1	17'-0⅞	17'-0¾	17'-0⅝	15'-0⅜	15'-0⅜	15'-0⅜	15'-0⅜	15'-0⅜	15'-0¼	15'-0¼	15'-0½	15'-0⅜	15'-0	14'-11¾	12'-11½	12'-11½	12'-11½	12'-11⅜	12'-11⅜	12'-11⅛	12'-11¼	12'-11⅛	12'-11	G2
G3	21'-10⅝	20'-4½	18'-10⅜	17'-4¼	15'-10⅛	14'-4⅛	12'-10	11'-3⅞	9'-9¾	8'-3⅝	6'-9⅜	21'-10⅝	20'-4½	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	G3
G4	22'-9⅝	21'-0¾	19'-6⅜	17'-9⅝	16'-0⅝	14'-6⅜	13'-0½	11'-3⅝	9'-9⅝	8'-3½	6'-9⅜	22'-9⅝	21'-0¾	19'-6⅜	17'-9⅝	16'-0⅝	14'-6⅜	13'-0½	11'-3⅝	9'-9⅝	8'-3½	6'-9⅝	19'-6⅜	17'-9⅝	16'-0⅝	14'-6⅜	13'-0½	11'-3⅝	9'-9⅝	8'-3½	6'-9⅝	G4
G5	16'-1	14'-11¾	13'-10⅜	12'-9	11'-7¾	10'-6⅜	9'-5	8'-3¾	7'-2⅜	6'-1	4'-11⅜	16'-1	14'-11¾	13'-10⅜	12'-9	11'-7¾	10'-6⅜	9'-5	8'-3¾	7'-2⅜	6'-1	4'-11⅜	13'-10⅜	12'-9	11'-7¾	10'-6⅜	9'-5	8'-3¾	7'-2⅜	6'-1	4'-11⅜	G5
G6	17'-6¼	16'-0⅝	14'-11¼	13'-7⅞	12'-4⅜	11'-3⅛	10'-1¾	8'-10⅜	7'-9⅛	6'-7⅞	5'-6⅝	17'-6¼	16'-0⅝	14'-11¼	13'-7⅞	12'-4⅜	11'-3⅛	10'-1¾	8'-10⅜	7'-9⅛	6'-7⅞	5'-6⅝	14'-11¼	13'-7⅞	12'-4⅜	11'-3⅛	10'-1¾	8'-10⅜	7'-9⅛	6'-7⅞	5'-6⅝	G6
G7	--	2⅝	2⅝	5⅜	8⅛	8⅛	8⅛	10¾	10⅝	10⅝	10½	--	2⅝	2⅝	5⅜	8⅛	8⅛	8⅛	10¾	10⅝	10⅝	10½	2⅝	5⅜	8⅛	8⅛	8⅛	10¾	10⅝	10⅝	10½	G7
G8	--	3¾	3¾	5⅝	7½	7½	7½	9¼	9¼	9¼	9⅛	--	3¾	3¾	5⅝	7½	7½	7½	9¼	9¼	9¼	9⅛	3¾	5⅝	7½	7½	7½	9¼	9¼	9¼	9⅛	G8
PL	49'-2⅛	45'-9	42'-3⅞	38'-10⅝	35'-5½	32'-0¼	28'-7⅛	25'-2	21'-8¾	18'-3⅝	14'-10⅜	49'-2⅛	45'-9	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	PL
PS	43'-0⅛	40'-0⅛	37'-0⅛	34'-0	31'-0	28'-0	25'-0	22'-0	19'-0	16'-0	13'-0	43'-0⅛	40'-0⅛	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	PS
RL	51'-2¾	47'-7⅞	44'-1	40'-6⅛	36'-11⅛	33'-4¼	29'-9⅜	26'-2½	22'-7⅝	19'-0¾	15'-5⅞	51'-2¾	47'-7⅞	44'-1	40'-6⅛	36'-11⅛	33'-4¼	29'-9⅜	26'-2½	22'-7⅝	19'-0¾	15'-5⅞	44'-1	40'-6⅛	36'-11⅛	33'-4¼	29'-9⅜	26'-2½	22'-7⅝	19'-0¾	15'-5⅞	RL
RS	45'-4	42'-2	39'-0⅛	35'-10⅛	32'-8⅛	29'-6¼	26'-4¼	23'-2⅜	20'-0⅜	16'-10⅜	13'-8½	45'-4	42'-2	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	RS
S1	16'-6¾	16'-6¾	16'-6¾	16'-6¾	16'-6¾	16'-6¾	16'-6¾	16'-6¾	16'-6¾	16'-6¾	16'-6¾	14'-5⅞	14'-5⅞	14'-5⅞	14'-5⅞	14'-5⅞	14'-5⅞	14'-5⅞	14'-5⅞	14'-5⅞	14'-5⅞	14'-5⅞	12'-5⅛	12'-5⅛	12'-5⅛	12'-5⅛	12'-5⅛	12'-5⅛	12'-5⅛	12'-5⅛	12'-5⅛	S1
T	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	T
U	1'-2	1'-0	1'-0	11	10	10	10	9	9	9	9	1'-2	1'-0	1'-0	11	10	10	10	9	9	9	9	1'-0	11	10	10	10	9	9	9	9	U
W	5'-6	5'-3	5'-0	4'-9	4'-6	4'-3	4'-0	3'-9	3'-6	3'-6	3'-6	5'-6	5'-3	5'-0	4'-9	4'-6	4'-3	4'-0	3'-9	3'-6	3'-6	3'-6	5'-0	4'-9	4'-6	4'-3	4'-0	3'-9	3'-6	3'-6	3'-6	W

Notes:

1. See Sheet FWH G2-21 for General Notes, Specifications, and Design Stresses.
2. See Sheet FWH 15-1-21 and sheets FWH 15-3-21 thru 15-5-21 for location of certain dimensions tabulated.
3. Dimensions are in feet and inches unless otherwise noted.

LATEST REVISION DATE

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IOWA DOT

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Dimension Table
15° Skew

FWH 15-2-21

Sheet 1 of 2

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 15-2-21 S1 - THIS SHEET ISSUED 02-2021.

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Dimension Table

S x H	10' x 12'	10' x 11'	10' x 10'	10' x 9'	10' x 8'	10' x 7'	10' x 6'	10' x 5'	10' x 4'	8' x 10'	8' x 9'	8' x 8'	8' x 7'	8' x 6'	8' x 5'	8' x 4'	6' x 8'	6' x 7'	6' x 6'	6' x 5'	6' x 4'	6' x 3'	5' x 6'	5' x 5'	5' x 4'	5' x 3'	S x H
A	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	25'-0	22'-0	19'-0	16'-0	13'-0	10'-0	19'-0	16'-0	13'-0	10'-0	A
B	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	8'-4	7'-4	6'-4	5'-4	4'-4	3'-4	6'-4	5'-4	4'-4	3'-4	B
C	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	16'-8	14'-8	12'-8	10'-8	8'-8	6'-8	12'-8	10'-8	8'-8	6'-8	C
C1	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	17'-3	15'-2¼	13'-1⅜	11'-0½	8'-11⅝	6'-10⅞	13'-1⅜	11'-0½	8'-11⅝	6'-10⅞	C1
DL	10'-3⅜	9'-5⅜	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	6'-11¼	6'-1¼	5'-3¼	4'-5¼	3'-7¼	2'-9¼	5'-3¼	4'-5¼	3'-7¼	2'-9¼	DL
DS	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	6'-0¾	5'-4	4'-7¼	3'-10⅝	3'-1⅞	2'-5⅛	4'-7¼	3'-10⅝	3'-1⅞	2'-5⅛	DS
D1	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	13'-10½	12'-2½	10'-6⅝	8'-10⅝	7'-2⅝	5'-6⅝	10'-6⅝	8'-10⅝	7'-2⅝	5'-6⅝	D1
D2	7½	6⅞	6¼	5⅝	5	4½	3⅞	3¼	2⅝	6¼	5⅝	5	4½	3⅞	3¼	2⅝	5	4½	3⅞	3¼	2⅝	2	3⅞	3¼	2⅝	2	D2
E	29'-2⅞	27'-8⅛	26'-1⅜	24'-6¾	23'-0	21'-5¼	19'-10½	18'-3⅞	16'-9⅛	24'-1⅜	22'-6¾	21'-0	19'-5¼	17'-10½	16'-3⅞	14'-9⅛	19'-0	17'-5¼	15'-10½	14'-3⅞	12'-9⅛	11'-2⅜	14'-10½	13'-3⅞	11'-9⅛	10'-2⅜	E
E1	30'-3¼	28'-7⅞	27'-0½	25'-5⅛	23'-9¾	22'-2⅜	20'-7	18'-11⅝	17'-4¼	24'-11⅝	23'-4¼	21'-8⅞	20'-1½	18'-6⅛	16'-10¾	15'-3⅜	19'-8	18'-0⅝	16'-5¼	14'-9⅞	13'-2½	11'-7⅛	15'-4⅞	13'-9½	12'-2⅛	10'-6¾	E1
FL	10'-7⅛	9'-9⅛	8'-11¼	8'-1¼	7'-3¼	6'-5¼	5'-7¼	4'-9¼	3'-11¼	8'-11¼	8'-1¼	7'-3¼	6'-5¼	5'-7¼	4'-9¼	3'-11¼	7'-3¼	6'-5¼	5'-7¼	4'-9¼	3'-11¼	3'-1¼	5'-7¼	4'-9¼	3'-11¼	3'-1¼	FL
FS	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	6'-4¾	5'-8	4'-11¼	4'-2⅝	3'-5⅞	2'-9⅛	4'-11¼	4'-2⅝	3'-5⅞	2'-9⅛	FS
F1	14'-3¼	13'-1⅞	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	9'-9⅛	8'-7½	7'-6	6'-4⅜	5'-2⅞	4'-1⅜	7'-6	6'-4⅜	5'-2⅞	4'-1⅜	F1
F2	6'-4	5'-10⅛	5'-4⅜	4'-10½	4'-4⅝	3'-10⅞	3'-5	2'-11¼	2'-5⅜	5'-4⅜	4'-10½	4'-4⅝	3'-10⅞	3'-5	2'-11¼	2'-5⅜	4'-4⅜	3'-10⅞	3'-5	2'-11¼	2'-5⅜	1'-11½	3'-5	2'-11¼	2'-5⅜	1'-11½	F2
G	9'-4	9'-4	9'-4	9'-4	9'-4	9'-4	9'-4	9'-4	9'-4	7'-4	7'-4	7'-4	7'-4	7'-4	7'-4	7'-4	5'-4	5'-4	5'-4	5'-4	5'-4	5'-4	4'-4	4'-4	4'-4	4'-4	G
G1	9'-8	9'-8	9'-8	9'-8	9'-8	9'-8	9'-8	9'-8	9'-8	7'-7⅛	7'-7⅛	7'-7⅛	7'-7⅛	7'-7⅛	7'-7⅛	7'-7⅛	5'-6¼	5'-6¼	5'-6¼	5'-6¼	5'-6¼	5'-6¼	4'-5⅞	4'-5⅞	4'-5⅞	4'-5⅞	G1
G2	10'-10¾	10'-10⅝	10'-10⅝	10'-10⅝	10'-10½	10'-10½	10'-10⅜	10'-10¼	10'-10⅛	8'-9¾	8'-9¾	8'-9¾	8'-9⅝	8'-9½	8'-9⅜	8'-9¼	6'-8⅞	6'-8¾	6'-8¾	6'-8⅝	6'-8⅜	6'-8⅛	5'-8¼	5'-8⅛	5'-8	5'-7¾	G2
G3	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	12'-10	11'-3⅞	9'-9¾	8'-3⅝	6'-9⅝	5'-3½	9'-9¾	8'-3⅝	6'-9⅝	5'-3½	G3
G4	19'-6⅜	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	13'-0½	11'-3⅝	9'-9⅝	8'-3½	6'-9⅝	5'-3¾	9'-9⅝	8'-3½	6'-9⅝	5'-3¾	G4
G5	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	9'-5	8'-3¾	7'-2⅜	6'-1	4'-11¾	3'-10⅜	7'-2⅜	6'-1	4'-11¾	3'-10⅜	G5
G6	14'-11¼	13'-7⅞	12'-4⅜	11'-1⅜	10'-1¾	8'-10⅜	7'-9⅛	6'-7⅞	5'-6⅝	12'-4⅜	11'-1⅜	10'-1¾	8'-10⅜	7'-9⅛	6'-7⅞	5'-6⅝	10'-1¾	8'-10⅜	7'-9⅛	6'-7⅞	5'-6⅝	4'-5½	7'-9⅛	6'-7⅞	5'-6⅝	4'-5½	G6
G7	2⅝	5⅜	8⅛	8⅛	8⅛	10¾	10⅝	10⅝	10½	8⅛	8⅛	8⅛	10¾	10⅝	10⅝	10½	8⅛	10¾	10⅝	10⅝	10½	10⅜	10⅝	10⅝	10½	10⅜	G7
G8	3¾	5⅝	7½	7½	7½	9¼	9¼	9¼	9⅛	7½	7½	7½	9¼	9¼	9¼	9⅛	7½	9¼	9¼	9¼	9⅛	9⅛	9¼	9¼	9⅛	9⅛	G8
PL	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	28'-7⅛	25'-2	21'-8¾	18'-3⅝	14'-10⅜	11'-5¼	21'-8¾	18'-3⅝	14'-10⅜	11'-5¼	PL
PS	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	25'-0	22'-0	19'-0	16'-0	13'-0	10'-0	19'-0	16'-0	13'-0	10'-0	PS
RL	44'-1	40'-6⅛	36'-11⅞	33'-4¼	29'-9⅜	26'-2½	22'-7⅞	19'-0¾	15'-5⅞	36'-11⅞	33'-4¼	29'-9⅜	26'-2½	22'-7⅞	19'-0¾	15'-5⅞	29'-9⅜	26'-2½	22'-7⅞	19'-0¾	15'-5⅞	11'-11	22'-7⅞	19'-0¾	15'-5⅞	11'-11	RL
RS	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	26'-4¼	23'-2⅜	20'-0⅜	16'-10⅜	13'-8½	10'-6½	20'-0⅜	16'-10⅜	13'-8½	10'-6½	RS
S1	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	6'-2½	6'-2½	6'-2½	6'-2½	6'-2½	6'-2½	5'-2⅛	5'-2⅛	5'-2⅛	5'-2⅛	S1
T	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	1'-0	1'-0	1'-0	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	10	10	10	9	9	9	9	10	9	9	9	9	9	9	9	9	9	U
W	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	4'-0	3'-9	3'-6	3'-6	3'-6	3'-6	3'-6	3'-6	3'-6	3'-6	W

Notes:

1. See Sheet FWH G2-21 for General Notes, Specifications, and Design Stresses.
2. See Sheet FWH 15-1-21 and sheets FWH 15-3-21 thru 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

IOWA DOT

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

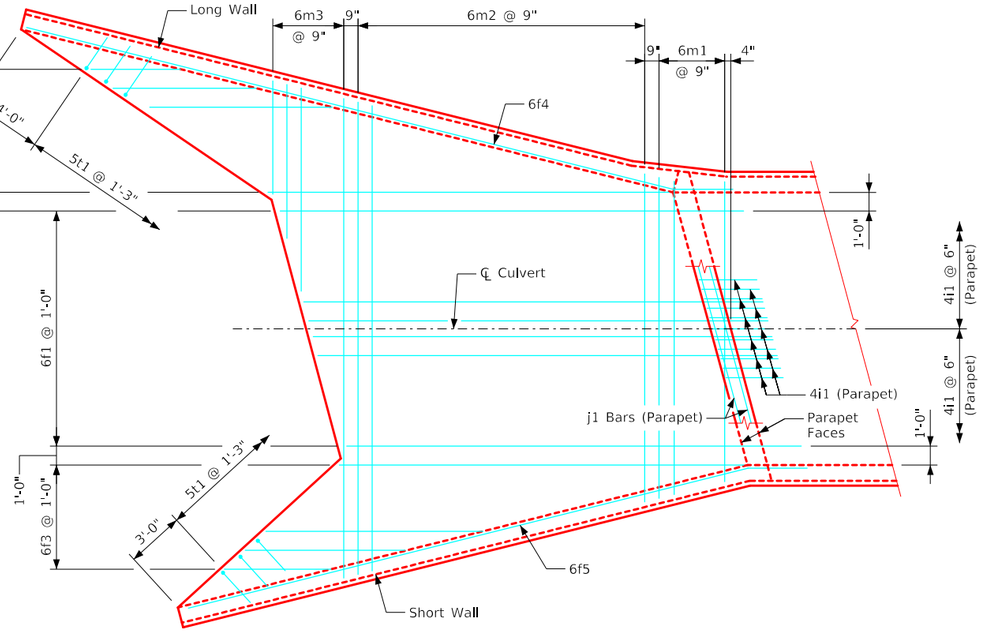
February, 2021

Dimension Table
15° Skew

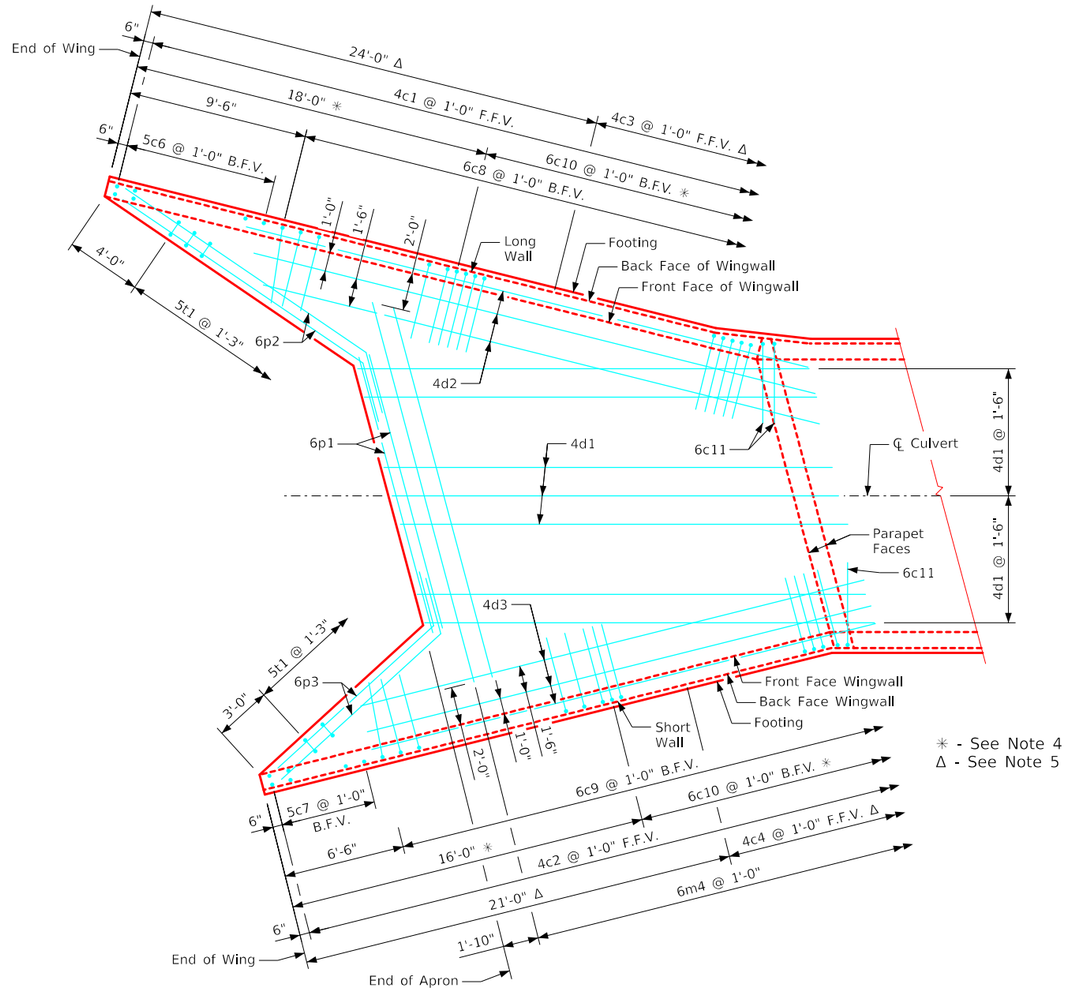
FWH 15-2-21

Sheet 2 of 2

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 15-2-21 S2 - 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 6c6 bars in the 3' thru 6' height headwalls.
5. 4c3 & 4c4 bars used only in the 9' thru 14' height headwalls.
6. For dimension table see Sheet FWH 15-2-21.
7. For reinforcing in curtain wall see Curtain Wall Details on Sheet FWH 15-4-21.

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Standard Design - Single Reinforced Concrete Box Culverts

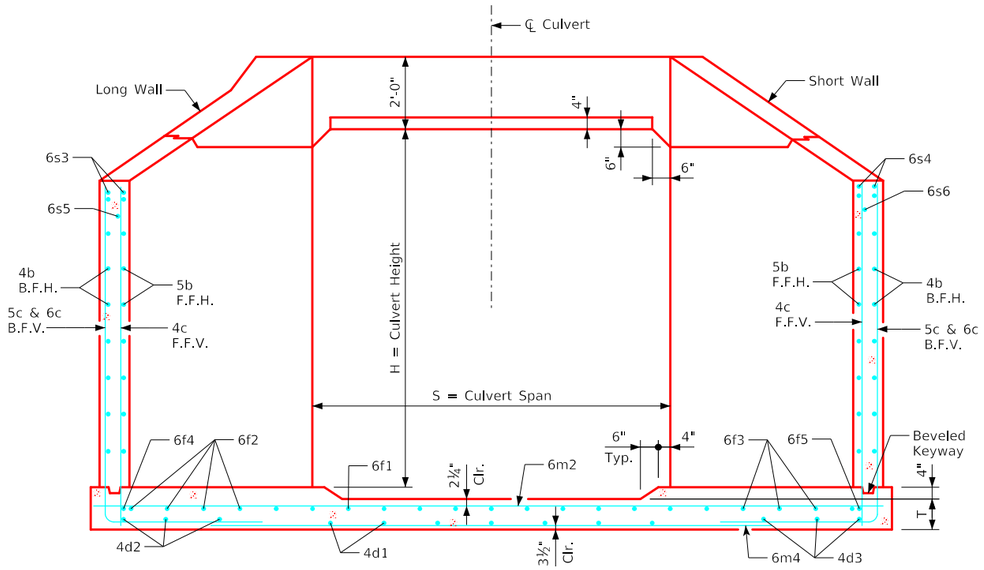
Flared Wing Headwalls

February, 2021

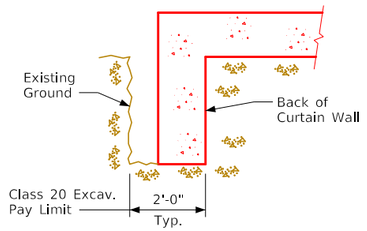
Apron Details 15° Skew

FWH 15-3-21

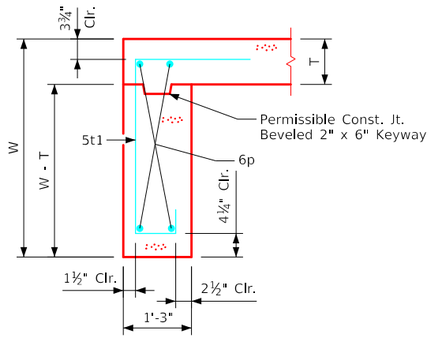
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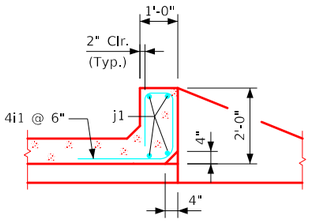
Typical Section - Near Center of Apron



Curtain Wall
Class 20 Excavation

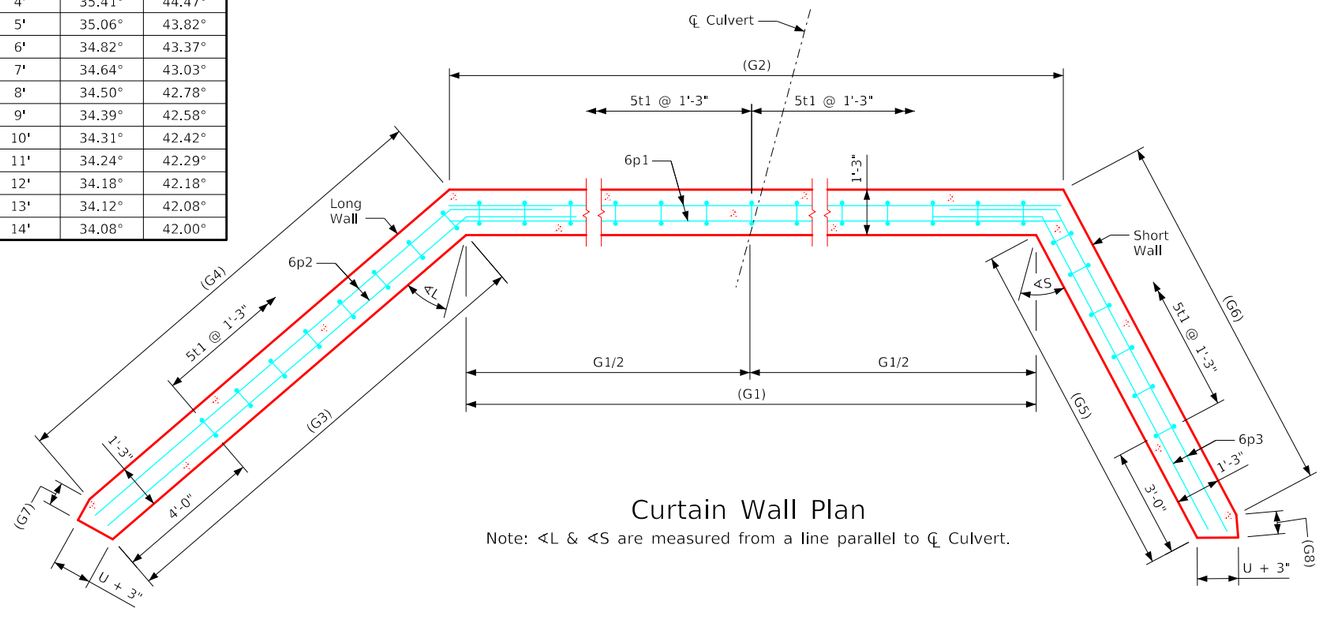


Section thru Curtain Wall



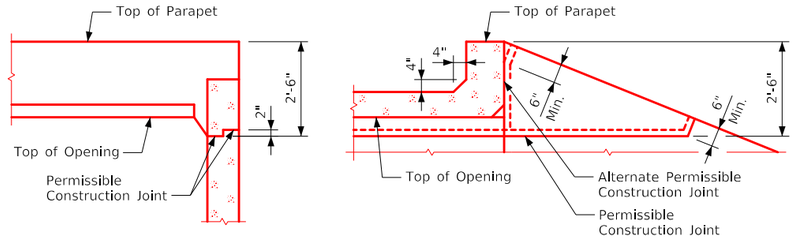
Section thru Parapet

Culvert Height (H)	Angle	
	∢L	∢S
3'	35.96°	45.50°
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°
13'	34.12°	42.08°
14'	34.08°	42.00°



Curtain Wall Plan

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



Top of Wingwall Details

Notes:

1. See Sheet FWH G2-21 for General Notes, Specifications, and Design Stresses.
2. See Sheet FWH 15-2-21 for dimensions table.

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Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

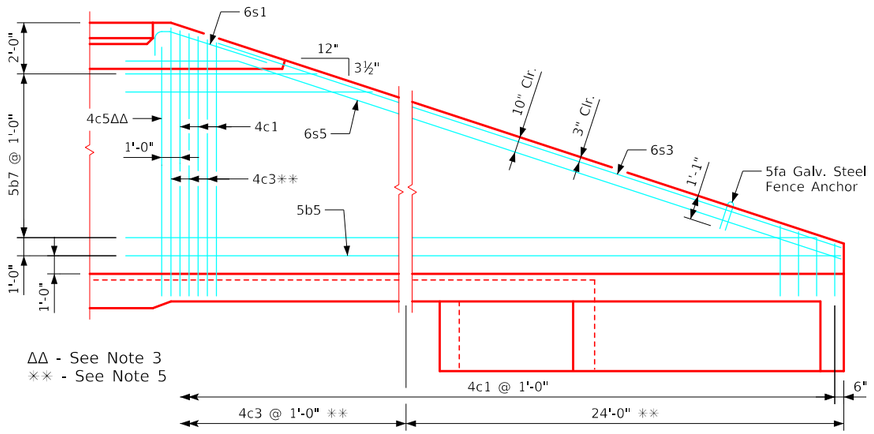
February, 2021

Parapet & Curtain Wall Details 15° Skew

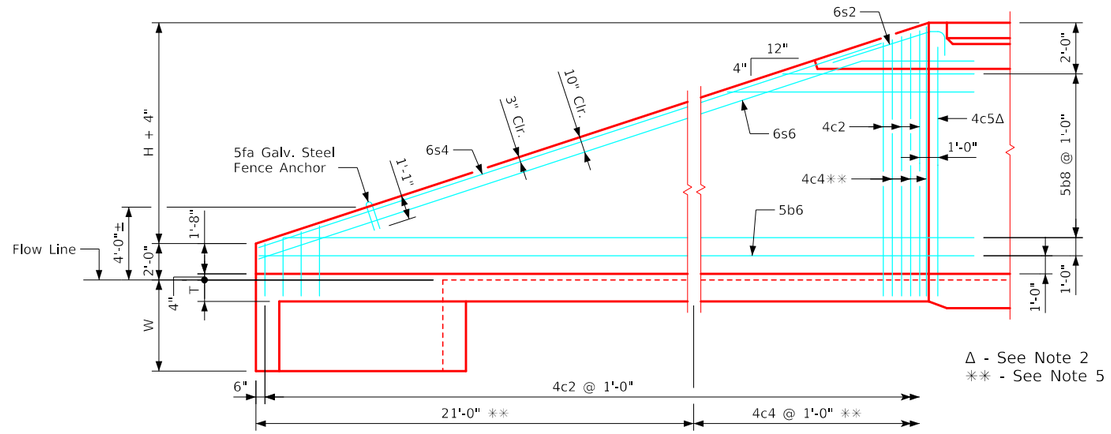
FWH 15-4-21

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 15-4-21 - THIS SHEET ISSUED 02-2021.

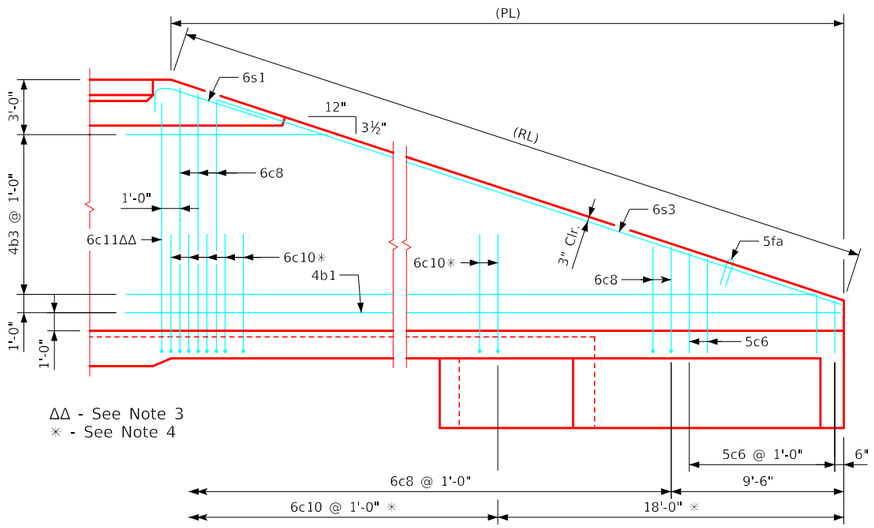
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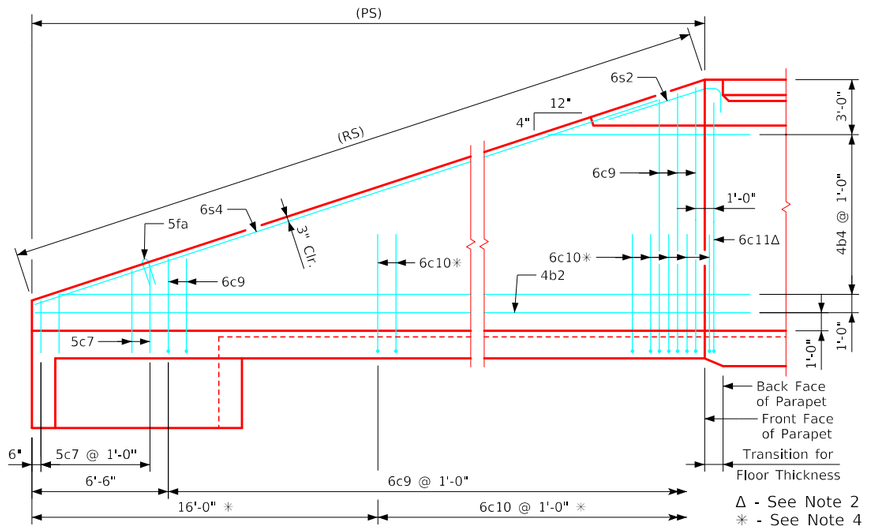
Typical View - Front Face Long Wingwall Reinforcing



Typical View - Front Face Short Wingwall Reinforcing



Typical View - Back Face Long Wingwall Reinforcing



Typical View - Back Face Short Wingwall Reinforcing

Notes:

1. Bar spacings and positions shown are similar for all sizes of headwalls in this standard.
2. Two 4c5 & two 6c11 bars for all headwalls.
3. Two 4c5 & two 6c11 for 3', 5', 7', 9', 10', 12' & 14' height headwalls. One 4c5 & one 6c11 bar for 4', 6', 8', 11' & 13' height headwalls.
4. Not applicable for 3' thru 6' height headwalls.
5. Not applicable for 3' thru 8' height headwalls.
6. For dimension table, see sheet FWH 15-2-21.
7. Top of wall slope may be rounded in some instances.

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWADOT

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Wingwall Details 15° Skew

FWH 15-5-21

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 15-5-21 - THIS SHEET ISSUED 02-2021.

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

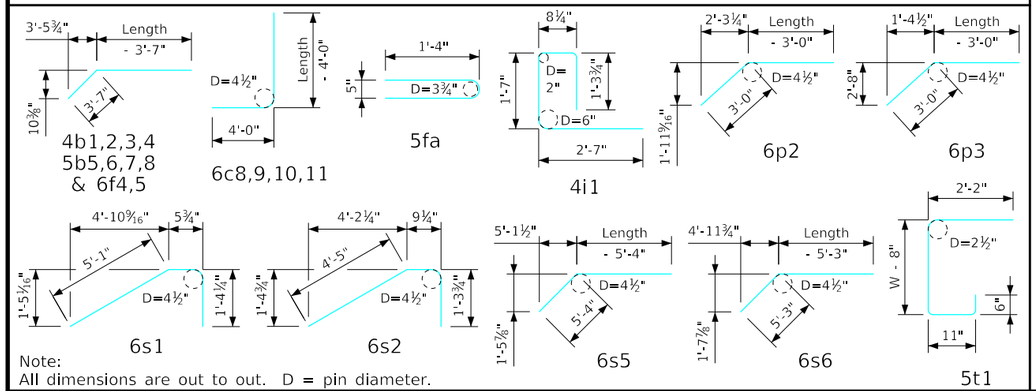
Bar	Location	Shape	16' x 14'			16' x 13'			16' x 12'			16' x 11'			16' x 10'			16' x 9'			16' x 8'			Bar
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	5fa
4b1	Wingwall, B.F.H. Long		1	52'-5	37	1	49'-0	34	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	46'-3	33	1	43'-4	31	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		12 Var.	13'-2 to 50'-10	263	11 Var.	13'-2 to 47'-6	228	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		12 Var.	11'-11 to 44'-10	231	11 Var.	11'-11 to 41'-11	199	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	52'-6	57	1	49'-1	54	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	46'-4	51	1	43'-4	48	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		13 Var.	9'-10 to 51'-0	423	12 Var.	9'-10 to 47'-6	366	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		13 Var.	9'-0 to 45'-0	371	12 Var.	9'-0 to 42'-0	322	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
4c1	Wingwall, F.F.V. Long		49 Var.	2'-10 to 16'-10	322	46 Var.	2'-10 to 16'-0	289	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		43 Var.	2'-10 to 16'-10	282	40 Var.	2'-10 to 15'-10	249	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		26 Var.	9'-8 to 17'-0	232	23 Var.	9'-8 to 16'-1	198	19 Var.	9'-8 to 14'-11	156	16 Var.	9'-8 to 14'-1	127	12 Var.	9'-8 to 12'-0	91	9 Var.	9'-8 to 12'-0	65	--	--	--	4c3
4c4	Wingwall, F.F.V. Short		23 Var.	9'-8 to 17'-0	205	20 Var.	9'-8 to 16'-0	171	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	15'-9	21	1	14'-9	10	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	15'-9	21	2	14'-9	20	2	13'-9	18	2	12'-9	17	2	11'-9	16	2	10'-9	14	2	9'-9	13	4c5
5c6	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	9 Var.	2'-10 to 5'-2	38	9 Var.	2'-10 to 5'-2	38	5c6
5c7	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	6 Var.	2'-10 to 4'-6	23	6 Var.	2'-10 to 4'-6	23	5c7
6c8	Wingwall, B.F.V. Long		40 Var.	9'-6 to 20'-0	911	37 Var.	9'-6 to 20'-0	820	33 Var.	9'-6 to 18'-10	702	30 Var.	9'-6 to 17'-11	618	26 Var.	9'-6 to 16'-9	513	23 Var.	9'-6 to 15'-11	439	20 Var.	9'-6 to 15'-0	368	6c8
6c9	Wingwall, B.F.V. Short		37 Var.	8'-10 to 20'-10	824	34 Var.	8'-10 to 19'-10	732	31 Var.	8'-10 to 18'-10	644	28 Var.	8'-10 to 17'-10	561	25 Var.	8'-10 to 16'-10	482	22 Var.	8'-10 to 15'-10	408	19 Var.	8'-10 to 14'-10	338	6c9
6c10	Wingwall, B.F.V. Long		32	10'-6	505	29	10'-6	457	25	10'-6	394	22	10'-6	347	18	10'-6	284	15	10'-6	237	12	10'-6	189	6c10
6c10	Wingwall, B.F.V. Short		28	10'-6	442	25	10'-6	394	22	10'-6	347	19	10'-6	300	16	10'-6	252	13	10'-6	205	10	10'-6	158	6c10
6c11	Wingwall, B.F.V. Long		2	19'-9	59	1	18'-9	28	2	17'-9	53	1	16'-9	25	2	15'-9	47	2	14'-9	44	1	13'-9	21	6c11
6c11	Wingwall, B.F.V. Short		2	19'-9	59	2	18'-9	56	2	17'-9	53	2	16'-9	50	2	15'-9	47	2	14'-9	44	2	13'-9	41	6c11
4d1	Apron, Longit., Bott.		11	33'-0	242	11	30'-11	227	11	28'-10	212	11	26'-9	197	11	24'-9	182	11	22'-8	167	11	20'-7	151	4d1
4d2	Apron, Longit., Bott. Long		3	47'-2	99	3	43'-8	92	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	41'-6	88	3	38'-6	77	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		15	33'-0	743	15	30'-11	697	15	28'-10	650	15	26'-9	603	15	24'-9	558	15	22'-8	511	15	20'-7	464	6f1
6f2	Apron, Longit., Top Long		10 Var.	7'-1 to 29'-9	277	9 Var.	7'-6 to 27'-8	238	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		9 Var.	6'-9 to 29'-10	247	9 Var.	4'-8 to 27'-9	219	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	52'-6	82	1	49'-1	77	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	46'-4	73	1	43'-4	69	1	40'-4	64	1	37'-4	56	1	34'-4	52	1	31'-4	47	1	28'-4	43	6f5
4i1	Parapet, Vertical		33	6'-2	136	33	6'-2	136	33	6'-2	136	33	6'-2	136	33	6'-2	136	33	6'-2	136	33	6'-2	136	4i1
9j1	Parapet, Horizontal		4	18'-7	253	4	18'-3	248	4	18'-3	248	4	18'-1	246	4	17'-11	244	4	17'-11	244	4	17'-11	244	9j1
6m1	Apron, Trans., Top		4 Var.	18'-10 to 19'-5	115	4 Var.	18'-6 to 19'-1	113	4 Var.	18'-6 to 19'-1	113	4 Var.	18'-4 to 18'-11	112	4 Var.	18'-2 to 18'-9	111	4 Var.	18'-2 to 18'-9	111	4 Var.	18'-2 to 18'-9	111	6m1
6m2	Apron, Trans., Top		34 Var.	19'-8 to 32'-1	1321	31 Var.	19'-4 to 30'-7	1162	28 Var.	19'-4 to 29'-6	1027	26 Var.	19'-2 to 28'-7	932	23 Var.	19'-0 to 27'-3	799	20 Var.	19'-0 to 26'-1	677	17 Var.	19'-0 to 25'-0	562	6m2
6m3	Apron, Trans., Top		6 Var.	9'-0 to 22'-0	140	6 Var.	8'-11 to 21'-11	139	6 Var.	9'-0 to 22'-1	140	5 Var.	9'-1 to 19'-6	107	6 Var.	6'-5 to 19'-6	117	6 Var.	6'-7 to 19'-7	118	6 Var.	6'-8 to 19'-8	119	6m3
6m4	Apron, Trans., Bott.		28 Var.	12'-2 to 26'-8	817	26 Var.	12'-2 to 25'-7	737	24 Var.	12'-2 to 24'-6	661	22 Var.	12'-2 to 23'-5	588	20 Var.	12'-2 to 22'-4	518	18 Var.	12'-2 to 21'-4	453	16 Var.	12'-2 to 20'-3	390	6m4
6p1	Curtain, Horizontal		4	16'-10	101	4	16'-10	101	4	16'-10	101	4	16'-10	101	4	16'-10	101	4	16'-10	101	4	16'-10	101	6p1
6p2	Curtain, Horizontal, Long		4	24'-9	149	4	23'-3	140	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	19'-1	115	4	17'-11	108	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	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	2	6'-6	20	2	6'-6	20	6s2
6s3	Wing Slope, Both F., Long		2	48'-5	153	2	44'-10	142	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	43'-2	137	2	40'-0	120	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	53'-7	84	1	50'-0	79	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	48'-0	76	1	44'-10	71	1	41'-8	66	1	38'-6	58	1	35'-4	53	1	32'-2	48	1	29'-0	44	6s6
5t1	Curtain, Vertical		39	8'-5	342	37	8'-2	315	34	7'-11	281	32	7'-8	256	30	7'-5	232	29	7'-2	217	27	6'-11	195	5t1
	Estimated Quantities One Headwall	Reinf. Steel	11,247 LB			10,121 LB			9080 LB			8059 LB			7097 LB			6236 LB			5296 LB			
		Concrete Parapet Δ	2.3	96.6 CY		2.2	81.3 CY		2.2	72.4 CY		2.1	62.0 CY		2.0	52.6 CY		2.0	45.7 CY		2.0	39.3 CY		
		Concrete Wingwalls	35.4			26.6			23.0			18.1			13.9			11.6			9.5			
		Concrete Apron ✳	58.9			52.5			47.2			41.8			36.7			32.1			27.8			

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

Bent Bar Details



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

Headwall Notes:

1. See Sheet FWH G2-21 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", "f1", "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

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
16'-0" Span
15° Skew

FWH 15-6-21

Sheet 1 of 2

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 15-6-21 S1 - THIS SHEET ISSUED 02-2021.

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

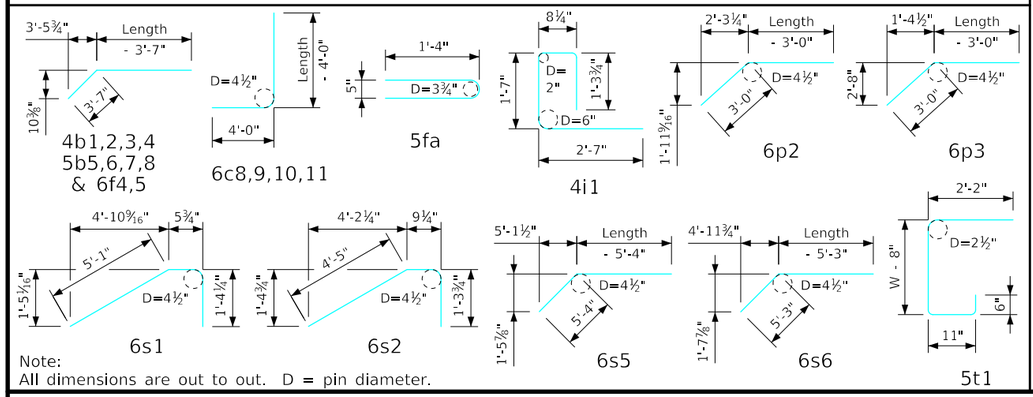
Bar	Location	Shape	16' x 7'			16' x 6'			16' x 5'			16' x 4'			Bar
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	5fa
4b1	Wingwall, B.F.H. Long		1	28'-6	19	1	25'-1	17	1	21'-7	14	1	18'-2	12	4b1
4b2	Wingwall, B.F.H. Short		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
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
5c6	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	5c6
5c7	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	5c7
6c8	Wingwall, B.F.V. Long		16 Var.	9'-6 to 13'-10	280	13 Var.	9'-6 to 13'-0	220	9 Var.	9'-6 to 11'-10	144	6 Var.	9'-6 to 10'-11	92	6c8
6c9	Wingwall, B.F.V. Short		16 Var.	8'-10 to 13'-10	272	13 Var.	8'-10 to 12'-10	212	10 Var.	8'-10 to 11'-10	155	7 Var.	8'-10 to 10'-10	103	6c9
6c10	Wingwall, B.F.V. Long		8	10'-6	126	--	--	--	--	--	--	--	--	--	6c10
6c10	Wingwall, B.F.V. Short		7	10'-6	110	--	--	--	--	--	--	--	--	--	6c10
6c11	Wingwall, B.F.V. Long		2	12'-9	38	1	11'-9	18	2	10'-9	32	1	9'-9	15	6c11
6c11	Wingwall, B.F.V. Short		2	12'-9	38	2	11'-9	35	2	10'-9	32	2	9'-9	29	6c11
4d1	Apron, Longit., Bott.		11	18'-6	136	11	16'-5	121	11	14'-4	105	11	12'-4	91	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		15	18'-6	417	15	16'-5	370	15	14'-4	323	15	12'-4	278	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		33	6'-2	136	33	6'-2	136	33	6'-2	136	33	6'-2	136	4i1
9j1	Parapet, Horizontal		4	17'-9	241	4	17'-9	241	4	17'-9	241	4	17'-9	241	9j1
6m1	Apron, Trans., Top		4 Var.	18'-0 to 18'-7	110	4 Var.	18'-0 to 18'-7	110	4 Var.	18'-0 to 18'-7	110	4 Var.	18'-0 to 18'-7	110	6m1
6m2	Apron, Trans., Top		15 Var.	18'-10 to 24'-1	483	12 Var.	18'-10 to 22'-11	376	9 Var.	18'-10 to 21'-10	275	6 Var.	18'-10 to 20'-8	178	6m2
6m3	Apron, Trans., Top		5 Var.	6'-8 to 17'-2	89	6 Var.	4'-2 to 17'-3	97	6 Var.	4'-3 to 17'-4	97	6 Var.	4'-5 to 17'-5	98	6m3
6m4	Apron, Trans., Bott.		14 Var.	12'-2 to 19'-2	329	12 Var.	12'-2 to 18'-1	273	10 Var.	12'-2 to 17'-0	219	8 Var.	12'-2 to 15'-11	169	6m4
6p1	Curtain, Horizontal		4	16'-10	101	4	16'-9	101	4	16'-9	101	4	16'-9	101	6p1
6p2	Curtain, Horizontal, Long		4	14'-2	85	4	12'-8	76	4	11'-2	67	4	9'-8	58	6p2
6p3	Curtain, Horizontal, Short		4	11'-3	68	4	10'-2	61	4	9'-1	55	4	7'-11	48	6p3
6s1	Wing Slope, Both F., Long		2	6'-11	21	2	6'-11	21	2	6'-11	21	2	6'-11	21	6s1
6s2	Wing Slope, Both F., Short		2	6'-6	20	2	6'-6	20	2	6'-6	20	2	6'-6	20	6s2
6s3	Wing Slope, Both F., Long		2	23'-5	70	2	19'-10	60	2	16'-3	49	2	12'-8	38	6s3
6s4	Wing Slope, Both F., Short		2	21'-1	63	2	17'-11	54	2	14'-9	44	2	11'-7	35	6s4
6s5	Wing Slope, F.F. Long		1	28'-7	43	1	25'-0	38	1	21'-5	32	1	17'-10	27	6s5
6s6	Wing Slope, F.F. Short		1	25'-10	39	1	22'-8	34	1	19'-6	29	1	16'-4	25	6s6
5t1	Curtain, Vertical		24	6'-8	167	22	6'-5	147	20	6'-5	134	18	6'-5	120	5t1
	Estimated Quantities One Headwall	Reinf. Steel	4512 LB			3658 LB			3077 LB			2526 LB			
		Concrete: Parapet Δ	1.9	32.3 CY		1.9	26.9 CY		1.9	22.3 CY		1.9	18.1 CY		
		Concrete: Wingwalls	6.8			5.2			3.8			2.6			
		Concrete: Apron ✳	23.6			19.8			16.6			13.6			

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

Bent Bar Details



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

Headwall Notes:

1. See Sheet FWH G2-21 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

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
16'-0" Span
15° Skew

FWH 15-6-21

Sheet 2 of 2

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 15-6-21 S2 - THIS SHEET ISSUED 02-2021.

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

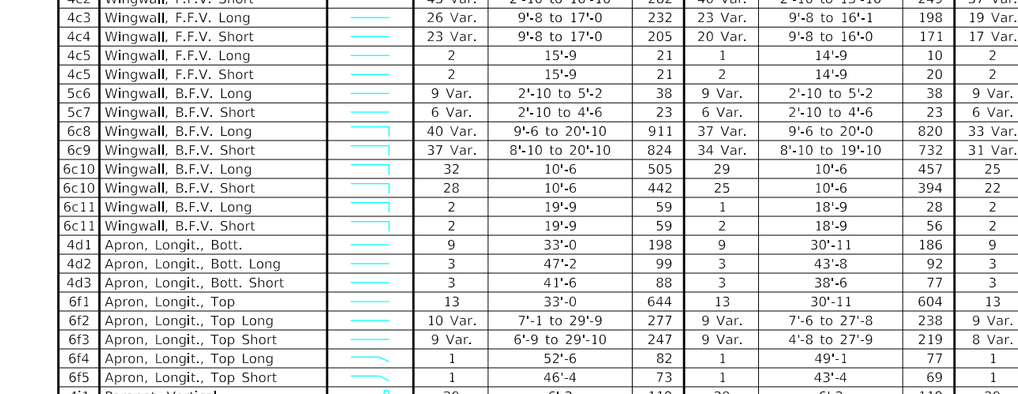
Bar	Location	Shape	14' x 14'			14' x 13'			14' x 12'			14' x 11'			14' x 10'			14' x 9'			14' x 8'			Bar
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	5fa
4b1	Wingwall, B.F.H. Long		1	52'-5	37	1	49'-0	34	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	46'-3	33	1	43'-4	31	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		12 Var.	13'-2 to 50'-10	263	11 Var.	13'-2 to 47'-6	228	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		12 Var.	11'-11 to 44'-10	231	11 Var.	11'-11 to 41'-11	199	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	52'-6	57	1	49'-1	54	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	46'-4	51	1	43'-4	48	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		13 Var.	9'-10 to 51'-0	423	12 Var.	9'-10 to 47'-6	366	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		13 Var.	9'-0 to 45'-0	371	12 Var.	9'-0 to 42'-0	322	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
4c1	Wingwall, F.F.V. Long		49 Var.	2'-10 to 16'-10	322	46 Var.	2'-10 to 16'-0	289	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		43 Var.	2'-10 to 16'-10	282	40 Var.	2'-10 to 15'-10	249	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		26 Var.	9'-8 to 17'-0	232	23 Var.	9'-8 to 16'-1	198	19 Var.	9'-8 to 14'-11	156	16 Var.	9'-8 to 14'-1	127	12 Var.	9'-8 to 12'-0	91	9 Var.	9'-8 to 12'-0	65	--	--	--	4c3
4c4	Wingwall, F.F.V. Short		23 Var.	9'-8 to 17'-0	205	20 Var.	9'-8 to 16'-0	171	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	15'-9	21	1	14'-9	10	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	15'-9	21	2	14'-9	20	2	13'-9	18	2	12'-9	17	2	11'-9	16	2	10'-9	14	2	9'-9	13	4c5
5c6	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	9 Var.	2'-10 to 5'-2	38	9 Var.	2'-10 to 5'-2	38	5c6
5c7	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	6 Var.	2'-10 to 4'-6	23	6 Var.	2'-10 to 4'-6	23	5c7
6c8	Wingwall, B.F.V. Long		40 Var.	9'-6 to 20'-10	911	37 Var.	9'-6 to 20'-0	820	33 Var.	9'-6 to 18'-10	702	30 Var.	9'-6 to 17'-11	618	26 Var.	9'-6 to 16'-9	513	23 Var.	9'-6 to 15'-11	439	20 Var.	9'-6 to 15'-0	368	6c8
6c9	Wingwall, B.F.V. Short		37 Var.	8'-10 to 20'-10	824	34 Var.	8'-10 to 19'-10	732	31 Var.	8'-10 to 18'-10	644	28 Var.	8'-10 to 17'-10	561	25 Var.	8'-10 to 16'-10	482	22 Var.	8'-10 to 15'-10	408	19 Var.	8'-10 to 14'-10	338	6c9
6c10	Wingwall, B.F.V. Long		32	10'-6	505	29	10'-6	457	25	10'-6	394	22	10'-6	347	18	10'-6	284	15	10'-6	237	12	10'-6	189	6c10
6c10	Wingwall, B.F.V. Short		28	10'-6	442	25	10'-6	394	22	10'-6	347	19	10'-6	300	16	10'-6	252	13	10'-6	205	10	10'-6	158	6c10
6c11	Wingwall, B.F.V. Long		2	19'-9	59	1	18'-9	28	2	17'-9	53	1	16'-9	25	2	15'-9	47	2	14'-9	44	1	13'-9	21	6c11
6c11	Wingwall, B.F.V. Short		2	19'-9	59	2	18'-9	56	2	17'-9	53	2	16'-9	50	2	15'-9	47	2	14'-9	44	2	13'-9	41	6c11
4d1	Apron, Longit., Bott.		9	33'-0	198	9	30'-11	186	9	28'-10	173	9	26'-9	161	9	24'-9	149	9	22'-8	136	9	20'-7	124	4d1
4d2	Apron, Longit., Bott. Long		3	47'-2	99	3	43'-8	92	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	41'-6	88	3	38'-6	77	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		13	33'-0	644	13	30'-11	604	13	28'-10	563	13	26'-9	522	13	24'-9	483	13	22'-8	443	13	20'-7	402	6f1
6f2	Apron, Longit., Top Long		10 Var.	7'-1 to 29'-9	277	9 Var.	7'-6 to 27'-8	238	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		9 Var.	6'-9 to 29'-10	247	9 Var.	4'-8 to 27'-9	219	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	52'-6	82	1	49'-1	77	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	46'-4	73	1	43'-4	69	1	40'-4	64	1	37'-4	56	1	34'-4	52	1	31'-4	47	1	28'-4	43	6f5
4i1	Parapet, Vertical		29	6'-2	119	29	6'-2	119	29	6'-2	119	29	6'-2	119	29	6'-2	119	29	6'-2	119	29	6'-2	119	4i1
9j1	Parapet, Horizontal		4	16'-6	224	4	16'-2	220	4	16'-2	220	4	16'-0	218	4	15'-10	215	4	15'-10	215	4	15'-10	215	9j1
6m1	Apron, Trans., Top		4 Var.	16'-9 to 17'-4	102	4 Var.	16'-5 to 17'-0	100	4 Var.	16'-5 to 17'-0	100	4 Var.	16'-3 to 16'-10	99	4 Var.	16'-1 to 16'-8	98	4 Var.	16'-1 to 16'-8	98	4 Var.	16'-1 to 16'-8	98	6m1
6m2	Apron, Trans., Top		34 Var.	17'-8 to 30'-1	1219	32 Var.	17'-4 to 29'-0	1113	29 Var.	17'-4 to 27'-10	984	26 Var.	17'-2 to 26'-7	854	23 Var.	17'-0 to 25'-3	730	21 Var.	17'-0 to 24'-6	654	18 Var.	17'-0 to 23'-4	545	6m2
6m3	Apron, Trans., Top		5 Var.	10'-8 to 21'-1	119	5 Var.	8'-0 to 18'-5	99	5 Var.	8'-1 to 18'-7	100	5 Var.	8'-1 to 18'-7	100	5 Var.	8'-2 to 18'-7	100	5 Var.	5'-7 to 16'-1	81	5 Var.	5'-9 to 16'-2	82	6m3
6m4	Apron, Trans., Bott.		28 Var.	10'-1 to 24'-7	729	26 Var.	10'-1 to 23'-6	656	24 Var.	10'-1 to 22'-6	587	22 Var.	10'-1 to 21'-4	519	20 Var.	10'-1 to 20'-4	457	18 Var.	10'-1 to 19'-3	397	16 Var.	10'-1 to 18'-2	339	6m4
6p1	Curtain, Horizontal		4	14'-9	89	4	14'-9	89	4	14'-9	89	4	14'-9	89	4	14'-9	89	4	14'-9	89	4	14'-9	89	6p1
6p2	Curtain, Horizontal, Long		4	24'-9	149	4	23'-3	140	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	19'-1	115	4	17'-11	108	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	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	2	6'-6	20	2	6'-6	20	6s2
6s3	Wing Slope, Both F., Long		2	48'-5	153	2	44'-10	142	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	43'-2	137	2	40'-0	120	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	53'-7	84	1	50'-0	79	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	48'-0	76	1	44'-10	71	1	41'-8	66	1	38'-6	58	1	35'-4	53	1	32'-2	48	1	29'-0	44	6s6
5t1	Curtain, Vertical		37	8'-5	325	35	8'-2	298	32	7'-11	264	30	7'-8	240	28	7'-5	217	27	7'-2	202	25	6'-11	180	5t1
	Estimated Quantities One Headwall	Reinf. Steel		10,805 LB			9730 LB			8710 LB			7702 LB			6756 LB			5935 LB			5016 LB		
		Concrete Parapet Δ	2.2			2.0			2.0			1.9			1.9			1.9			1.9			
		Concrete Wingwalls	35.4	93.5 CY		26.6	78.2 CY		23.0	69.5 CY		18.1	59.3 CY		13.9	50.2 CY		11.6	43.6 CY		9.5	37.4 CY		
		Concrete Apron ✳	55.9			49.6			44.5			39.3			34.4			30.1			26.0			

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

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

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

Bent Bar Details



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

Headwall Notes:

1. See Sheet FWH G2-21 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", "f1", "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

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
14'-0" Span
15° Skew

FWH 15-7-21

Sheet 1 of 2

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 15-7-21 S1 - THIS SHEET ISSUED 02-2021.

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

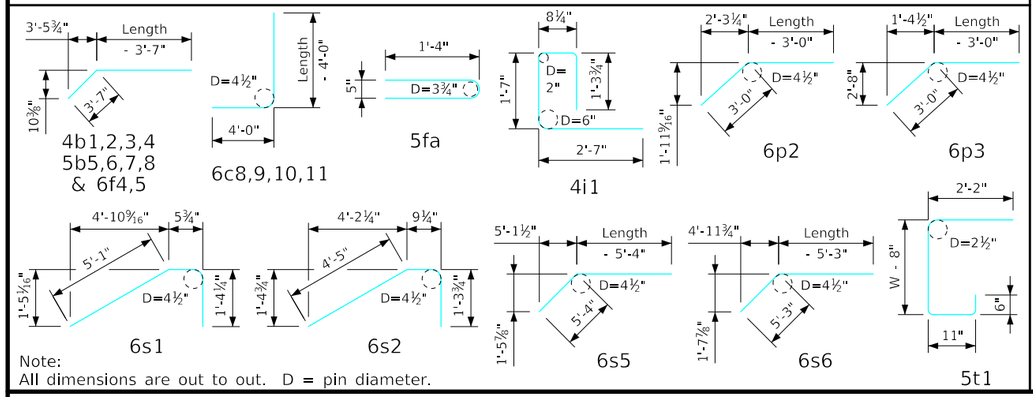
Bar	Location	Shape	14' x 7' No.	14' x 7' Length	14' x 7' Wt.	14' x 6' No.	14' x 6' Length	14' x 6' Wt.	14' x 5' No.	14' x 5' Length	14' x 5' Wt.	14' x 4' No.	14' x 4' Length	14' x 4' Wt.	Bar
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	5fa
4b1	Wingwall, B.F.H. Long		1	28'-6	19	1	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
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
5c6	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	5c6
5c7	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	5c7
6c8	Wingwall, B.F.V. Long		16 Var.	9'-6 to 13'-10	280	13 Var.	9'-6 to 13'-0	220	9 Var.	9'-6 to 11'-10	144	6 Var.	9'-6 to 10'-11	92	6c8
6c9	Wingwall, B.F.V. Short		16 Var.	8'-10 to 13'-10	272	13 Var.	8'-10 to 12'-10	212	10 Var.	8'-10 to 11'-10	155	7 Var.	8'-10 to 10'-10	103	6c9
6c10	Wingwall, B.F.V. Long		8	10'-6	126	--	--	--	--	--	--	--	--	--	6c10
6c10	Wingwall, B.F.V. Short		7	10'-6	110	--	--	--	--	--	--	--	--	--	6c10
6c11	Wingwall, B.F.V. Long		2	12'-9	38	1	11'-9	18	2	10'-9	32	1	9'-9	15	6c11
6c11	Wingwall, B.F.V. Short		2	12'-9	38	2	11'-9	35	2	10'-9	32	2	9'-9	29	6c11
4d1	Apron, Longit., Bott.		9	18'-6	111	9	16'-5	99	9	14'-4	86	9	12'-4	74	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		13	18'-6	361	13	16'-5	321	13	14'-4	280	13	12'-4	241	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		29	6'-2	119	29	6'-2	119	29	6'-2	119	29	6'-2	119	4i1
9j1	Parapet, Horizontal		4	15'-8	213	4	15'-8	213	4	15'-8	213	4	15'-8	213	9j1
6m1	Apron, Trans., Top		4 Var.	15'-11 to 16'-6	97	4 Var.	15'-11 to 16'-6	97	4 Var.	15'-11 to 16'-6	97	4 Var.	15'-11 to 16'-6	97	6m1
6m2	Apron, Trans., Top		15 Var.	16'-10 to 22'-1	438	12 Var.	16'-10 to 20'-11	340	9 Var.	16'-10 to 19'-10	248	7 Var.	16'-10 to 19'-1	189	6m2
6m3	Apron, Trans., Top		5 Var.	5'-9 to 16'-3	83	5 Var.	5'-10 to 16'-4	83	6 Var.	3'-4 to 16'-5	89	5 Var.	3'-5 to 13'-11	65	6m3
6m4	Apron, Trans., Bott.		14 Var.	10'-1 to 17'-1	286	12 Var.	10'-1 to 16'-0	235	10 Var.	10'-1 to 14'-11	188	8 Var.	10'-1 to 13'-10	144	6m4
6p1	Curtain, Horizontal		4	14'-9	89	4	14'-9	89	4	14'-9	89	4	14'-8	88	6p1
6p2	Curtain, Horizontal, Long		4	14'-2	85	4	12'-8	76	4	11'-2	67	4	9'-8	58	6p2
6p3	Curtain, Horizontal, Short		4	11'-3	68	4	10'-2	61	4	9'-1	55	4	7'-11	48	6p3
6s1	Wing Slope, Both F., Long		2	6'-11	21	2	6'-11	21	2	6'-11	21	2	6'-11	21	6s1
6s2	Wing Slope, Both F., Short		2	6'-6	20	2	6'-6	20	2	6'-6	20	2	6'-6	20	6s2
6s3	Wing Slope, Both F., Long		2	23'-5	70	2	19'-10	60	2	16'-3	49	2	12'-8	38	6s3
6s4	Wing Slope, Both F., Short		2	21'-1	63	2	17'-11	54	2	14'-9	44	2	11'-7	35	6s4
6s5	Wing Slope, F.F. Long		1	28'-7	43	1	25'-0	38	1	21'-5	32	1	17'-10	27	6s5
6s6	Wing Slope, F.F. Short		1	25'-10	39	1	22'-8	34	1	19'-6	29	1	16'-4	25	6s6
5t1	Curtain, Vertical		22	6'-8	153	20	6'-5	134	18	6'-5	120	16	6'-5	107	5t1
	Estimated Quantities One Headwall	Reinf. Steel		4253 LB			3416 LB			2865 LB			2341 LB		
		Concrete: Parapet Δ	1.8	30.5 CY		1.8	25.3 CY		1.8	21.0 CY		1.8	16.9 CY		
		Concrete: Wingwalls	6.8			5.2			3.8			2.6			
		Concrete: Apron ✳	21.9			18.3			15.4			12.5			

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.

Headwall Notes:

1. See Sheet FWH G2-21 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", "f1", "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

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
14'-0" Span
15° Skew

FWH 15-7-21

Sheet 2 of 2

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 15-7-21 S2 - THIS SHEET ISSUED 02-2021.

Revised 08-2022: Corrected Typos in Bill of Reinforcing bar "Location" with bars 7j1, 6m1, 6m2, 6m3, 6m4, 6p1, 6p2, 6p3, 6s1, 6s2, 6s3, 6s4, 6s5, 6s6, 5t1.
ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 15-8-21 S1 - THIS SHEET ISSUED 02-2021.

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

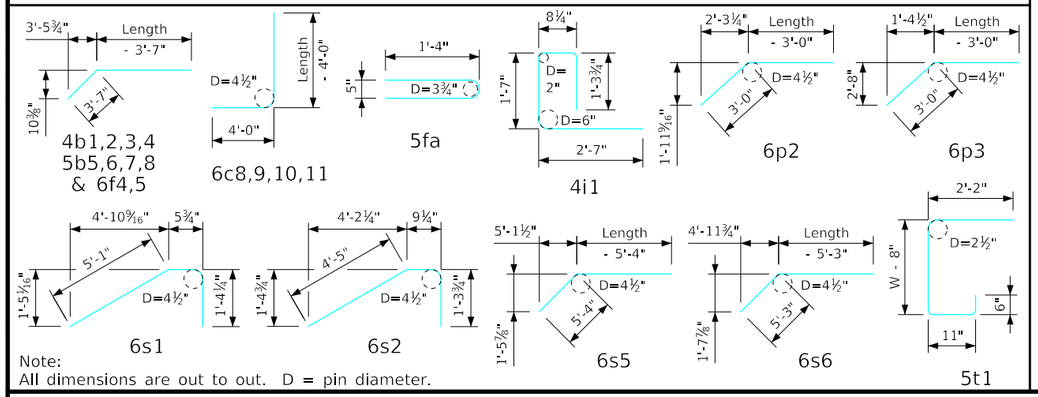
Bar	Location	Shape	12' x 12'			12' x 11'			12' x 10'			12' x 9'			12' x 8'			12' x 7'			Bar
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	5fa
4b1	Wingwall, B.F.H. Long		1	45'-7	32	1	42'-2	30	1	38'-9	26	1	35'-4	24	1	31'-11	21	1	28'-6	19	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	1	25'-4	17	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	5 Var.	13'-2 to 26'-11	67	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	5 Var.	11'-11 to 23'-11	60	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	1	28'-6	30	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	1	25'-4	26	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	6 Var.	9'-10 to 26'-11	115	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	6 Var.	9'-0 to 24'-0	103	5b8
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	25 Var.	2'-10 to 9'-10	106	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	22 Var.	2'-10 to 9'-10	93	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	2	8'-9	12	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	2	8'-9	12	4c5
5c6	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	9 Var.	2'-10 to 5'-2	38	5c6
5c7	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	6 Var.	2'-10 to 4'-6	23	5c7
6c8	Wingwall, B.F.V. Long		33 Var.	9'-6 to 18'-10	702	30 Var.	9'-6 to 17'-11	618	26 Var.	9'-6 to 16'-9	513	23 Var.	9'-6 to 15'-11	439	20 Var.	9'-6 to 15'-0	368	16 Var.	9'-6 to 13'-10	280	6c8
6c9	Wingwall, B.F.V. Short		31 Var.	8'-10 to 18'-10	644	28 Var.	8'-10 to 17'-10	561	25 Var.	8'-10 to 16'-10	482	22 Var.	8'-10 to 15'-10	408	19 Var.	8'-10 to 14'-10	338	16 Var.	8'-10 to 13'-10	272	6c9
6c10	Wingwall, B.F.V. Long		25	10'-6	394	22	10'-6	347	18	10'-6	284	15	10'-6	237	12	10'-6	189	8	10'-6	126	6c10
6c10	Wingwall, B.F.V. Short		22	10'-6	347	19	10'-6	300	16	10'-6	252	13	10'-6	205	10	10'-6	158	7	10'-6	110	6c10
6c11	Wingwall, B.F.V. Long		2	17'-9	53	1	16'-9	25	2	15'-9	47	2	14'-9	44	1	13'-9	21	2	12'-9	38	6c11
6c11	Wingwall, B.F.V. Short		2	17'-9	53	2	16'-9	50	2	15'-9	47	2	14'-9	44	2	13'-9	41	2	12'-9	38	6c11
4d1	Apron, Longit., Bott.		9	28'-10	173	9	26'-9	161	9	24'-9	149	9	22'-8	136	9	20'-7	124	9	18'-6	111	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	3	23'-1	46	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	3	20'-5	41	4d3
6f1	Apron, Longit., Top		11	28'-10	476	11	26'-9	442	11	24'-9	409	11	22'-8	374	11	20'-7	340	11	18'-6	306	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	4 Var.	7'-7 to 15'-3	69	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	4 Var.	6'-7 to 15'-4	66	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	1	28'-6	43	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	1	25'-4	38	6f5
4i1	Parapet, Vertical		25	6'-2	103	25	6'-2	103	25	6'-2	103	25	6'-2	103	25	6'-2	103	25	6'-2	103	4i1
7j1	Parapet, Horizontal		4	14'-1	115	4	13'-11	114	4	13'-9	112	4	13'-9	112	4	13'-9	112	4	13'-7	111	7j1
6m1	Apron, Trans., Top		3 Var.	14'-5 to 14'-9	66	3 Var.	14'-3 to 14'-7	65	3 Var.	14'-1 to 14'-5	64	3 Var.	14'-1 to 14'-5	64	3 Var.	14'-1 to 14'-5	64	3 Var.	13'-11 to 14'-3	63	6m1
6m2	Apron, Trans., Top		30 Var.	15'-0 to 25'-10	920	27 Var.	14'-10 to 24'-7	799	25 Var.	14'-7 to 23'-7	717	22 Var.	14'-7 to 22'-6	613	19 Var.	14'-7 to 21'-4	512	16 Var.	14'-5 to 20'-1	415	6m2
6m3	Apron, Trans., Top		5 Var.	7'-2 to 17'-7	93	5 Var.	7'-2 to 17'-8	93	4 Var.	7'-2 to 15'-0	67	4 Var.	7'-4 to 15'-2	68	4 Var.	7'-5 to 15'-3	68	5 Var.	4'-10 to 15'-3	75	6m3
6m4	Apron, Trans., Bott.		24 Var.	8'-0 to 20'-5	512	22 Var.	8'-0 to 19'-4	452	20 Var.	8'-0 to 18'-3	394	18 Var.	8'-0 to 17'-2	340	16 Var.	8'-0 to 16'-1	289	14 Var.	8'-0 to 15'-0	242	6m4
6p1	Curtain, Horizontal		4	12'-8	76	4	12'-8	76	4	12'-8	76	4	12'-8	76	4	12'-8	76	4	12'-8	76	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	4	14'-2	85	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	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	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	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	2	23'-5	70	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	2	21'-1	63	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	1	28'-7	43	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	1	25'-10	39	6s6
5t1	Curtain, Vertical		30	7'-11	248	28	7'-8	224	26	7'-5	201	25	7'-2	187	23	6'-11	166	20	6'-8	139	5t1
	Estimated Quantities One Headwall	Reinf. Steel		8293 LB			7310 LB			6391 LB			5574 LB			4677 LB			3944 LB		
		Concrete Parapet Δ	1.8	66.7 CY		1.8	56.8 CY		1.7	47.7 CY		1.7	41.3 CY		1.7	35.3 CY		1.6	28.7 CY		
		Concrete Wingwalls	23.0			18.1			13.9			11.6			9.5			6.8			
		Concrete Apron ✳	41.9			36.9			32.1			28.0			24.1			20.3			

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.

Headwall Notes:

1. See Sheet FWH G2-21 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.

August 2022
LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWA DOT

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
12'-0" Span
15° Skew

FWH 15-8-21
Sheet 1 of 2

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

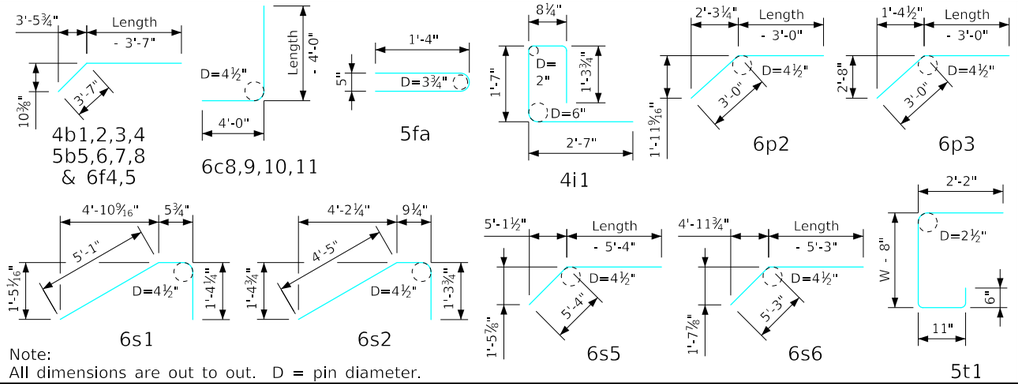
Bar	Location	Shape	12' x 6' No.	12' x 6' Length	12' x 6' Wt.	12' x 5' No.	12' x 5' Length	12' x 5' Wt.	12' x 4' No.	12' x 4' Length	12' x 4' Wt.	Bar
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	5fa
4b1	Wingwall, B.F.H. Long		1	25'-1	17	1	21'-7	14	1	18'-2	12	4b1
4b2	Wingwall, B.F.H. Short		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
4c1	Wingwall, F.F.V. Long		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		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		1	7'-9	5	2	6'-9	9	1	5'-9	4	4c5
4c5	Wingwall, F.F.V. Short		2	7'-9	10	2	6'-9	9	2	5'-9	8	4c5
5c6	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	5c6
5c7	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	5c7
6c8	Wingwall, B.F.V. Long		13 Var.	9'-6 to 13'-0	220	9 Var.	9'-6 to 11'-10	144	6 Var.	9'-6 to 10'-11	92	6c8
6c9	Wingwall, B.F.V. Short		13 Var.	8'-10 to 12'-10	212	10 Var.	8'-10 to 11'-10	155	7 Var.	8'-10 to 10'-10	103	6c9
6c10	Wingwall, B.F.V. Long		--	--	--	--	--	--	--	--	--	6c10
6c10	Wingwall, B.F.V. Short		--	--	--	--	--	--	--	--	--	6c10
6c11	Wingwall, B.F.V. Long		1	11'-9	18	2	10'-9	32	1	9'-9	15	6c11
6c11	Wingwall, B.F.V. Short		2	11'-9	35	2	10'-9	32	2	9'-9	29	6c11
4d1	Apron, Longit., Bott.		9	16'-5	99	9	14'-4	86	9	12'-4	74	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		11	16'-5	271	11	14'-4	237	11	12'-4	204	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		25	6'-2	103	25	6'-2	103	25	6'-2	103	4i1
7j1	Parapet, Horizontal		4	13'-7	111	4	13'-7	111	4	13'-7	111	7j1
6m1	Apron, Trans., Top		3 Var.	13'-11 to 14'-3	63	3 Var.	13'-11 to 14'-3	63	3 Var.	13'-11 to 14'-3	63	6m1
6m2	Apron, Trans., Top		14 Var.	14'-5 to 19'-4	355	11 Var.	14'-5 to 18'-2	269	8 Var.	14'-5 to 17'-1	189	6m2
6m3	Apron, Trans., Top		4 Var.	4'-11 to 12'-9	53	4 Var.	5'-0 to 12'-10	54	4 Var.	5'-2 to 13'-0	55	6m3
6m4	Apron, Trans., Bott.		12 Var.	8'-0 to 13'-11	198	10 Var.	8'-0 to 12'-10	156	8 Var.	8'-0 to 11'-9	119	6m4
6p1	Curtain, Horizontal		4	12'-8	76	4	12'-8	76	4	12'-8	76	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
5t1	Curtain, Vertical		18	6'-5	120	16	6'-5	107	14	6'-5	94	5t1
	Estimated Quantities One Headwall	Reinf. Steel		3135 LB			2598 LB			2092 LB		
		Concrete Parapet Δ	1.6	23.7 CY		1.6	19.5 CY		1.6	15.7 CY		
		Concrete Wingwalls	5.2			3.8			2.6			
		Concrete Apron ✳	16.9			14.1			11.5			

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.

Headwall Notes:

1. See Sheet FWH G2-21 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

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
12'-0" Span
15° Skew

FWH 15-8-21

Sheet 2 of 2

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 15-8-21 S2 - THIS SHEET ISSUED 02-2021

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

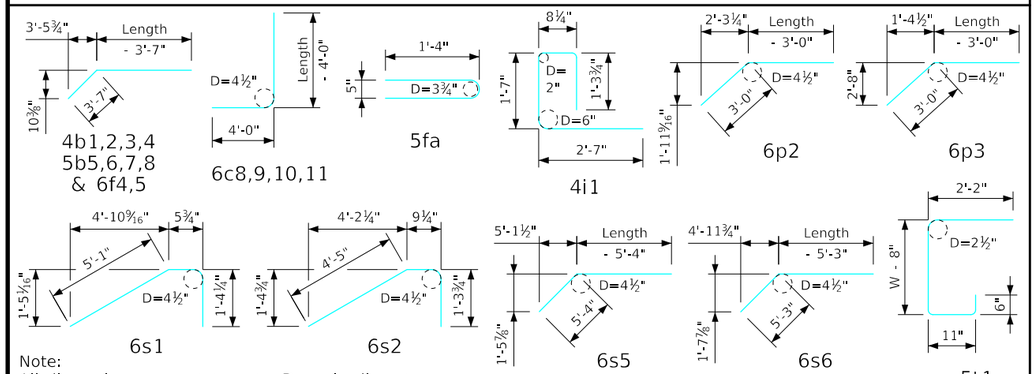
Bar	Location	Shape	10' x 12'			10' x 11'			10' x 10'			10' x 9'			10' x 8'			10' x 7'			Bar
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	5fa
4b1	Wingwall, B.F.H. Long		1	45'-7	32	1	42'-2	30	1	38'-9	26	1	35'-4	24	1	31'-11	21	1	28'-6	19	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	1	25'-4	17	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	5 Var.	13'-2 to 26'-11	67	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	5 Var.	11'-11 to 23'-11	60	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	1	28'-6	30	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	1	25'-4	26	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	6 Var.	9'-10 to 26'-11	115	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	6 Var.	9'-0 to 24'-0	103	5b8
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	25 Var.	2'-9 to 9'-9	104	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	22 Var.	2'-9 to 9'-9	92	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	2	8'-8	12	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	2	8'-8	12	4c5
5c6	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	9 Var.	2'-9 to 5'-1	37	5c6
5c7	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	6 Var.	2'-9 to 4'-5	22	5c7
6c8	Wingwall, B.F.V. Long		33 Var.	9'-5 to 18'-9	698	30 Var.	9'-5 to 17'-10	614	26 Var.	9'-5 to 16'-8	509	23 Var.	9'-5 to 15'-10	436	20 Var.	9'-5 to 14'-11	365	16 Var.	9'-5 to 13'-9	278	6c8
6c9	Wingwall, B.F.V. Short		31 Var.	8'-9 to 18'-9	640	28 Var.	8'-9 to 17'-9	557	25 Var.	8'-9 to 16'-9	479	22 Var.	8'-9 to 15'-9	405	19 Var.	8'-9 to 14'-9	335	16 Var.	8'-9 to 13'-9	270	6c9
6c10	Wingwall, B.F.V. Long		25	10'-6	394	22	10'-6	347	18	10'-6	284	15	10'-6	237	12	10'-6	189	8	10'-6	126	6c10
6c10	Wingwall, B.F.V. Short		22	10'-6	347	19	10'-6	300	16	10'-6	252	13	10'-6	205	10	10'-6	158	7	10'-6	110	6c10
6c11	Wingwall, B.F.V. Long		2	17'-8	53	1	16'-8	25	2	15'-8	47	2	14'-8	44	1	13'-8	21	2	12'-8	38	6c11
6c11	Wingwall, B.F.V. Short		2	17'-8	53	2	16'-8	50	2	15'-8	47	2	14'-8	44	2	13'-8	41	2	12'-8	38	6c11
4d1	Apron, Longit., Bott.		7	28'-10	135	7	26'-9	125	7	24'-9	116	7	22'-8	106	7	20'-7	96	7	18'-6	87	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	3	23'-1	46	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	3	20'-5	41	4d3
6f1	Apron, Longit., Top		9	28'-10	390	9	26'-9	362	9	24'-9	335	9	22'-8	306	9	20'-7	278	9	18'-6	250	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	4 Var.	7'-7 to 15'-3	69	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	4 Var.	6'-7 to 15'-4	66	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	1	28'-6	43	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	1	25'-4	38	6f5
4i1	Parapet, Vertical		21	6'-2	87	21	6'-2	87	21	6'-2	87	21	6'-2	87	21	6'-2	87	21	6'-2	87	4i1
7j1	Parapet, Horizontal		4	12'-0	98	4	11'-10	97	4	11'-8	95	4	11'-8	95	4	11'-8	95	4	11'-6	94	7j1
6m1	Apron, Trans., Top		3 Var.	12'-4 to 12'-8	56	3 Var.	12'-2 to 12'-6	56	3 Var.	12'-0 to 12'-4	55	3 Var.	12'-0 to 12'-4	55	3 Var.	12'-0 to 12'-4	55	3 Var.	11'-10 to 12'-2	54	6m1
6m2	Apron, Trans., Top		31 Var.	13'-0 to 24'-3	867	28 Var.	12'-10 to 22'-11	752	25 Var.	12'-7 to 21'-7	641	22 Var.	12'-7 to 20'-6	547	19 Var.	12'-7 to 19'-4	455	17 Var.	12'-5 to 18'-5	394	6m2
6m3	Apron, Trans., Top		3 Var.	8'-10 to 14'-1	52	3 Var.	8'-10 to 14'-1	52	4 Var.	6'-3 to 14'-1	61	4 Var.	6'-4 to 14'-2	62	4 Var.	6'-5 to 14'-4	62	3 Var.	6'-6 to 11'-9	41	6m3
6m4	Apron, Trans., Bott.		24 Var.	5'-11 to 18'-4	437	22 Var.	5'-11 to 17'-3	383	20 Var.	5'-11 to 16'-2	332	18 Var.	5'-11 to 15'-1	284	16 Var.	5'-11 to 14'-0	239	14 Var.	5'-11 to 12'-11	198	6m4
6p1	Curtain, Horizontal		4	10'-7	64	4	10'-7	64	4	10'-7	64	4	10'-7	64	4	10'-7	64	4	10'-7	64	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	4	14'-2	85	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	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	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	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	2	23'-5	70	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	2	21'-1	63	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	1	28'-7	43	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	1	25'-10	39	6s6
5t1	Curtain, Vertical		28	7'-11	231	26	7'-8	208	24	7'-5	186	23	7'-2	172	21	6'-11	151	18	6'-8	125	5t1
	Estimated Quantities One Headwall	Reinf. Steel		7911 LB			6950 LB			6057 LB			5267 LB			4393 LB			3688 LB		
		Concrete Parapet Δ	1.7			1.6			1.5			1.5			1.5			1.5			
		Concrete Wingwalls	23.0	62.2 CY		18.1	52.6 CY		13.9	44.0 CY		11.6	37.9 CY		9.5	32.3 CY		6.8	26.1 CY		
		Concrete Apron ✳	37.5			32.9			28.6			24.8			21.3			17.8			

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

Bent Bar Details



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

Headwall Notes:

1. See Sheet FWH G2-21 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", "f1", "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

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
10'-0" Span
15° Skew

FWH 15-9-21

Sheet 1 of 2

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 15-9-21 S1 - THIS SHEET ISSUED 02-2021.

Revised 08-2022: Corrected Typos in Bill of Reinforcing bar "Location" with bars 7j1, 6m1, 6m2, 6m3, 6m4, 6p1, 6p2, 6p3, 6s1, 6s2, 6s3, 6s4, 6s5, 6s6, 5t1.
ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 15-9-21 S2 - THIS SHEET ISSUED 02-2021.

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

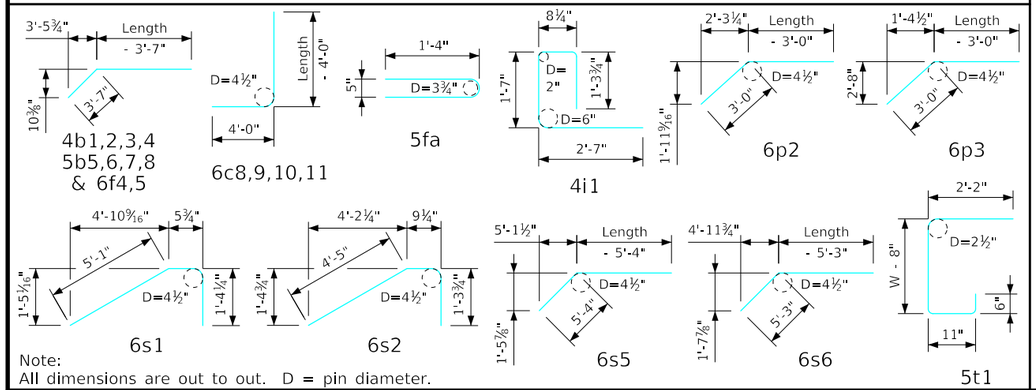
Bar	Location	Shape	10' x 6' No.	10' x 6' Length	10' x 6' Wt.	10' x 5' No.	10' x 5' Length	10' x 5' Wt.	10' x 4' No.	10' x 4' Length	10' x 4' Wt.	Bar
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	5fa
4b1	Wingwall, B.F.H. Long		1	25'-1	17	1	21'-7	14	1	18'-2	12	4b1
4b2	Wingwall, B.F.H. Short		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
4c1	Wingwall, F.F.V. Long		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		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		1	7'-8	5	2	6'-8	9	1	5'-8	4	4c5
4c5	Wingwall, F.F.V. Short		2	7'-8	10	2	6'-8	9	2	5'-8	8	4c5
5c6	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	5c6
5c7	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	5c7
6c8	Wingwall, B.F.V. Long		13 Var.	9'-5 to 12'-11	218	9 Var.	9'-5 to 11'-9	143	6 Var.	9'-5 to 10'-10	91	6c8
6c9	Wingwall, B.F.V. Short		13 Var.	8'-9 to 12'-9	210	10 Var.	8'-9 to 11'-9	154	7 Var.	8'-9 to 10'-9	103	6c9
6c10	Wingwall, B.F.V. Long		--	--	--	--	--	--	--	--	--	6c10
6c10	Wingwall, B.F.V. Short		--	--	--	--	--	--	--	--	--	6c10
6c11	Wingwall, B.F.V. Long		1	11'-8	18	2	10'-8	32	1	9'-8	15	6c11
6c11	Wingwall, B.F.V. Short		2	11'-8	35	2	10'-8	32	2	9'-8	29	6c11
4d1	Apron, Longit., Bott.		7	16'-5	77	7	14'-4	67	7	12'-4	58	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		9	16'-5	222	9	14'-4	194	9	12'-4	167	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		21	6'-2	87	21	6'-2	87	21	6'-2	87	4i1
7j1	Parapet, Horizontal		4	11'-6	94	4	11'-6	94	4	11'-6	94	7j1
6m1	Apron, Trans., Top		3 Var.	11'-10 to 12'-2	54	3 Var.	11'-10 to 12'-2	54	3 Var.	11'-10 to 12'-2	54	6m1
6m2	Apron, Trans., Top		14 Var.	12'-5 to 17'-4	313	11 Var.	12'-5 to 16'-2	236	8 Var.	12'-5 to 15'-1	165	6m2
6m3	Apron, Trans., Top		4 Var.	4'-0 to 11'-10	48	4 Var.	4'-1 to 11'-11	48	4 Var.	4'-2 to 12'-0	49	6m3
6m4	Apron, Trans., Bott.		12 Var.	5'-11 to 11'-10	160	10 Var.	5'-11 to 10'-9	125	8 Var.	5'-11 to 9'-8	94	6m4
6p1	Curtain, Horizontal		4	10'-7	64	4	10'-7	64	4	10'-7	64	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
5t1	Curtain, Vertical		16	6'-5	107	14	6'-5	94	12	6'-5	80	5t1
	Estimated Quantities One Headwall	Reinf. Steel		2904 LB			2393 LB			1911 LB		
		Concrete Parapet Δ	1.5			1.5			1.5			
		Concrete Wingwalls	5.2	21.5 CY		3.8	17.6 CY		2.6	14.1 CY		
		Concrete Apron ✳	14.8			12.3			10.0			

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

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

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

Bent Bar Details



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

Headwall Notes:

1. See Sheet FWH G2-21 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.

August 2022
LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWADOT

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
10'-0" Span
15° Skew

FWH 15-9-21
Sheet 2 of 2

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

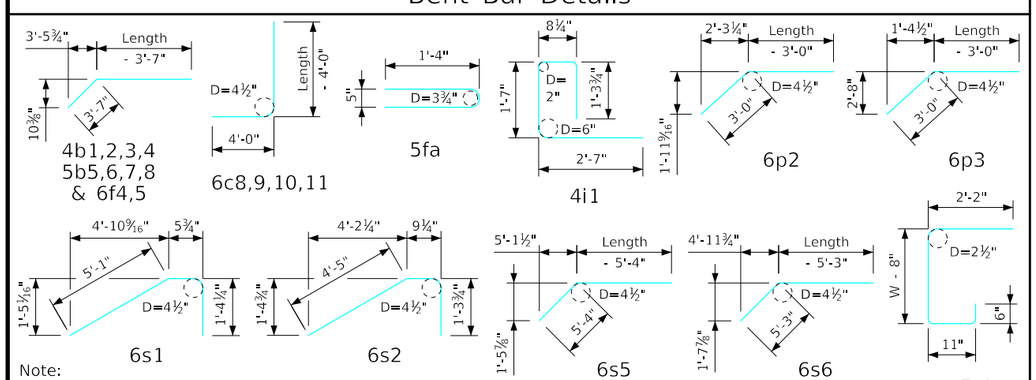
Bar	Location	Shape	8' x 10' No.	8' x 10' Length	8' x 10' Wt.	8' x 9' No.	8' x 9' Length	8' x 9' Wt.	8' x 8' No.	8' x 8' Length	8' x 8' Wt.	8' x 7' No.	8' x 7' Length	8' x 7' Wt.	8' x 6' No.	8' x 6' Length	8' x 6' Wt.	8' x 5' No.	8' x 5' Length	8' x 5' Wt.	8' x 4' No.	8' x 4' Length	8' x 4' Wt.	Bar
5fa	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. Long		1	38'-9	26	1	35'-4	24	1	31'-11	21	1	28'-6	19	1	25'-1	17	1	21'-7	14	1	18'-2	12	4b1
4b2	Wingwall, B.F.H. Short		1	34'-4	23	1	31'-4	21	1	28'-4	19	1	25'-4	17	1	22'-4	15	1	19'-4	13	1	16'-4	11	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	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		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	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	38'-10	41	1	35'-5	37	1	31'-11	33	1	28'-6	30	1	25'-1	26	1	21'-8	23	1	18'-3	19	5b5
5b6	Wingwall, F.F.H. Short		1	34'-4	36	1	31'-4	33	1	28'-4	30	1	25'-4	26	1	22'-4	23	1	19'-4	20	1	16'-4	17	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	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		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	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
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	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		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	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		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	1	7'-7	5	2	6'-7	9	1	5'-7	4	4c5
4c5	Wingwall, F.F.V. Short		2	11'-7	15	2	10'-7	14	2	9'-7	13	2	8'-7	11	2	7'-7	10	2	6'-7	9	2	5'-7	7	4c5
5c6	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	9 Var.	2'-8 to 5'-0	36	9 Var.	2'-8 to 5'-0	36	9 Var.	2'-8 to 5'-0	36	5c6
5c7	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	6 Var.	2'-8 to 4'-4	22	6 Var.	2'-8 to 4'-4	22	6 Var.	2'-8 to 4'-4	22	5c7
6c8	Wingwall, B.F.V. Long		26 Var.	9'-4 to 16'-7	506	23 Var.	9'-4 to 15'-9	433	20 Var.	9'-4 to 14'-10	363	16 Var.	9'-4 to 13'-8	276	13 Var.	9'-4 to 12'-10	216	9 Var.	9'-4 to 11'-8	142	6 Var.	9'-4 to 10'-9	90	6c8
6c9	Wingwall, B.F.V. Short		25 Var.	8'-8 to 16'-8	476	22 Var.	8'-8 to 15'-8	402	19 Var.	8'-8 to 14'-8	333	16 Var.	8'-8 to 13'-8	268	13 Var.	8'-8 to 12'-8	208	10 Var.	8'-8 to 11'-8	153	7 Var.	8'-8 to 10'-8	102	6c9
6c10	Wingwall, B.F.V. Long		18	10'-6	284	15	10'-6	237	12	10'-6	189	8	10'-6	126	--	--	--	--	--	--	--	--	--	6c10
6c10	Wingwall, B.F.V. Short		16	10'-6	252	13	10'-6	205	10	10'-6	158	7	10'-6	110	--	--	--	--	--	--	--	--	--	6c10
6c11	Wingwall, B.F.V. Long		2	15'-7	47	2	14'-7	44	1	13'-7	20	2	12'-7	38	1	11'-7	17	2	10'-7	32	1	9'-7	14	6c11
6c11	Wingwall, B.F.V. Short		2	15'-7	47	2	14'-7	44	2	13'-7	41	2	12'-7	38	2	11'-7	35	2	10'-7	32	2	9'-7	29	6c11
4d1	Apron, Longit., Bott.		5	24'-9	83	5	22'-8	76	5	20'-7	69	5	18'-6	62	5	16'-5	55	5	14'-4	48	5	12'-4	41	4d1
4d2	Apron, Longit., Bott. Long		3	33'-5	67	3	30'-0	60	3	26'-7	53	3	23'-1	46	3	19'-8	39	3	16'-3	33	3	12'-10	26	4d2
4d3	Apron, Longit., Bott. Short		3	29'-5	59	3	26'-5	53	3	23'-5	47	3	20'-5	41	3	17'-5	35	3	14'-5	29	3	11'-5	23	4d3
6f1	Apron, Longit., Top		7	24'-9	260	7	22'-8	238	7	20'-7	216	7	18'-6	195	7	16'-5	173	7	14'-4	151	7	12'-4	130	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	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		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	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	38'-10	58	1	35'-5	53	1	31'-11	48	1	28'-6	43	1	25'-1	38	1	21'-8	33	1	18'-3	27	6f4
6f5	Apron, Longit., Top Short		1	34'-4	52	1	31'-4	47	1	28'-4	43	1	25'-4	38	1	22'-4	34	1	19'-4	29	1	16'-4	25	6f5
4i1	Parapet, Vertical		17	6'-2	70	17	6'-2	70	17	6'-2	70	17	6'-2	70	17	6'-2	70	17	6'-2	70	17	6'-2	70	4i1
7j1	Parapet, Horizontal		4	9'-7	78	4	9'-7	78	4	9'-7	78	4	9'-5	77	4	9'-5	77	4	9'-5	77	4	9'-5	77	7j1
6m1	Apron, Trans., Top		3 Var.	9'-11 to 10'-3	45	3 Var.	9'-11 to 10'-3	45	3 Var.	9'-11 to 10'-3	45	3 Var.	9'-9 to 10'-1	45	3 Var.	9'-9 to 10'-1	45	3 Var.	9'-9 to 10'-1	45	3 Var.	9'-9 to 10'-1	45	6m1
6m2	Apron, Trans., Top		25 Var.	10'-7 to 19'-7	566	23 Var.	10'-7 to 18'-10	508	20 Var.	10'-7 to 17'-9	426	17 Var.	10'-5 to 16'-5	343	14 Var.	10'-5 to 15'-4	271	12 Var.	10'-5 to 14'-7	225	9 Var.	10'-5 to 13'-5	161	6m2
6m3	Apron, Trans., Top		3 Var.	7'-11 to 13'-2	48	3 Var.	5'-5 to 10'-8	36	3 Var.	5'-6 to 10'-9	37	3 Var.	5'-7 to 10'-10	37	3 Var.	5'-8 to 10'-11	37	2 Var.	5'-9 to 8'-5	21	3 Var.	3'-3 to 8'-6	26	6m3
6m4	Apron, Trans., Bott.		20 Var.	3'-10 to 14'-1	269	18 Var.	3'-10 to 13'-0	228	16 Var.	3'-10 to 11'-11	189	14 Var.	3'-10 to 10'-10	154	12 Var.	3'-10 to 9'-9	122	10 Var.	3'-10 to 8'-9	95	8 Var.	3'-10 to 7'-8	69	6m4
6p1	Curtain, Horizontal		4	8'-6	51	4	8'-6	51	4	8'-6	51	4	8'-6	51	4	8'-6	51	4	8'-6	51	4	8'-6	51	6p1
6p2	Curtain, Horizontal, Long		4	18'-9	113	4	17'-3	104	4	15'-9	95	4	14'-2	85	4	12'-8	76	4	11'-2	67	4	9'-8	58	6p2
6p3	Curtain, Horizontal, Short		4	14'-7	88	4	13'-6	81	4	12'-5	75	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	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	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	2	19'-10	60	2	16'-3	49	2	12'-8	38	6s3
6s4	Wing Slope, Both F., Short		2	30'-7	92	2	27'-5	82	2	24'-3	73	2	21'-1	63	2	17'-11	54	2	14'-9	44	2	11'-7	35	6s4
6s5	Wing Slope, F.F. Long		1	39'-3	59	1	35'-8	54	1	32'-1	48	1	28'-7	43	1	25'-0	38	1	21'-5	32	1	17'-10	27	6s5
6s6	Wing Slope, F.F. Short		1	35'-4	53	1	32'-2	48	1	29'-0	44	1	25'-10	39	1	22'-8	34	1	19'-6	29	1	16'-4	25	6s6
5t1	Curtain, Vertical		24	7'-5	186	23	7'-2	172	21	6'-11	151	18	6'-8	125	16	6'-5	107	14	6'-5	94	12	6'-5	80	5t1
	Estimated Quantities One Headwall	Reinf. Steel		5727 LB			4979 LB			4134 LB			3444 LB			2678 LB			2202 LB			1743 LB		
		Concrete Parapet Δ	1.4			1.4			1.4			1.3			1.3			1.3			1.3			
		Concrete Wingwalls	13.9	40.6 CY		11.6	34.9 CY		9.5	29.6 CY		6.8	23.6 CY		5.2	19.3 CY		3.8	15.7 CY		2.6	12.5 CY		
		Concrete Apron ✳	25.3			21.9			18.7			15.5			12.8			10.6			8.6			

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

Bent Bar Details



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

Headwall Notes:

1. See Sheet FWH G2-21 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.

August 2022
LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWA DOT

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
8'-0" Span
15° Skew

FWH
15-10-21

Revised 08-2022: Corrected Typos in Bill of Reinforcing bar "Location" with bars 7j1, 6m1, 6m2, 6m3, 6m4, 6p1, 6p2, 6p3, 6s1, 6s2, 6s3, 6s4, 6s5, 6s6, 5t1.
ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 15-10-21 - THIS SHEET ISSUED 02-2021.

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

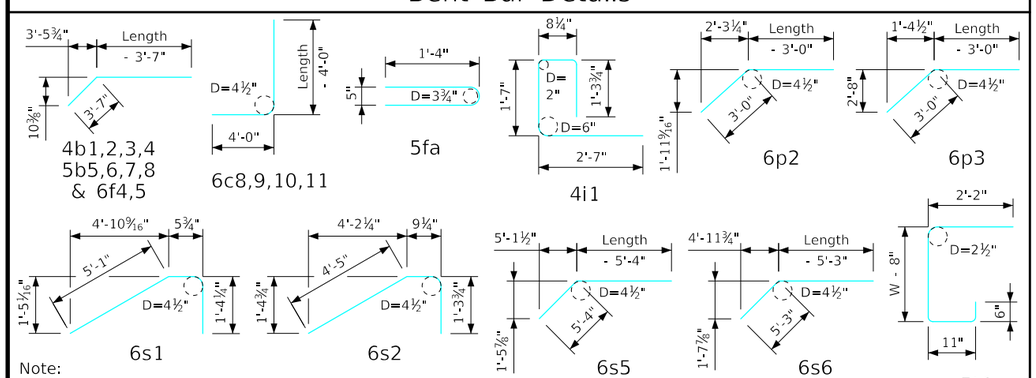
Bar	Location	Shape	6' x 8'			6' x 7'			6' x 6'			6' x 5'			6' x 4'			6' x 3'			Bar
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	5fa
4b1	Wingwall, B.F.H. Long		1	31'-11	21	1	28'-6	19	1	25'-1	17	1	21'-7	14	1	18'-2	12	1	14'-9	10	4b1
4b2	Wingwall, B.F.H. Short		1	28'-4	19	1	25'-4	17	1	22'-4	15	1	19'-4	13	1	16'-4	11	1	13'-4	9	4b2
4b3	Wingwall, B.F.H. Long		6 Var.	13'-2 to 30'-4	87	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	1	13'-2	9	4b3
4b4	Wingwall, B.F.H. Short		6 Var.	11'-11 to 26'-11	78	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	1	11'-11	8	4b4
5b5	Wingwall, F.F.H. Long		1	31'-11	33	1	28'-6	30	1	25'-1	26	1	21'-8	23	1	18'-3	19	1	14'-10	15	5b5
5b6	Wingwall, F.F.H. Short		1	28'-4	30	1	25'-4	26	1	22'-4	23	1	19'-4	20	1	16'-4	17	1	13'-4	14	5b6
5b7	Wingwall, F.F.H. Long		7 Var.	9'-10 to 30'-5	147	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	2 Var.	9'-10 to 13'-3	24	5b7
5b8	Wingwall, F.F.H. Short		7 Var.	9'-0 to 27'-0	131	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	2 Var.	9'-0 to 12'-0	22	5b8
4c1	Wingwall, F.F.V. Long		29 Var.	2'-8 to 10'-10	131	25 Var.	2'-8 to 9'-8	103	22 Var.	2'-8 to 8'-10	85	18 Var.	2'-8 to 7'-8	62	15 Var.	2'-8 to 6'-9	47	11 Var.	2'-8 to 5'-7	30	4c1
4c2	Wingwall, F.F.V. Short		25 Var.	2'-8 to 10'-8	111	22 Var.	2'-8 to 9'-8	91	19 Var.	2'-8 to 8'-8	72	16 Var.	2'-8 to 7'-8	55	13 Var.	2'-8 to 6'-8	41	10 Var.	2'-8 to 5'-8	28	4c2
4c3	Wingwall, F.F.V. Long		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4c3
4c4	Wingwall, F.F.V. Short		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4c4
4c5	Wingwall, F.F.V. Long		1	9'-7	6	2	8'-7	11	1	7'-7	5	2	6'-7	9	1	5'-7	4	2	4'-7	6	4c5
4c5	Wingwall, F.F.V. Short		2	9'-7	13	2	8'-7	11	2	7'-7	10	2	6'-7	9	2	5'-7	7	2	4'-7	6	4c5
5c6	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	9 Var.	2'-8 to 5'-0	36	9 Var.	2'-8 to 5'-0	36	5c6
5c7	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	6 Var.	2'-8 to 4'-4	22	6 Var.	2'-8 to 4'-4	22	5c7
6c8	Wingwall, B.F.V. Long		20 Var.	9'-4 to 14'-10	363	16 Var.	9'-4 to 13'-8	276	13 Var.	9'-4 to 12'-10	216	9 Var.	9'-4 to 11'-8	142	6 Var.	9'-4 to 10'-9	90	2 Var.	9'-4 to 9'-7	28	6c8
6c9	Wingwall, B.F.V. Short		19 Var.	8'-8 to 14'-8	333	16 Var.	8'-8 to 13'-8	268	13 Var.	8'-8 to 12'-8	208	10 Var.	8'-8 to 11'-8	153	7 Var.	8'-8 to 10'-8	102	4 Var.	8'-8 to 9'-8	55	6c9
6c10	Wingwall, B.F.V. Long		12	10'-6	189	8	10'-6	126	--	--	--	--	--	--	--	--	--	--	--	--	6c10
6c10	Wingwall, B.F.V. Short		10	10'-6	158	7	10'-6	110	--	--	--	--	--	--	--	--	--	--	--	--	6c10
6c11	Wingwall, B.F.V. Long		1	13'-7	20	2	12'-7	38	1	11'-7	17	2	10'-7	32	1	9'-7	14	2	8'-7	26	6c11
6c11	Wingwall, B.F.V. Short		2	13'-7	41	2	12'-7	38	2	11'-7	35	2	10'-7	32	2	9'-7	29	2	8'-7	26	6c11
4d1	Apron, Longit., Bott.		5	20'-7	69	5	18'-6	62	5	16'-5	55	5	14'-4	48	5	12'-4	41	5	10'-3	34	4d1
4d2	Apron, Longit., Bott. Long		3	26'-7	53	3	23'-1	46	3	19'-8	39	3	16'-3	33	3	12'-10	26	3	9'-5	19	4d2
4d3	Apron, Longit., Bott. Short		3	23'-5	47	3	20'-5	41	3	17'-5	35	3	14'-5	29	3	11'-5	23	3	8'-5	17	4d3
6f1	Apron, Longit., Top		5	20'-7	155	5	18'-6	139	5	16'-5	123	5	14'-4	108	5	12'-4	93	5	10'-3	77	6f1
6f2	Apron, Longit., Top Long		5 Var.	7'-2 to 17'-4	92	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	1	6'-11	10	6f2
6f3	Apron, Longit., Top Short		5 Var.	5'-9 to 17'-5	87	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	1	7'-1	11	6f3
6f4	Apron, Longit., Top Long		1	31'-11	48	1	28'-6	43	1	25'-1	38	1	21'-8	33	1	18'-3	27	1	14'-10	22	6f4
6f5	Apron, Longit., Top Short		1	28'-4	43	1	25'-4	38	1	22'-4	34	1	19'-4	29	1	16'-4	25	1	13'-4	20	6f5
4i1	Parapet, Vertical		13	6'-2	54	13	6'-2	54	13	6'-2	54	13	6'-2	54	13	6'-2	54	13	6'-2	54	4i1
7j1	Parapet, Horizontal		4	7'-7	62	4	7'-5	61	4	7'-5	61	4	7'-5	61	4	7'-5	61	4	7'-5	61	7j1
6m1	Apron, Trans., Top		2 Var.	7'-10 to 8'-0	24	2 Var.	7'-8 to 7'-10	23	2 Var.	7'-8 to 7'-10	23	2 Var.	7'-8 to 7'-10	23	2 Var.	7'-8 to 7'-10	23	2 Var.	7'-8 to 7'-10	23	6m1
6m2	Apron, Trans., Top		21 Var.	8'-3 to 15'-9	379	18 Var.	8'-1 to 14'-5	304	16 Var.	8'-1 to 13'-8	261	13 Var.	8'-1 to 12'-7	202	10 Var.	8'-1 to 11'-5	146	7 Var.	8'-1 to 10'-4	97	6m2
6m3	Apron, Trans., Top		2 Var.	7'-2 to 9'-10	26	3 Var.	4'-8 to 9'-10	33	2 Var.	4'-9 to 7'-4	18	2 Var.	4'-10 to 7'-5	18	2 Var.	4'-11 to 7'-7	19	3 Var.	2'-6 to 7'-8	23	6m3
6m4	Apron, Trans., Bott.		16 Var.	1'-9 to 9'-10	139	14 Var.	1'-9 to 8'-9	110	12 Var.	1'-9 to 7'-9	86	10 Var.	1'-9 to 6'-8	63	8 Var.	1'-9 to 5'-7	44	6 Var.	1'-9 to 4'-6	28	6m4
6p1	Curtain, Horizontal		4	6'-5	39	4	6'-5	39	4	6'-5	39	4	6'-5	39	4	6'-5	39	4	6'-5	39	6p1
6p2	Curtain, Horizontal, Long		4	15'-9	95	4	14'-2	85	4	12'-8	76	4	11'-2	67	4	9'-8	58	4	8'-2	49	6p2
6p3	Curtain, Horizontal, Short		4	12'-5	75	4	11'-3	68	4	10'-2	61	4	9'-1	55	4	7'-11	48	4	6'-10	41	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	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	2	6'-6	20	6s2
6s3	Wing Slope, Both F., Long		2	27'-0	81	2	23'-5	70	2	19'-10	60	2	16'-3	49	2	12'-8	38	2	9'-1	27	6s3
6s4	Wing Slope, Both F., Short		2	24'-3	73	2	21'-1	63	2	17'-11	54	2	14'-9	44	2	11'-7	35	2	8'-5	25	6s4
6s5	Wing Slope, F.F. Long		1	32'-1	48	1	28'-7	43	1	25'-0	38	1	21'-5	32	1	17'-10	27	1	14'-3	21	6s5
6s6	Wing Slope, F.F. Short		1	29'-0	44	1	25'-10	39	1	22'-8	34	1	19'-6	29	1	16'-4	25	1	13'-2	20	6s6
5t1	Curtain, Vertical		19	6'-11	137	16	6'-8	111	14	6'-5	94	12	6'-5	80	10	6'-5	67	8	6'-5	54	5t1
	Estimated Quantities One Headwall	Reinf. Steel		3886 LB			3221 LB			2484 LB			2021 LB			1580 LB			1193 LB		
		Concrete Parapet Δ	1.2	27.8 CY		1.2	22.1 CY		1.2	17.9 CY		1.2	14.5 CY		1.2	11.4 CY		1.2	8.6 CY		
		Concrete Wingwalls	9.5			6.8			5.2			3.8			2.6			1.6			
		Concrete Apron ✳	17.1			14.1			11.5			9.5			7.6			5.8			

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

Bent Bar Details



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

Headwall Notes:

1. See Sheet FWH G2-21 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

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
6'-0" Span
15° Skew

FWH
15-11-21

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 15-11-21 - THIS SHEET ISSUED 02-2021.

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

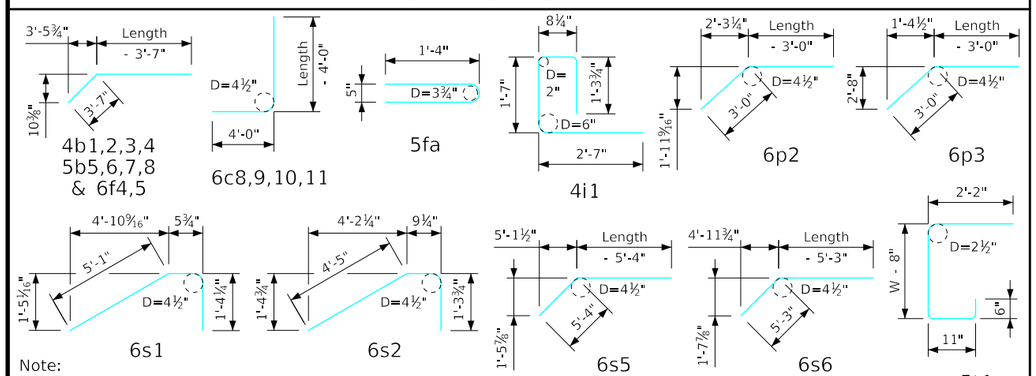
Bar	Location	Shape	5' x 6'			5' x 5'			5' x 4'			5' x 3'			Bar
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	5fa
4b1	Wingwall, B.F.H. Long		1	25'-1	17	1	21'-7	14	1	18'-2	12	1	14'-9	10	4b1
4b2	Wingwall, B.F.H. Short		1	22'-4	15	1	19'-4	13	1	16'-4	11	1	13'-4	9	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	1	13'-2	9	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	1	11'-11	8	4b4
5b5	Wingwall, F.F.H. Long		1	25'-1	26	1	21'-8	23	1	18'-3	19	1	14'-10	15	5b5
5b6	Wingwall, F.F.H. Short		1	22'-4	23	1	19'-4	20	1	16'-4	17	1	13'-4	14	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	2 Var.	9'-10 to 13'-3	24	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	2 Var.	9'-0 to 12'-0	22	5b8
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	11 Var.	2'-8 to 5'-7	30	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	10 Var.	2'-8 to 5'-8	28	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	2	4'-7	6	4c5
4c5	Wingwall, F.F.V. Short		2	7'-7	10	2	6'-7	9	2	5'-7	7	2	4'-7	6	4c5
5c6	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	5c6
5c7	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	5c7
6c8	Wingwall, B.F.V. Long		13 Var.	9'-4 to 12'-10	216	9 Var.	9'-4 to 11'-8	142	6 Var.	9'-4 to 10'-9	90	2 Var.	9'-4 to 9'-7	28	6c8
6c9	Wingwall, B.F.V. Short		13 Var.	8'-8 to 12'-8	208	10 Var.	8'-8 to 11'-8	153	7 Var.	8'-8 to 10'-8	102	4 Var.	8'-8 to 9'-8	55	6c9
6c10	Wingwall, B.F.V. Long		--	--	--	--	--	--	--	--	--	--	--	--	6c10
6c10	Wingwall, B.F.V. Short		--	--	--	--	--	--	--	--	--	--	--	--	6c10
6c11	Wingwall, B.F.V. Long		1	11'-7	17	2	10'-7	32	1	9'-7	14	2	8'-7	26	6c11
6c11	Wingwall, B.F.V. Short		2	11'-7	35	2	10'-7	32	2	9'-7	29	2	8'-7	26	6c11
4d1	Apron, Longit., Bott.		3	16'-5	33	3	14'-4	29	3	12'-4	25	3	10'-3	21	4d1
4d2	Apron, Longit., Bott. Long		3	19'-8	39	3	16'-3	33	3	12'-10	26	3	9'-5	19	4d2
4d3	Apron, Longit., Bott. Short		3	17'-5	35	3	14'-5	29	3	11'-5	23	3	8'-5	17	4d3
6f1	Apron, Longit., Top		4	16'-5	99	4	14'-4	86	4	12'-4	74	4	10'-3	62	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	1	6'-11	10	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	1	7'-1	11	6f3
6f4	Apron, Longit., Top Long		1	25'-1	38	1	21'-8	33	1	18'-3	27	1	14'-10	22	6f4
6f5	Apron, Longit., Top Short		1	22'-4	34	1	19'-4	29	1	16'-4	25	1	13'-4	20	6f5
4i1	Parapet, Vertical		11	6'-2	45	11	6'-2	45	11	6'-2	45	11	6'-2	45	4i1
7j1	Parapet, Horizontal		4	6'-4	52	4	6'-4	52	4	6'-4	52	4	6'-4	52	7j1
6m1	Apron, Trans., Top		2 Var.	6'-8 to 6'-10	20	2 Var.	6'-8 to 6'-10	20	2 Var.	6'-8 to 6'-10	20	2 Var.	6'-8 to 6'-10	20	6m1
6m2	Apron, Trans., Top		16 Var.	7'-1 to 12'-8	237	13 Var.	7'-1 to 11'-7	182	10 Var.	7'-1 to 10'-5	131	8 Var.	7'-1 to 9'-8	101	6m2
6m3	Apron, Trans., Top		2 Var.	4'-3 to 6'-11	17	2 Var.	4'-4 to 7'-0	17	2 Var.	4'-6 to 7'-1	17	1	4'-7	7	6m3
6m4	Apron, Trans., Bott.		10 Var.	1'-10 to 6'-8	64	8 Var.	1'-10 to 5'-7	45	6 Var.	1'-10 to 4'-6	29	4 Var.	1'-10 to 3'-5	16	6m4
6p1	Curtain, Horizontal		4	5'-5	33	4	5'-5	33	4	5'-5	33	4	5'-4	32	6p1
6p2	Curtain, Horizontal, Long		4	12'-8	76	4	11'-2	67	4	9'-8	58	4	8'-2	49	6p2
6p3	Curtain, Horizontal, Short		4	10'-2	61	4	9'-1	55	4	7'-11	48	4	6'-10	41	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	19'-10	60	2	16'-3	49	2	12'-8	38	2	9'-1	27	6s3
6s4	Wing Slope, Both F., Short		2	17'-11	54	2	14'-9	44	2	11'-7	35	2	8'-5	25	6s4
6s5	Wing Slope, F.F. Long		1	25'-0	38	1	21'-5	32	1	17'-10	27	1	14'-3	21	6s5
6s6	Wing Slope, F.F. Short		1	22'-8	34	1	19'-6	29	1	16'-4	25	1	13'-2	20	6s6
5t1	Curtain, Vertical		12	6'-5	80	10	6'-5	67	8	6'-5	54	6	6'-5	40	5t1
	Estimated Quantities One Headwall	Reinf. Steel		2350 LB			1901 LB			1473 LB			1099 LB		
		Concrete, Parapet Δ	1.1	17.2 CY		1.1	13.8 CY		1.1	10.8 CY		1.1	8.1 CY		
		Concrete, Wingwalls	5.2			3.8			2.6			1.6			
		Concrete, Apron ✳	10.9			8.9			7.1			5.4			

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.

Headwall Notes:

1. See Sheet FWH G2-21 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.

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IOWADOT

Standard Design - Single Reinforced Concrete Box Culverts

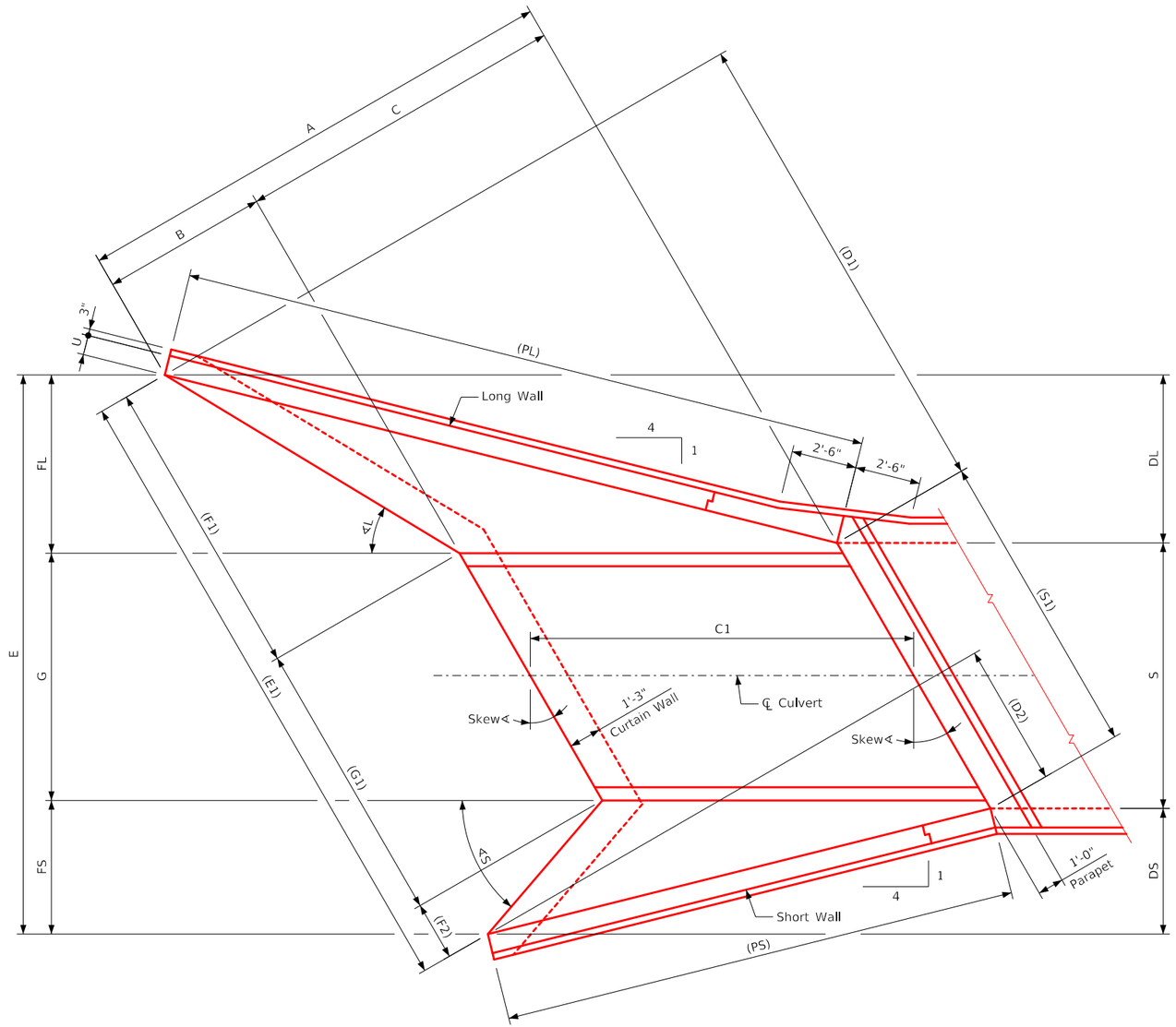
Flared Wing Headwalls

February, 2021

Quantity Tabulation
5'-0" Span
15° Skew

FWH
15-12-21

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 15-12-21 - THIS SHEET ISSUED 02-2021.



Plan View

Notes:

1. See Sheet FWH G2-21 for General Notes, Specifications, and Design Stresses.
2. See Sheet FWH 30-2-21 for dimensions table.
3. See Sheet FWH 30-4-21 for Angle L & Angle S.

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Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Dimension Plan 30° Skew

FWH 30-1-21

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Dimension Table

S x H	16' x 14'	16' x 13'	16' x 12'	16' x 11'	16' x 10'	16' x 9'	16' x 8'	16' x 7'	16' x 6'	16' x 5'	16' x 4'	14' x 14'	14' x 13'	14' x 12'	14' x 11'	14' x 10'	14' x 9'	14' x 8'	14' x 7'	14' x 6'	14' x 5'	14' x 4'	12' x 12'	12' x 11'	12' x 10'	12' x 9'	12' x 8'	12' x 7'	12' x 6'	12' x 5'	12' x 4'	S x H
A	43'-0	40'-0	37'-0	34'-0	31'-0	28'-0	25'-0	22'-0	19'-0	16'-0	13'-0	43'-0	40'-0	37'-0	34'-0	31'-0	28'-0	25'-0	22'-0	19'-0	16'-0	13'-0	37'-0	34'-0	31'-0	28'-0	25'-0	22'-0	19'-0	16'-0	13'-0	A
B	14'-4	13'-4	12'-4	11'-4	10'-4	9'-4	8'-4	7'-4	6'-4	5'-4	4'-4	14'-4	13'-4	12'-4	11'-4	10'-4	9'-4	8'-4	7'-4	6'-4	5'-4	4'-4	12'-4	11'-4	10'-4	9'-4	8'-4	7'-4	6'-4	5'-4	4'-4	B
C	28'-8	26'-8	24'-8	22'-8	20'-8	18'-8	16'-8	14'-8	12'-8	10'-8	8'-8	28'-8	26'-8	24'-8	22'-8	20'-8	18'-8	16'-8	14'-8	12'-8	10'-8	8'-8	24'-8	22'-8	20'-8	18'-8	16'-8	14'-8	12'-8	10'-8	8'-8	C
C1	33'-1¼	30'-9½	28'-5⅞	26'-2⅛	23'-10⅜	21'-6⅝	19'-3	16'-11¼	14'-7½	12'-3¾	10'-0⅛	33'-1¼	30'-9½	28'-5⅞	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	C1
DL	14'-6⅛	13'-6	12'-5¾	11'-5⅝	10'-5½	9'-5⅜	8'-5¼	7'-5⅛	6'-4⅞	5'-4¾	4'-4⅝	14'-6⅛	13'-6	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	DL
DS	10'-10⅜	10'-1⅛	9'-4	8'-6⅞	7'-9⅞	7'-0¾	6'-3⅝	5'-6⅝	4'-9½	4'-0⅜	3'-3⅜	10'-10⅜	10'-1⅛	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'-6⅝	4'-9½	4'-0⅜	3'-3⅜	DS
D1	41'-6⅞	38'-8⅛	35'-9¼	32'-10½	29'-11¾	27'-0⅞	24'-2⅛	21'-3¼	18'-4½	15'-5⅝	12'-6⅞	41'-6⅞	38'-8⅛	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	D1
D2	12'-3⅝	11'-5¼	10'-7	9'-8¾	8'-10⅜	8'-0⅛	7'-1⅞	6'-3½	5'-5¼	4'-6⅞	3'-8⅝	12'-3⅝	11'-5¼	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	D2
E	41'-4¼	39'-7	37'-9¾	36'-0⅝	34'-3⅜	32'-6⅛	30'-8⅞	28'-11⅝	27'-2⅜	25'-5¼	23'-8	39'-4¼	37'-7	35'-9¾	34'-0⅝	32'-3⅜	30'-6⅛	28'-8⅞	26'-11⅝	25'-2⅜	23'-5¼	21'-8	33'-9¾	32'-0⅝	30'-3⅜	28'-6⅛	26'-8⅞	24'-11⅝	23'-2⅜	21'-5¼	19'-8	E
E1	47'-9	45'-8½	43'-8	41'-7½	39'-7	37'-6½	35'-6	33'-5½	31'-4⅞	29'-4⅜	27'-3⅞	45'-5¼	43'-4¾	41'-4¼	39'-3¾	37'-3¼	35'-2¾	33'-2¼	31'-1¾	29'-1¼	27'-0¾	25'-0¼	39'-0⅝	37'-0⅛	34'-11½	32'-11	30'-10½	28'-10	26'-9½	24'-9	22'-8½	E1
FL	14'-10⅛	13'-10	12'-9¾	11'-9⅝	10'-9½	9'-9⅜	8'-9¼	7'-9⅛	6'-8⅞	5'-8¾	4'-8⅝	14'-10⅛	13'-10	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	FL
FS	11'-2⅛	10'-5⅛	9'-8	8'-10⅞	8'-1⅞	7'-4¾	6'-7⅞	5'-10⅝	5'-1½	4'-4⅜	3'-7⅜	11'-2⅛	10'-5⅛	9'-8	8'-10⅞	8'-1⅞	7'-4¾	6'-7⅞	5'-10⅝	5'-1½	4'-4⅜	3'-7⅜	9'-8	8'-10⅞	8'-1⅞	7'-4¾	6'-7⅞	5'-10⅝	5'-1½	4'-4⅜	3'-7⅜	FS
F1	25'-4⅞	23'-8	21'-11	20'-2⅛	18'-5⅛	16'-8⅛	14'-11¼	13'-2¼	11'-5⅜	9'-8⅜	7'-11⅜	25'-4⅞	23'-8	21'-11	20'-2⅛	18'-5⅛	16'-8⅛	14'-11¼	13'-2¼	11'-5⅜	9'-8⅜	7'-11⅜	21'-11	20'-2⅛	18'-5⅛	16'-8⅛	14'-11¼	13'-2¼	11'-5⅜	9'-8⅜	7'-11⅜	F1
F2	4'-7⅝	4'-4	4'-0½	3'-9	3'-5⅜	3'-1⅞	2'-10¼	2'-6¾	2'-3⅛	1'-11⅝	1'-8	4'-7⅝	4'-4	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	F2
G	15'-4	15'-4	15'-4	15'-4	15'-4	15'-4	15'-4	15'-4	15'-4	15'-4	15'-4	13'-4	13'-4	13'-4	13'-4	13'-4	13'-4	13'-4	13'-4	13'-4	13'-4	13'-4	11'-4	11'-4	11'-4	11'-4	11'-4	11'-4	11'-4	11'-4	11'-4	G
G1	17'-8½	17'-8½	17'-8½	17'-8½	17'-8½	17'-8½	17'-8½	17'-8½	17'-8½	17'-8½	17'-8½	15'-4¾	15'-4¾	15'-4¾	15'-4¾	15'-4¾	15'-4¾	15'-4¾	15'-4¾	15'-4¾	15'-4¾	15'-4¾	13'-1	13'-1	13'-1	13'-1	13'-1	13'-1	13'-1	13'-1	13'-1	G1
G2	18'-11⅜	18'-11¼	18'-11¼	18'-11¼	18'-11¼	18'-11⅛	18'-11⅛	18'-11	18'-10⅞	18'-10¾	18'-10⅝	16'-7⅝	16'-7⅝	16'-7½	16'-7½	16'-7½	16'-7⅜	16'-7⅜	16'-7¼	16'-7¼	16'-7	16'-6⅞	14'-3⅞	14'-3¾	14'-3¾	14'-3¾	14'-3⅝	14'-3⅝	14'-3½	14'-3⅜	14'-3⅛	G2
G3	29'-2⅛	27'-2	25'-1⅜	23'-1⅝	21'-1½	19'-1⅜	17'-1¼	15'-1⅛	13'-1	11'-0¾	9'-0⅝	29'-2⅛	27'-2	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	G3
G4	29'-10½	27'-8⅝	25'-7⅞	23'-4¼	21'-0⅝	19'-0½	17'-0⅜	14'-8⅞	12'-8¾	10'-8¾	8'-8¾	29'-10½	27'-8⅝	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	G4
G5	15'-0¾	14'-0¼	12'-11¾	11'-11¼	10'-10¾	9'-10¼	8'-9¾	7'-9¼	6'-8¾	5'-8¼	4'-7¾	15'-0¾	14'-0¼	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	G5
G6	16'-7⅞	15'-3¾	14'-3¼	13'-0⅞	11'-10⅝	10'-10⅛	9'-9⅝	8'-7⅜	7'-7	6'-6½	5'-6⅛	16'-7⅞	15'-3¾	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	G6
G7	--	2¼	2¼	5½	8⅞	8⅞	8⅞	1'-0⅛	1'-0	1'-0	11⅞	--	2¼	2¼	5½	8⅞	8⅞	8⅞	1'-0⅛	1'-0	1'-0	11⅞	2¼	5½	8⅞	8⅞	8⅞	1'-0⅛	1'-0	1'-0	11⅞	G7
G8	1⅝	4⅜	4⅜	6⅛	7⅜	7⅜	7⅜	9	9	9	9	1⅝	4⅜	4⅜	6⅛	7⅜	7⅜	7⅜	9	9	9	9	4⅜	6⅛	7⅜	7⅜	7⅜	9	9	9	9	G8
PL	59'-9¾	55'-7⅝	51'-5⅝	47'-3½	43'-1½	38'-11⅜	34'-9¼	30'-7¼	26'-5⅛	22'-3⅛	18'-1	59'-9¾	55'-7⅝	51'-5⅝	47'-3½	43'-1½	38'-11⅜	34'-9¼	30'-7¼	26'-5⅛	22'-3⅛	18'-1	51'-5⅝	47'-3½	43'-1½	38'-11⅜	34'-9¼	30'-7¼	26'-5⅛	22'-3⅛	18'-1	PL
PS	44'-8¾	41'-7¼	38'-5¾	35'-4⅜	32'-2⅞	29'-1½	26'-0	22'-10⅝	19'-9⅛	16'-7¾	13'-6¼	44'-8¾	41'-7¼	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	PS
RL	61'-6⅛	57'-2⅝	52'-11⅛	48'-7⅝	44'-4⅛	40'-0⅝	35'-9⅛	31'-5⅝	27'-2⅛	22'-10⅝	18'-7⅛	61'-6⅛	57'-2⅝	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	RL
RS	46'-11⅝	43'-8¼	40'-5	37'-1⅝	33'-10¼	30'-7	27'-3⅝	24'-0⅜	20'-9	17'-5¾	14'-2⅜	46'-11⅝	43'-8¼	40'-5	37'-1⅝	33'-10¼	30'-7	27'-3⅝	24'-0⅜	20'-9	17'-5¾	14'-2⅜	40'-5	37'-1⅝	33'-10¼	30'-7	27'-3⅝	24'-0⅜	20'-9	17'-5¾	14'-2⅜	RS
S1	18'-5¾	18'-5¾	18'-5¾	18'-5¾	18'-5¾	18'-5¾	18'-5¾	18'-5¾	18'-5¾	18'-5¾	18'-5¾	16'-2	16'-2	16'-2	16'-2	16'-2	16'-2	16'-2	16'-2	16'-2	16'-2	16'-2	13'-10¼	13'-10¼	13'-10¼	13'-10¼	13'-10¼	13'-10¼	13'-10¼	13'-10¼	13'-10¼	S1
T	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	T
U	1'-2	1'-0	1'-0	11	10	10	10	9	9	9	9	1'-2	1'-0	1'-0	11	10	10	10	9	9	9	9	1'-0	11	10	10	10	9	9	9	9	U
W	5'-6	5'-3	5'-0	4'-9	4'-6	4'-3	4'-0	3'-9	3'-6	3'-6	3'-6	5'-6	5'-3	5'-0	4'-9	4'-6	4'-3	4'-0	3'-9	3'-6	3'-6	3'-6	5'-0	4'-9	4'-6	4'-3	4'-0	3'-9	3'-6	3'-6	3'-6	W

Notes:

1. See Sheet FWH G2-21 for General Notes, Specifications, and Design Stresses.
2. See Sheet FWH 30-1-21 and sheets FWH 30-3-21 thru 30-5-21 for location of certain dimensions tabulated.
3. Dimensions are in feet and inches unless otherwise noted.

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IOWA DOT

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Dimension Table
30° Skew

FWH 30-2-21

Sheet 1 of 2

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 30-2-21 S1 - THIS SHEET ISSUED 02-2021.

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Dimension Table

S x H	10' x 12'	10' x 11'	10' x 10'	10' x 9'	10' x 8'	10' x 7'	10' x 6'	10' x 5'	10' x 4'	8' x 10'	8' x 9'	8' x 8'	8' x 7'	8' x 6'	8' x 5'	8' x 4'	6' x 8'	6' x 7'	6' x 6'	6' x 5'	6' x 4'	6' x 3'	5' x 6'	5' x 5'	5' x 4'	5' x 3'	S x H
A	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	25'-0	22'-0	19'-0	16'-0	13'-0	10'-0	19'-0	16'-0	13'-0	10'-0	A
B	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	8'-4	7'-4	6'-4	5'-4	4'-4	3'-4	6'-4	5'-4	4'-4	3'-4	B
C	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	16'-8	14'-8	12'-8	10'-8	8'-8	6'-8	12'-8	10'-8	8'-8	6'-8	C
C1	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	19'-3	16'-11¼	14'-7½	12'-3¾	10'-0⅛	7'-8⅜	14'-7½	12'-3¾	10'-0⅛	7'-8⅜	C1
DL	12'-5¾	11'-5⅜	10'-5½	9'-5⅜	8'-5¼	7'-5⅛	6'-4⅞	5'-4⅜	4'-4⅝	10'-5½	9'-5⅜	8'-5¼	7'-5⅛	6'-4⅞	5'-4¾	4'-4⅜	8'-5¼	7'-5⅛	6'-4⅞	5'-4¾	4'-4⅜	3'-4½	6'-4⅞	5'-4¾	4'-4⅜	3'-4½	DL
DS	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	6'-3⅝	5'-6⅜	4'-9½	4'-0⅜	3'-3⅜	2'-6¼	4'-9½	4'-0⅜	3'-3⅜	2'-6¼	DS
D1	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	24'-2⅛	21'-3¼	18'-4½	15'-5⅝	12'-6⅞	9'-8	18'-4½	15'-5⅝	12'-6⅞	9'-8	D1
D2	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	7'-1⅞	6'-3½	5'-5¼	4'-6⅞	3'-8⅝	2'-10⅜	5'-5¼	4'-6⅞	3'-8⅝	2'-10⅜	D2
E	31'-9¾	30'-0⅝	28'-3⅜	26'-6⅛	24'-8⅞	22'-11⅝	21'-2⅜	19'-5¼	17'-8	26'-3⅜	24'-6⅛	22'-8⅞	20'-11⅝	19'-2⅜	17'-5¼	15'-8	20'-8⅞	18'-11⅝	17'-2⅜	15'-5¼	13'-8	11'-10¾	16'-2⅜	14'-5¼	12'-8	10'-10¾	E
E1	36'-8⅞	34'-8⅜	32'-7⅞	30'-7⅜	28'-6⅞	26'-6¼	24'-5¾	22'-5¼	20'-4¾	30'-4⅝	28'-3⅜	26'-3⅛	24'-2⅝	22'-2⅛	20'-1⅜	18'-1⅛	23'-11⅜	21'-10⅞	19'-10⅜	17'-9⅞	15'-9⅜	13'-8⅞	18'-8½	16'-8	14'-7½	12'-7	E1
FL	12'-9¾	11'-9⅜	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	8'-9¼	7'-9⅛	6'-8⅞	5'-8¾	4'-8⅝	3'-8½	6'-8⅞	5'-8¾	4'-8⅝	3'-8½	FL
FS	9'-8	8'-10⅞	8'-1⅞	7'-4¾	6'-7⅝	5'-10⅝	5'-1½	4'-4⅜	3'-7⅞	8'-1⅞	7'-4¾	6'-7⅝	5'-10⅝	5'-1½	4'-4⅜	3'-7⅜	6'-7⅝	5'-10⅝	5'-1½	4'-4⅜	3'-7⅜	2'-10¼	5'-1½	4'-4⅜	3'-7⅜	2'-10¼	FS
F1	21'-11	20'-2⅛	18'-5⅛	16'-8⅛	14'-11¼	13'-2¼	11'-5⅜	9'-8⅜	7'-11⅜	18'-5⅛	16'-8⅛	14'-11¼	13'-2¼	11'-5⅜	9'-8⅜	7'-11⅜	14'-11¼	13'-2¼	11'-5⅜	9'-8⅜	7'-11⅜	6'-2½	11'-5⅜	9'-8⅜	7'-11⅜	6'-2½	F1
F2	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	2'-10¼	2'-6¾	2'-3⅛	1'-11⅝	1'-8	1'-4½	2'-3⅛	1'-11⅝	1'-8	1'-4½	F2
G	9'-4	9'-4	9'-4	9'-4	9'-4	9'-4	9'-4	9'-4	9'-4	7'-4	7'-4	7'-4	7'-4	7'-4	7'-4	5'-4	5'-4	5'-4	5'-4	5'-4	5'-4	5'-4	4'-4	4'-4	4'-4	4'-4	G
G1	10'-9⅜	10'-9⅜	10'-9⅜	10'-9⅜	10'-9⅜	10'-9⅜	10'-9⅜	10'-9⅜	10'-9⅜	8'-5⅝	8'-5⅝	8'-5⅝	8'-5⅝	8'-5⅝	8'-5⅝	8'-5⅝	6'-1⅞	6'-1⅞	6'-1⅞	6'-1⅞	6'-1⅞	6'-1⅞	5'-0	5'-0	5'-0	5'-0	G1
G2	12'-0⅛	12'-0⅛	12'-0	12'-0	12'-0	11'-11⅞	11'-11¾	11'-11⅝	11'-11½	9'-8⅜	9'-8¼	9'-8¼	9'-8⅛	9'-8	9'-7⅞	9'-7¾	7'-4½	7'-4½	7'-4⅜	7'-4¼	7'-4	7'-3¾	6'-2½	6'-2⅜	6'-2⅛	6'-1⅞	G2
G3	25'-1⅜	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	17'-1¼	15'-1⅛	13'-1	11'-0¾	9'-0⅝	7'-0½	13'-1	11'-0¾	9'-0⅝	7'-0½	G3
G4	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	17'-0⅜	14'-8⅞	12'-8¾	10'-8¾	8'-8¾	6'-8¾	12'-8¾	10'-8¾	8'-8¾	6'-8¾	G4
G5	12'-11¾	11'-11¼	10'-10⅝	9'-10¼	8'-9¾	7'-9¼	6'-8¾	5'-8¼	4'-7¾	10'-10⅝	9'-10¼	8'-9¾	7'-9¼	6'-8¾	5'-8¼	4'-7¾	8'-9¾	7'-9¼	6'-8¾	5'-8¼	4'-7¾	3'-7¼	6'-8¾	5'-8¼	4'-7¾	3'-7¼	G5
G6	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	9'-9⅝	8'-7⅜	7'-7	6'-6½	5'-6⅛	4'-5⅝	7'-7	6'-6½	5'-6⅛	4'-5⅝	G6
G7	2¼	5½	8⅞	8⅞	8⅞	1'-0⅛	1'-0	1'-0	11⅞	8⅞	8⅞	8⅞	1'-0⅛	1'-0	1'-0	11⅞	8⅞	1'-0⅛	1'-0	1'-0	11⅞	11¾	1'-0	1'-0	11⅞	11¾	G7
G8	4⅝	6⅛	7⅝	7⅝	7⅝	9	9	9	9	7⅝	7⅝	7⅝	9	9	9	9	7⅝	9	9	9	9	9	9	9	9	9	G8
PL	51'-5⅝	47'-3½	43'-1½	38'-11⅞	34'-9¼	30'-7¼	26'-5⅛	22'-3⅛	18'-1	43'-1½	38'-11⅞	34'-9¼	30'-7¼	26'-5⅛	22'-3⅛	18'-1	34'-9¼	30'-7¼	26'-5⅛	22'-3⅛	18'-1	13'-10⅞	26'-5⅛	22'-3⅛	18'-1	13'-10⅞	PL
PS	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	26'-0	22'-10⅝	19'-9⅛	16'-7¾	13'-6¼	10'-4⅞	19'-9⅛	16'-7¾	13'-6¼	10'-4⅞	PS
RL	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	35'-9⅛	31'-5⅝	27'-2⅛	22'-10⅝	18'-7⅛	14'-3⅝	27'-2⅛	22'-10⅝	18'-7⅛	14'-3⅝	RL
RS	40'-5	37'-1⅝	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	27'-3⅝	24'-0⅜	20'-9	17'-5¾	14'-2⅜	10'-11⅛	20'-9	17'-5¾	14'-2⅜	10'-11⅛	RS
S1	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	6'-11⅛	6'-11⅛	6'-11⅛	6'-11⅛	6'-11⅛	6'-11⅛	5'-9¼	5'-9¼	5'-9¼	5'-9¼	S1
T	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	1'-0	1'-0	1'-0	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	10	10	10	9	9	9	9	10	9	9	9	9	9	9	9	9	9	U
W	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	4'-0	3'-9	3'-6	3'-6	3'-6	3'-6	3'-6	3'-6	3'-6	3'-6	W

Notes:

1. See Sheet FWH G2-21 for General Notes, Specifications, and Design Stresses.
2. See Sheet FWH 30-1-21 and sheets FWH 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

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

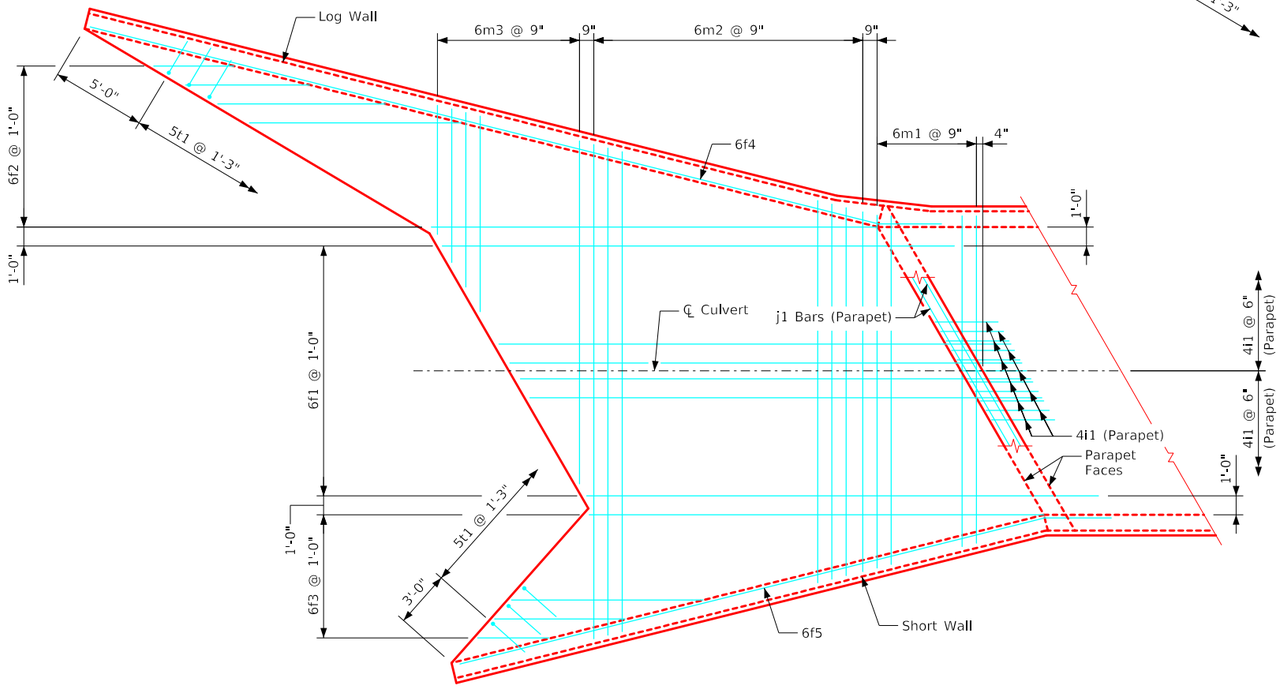
February, 2021

Dimension Table
30° Skew

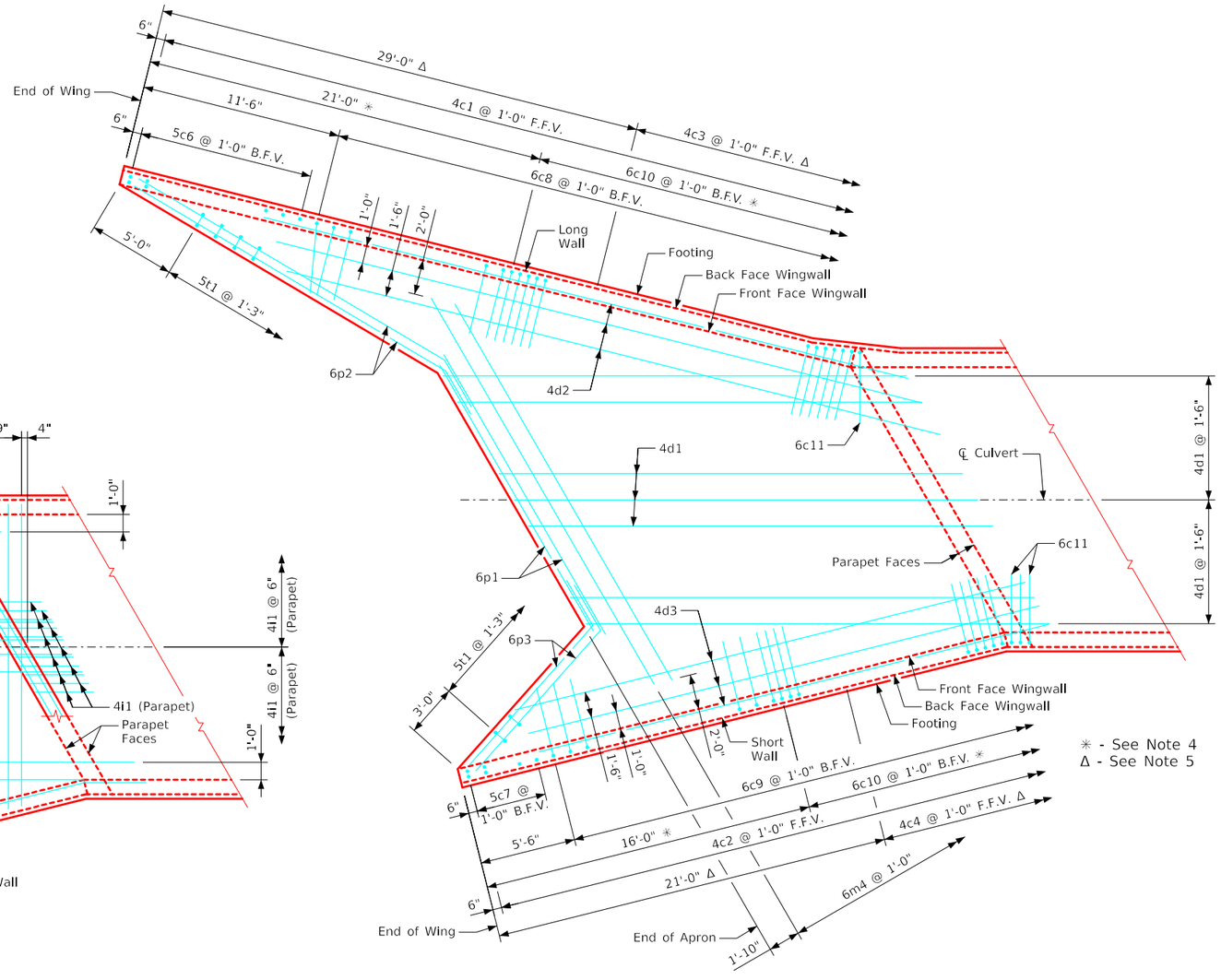
FWH 30-2-21

Sheet 2 of 2

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 30-2-21 S2 - 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 6c10 bars in the 3' thru 6' height headwalls.
5. 4c3 & 4c4 bars used only in the 9' thru 14' height headwalls.
6. For dimension table see Sheet FWH 30-2-21.
7. For reinforcing in curtain wall see Curtain Wall Details on Sheet FWH 30-4-21.

LATEST REVISION DATE

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Standard Design - Single Reinforced Concrete Box Culverts

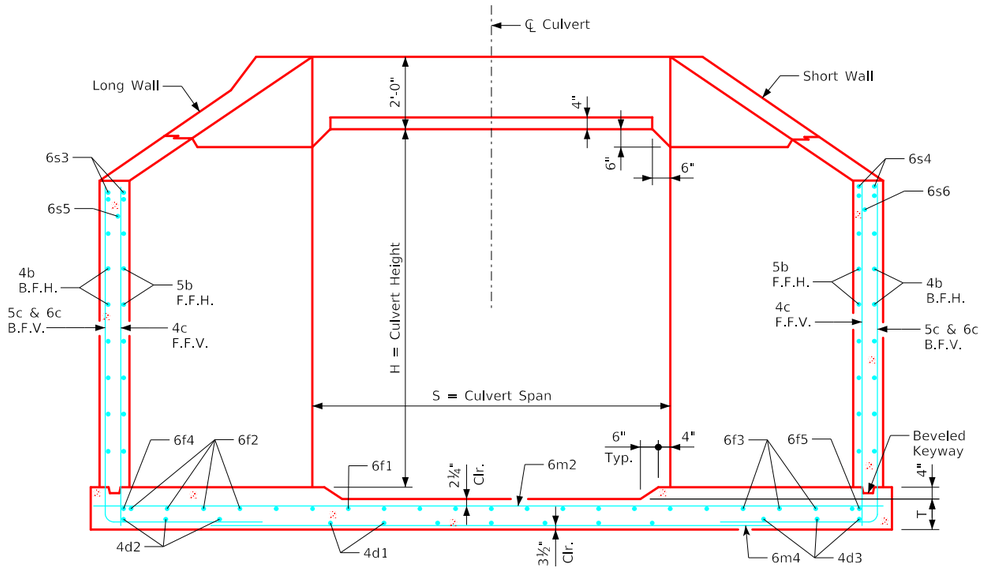
Flared Wing Headwalls

February, 2021

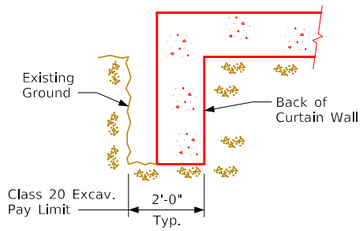
Apron Details 30° Skew

FWH 30-3-21

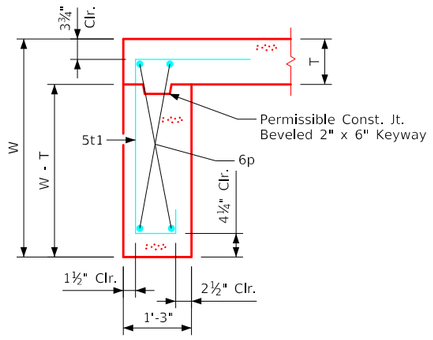
ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 30-3-21 - THIS SHEET ISSUED 02-2021.



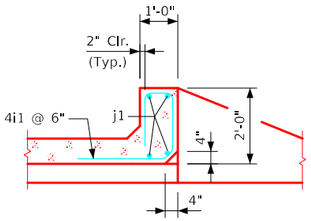
Typical Section - Near Center of Apron



Curtain Wall
Class 20 Excavation

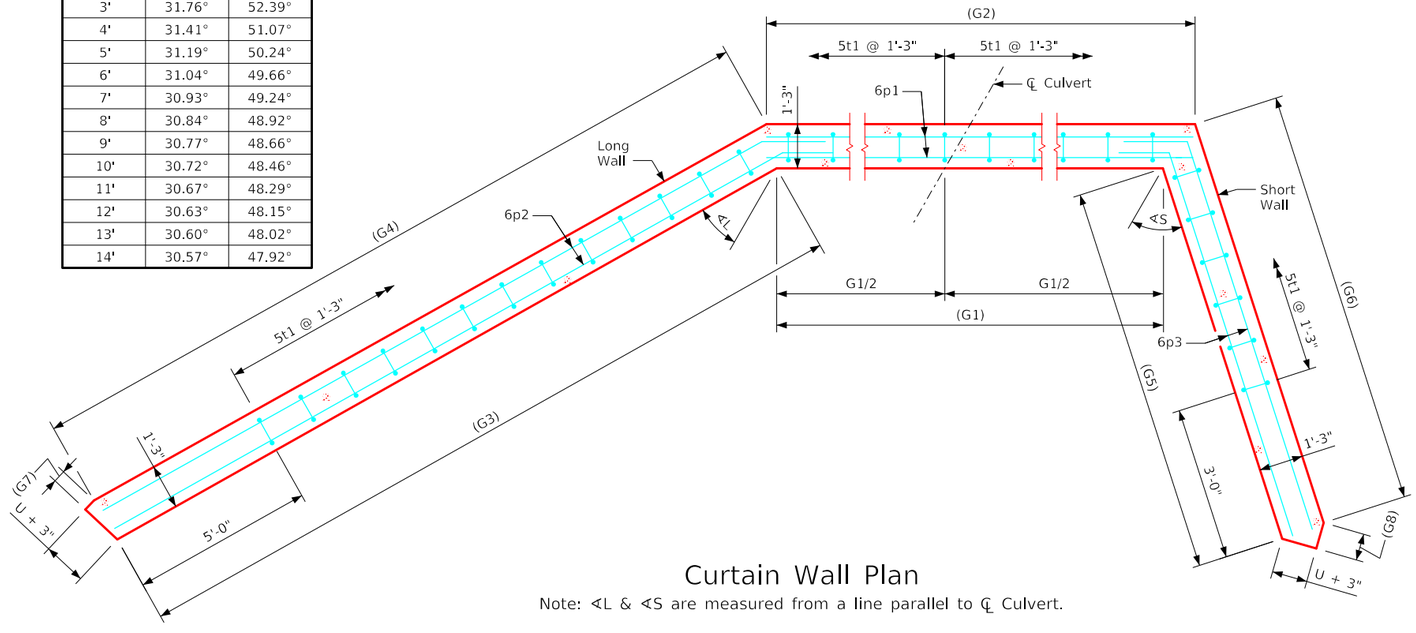


Section thru Curtain Wall



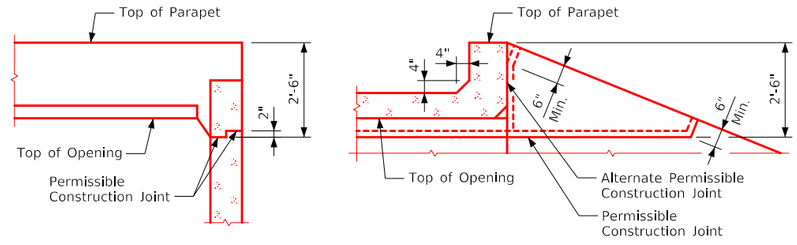
Section thru Parapet

Culvert Height (H)	Angle	
	∢L	∢S
3'	31.76°	52.39°
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°
13'	30.60°	48.02°
14'	30.57°	47.92°



Curtain Wall Plan

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



Top of Wingwall Details

Notes:

1. See Sheet FWH G2-21 for General Notes, Specifications, and Design Stresses.
2. See Sheet FWH 30-2-21 for dimensions table.

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Standard Design - Single Reinforced Concrete Box Culverts

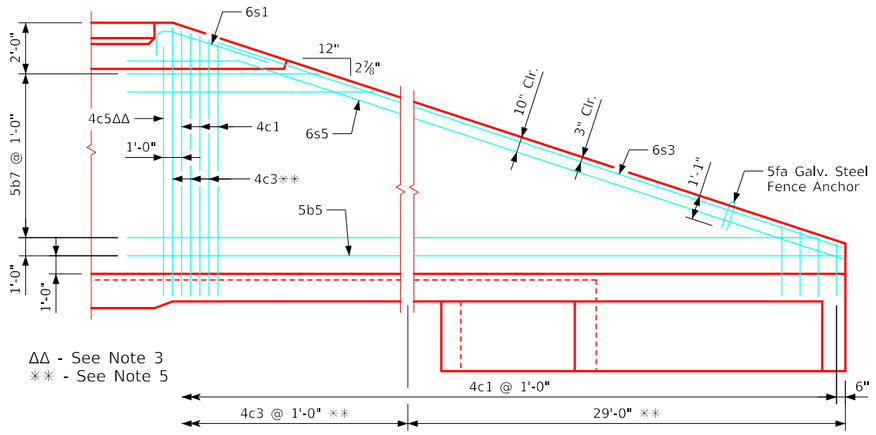
Flared Wing Headwalls

February, 2021

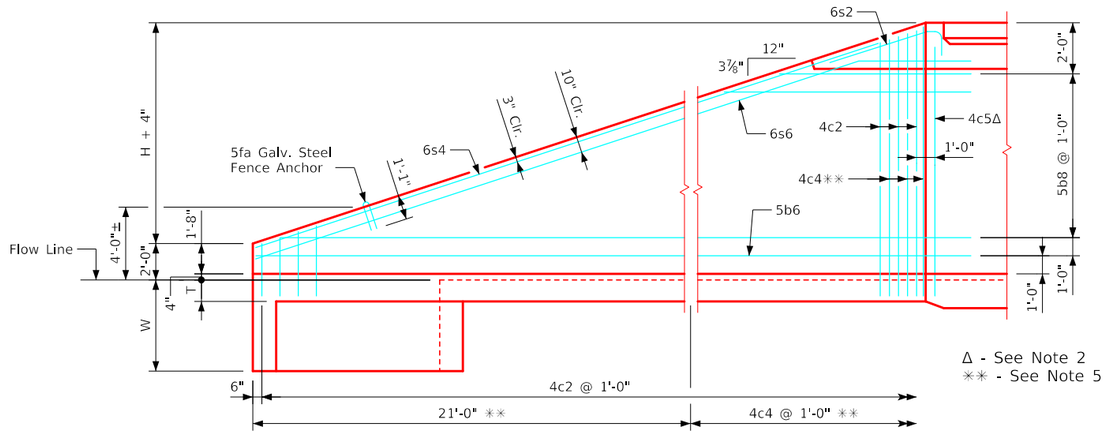
Parapet & Curtain Wall Details 30° Skew

FWH 30-4-21

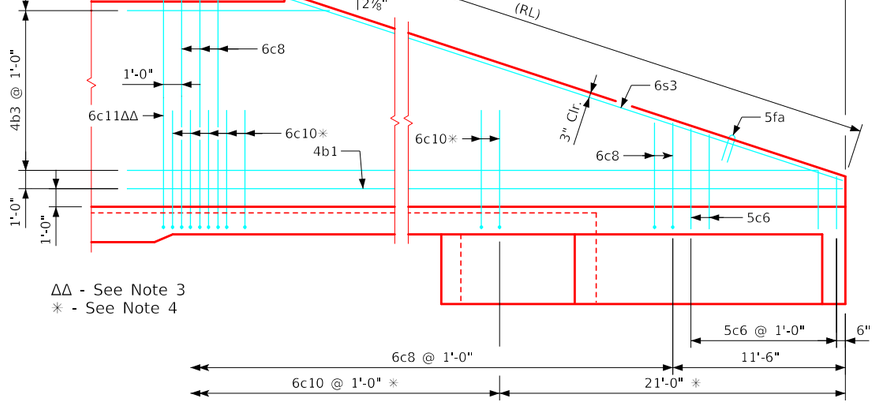
ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 30-4-21 - THIS SHEET ISSUED 02-2021.



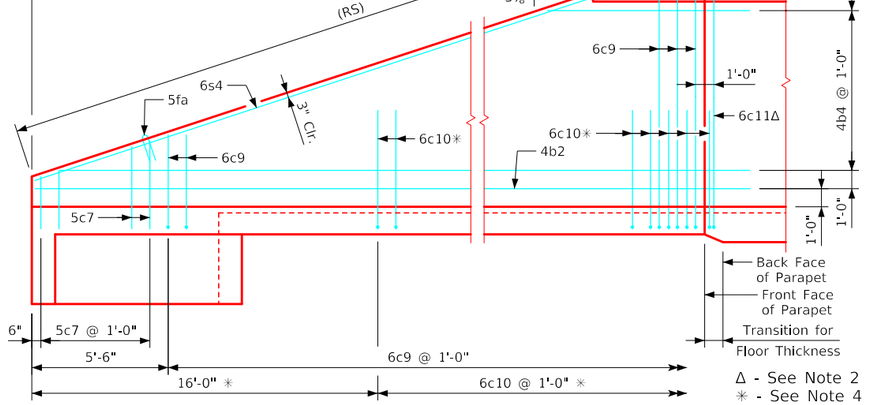
Typical View - Front Face Long Wingwall Reinforcing



Typical View - Front Face Short Wingwall Reinforcing



Typical View - Back Face Long Wingwall Reinforcing



Typical View - Back Face Short Wingwall Reinforcing

Notes:

1. Bar spacings and positions shown are similar for all sizes of headwalls in this standard.
2. Two 4c5 & two 6c11 bars for 3' & 8' thru 12' height headwalls. One 4c5 & one 6c11 bar for 4' thru 7', 13' & 14' height headwalls.
3. Two 4c5 & two 6c11 for 4', 5', 6', 10', 11' & 12' height headwalls. One 4c5 & one 6c11 bar for 3', 7', 8', 9', 13' & 14' height headwalls.
4. Not applicable for 3' thru 6' height headwalls.
5. Not applicable for 3' thru 8' height headwalls.
6. For dimension table, see sheet FWH 30-2-21.
7. Top of wall slope may be rounded in some instances.

LATEST REVISION DATE

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Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Wingwall Details 30° Skew

FWH 30-5-21

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 30-5-21 - THIS SHEET ISSUED 02-2021.

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

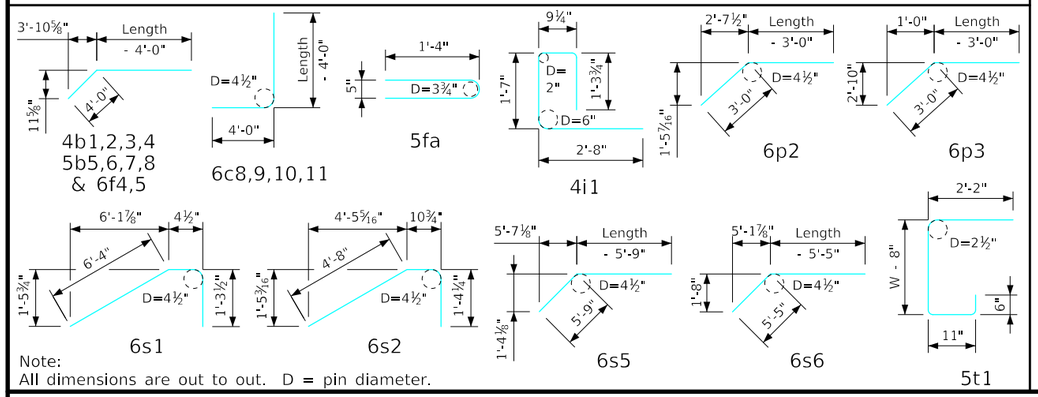
Bar	Location	Shape	16' x 14'			16' x 13'			16' x 12'			16' x 11'			16' x 10'			16' x 9'			16' x 8'			Bar
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	5fa
4b1	Wingwall, B.F.H. Long		1	63'-6	44	1	59'-4	41	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	48'-5	34	1	45'-4	32	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		12 Var.	15'-8 to 61'-7	319	11 Var.	15'-8 to 57'-5	277	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		12 Var.	12'-11 to 47'-0	245	11 Var.	12'-11 to 43'-11	212	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	63'-7	69	1	59'-5	64	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	48'-6	53	1	45'-5	50	1	42'-3	47	1	39'-2	41	1	36'-0	38	1	32'-11	34	1	29'-9	31	5b6
5b7	Wingwall, F.F.H. Long		13 Var.	11'-7 to 61'-8	512	12 Var.	11'-7 to 57'-6	445	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		13 Var.	9'-11 to 47'-1	394	12 Var.	9'-11 to 44'-0	342	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
4c1	Wingwall, F.F.V. Long		60 Var.	2'-10 to 17'-0	397	56 Var.	2'-10 to 16'-0	352	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		45 Var.	2'-10 to 17'-0	298	42 Var.	2'-10 to 16'-0	264	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		32 Var.	9'-8 to 17'-1	286	28 Var.	9'-8 to 16'-1	241	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		25 Var.	9'-5 to 17'-1	221	22 Var.	9'-5 to 16'-1	187	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		1	15'-9	11	1	14'-9	10	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		1	15'-9	11	1	14'-9	10	2	13'-9	18	2	12'-9	17	2	11'-9	16	2	10'-9	14	2	9'-9	13	4c5
5c6	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	11 Var.	2'-10 to 5'-3	46	11 Var.	2'-10 to 5'-3	46	5c6
5c7	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	5 Var.	2'-10 to 4'-2	18	5 Var.	2'-10 to 4'-2	18	5c7
6c8	Wingwall, B.F.V. Long		49 Var.	9'-6 to 21'-0	1122	45 Var.	9'-6 to 20'-0	997	40 Var.	9'-6 to 18'-10	851	36 Var.	9'-6 to 17'-10	739	32 Var.	9'-6 to 16'-11	635	28 Var.	9'-6 to 15'-11	534	24 Var.	9'-6 to 15'-0	442	6c8
6c9	Wingwall, B.F.V. Short		40 Var.	8'-6 to 21'-0	886	37 Var.	8'-6 to 20'-0	792	33 Var.	8'-6 to 18'-9	675	30 Var.	8'-6 to 17'-9	591	27 Var.	8'-6 to 16'-10	514	24 Var.	8'-6 to 15'-10	439	21 Var.	8'-6 to 14'-10	368	6c9
6c10	Wingwall, B.F.V. Long		40	10'-6	631	36	10'-6	568	31	10'-6	489	27	10'-6	426	23	10'-6	363	19	10'-6	300	15	10'-6	237	6c10
6c10	Wingwall, B.F.V. Short		30	10'-6	473	27	10'-6	426	23	10'-6	363	20	10'-6	315	17	10'-6	268	14	10'-6	221	11	10'-6	173	6c10
6c11	Wingwall, B.F.V. Long		1	19'-9	30	1	18'-9	28	2	17'-9	53	2	16'-9	50	2	15'-9	47	1	14'-9	22	1	13'-9	21	6c11
6c11	Wingwall, B.F.V. Short		1	19'-9	30	1	18'-9	28	2	17'-9	53	2	16'-9	50	2	15'-9	47	2	14'-9	44	2	13'-9	41	6c11
4d1	Apron, Longit., Bott.		11	36'-6	268	11	34'-3	252	11	31'-11	235	11	29'-7	217	11	27'-3	200	11	25'-0	184	11	22'-8	167	4d1
4d2	Apron, Longit., Bott. Long		3	57'-1	119	3	52'-11	111	3	48'-9	103	3	44'-7	94	3	40'-5	86	3	36'-3	73	3	32'-1	64	4d2
4d3	Apron, Longit., Bott. Short		3	43'-6	92	3	40'-5	86	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		15	36'-6	822	15	34'-3	772	15	31'-11	719	15	29'-7	667	15	27'-3	614	15	25'-0	563	15	22'-8	511	6f1
6f2	Apron, Longit., Top Long		13 Var.	5'-5 to 33'-1	376	12 Var.	5'-5 to 30'-10	327	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		10 Var.	5'-6 to 33'-4	292	9 Var.	6'-3 to 31'-0	252	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	63'-7	99	1	59'-5	93	1	55'-3	87	1	51'-1	80	1	46'-11	74	1	42'-9	68	1	38'-7	58	6f4
6f5	Apron, Longit., Top Short		1	48'-6	76	1	45'-5	72	1	42'-3	67	1	39'-2	59	1	36'-0	54	1	32'-11	49	1	29'-9	45	6f5
4i1	Parapet, Vertical		33	6'-4	140	33	6'-4	140	33	6'-4	140	33	6'-4	140	33	6'-4	140	33	6'-4	140	33	6'-4	140	4i1
9j1	Parapet, Horizontal		4	20'-9	282	4	20'-4	277	4	20'-4	277	4	20'-2	274	4	20'-0	272	4	20'-0	272	4	20'-0	272	9j1
6m1	Apron, Trans., Top		8 Var.	19'-5 to 20'-9	241	8 Var.	19'-1 to 20'-5	237	8 Var.	19'-1 to 20'-5	237	8 Var.	18'-11 to 20'-3	235	8 Var.	18'-9 to 20'-1	233	8 Var.	18'-9 to 20'-1	233	8 Var.	18'-9 to 20'-1	233	6m1
6m2	Apron, Trans., Top		32 Var.	21'-1 to 32'-9	1294	28 Var.	20'-9 to 30'-11	1086	25 Var.	20'-9 to 29'-9	948	22 Var.	20'-7 to 28'-6	811	19 Var.	20'-5 to 27'-2	679	16 Var.	20'-5 to 26'-1	559	13 Var.	20'-5 to 24'-11	443	6m2
6m3	Apron, Trans., Top		12 Var.	9'-8 to 21'-10	284	13 Var.	8'-9 to 22'-1	301	12 Var.	9'-3 to 21'-5	276	12 Var.	8'-6 to 20'-9	264	12 Var.	7'-9 to 19'-11	249	12 Var.	7'-1 to 19'-3	237	12 Var.	6'-5 to 18'-8	226	6m3
6m4	Apron, Trans., Bott.		28 Var.	13'-5 to 31'-10	952	26 Var.	13'-5 to 30'-6	858	24 Var.	13'-5 to 29'-1	766	22 Var.	13'-6 to 27'-9	682	20 Var.	13'-6 to 26'-5	600	18 Var.	13'-6 to 25'-0	520	16 Var.	13'-6 to 23'-8	447	6m4
6p1	Curtain, Horizontal		4	18'-8	112	4	18'-8	112	4	18'-8	112	4	18'-8	112	4	18'-8	112	4	18'-8	112	4	18'-8	112	6p1
6p2	Curtain, Horizontal, Long		4	32'-1	193	4	30'-1	181	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	18'-0	108	4	17'-0	102	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	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	2	6'-11	21	2	6'-11	21	6s2
6s3	Wing Slope, Both F., Long		2	57'-6	180	2	53'-2	167	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	44'-7	141	2	41'-4	131	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	63'-7	99	1	59'-4	93	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	49'-10	78	1	46'-6	73	1	43'-3	69	1	40'-0	60	1	36'-8	55	1	33'-5	50	1	30'-2	45	6s6
5t1	Curtain, Vertical		46	8'-5	404	43	8'-2	366	40	7'-11	330	39	7'-8	312	36	7'-5	278	34	7'-2	254	31	6'-11	224	5t1
	Estimated Quantities One Headwall	Reinf. Steel		12,833 LB			11,570 LB			10,314 LB			9188 LB			8117 LB			7064 LB			6000 LB		
		Concrete Parapet Δ	2.6			2.4			2.4			2.3			2.3			2.3			2.3			
		Concrete Wingwalls	40.1	111.7 CY		30.1	93.9 CY		26.1	83.6 CY		20.5	71.4 CY		15.8	60.7 CY		13.2	52.7 CY		10.7	45.2 CY		
		Concrete Apron ✳	69.0			61.4			55.1			48.6			42.6			37.2			32.2			

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

Bent Bar Details



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

Headwall Notes:

1. See Sheet FWH G2-21 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", "f1", "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

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
16'-0" Span
30° Skew

FWH 30-6-21

Sheet 1 of 2

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 30-6-21 S1 - THIS SHEET ISSUED 02-2021.

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

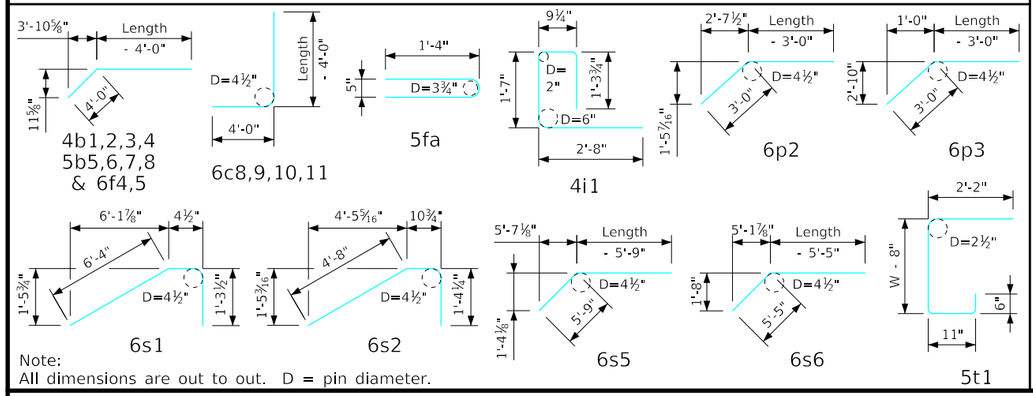
Bar	Location	Shape	16' x 7'			16' x 6'			16' x 5'			16' x 4'			Bar
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	5fa
4b1	Wingwall, B.F.H. Long		1	34'-4	23	1	30'-2	20	1	26'-0	17	1	21'-10	15	4b1
4b2	Wingwall, B.F.H. Short		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
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
5c6	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	5c6
5c7	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	5c7
6c8	Wingwall, B.F.V. Long		20 Var.	9'-6 to 14'-0	353	15 Var.	9'-6 to 12'-10	252	11 Var.	9'-6 to 11'-10	176	7 Var.	9'-6 to 10'-11	107	6c8
6c9	Wingwall, B.F.V. Short		18 Var.	8'-6 to 13'-11	303	15 Var.	8'-6 to 12'-11	241	12 Var.	8'-6 to 12'-0	185	9 Var.	8'-6 to 11'-0	132	6c9
6c10	Wingwall, B.F.V. Long		11	10'-6	173	--	--	--	--	--	--	--	--	--	6c10
6c10	Wingwall, B.F.V. Short		8	10'-6	126	--	--	--	--	--	--	--	--	--	6c10
6c11	Wingwall, B.F.V. Long		1	12'-9	19	2	11'-9	35	2	10'-9	32	2	9'-9	29	6c11
6c11	Wingwall, B.F.V. Short		1	12'-9	19	1	11'-9	18	1	10'-9	16	1	9'-9	15	6c11
4d1	Apron, Longit., Bott.		11	20'-4	149	11	18'-1	133	11	15'-9	116	11	13'-5	99	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		15	20'-4	458	15	18'-1	407	15	15'-9	355	15	13'-5	302	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		33	6'-4	140	33	6'-4	140	33	6'-4	140	33	6'-4	140	4i1
9j1	Parapet, Horizontal		4	19'-9	269	4	19'-9	269	4	19'-9	269	4	19'-9	269	9j1
6m1	Apron, Trans., Top		8 Var.	18'-7 to 19'-11	231	8 Var.	18'-7 to 19'-11	231	8 Var.	18'-7 to 19'-11	231	8 Var.	18'-7 to 19'-11	231	6m1
6m2	Apron, Trans., Top		10 Var.	20'-3 to 23'-8	330	7 Var.	20'-3 to 22'-6	225	4 Var.	20'-3 to 21'-5	125	1	20'-3	30	6m2
6m3	Apron, Trans., Top		12 Var.	5'-8 to 17'-11	213	12 Var.	5'-0 to 17'-2	200	12 Var.	4'-4 to 16'-6	188	12 Var.	3'-8 to 15'-11	176	6m3
6m4	Apron, Trans., Bott.		14 Var.	13'-6 to 22'-4	377	12 Var.	13'-5 to 20'-11	309	10 Var.	13'-5 to 19'-7	248	8 Var.	13'-5 to 18'-3	190	6m4
6p1	Curtain, Horizontal		4	18'-8	112	4	18'-7	112	4	18'-7	112	4	18'-7	112	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'-10	40	1	23'-7	35	1	20'-4	31	1	17'-0	26	6s6
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	5098 LB			4098 LB			3450 LB			2841 LB			
		Concrete Parapet Δ	2.2	37.1 CY		2.2	30.8 CY		2.2	25.5 CY		2.2	20.6 CY		
		Concrete Wingwalls	7.7			5.9			4.3			2.9			
		Concrete Apron ✳	27.2			22.7			19.0			15.5			

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.

Headwall Notes:

1. See Sheet FWH G2-21 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

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
16'-0" Span
30° Skew

FWH 30-6-21

Sheet 2 of 2

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 30-6-21 S2 - THIS SHEET ISSUED 02-2021.

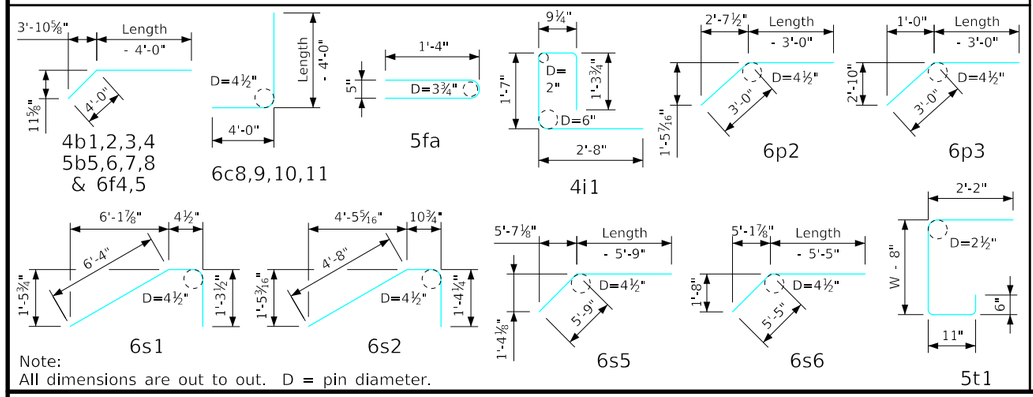
Bill of Reinforcing for One Headwall 30° Skew Span x Culvert Height

Bar	Location	Shape	14' x 14'			14' x 13'			14' x 12'			14' x 11'			14' x 10'			14' x 9'			14' x 8'			Bar
			No.	Length	Wt.	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	2	2'-10	6	5fa
4b1	Wingwall, B.F.H. Long		1	63'-6	44	1	59'-4	41	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	48'-5	34	1	45'-4	32	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		12 Var.	15'-8 to 61'-7	319	11 Var.	15'-8 to 57'-5	277	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		12 Var.	12'-11 to 47'-0	245	11 Var.	12'-11 to 43'-11	212	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	63'-7	69	1	59'-5	64	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	48'-6	53	1	45'-5	50	1	42'-3	47	1	39'-2	41	1	36'-0	38	1	32'-11	34	1	29'-9	31	5b6
5b7	Wingwall, F.F.H. Long		13 Var.	11'-7 to 61'-8	512	12 Var.	11'-7 to 57'-6	445	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		13 Var.	9'-11 to 47'-1	394	12 Var.	9'-11 to 44'-0	342	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
4c1	Wingwall, F.F.V. Long		60 Var.	2'-10 to 17'-0	397	56 Var.	2'-10 to 16'-0	352	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		45 Var.	2'-10 to 17'-0	298	42 Var.	2'-10 to 16'-0	264	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		32 Var.	9'-8 to 17'-1	286	28 Var.	9'-8 to 16'-1	241	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		25 Var.	9'-5 to 17'-1	221	22 Var.	9'-5 to 16'-1	187	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		1	15'-9	11	1	14'-9	10	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		1	15'-9	11	1	14'-9	10	2	13'-9	18	2	12'-9	17	2	11'-9	16	2	10'-9	14	2	9'-9	13	4c5
5c6	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	11 Var.	2'-10 to 5'-3	46	11 Var.	2'-10 to 5'-3	46	5c6
5c7	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	5 Var.	2'-10 to 4'-2	18	5 Var.	2'-10 to 4'-2	18	5c7
6c8	Wingwall, B.F.V. Long		49 Var.	9'-6 to 21'-0	1122	45 Var.	9'-6 to 20'-0	997	40 Var.	9'-6 to 18'-10	851	36 Var.	9'-6 to 17'-10	739	32 Var.	9'-6 to 16'-11	635	28 Var.	9'-6 to 15'-11	534	24 Var.	9'-6 to 15'-0	442	6c8
6c9	Wingwall, B.F.V. Short		40 Var.	8'-6 to 21'-0	886	37 Var.	8'-6 to 20'-0	792	33 Var.	8'-6 to 18'-9	675	30 Var.	8'-6 to 17'-9	591	27 Var.	8'-6 to 16'-10	514	24 Var.	8'-6 to 15'-10	439	21 Var.	8'-6 to 14'-10	368	6c9
6c10	Wingwall, B.F.V. Long		40	10'-6	631	36	10'-6	568	31	10'-6	489	27	10'-6	426	23	10'-6	363	19	10'-6	300	15	10'-6	237	6c10
6c10	Wingwall, B.F.V. Short		30	10'-6	473	27	10'-6	426	23	10'-6	363	20	10'-6	315	17	10'-6	268	14	10'-6	221	11	10'-6	173	6c10
6c11	Wingwall, B.F.V. Long		1	19'-9	30	1	18'-9	28	2	17'-9	53	2	16'-9	50	2	15'-9	47	1	14'-9	22	1	13'-9	21	6c11
6c11	Wingwall, B.F.V. Short		1	19'-9	30	1	18'-9	28	2	17'-9	53	2	16'-9	50	2	15'-9	47	2	14'-9	44	2	13'-9	41	6c11
4d1	Apron, Longit., Bott.		9	36'-6	219	9	34'-3	206	9	31'-11	192	9	29'-7	178	9	27'-3	164	9	25'-0	150	9	22'-8	136	4d1
4d2	Apron, Longit., Bott. Long		3	57'-1	119	3	52'-11	111	3	48'-9	103	3	44'-7	94	3	40'-5	86	3	36'-3	73	3	32'-1	64	4d2
4d3	Apron, Longit., Bott. Short		3	43'-6	92	3	40'-5	86	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		13	36'-6	713	13	34'-3	669	13	31'-11	623	13	29'-7	578	13	27'-3	532	13	25'-0	488	13	22'-8	443	6f1
6f2	Apron, Longit., Top Long		13 Var.	5'-5 to 33'-1	376	12 Var.	5'-5 to 30'-10	327	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		10 Var.	5'-6 to 33'-4	292	9 Var.	6'-3 to 31'-0	252	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	63'-7	99	1	59'-5	93	1	55'-3	87	1	51'-1	80	1	46'-11	74	1	42'-9	68	1	38'-7	58	6f4
6f5	Apron, Longit., Top Short		1	48'-6	76	1	45'-5	72	1	42'-3	67	1	39'-2	59	1	36'-0	54	1	32'-11	49	1	29'-9	45	6f5
4i1	Parapet, Vertical		29	6'-4	123	29	6'-4	123	29	6'-4	123	29	6'-4	123	29	6'-4	123	29	6'-4	123	29	6'-4	123	4i1
9j1	Parapet, Horizontal		4	18'-5	250	4	18'-1	246	4	18'-1	246	4	17'-10	243	4	17'-8	240	4	17'-8	240	4	17'-8	240	9j1
6m1	Apron, Trans., Top		7 Var.	17'-4 to 18'-5	188	7 Var.	17'-0 to 18'-1	184	7 Var.	17'-0 to 18'-1	184	7 Var.	16'-10 to 17'-11	183	7 Var.	16'-7 to 17'-9	180	7 Var.	16'-7 to 17'-9	180	7 Var.	16'-7 to 17'-9	180	6m1
6m2	Apron, Trans., Top		33 Var.	18'-9 to 30'-9	1227	30 Var.	18'-5 to 29'-3	1074	27 Var.	18'-5 to 28'-2	945	24 Var.	18'-3 to 26'-10	813	21 Var.	18'-1 to 25'-7	689	18 Var.	18'-1 to 24'-5	575	15 Var.	18'-1 to 23'-4	467	6m2
6m3	Apron, Trans., Top		11 Var.	9'-11 to 21'-0	255	11 Var.	9'-0 to 20'-2	241	11 Var.	8'-4 to 19'-6	230	11 Var.	7'-8 to 18'-9	218	11 Var.	6'-10 to 18'-0	205	10 Var.	7'-4 to 17'-4	185	10 Var.	6'-8 to 16'-8	175	6m3
6m4	Apron, Trans., Bott.		28 Var.	11'-2 to 29'-6	855	26 Var.	11'-2 to 28'-2	768	24 Var.	11'-2 to 26'-10	685	22 Var.	11'-2 to 25'-5	604	20 Var.	11'-2 to 24'-1	529	18 Var.	11'-2 to 22'-9	458	16 Var.	11'-2 to 21'-4	391	6m4
6p1	Curtain, Horizontal		4	16'-4	98	4	16'-4	98	4	16'-4	98	4	16'-4	98	4	16'-4	98	4	16'-4	98	4	16'-4	98	6p1
6p2	Curtain, Horizontal, Long		4	32'-1	193	4	30'-1	181	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	18'-0	108	4	17'-0	102	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	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	2	6'-11	21	2	6'-11	21	6s2
6s3	Wing Slope, Both F., Long		2	57'-6	180	2	53'-2	167	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	44'-7	141	2	41'-4	131	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	63'-7	99	1	59'-4	93	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	49'-10	78	1	46'-6	73	1	43'-3	69	1	40'-0	60	1	36'-8	55	1	33'-5	50	1	30'-2	45	6s6
5t1	Curtain, Vertical		44	8'-5	386	41	8'-2	349	38	7'-11	314	37	7'-8	296	34	7'-5	263	32	7'-2	239	29	6'-11	209	5t1
	Estimated Quantities One Headwall	Reinf. Steel		12,348 LB			11,127 LB			9914 LB			8808 LB			7763 LB			6726 LB			5687 LB		
		Concrete Parapet Δ	2.4			2.3			2.3			2.2			2.1			2.1			2.1			
		Concrete Wingwalls	40.1	108.1 CY		30.1	90.6 CY		26.1	80.5 CY		20.5	68.6 CY		15.8	58.0 CY		13.2	50.2 CY		10.7	42.9 CY		
		Concrete Apron ✳	65.6			58.2			52.1			45.9			40.1			34.9			30.1			

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.

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.

Headwall Notes:

1. See Sheet FWH G2-21 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

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
14'-0" Span
30° Skew

FWH 30-7-21

Sheet 1 of 2

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 30-7-21 S1 - THIS SHEET ISSUED 02-2021.

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

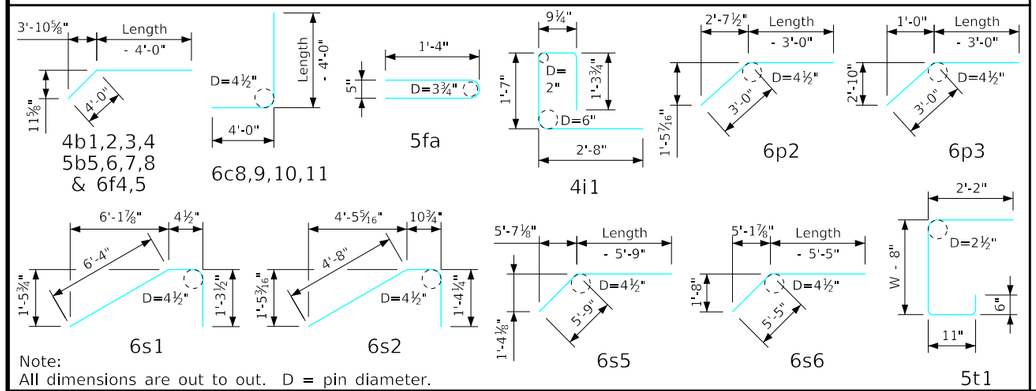
Bar	Location	Shape	14' x 7'			14' x 6'			14' x 5'			14' x 4'			Bar
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	5fa
4b1	Wingwall, B.F.H. Long		1	34'-4	23	1	30'-2	20	1	26'-0	17	1	21'-10	15	4b1
4b2	Wingwall, B.F.H. Short		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
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
5c6	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	5c6
5c7	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	5c7
6c8	Wingwall, B.F.V. Long		20 Var.	9'-6 to 14'-0	353	15 Var.	9'-6 to 12'-10	252	11 Var.	9'-6 to 11'-10	176	7 Var.	9'-6 to 10'-11	107	6c8
6c9	Wingwall, B.F.V. Short		18 Var.	8'-6 to 13'-11	303	15 Var.	8'-6 to 12'-11	241	12 Var.	8'-6 to 12'-0	185	9 Var.	8'-6 to 11'-0	132	6c9
6c10	Wingwall, B.F.V. Long		11	10'-6	173	--	--	--	--	--	--	--	--	--	6c10
6c10	Wingwall, B.F.V. Short		8	10'-6	126	--	--	--	--	--	--	--	--	--	6c10
6c11	Wingwall, B.F.V. Long		1	12'-9	19	2	11'-9	35	2	10'-9	32	2	9'-9	29	6c11
6c11	Wingwall, B.F.V. Short		1	12'-9	19	1	11'-9	18	1	10'-9	16	1	9'-9	15	6c11
4d1	Apron, Longit., Bott.		9	20'-4	122	9	18'-1	109	9	15'-9	95	9	13'-5	81	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		13	20'-4	397	13	18'-1	353	13	15'-9	308	13	13'-5	262	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		29	6'-4	123	29	6'-4	123	29	6'-4	123	29	6'-4	123	4i1
9j1	Parapet, Horizontal		4	17'-6	238	4	17'-6	238	4	17'-6	238	4	17'-6	238	9j1
6m1	Apron, Trans., Top		7 Var.	16'-5 to 17'-7	179	7 Var.	16'-5 to 17'-7	179	7 Var.	16'-5 to 17'-7	179	7 Var.	16'-5 to 17'-7	179	6m1
6m2	Apron, Trans., Top		12 Var.	17'-11 to 22'-0	360	9 Var.	17'-11 to 20'-11	262	6 Var.	17'-11 to 19'-9	170	3 Var.	17'-11 to 18'-8	82	6m2
6m3	Apron, Trans., Top		10 Var.	5'-11 to 15'-11	164	10 Var.	5'-3 to 15'-3	154	10 Var.	4'-7 to 14'-7	144	10 Var.	3'-11 to 13'-11	134	6m3
6m4	Apron, Trans., Bott.		14 Var.	11'-2 to 20'-0	328	12 Var.	11'-2 to 18'-8	269	10 Var.	11'-2 to 17'-3	213	8 Var.	11'-2 to 15'-11	163	6m4
6p1	Curtain, Horizontal		4	16'-4	98	4	16'-4	98	4	16'-4	98	4	16'-3	98	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'-10	40	1	23'-7	35	1	20'-4	31	1	17'-0	26	6s6
5t1	Curtain, Vertical		26	6'-8	181	24	6'-5	161	22	6'-5	147	20	6'-5	134	5t1
	Estimated Quantities One Headwall	Reinf. Steel		4814 LB			3844 LB			3220 LB			2639 LB		
		Concrete Parapet Δ	2.0	35.0 CY		2.0	29.0 CY		2.0	23.9 CY		2.0	19.2 CY		
		Concrete Wingwalls	7.7			5.9			4.3			2.9			
		Concrete Apron ✳	25.3			21.1			17.6			14.3			

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.

Headwall Notes:

1. See Sheet FWH G2-21 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", "f1", "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

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
14'-0" Span
30° Skew

FWH 30-7-21

Sheet 2 of 2

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 30-7-21 S2 - THIS SHEET ISSUED 02-2021.

Revised 08-2022: Corrected Typos in Bill of Reinforcing bar "Location" with bars 7j1, 6m1, 6m2, 6m3, 6m4, 6p1, 6p2, 6p3, 6s1, 6s2, 6s3, 6s4, 6s5, 6s6, 5t1.
ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 30-8-21 S1 - THIS SHEET ISSUED 02-2021.

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

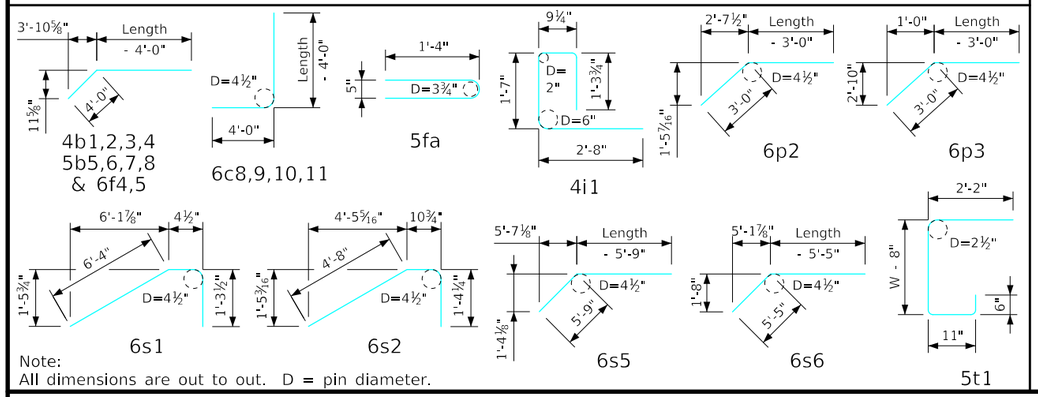
Bar	Location	Shape	12' x 12'			12' x 11'			12' x 10'			12' x 9'			12' x 8'			12' x 7'			Bar
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	5fa
4b1	Wingwall, B.F.H. Long		1	55'-2	38	1	51'-0	36	1	46'-10	33	1	42'-8	30	1	38'-6	26	1	34'-4	23	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	1	26'-7	18	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	5 Var.	15'-8 to 32'-5	80	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	5 Var.	12'-10 to 25'-3	64	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	1	34'-5	36	5b5
5b6	Wingwall, F.F.H. Short		1	42'-3	47	1	39'-2	41	1	36'-0	38	1	32'-11	34	1	29'-9	31	1	26'-8	28	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	6 Var.	11'-7 to 32'-5	138	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	6 Var.	9'-9 to 25'-3	110	5b8
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	31 Var.	2'-10 to 10'-0	133	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	23 Var.	2'-10 to 9'-11	98	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	1	8'-9	6	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	1	8'-9	6	4c5
5c6	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	11 Var.	2'-10 to 5'-3	46	5c6
5c7	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	5 Var.	2'-10 to 4'-2	18	5c7
6c8	Wingwall, B.F.V. Long		40 Var.	9'-6 to 18'-10	851	36 Var.	9'-6 to 17'-10	739	32 Var.	9'-6 to 16'-11	635	28 Var.	9'-6 to 15'-11	534	24 Var.	9'-6 to 15'-0	442	20 Var.	9'-6 to 14'-0	353	6c8
6c9	Wingwall, B.F.V. Short		33 Var.	8'-6 to 18'-9	675	30 Var.	8'-6 to 17'-9	591	27 Var.	8'-6 to 16'-10	514	24 Var.	8'-6 to 15'-10	439	21 Var.	8'-6 to 14'-10	368	18 Var.	8'-6 to 13'-11	303	6c9
6c10	Wingwall, B.F.V. Long		31	10'-6	489	27	10'-6	426	23	10'-6	363	19	10'-6	300	15	10'-6	237	11	10'-6	173	6c10
6c10	Wingwall, B.F.V. Short		23	10'-6	363	20	10'-6	315	17	10'-6	268	14	10'-6	221	11	10'-6	173	8	10'-6	126	6c10
6c11	Wingwall, B.F.V. Long		2	17'-9	53	2	16'-9	50	2	15'-9	47	1	14'-9	22	1	13'-9	21	1	12'-9	19	6c11
6c11	Wingwall, B.F.V. Short		2	17'-9	53	2	16'-9	50	2	15'-9	47	2	14'-9	44	2	13'-9	41	1	12'-9	19	6c11
4d1	Apron, Longit., Bott.		9	31'-11	192	9	29'-7	178	9	27'-3	164	9	25'-0	150	9	22'-8	136	9	20'-4	122	4d1
4d2	Apron, Longit., Bott. Long		3	48'-9	103	3	44'-7	94	3	40'-5	86	3	36'-3	73	3	32'-1	64	3	27'-11	56	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	3	21'-8	43	4d3
6f1	Apron, Longit., Top		11	31'-11	527	11	29'-7	489	11	27'-3	450	11	25'-0	413	11	22'-8	374	11	20'-4	336	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	6 Var.	5'-3 to 16'-11	100	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	4 Var.	7'-9 to 17'-2	75	6f3
6f4	Apron, Longit., Top Long		1	55'-3	87	1	51'-1	80	1	46'-11	74	1	42'-9	68	1	38'-7	58	1	34'-5	52	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	1	26'-8	40	6f5
4i1	Parapet, Vertical		25	6'-4	106	25	6'-4	106	25	6'-4	106	25	6'-4	106	25	6'-4	106	25	6'-4	106	4i1
7j1	Parapet, Horizontal		4	15'-9	129	4	15'-7	127	4	15'-4	125	4	15'-4	125	4	15'-4	125	4	15'-2	124	7j1
6m1	Apron, Trans., Top		6 Var.	14'-10 to 15'-9	138	6 Var.	14'-8 to 15'-7	136	6 Var.	14'-6 to 15'-5	135	6 Var.	14'-6 to 15'-5	135	6 Var.	14'-6 to 15'-5	135	6 Var.	14'-4 to 15'-3	133	6m1
6m2	Apron, Trans., Top		29 Var.	16'-0 to 26'-6	926	26 Var.	15'-10 to 25'-3	802	23 Var.	15'-8 to 23'-11	684	20 Var.	15'-8 to 22'-10	578	17 Var.	15'-8 to 21'-8	477	14 Var.	15'-6 to 20'-5	378	6m2
6m3	Apron, Trans., Top		9 Var.	8'-7 to 17'-6	176	9 Var.	7'-11 to 16'-9	167	9 Var.	7'-2 to 16'-0	157	9 Var.	6'-5 to 15'-4	147	9 Var.	5'-10 to 14'-8	139	9 Var.	5'-1 to 13'-11	128	6m3
6m4	Apron, Trans., Bott.		24 Var.	8'-10 to 24'-6	601	22 Var.	8'-10 to 23'-2	529	20 Var.	8'-10 to 21'-9	459	18 Var.	8'-10 to 20'-5	395	16 Var.	8'-10 to 19'-1	335	14 Var.	8'-10 to 17'-8	279	6m4
6p1	Curtain, Horizontal		4	14'-0	84	4	14'-0	84	4	14'-0	84	4	14'-0	84	4	14'-0	84	4	14'-0	84	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	4	18'-0	108	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	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	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	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	2	27'-5	82	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	2	21'-8	65	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	1	33'-7	50	6s5
6s6	Wing Slope, F.F. Short		1	43'-3	69	1	40'-0	60	1	36'-8	55	1	33'-5	50	1	30'-2	45	1	26'-10	40	6s6
5t1	Curtain, Vertical		36	7'-11	297	35	7'-8	280	32	7'-5	248	30	7'-2	224	27	6'-11	195	24	6'-8	167	5t1
	Estimated Quantities One Headwall	Reinf. Steel		9450 LB			8372 LB			7352 LB			6347 LB			5331 LB			4481 LB		
		Concrete Parapet Δ	2.1	77.3 CY		2.0	65.6 CY		1.9	55.2 CY		1.9	47.7 CY		1.9	40.6 CY		1.8	33.0 CY		
		Concrete Wingwalls	26.1			20.5			15.8			13.2			10.7			7.7			
		Concrete Apron ✳	49.1			43.1			37.5			32.6			28.0			23.5			

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.

Headwall Notes:

1. See Sheet FWH G2-21 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", "f1", "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.

August 2022
LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWA DOT

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
12'-0" Span
30° Skew

FWH 30-8-21
Sheet 1 of 2

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

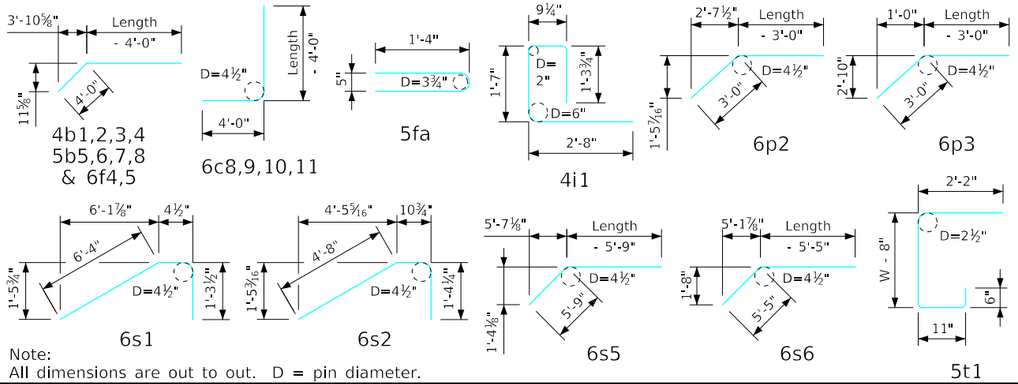
Bar	Location	Shape	12' x 6' No.	12' x 6' Length	12' x 6' Wt.	12' x 5' No.	12' x 5' Length	12' x 5' Wt.	12' x 4' No.	12' x 4' Length	12' x 4' Wt.	Bar
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	5fa
4b1	Wingwall, B.F.H. Long		1	30'-2	20	1	26'-0	17	1	21'-10	15	4b1
4b2	Wingwall, B.F.H. Short		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
4c1	Wingwall, F.F.V. Long		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		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		2	7'-9	10	2	6'-9	9	2	5'-9	8	4c5
4c5	Wingwall, F.F.V. Short		1	7'-9	5	1	6'-9	5	1	5'-9	4	4c5
5c6	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	5c6
5c7	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	5c7
6c8	Wingwall, B.F.V. Long		15 Var.	9'-6 to 12'-10	252	11 Var.	9'-6 to 11'-10	176	7 Var.	9'-6 to 10'-11	107	6c8
6c9	Wingwall, B.F.V. Short		15 Var.	8'-6 to 12'-11	241	12 Var.	8'-6 to 12'-0	185	9 Var.	8'-6 to 11'-0	132	6c9
6c10	Wingwall, B.F.V. Long		--	--	--	--	--	--	--	--	--	6c10
6c10	Wingwall, B.F.V. Short		--	--	--	--	--	--	--	--	--	6c10
6c11	Wingwall, B.F.V. Long		2	11'-9	35	2	10'-9	32	2	9'-9	29	6c11
6c11	Wingwall, B.F.V. Short		1	11'-9	18	1	10'-9	16	1	9'-9	15	6c11
4d1	Apron, Longit., Bott.		9	18'-1	109	9	15'-9	95	9	13'-5	81	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		11	18'-1	299	11	15'-9	260	11	13'-5	222	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		25	6'-4	106	25	6'-4	106	25	6'-4	106	4i1
7j1	Parapet, Horizontal		4	15'-2	124	4	15'-2	124	4	15'-2	124	7j1
6m1	Apron, Trans., Top		6 Var.	14'-4 to 15'-3	133	6 Var.	14'-4 to 15'-3	133	6 Var.	14'-4 to 15'-3	133	6m1
6m2	Apron, Trans., Top		10 Var.	15'-6 to 18'-11	258	7 Var.	15'-6 to 17'-9	175	4 Var.	15'-6 to 16'-8	97	6m2
6m3	Apron, Trans., Top		9 Var.	5'-6 to 14'-5	135	9 Var.	4'-10 to 13'-9	126	9 Var.	4'-2 to 13'-1	117	6m3
6m4	Apron, Trans., Bott.		12 Var.	8'-10 to 16'-4	227	10 Var.	8'-10 to 15'-0	179	8 Var.	8'-10 to 13'-7	135	6m4
6p1	Curtain, Horizontal		4	14'-0	84	4	14'-0	84	4	14'-0	84	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'-7	35	1	20'-4	31	1	17'-0	26	6s6
5t1	Curtain, Vertical		22	6'-5	147	20	6'-5	134	18	6'-5	120	5t1
	Estimated Quantities One Headwall	Reinf. Steel		3520 LB			2921 LB			2364 LB		
		Concrete Parapet Δ	1.8	27.2 CY		1.8	22.3 CY		1.8	17.8 CY		
		Concrete Wingwalls	5.9			4.3			2.9			
		Concrete Apron ✳	19.5			16.2			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

Bent Bar Details



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

Headwall Notes:

1. See Sheet FWH G2-21 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

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
12'-0" Span
30° Skew

FWH 30-8-21

Sheet 2 of 2

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 30-8-21 S2 - THIS SHEET ISSUED 02-2021

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

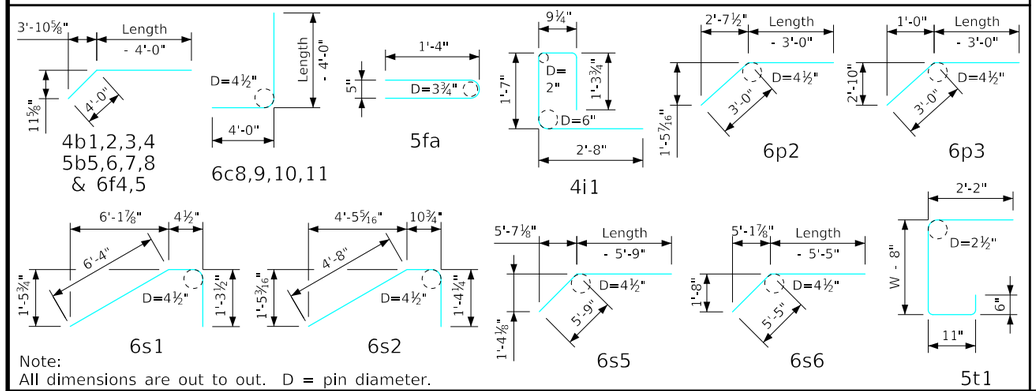
Bar	Location	Shape	10' x 12'			10' x 11'			10' x 10'			10' x 9'			10' x 8'			10' x 7'			Bar
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	5fa
4b1	Wingwall, B.F.H. Long		1	55'-2	38	1	51'-0	36	1	46'-10	33	1	42'-8	30	1	38'-6	26	1	34'-4	23	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	1	26'-7	18	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	5 Var.	15'-8 to 32'-5	80	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	5 Var.	12'-10 to 25'-3	64	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	1	34'-5	36	5b5
5b6	Wingwall, F.F.H. Short		1	42'-3	47	1	39'-2	41	1	36'-0	38	1	32'-11	34	1	29'-9	31	1	26'-8	28	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	6 Var.	11'-7 to 32'-5	138	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	6 Var.	9'-9 to 25'-3	110	5b8
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	31 Var.	2'-9 to 9'-11	131	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	23 Var.	2'-9 to 9'-10	97	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	1	8'-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	1	8'-8	6	4c5
5c6	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	11 Var.	2'-9 to 5'-2	45	5c6
5c7	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	5 Var.	2'-9 to 4'-1	18	5c7
6c8	Wingwall, B.F.V. Long		40 Var.	9'-5 to 18'-9	846	36 Var.	9'-5 to 17'-9	734	32 Var.	9'-5 to 16'-10	631	28 Var.	9'-5 to 15'-10	531	24 Var.	9'-5 to 14'-11	439	20 Var.	9'-5 to 13'-11	350	6c8
6c9	Wingwall, B.F.V. Short		33 Var.	8'-5 to 18'-8	671	30 Var.	8'-5 to 17'-8	588	27 Var.	8'-5 to 16'-9	510	24 Var.	8'-5 to 15'-9	436	21 Var.	8'-5 to 14'-9	365	18 Var.	8'-5 to 13'-10	301	6c9
6c10	Wingwall, B.F.V. Long		31	10'-6	489	27	10'-6	426	23	10'-6	363	19	10'-6	300	15	10'-6	237	11	10'-6	173	6c10
6c10	Wingwall, B.F.V. Short		23	10'-6	363	20	10'-6	315	17	10'-6	268	14	10'-6	221	11	10'-6	173	8	10'-6	126	6c10
6c11	Wingwall, B.F.V. Long		2	17'-8	53	2	16'-8	50	2	15'-8	47	1	14'-8	22	1	13'-8	21	1	12'-8	19	6c11
6c11	Wingwall, B.F.V. Short		2	17'-8	53	2	16'-8	50	2	15'-8	47	2	14'-8	44	2	13'-8	41	1	12'-8	19	6c11
4d1	Apron, Longit., Bott.		7	31'-11	149	7	29'-7	138	7	27'-3	127	7	25'-0	117	7	22'-8	106	7	20'-4	95	4d1
4d2	Apron, Longit., Bott. Long		3	48'-9	103	3	44'-7	94	3	40'-5	86	3	36'-3	73	3	32'-1	64	3	27'-11	56	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	3	21'-8	43	4d3
6f1	Apron, Longit., Top		9	31'-11	431	9	29'-7	400	9	27'-3	368	9	25'-0	338	9	22'-8	306	9	20'-4	275	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	6 Var.	5'-3 to 16'-11	100	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	4 Var.	7'-9 to 17'-2	75	6f3
6f4	Apron, Longit., Top Long		1	55'-3	87	1	51'-1	80	1	46'-11	74	1	42'-9	68	1	38'-7	58	1	34'-5	52	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	1	26'-8	40	6f5
4i1	Parapet, Vertical		21	6'-4	89	21	6'-4	89	21	6'-4	89	21	6'-4	89	21	6'-4	89	21	6'-4	89	4i1
7j1	Parapet, Horizontal		4	13'-5	110	4	13'-3	108	4	13'-1	107	4	13'-1	107	4	13'-1	107	4	12'-10	105	7j1
6m1	Apron, Trans., Top		5 Var.	12'-8 to 13'-5	98	5 Var.	12'-6 to 13'-3	97	5 Var.	12'-4 to 13'-1	95	5 Var.	12'-4 to 13'-1	95	5 Var.	12'-4 to 13'-1	95	5 Var.	12'-2 to 12'-11	94	6m1
6m2	Apron, Trans., Top		31 Var.	13'-8 to 24'-11	898	28 Var.	13'-6 to 23'-7	780	25 Var.	13'-4 to 22'-4	670	21 Var.	13'-4 to 20'-10	539	18 Var.	13'-4 to 19'-8	446	15 Var.	13'-2 to 18'-5	356	6m2
6m3	Apron, Trans., Top		7 Var.	8'-11 to 15'-7	129	7 Var.	8'-2 to 14'-10	121	7 Var.	7'-5 to 14'-1	113	8 Var.	6'-9 to 14'-6	128	8 Var.	6'-1 to 13'-10	120	8 Var.	5'-4 to 13'-1	111	6m3
6m4	Apron, Trans., Bott.		24 Var.	6'-6 to 22'-2	517	22 Var.	6'-6 to 20'-10	452	20 Var.	6'-6 to 19'-6	391	18 Var.	6'-6 to 18'-1	332	16 Var.	6'-6 to 16'-9	279	14 Var.	6'-6 to 15'-5	230	6m4
6p1	Curtain, Horizontal		4	11'-9	71	4	11'-9	71	4	11'-9	71	4	11'-9	71	4	11'-9	71	4	11'-8	70	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	4	18'-0	108	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	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	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	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	2	27'-5	82	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	2	21'-8	65	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	1	33'-7	50	6s5
6s6	Wing Slope, F.F. Short		1	43'-3	69	1	40'-0	60	1	36'-8	55	1	33'-5	50	1	30'-2	45	1	26'-10	40	6s6
5t1	Curtain, Vertical		34	7'-11	281	33	7'-8	264	30	7'-5	232	28	7'-2	209	25	6'-11	180	22	6'-8	153	5t1
	Estimated Quantities One Headwall	Reinf. Steel		9030 LB			7978 LB			6989 LB			6003 LB			5012 LB			4193 LB		
		Concrete Parapet Δ	1.9	72.1 CY		1.8	60.9 CY		1.7	51.0 CY		1.7	43.9 CY		1.7	37.2 CY		1.7	30.1 CY		
		Concrete Wingwalls	26.1			20.5			15.8			13.2			10.7			7.7			
		Concrete Apron ✳	44.1			38.6			33.5			29.0			24.8			20.7			

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

Bent Bar Details



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

Headwall Notes:

1. See Sheet FWH G2-21 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", "f1", "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

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
10'-0" Span
30° Skew

FWH 30-9-21

Sheet 1 of 2

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 30-9-21 S1 - THIS SHEET ISSUED 02-2021.

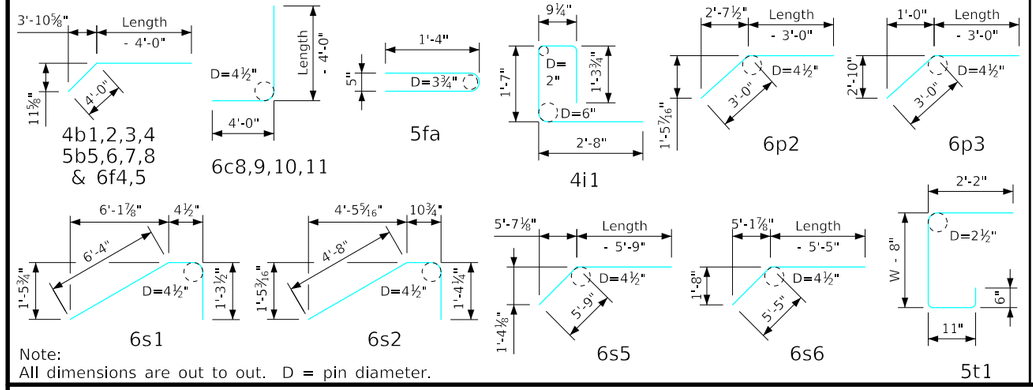
Bill of Reinforcing for One Headwall 30° Skew Span x Culvert Height

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. 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
4c1	Wingwall, F.F.V. Long		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		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		2	7'-8	10	2	6'-8	9	2	5'-8	8	4c5
4c5	Wingwall, F.F.V. Short		1	7'-8	5	1	6'-8	4	1	5'-8	4	4c5
5c6	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	5c6
5c7	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	5c7
6c8	Wingwall, B.F.V. Long		15 Var.	9'-5 to 12'-9	250	11 Var.	9'-5 to 11'-9	175	7 Var.	9'-5 to 10'-10	106	6c8
6c9	Wingwall, B.F.V. Short		15 Var.	8'-5 to 12'-10	239	12 Var.	8'-5 to 11'-11	183	9 Var.	8'-5 to 10'-11	131	6c9
6c10	Wingwall, B.F.V. Long		--	--	--	--	--	--	--	--	--	6c10
6c10	Wingwall, B.F.V. Short		--	--	--	--	--	--	--	--	--	6c10
6c11	Wingwall, B.F.V. Long		2	11'-8	35	2	10'-8	32	2	9'-8	29	6c11
6c11	Wingwall, B.F.V. Short		1	11'-8	18	1	10'-8	16	1	9'-8	15	6c11
4d1	Apron, Longit., Bott.		7	18'-1	85	7	15'-9	74	7	13'-5	63	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		9	18'-1	244	9	15'-9	213	9	13'-5	181	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		21	6'-4	89	21	6'-4	89	21	6'-4	89	4i1
7j1	Parapet, Horizontal		4	12'-10	105	4	12'-10	105	4	12'-10	105	7j1
6m1	Apron, Trans., Top		5 Var.	12'-2 to 12'-11	94	5 Var.	12'-2 to 12'-11	94	5 Var.	12'-2 to 12'-11	94	6m1
6m2	Apron, Trans., Top		12 Var.	13'-2 to 17'-3	274	9 Var.	13'-2 to 16'-2	198	6 Var.	13'-2 to 15'-0	127	6m2
6m3	Apron, Trans., Top		8 Var.	4'-8 to 12'-5	103	8 Var.	4'-0 to 11'-9	95	8 Var.	3'-4 to 11'-1	87	6m3
6m4	Apron, Trans., Bott.		12 Var.	6'-6 to 14'-0	185	10 Var.	6'-6 to 12'-8	144	8 Var.	6'-6 to 11'-4	107	6m4
6p1	Curtain, Horizontal		4	11'-8	70	4	11'-8	70	4	11'-8	70	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'-7	35	1	20'-4	31	1	17'-0	26	6s6
5t1	Curtain, Vertical		20	6'-5	134	18	6'-5	120	16	6'-5	107	5t1
	Estimated Quantities One Headwall	Reinf. Steel		3274 LB			2700 LB			2170 LB		
		Concrete Parapet Δ	1.7	24.7 CY		1.7	20.2 CY		1.7	16.0 CY		
		Concrete Wingwalls	5.9			4.3			2.9			
		Concrete Apron ✳	17.1			14.2			11.4			

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.

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.

Headwall Notes:

1. See Sheet FWH G2-21 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", "f1", "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

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
10'-0" Span
30° Skew

FWH 30-9-21

Sheet 2 of 2

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 30-9-21 S2 - THIS SHEET ISSUED 02-2021.

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

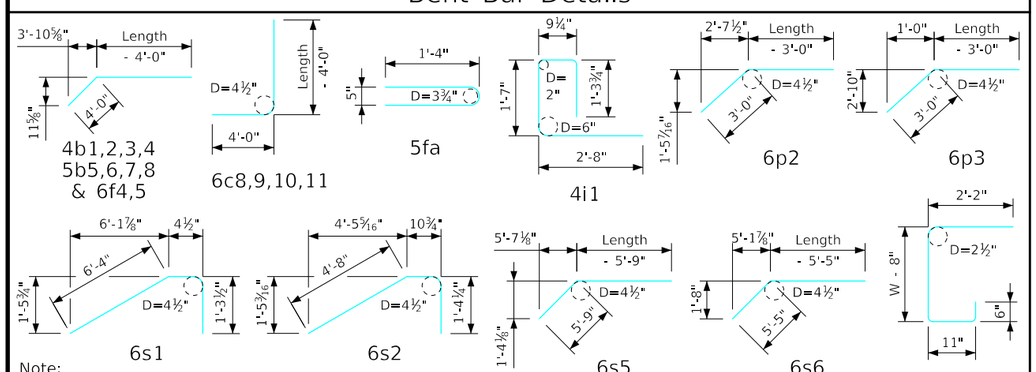
Bar	Location	Shape	8' x 10'			8' x 9'			8' x 8'			8' x 7'			8' x 6'			8' x 5'			8' x 4'			Bar
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	5fa
4b1	Wingwall, B.F.H. Long		1	46'-10	33	1	42'-8	30	1	38'-6	26	1	34'-4	23	1	30'-2	20	1	26'-0	17	1	21'-10	15	4b1
4b2	Wingwall, B.F.H. Short		1	36'-0	24	1	32'-10	22	1	29'-9	20	1	26'-7	18	1	23'-6	16	1	20'-5	14	1	17'-3	12	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	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		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	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	46'-11	51	1	42'-9	47	1	38'-7	40	1	34'-5	36	1	30'-2	31	1	26'-0	27	1	21'-10	23	5b5
5b6	Wingwall, F.F.H. Short		1	36'-0	38	1	32'-11	34	1	29'-9	31	1	26'-8	28	1	23'-6	25	1	20'-5	21	1	17'-4	18	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	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		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	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
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	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		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	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		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	2	7'-7	10	2	6'-7	9	2	5'-7	7	4c5
4c5	Wingwall, F.F.V. Short		2	11'-7	15	2	10'-7	14	2	9'-7	13	1	8'-7	6	1	7'-7	5	1	6'-7	4	1	5'-7	4	4c5
5c6	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	11 Var.	2'-8 to 5'-1	44	11 Var.	2'-8 to 5'-1	44	11 Var.	2'-8 to 5'-1	44	5c6
5c7	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	5 Var.	2'-8 to 4'-0	17	5 Var.	2'-8 to 4'-0	17	5 Var.	2'-8 to 4'-0	17	5c7
6c8	Wingwall, B.F.V. Long		32 Var.	9'-4 to 16'-9	627	28 Var.	9'-4 to 15'-9	527	24 Var.	9'-4 to 14'-10	436	20 Var.	9'-4 to 13'-10	348	15 Var.	9'-4 to 12'-8	248	11 Var.	9'-4 to 11'-8	173	7 Var.	9'-4 to 10'-9	106	6c8
6c9	Wingwall, B.F.V. Short		27 Var.	8'-4 to 16'-8	507	24 Var.	8'-4 to 15'-8	433	21 Var.	8'-4 to 14'-8	363	18 Var.	8'-4 to 13'-9	299	15 Var.	8'-4 to 12'-9	238	12 Var.	8'-4 to 11'-10	182	9 Var.	8'-4 to 10'-10	130	6c9
6c10	Wingwall, B.F.V. Long		23	10'-6	363	19	10'-6	300	15	10'-6	237	11	10'-6	173	--	--	--	--	--	--	--	--	--	6c10
6c10	Wingwall, B.F.V. Short		17	10'-6	268	14	10'-6	221	11	10'-6	173	8	10'-6	126	--	--	--	--	--	--	--	--	--	6c10
6c11	Wingwall, B.F.V. Long		2	15'-7	47	1	14'-7	22	1	13'-7	20	1	12'-7	19	2	11'-7	35	2	10'-7	32	2	9'-7	29	6c11
6c11	Wingwall, B.F.V. Short		2	15'-7	47	2	14'-7	44	2	13'-7	41	1	12'-7	19	1	11'-7	17	1	10'-7	16	1	9'-7	14	6c11
4d1	Apron, Longit., Bott.		5	27'-3	91	5	25'-0	84	5	22'-8	76	5	20'-4	68	5	18'-1	60	5	15'-9	53	5	13'-5	45	4d1
4d2	Apron, Longit., Bott. Long		3	40'-5	86	3	36'-3	73	3	32'-1	64	3	27'-11	56	3	23'-9	48	3	19'-7	39	3	15'-4	31	4d2
4d3	Apron, Longit., Bott. Short		3	31'-0	62	3	27'-11	56	3	24'-9	50	3	21'-8	43	3	18'-7	37	3	15'-5	31	3	12'-4	25	4d3
6f1	Apron, Longit., Top		7	27'-3	287	7	25'-0	263	7	22'-8	238	7	20'-4	214	7	18'-1	190	7	15'-9	166	7	13'-5	141	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	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		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	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	46'-11	74	1	42'-9	68	1	38'-7	58	1	34'-5	52	1	30'-2	45	1	26'-0	39	1	21'-10	33	6f4
6f5	Apron, Longit., Top Short		1	36'-0	54	1	32'-11	49	1	29'-9	45	1	26'-8	40	1	23'-6	35	1	20'-5	31	1	17'-4	26	6f5
4i1	Parapet, Vertical		17	6'-4	72	17	6'-4	72	17	6'-4	72	17	6'-4	72	17	6'-4	72	17	6'-4	72	17	6'-4	72	4i1
7j1	Parapet, Horizontal		4	10'-9	88	4	10'-9	88	4	10'-9	88	4	10'-7	87	4	10'-7	87	4	10'-7	87	4	10'-7	87	7j1
6m1	Apron, Trans., Top		5 Var.	10'-2 to 10'-11	79	5 Var.	10'-2 to 10'-11	79	5 Var.	10'-2 to 10'-11	79	5 Var.	10'-0 to 10'-9	78	5 Var.	10'-0 to 10'-9	78	5 Var.	10'-0 to 10'-9	78	5 Var.	10'-0 to 10'-9	78	6m1
6m2	Apron, Trans., Top		25 Var.	11'-4 to 20'-4	595	22 Var.	11'-4 to 19'-2	504	19 Var.	11'-4 to 18'-1	420	16 Var.	11'-2 to 16'-9	335	13 Var.	11'-2 to 15'-8	262	10 Var.	11'-2 to 14'-6	193	7 Var.	11'-2 to 13'-5	129	6m2
6m3	Apron, Trans., Top		6 Var.	7'-8 to 13'-2	94	6 Var.	7'-0 to 12'-6	88	6 Var.	6'-4 to 11'-10	82	6 Var.	5'-7 to 11'-1	75	6 Var.	4'-11 to 10'-5	69	6 Var.	4'-3 to 9'-9	63	6 Var.	3'-7 to 9'-1	57	6m3
6m4	Apron, Trans., Bott.		20 Var.	4'-3 to 17'-2	322	18 Var.	4'-3 to 15'-10	271	16 Var.	4'-3 to 14'-5	224	14 Var.	4'-3 to 13'-1	182	12 Var.	4'-3 to 11'-9	144	10 Var.	4'-3 to 10'-4	110	8 Var.	4'-3 to 9'-0	80	6m4
6p1	Curtain, Horizontal		4	9'-5	57	4	9'-5	57	4	9'-5	57	4	9'-5	57	4	9'-5	57	4	9'-4	56	4	9'-4	56	6p1
6p2	Curtain, Horizontal, Long		4	24'-0	144	4	22'-0	132	4	20'-0	120	4	18'-0	108	4	16'-0	96	4	13'-11	84	4	11'-11	72	6p2
6p3	Curtain, Horizontal, Short		4	13'-10	83	4	12'-10	77	4	11'-9	71	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	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	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	2	23'-2	70	2	18'-10	57	2	14'-7	44	6s3
6s4	Wing Slope, Both F., Short		2	31'-6	95	2	28'-2	85	2	24'-11	75	2	21'-8	65	2	18'-4	55	2	15'-1	45	2	11'-10	36	6s4
6s5	Wing Slope, F.F. Long		1	46'-5	73	1	42'-2	67	1	37'-10	57	1	33'-7	50	1	29'-3	44	1	25'-0	38	1	20'-8	31	6s5
6s6	Wing Slope, F.F. Short		1	36'-8	55	1	33'-5	50	1	30'-2	45	1	26'-10	40	1	23'-7	35	1	20'-4	31	1	17'-0	26	6s6
5t1	Curtain, Vertical		28	7'-5	217	26	7'-2	194	23	6'-11	166	20	6'-8	139	18	6'-5	120	16	6'-5	107	14	6'-5	94	5t1
	Estimated Quantities One Headwall	Reinf. Steel		6610 LB			5665 LB			4704 LB			3912 LB			3021 LB			2476 LB			1972 LB		
		Concrete Parapet Δ	1.6			1.6			1.6			1.5			1.5			1.5			1.5			
		Concrete Wingwalls	15.8	47.1 CY		13.2	40.5 CY		10.7	34.2 CY		7.7	27.3 CY		5.9	22.3 CY		4.3	18.1 CY		2.9	14.3 CY		
		Concrete Apron ✳	29.7			25.7			21.9			18.1			14.9			12.3			9.9			

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 FWH G2-21 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

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
8'-0" Span
30° Skew

FWH
30-10-21

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 30-10-21 - THIS SHEET ISSUED 02-2021.

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

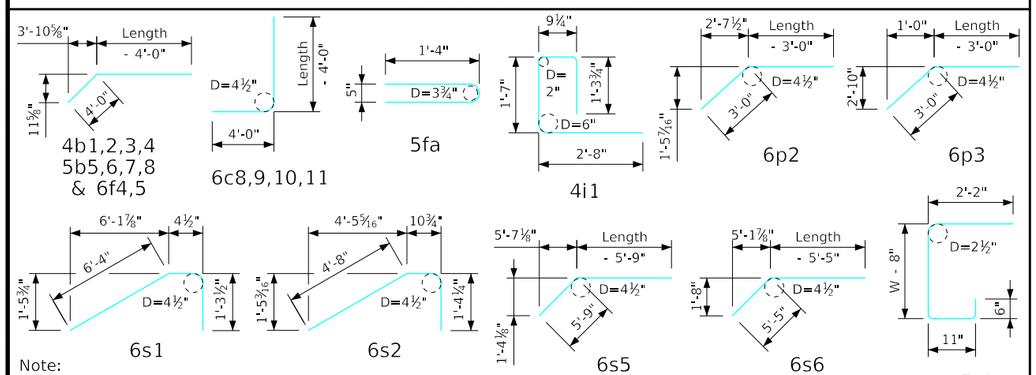
Bar	Location	Shape	6' x 8'			6' x 7'			6' x 6'			6' x 5'			6' x 4'			6' x 3'			Bar
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	5fa
4b1	Wingwall, B.F.H. Long		1	38'-6	26	1	34'-4	23	1	30'-2	20	1	26'-0	17	1	21'-10	15	1	17'-8	12	4b1
4b2	Wingwall, B.F.H. Short		1	29'-9	20	1	26'-7	18	1	23'-6	16	1	20'-5	14	1	17'-3	12	1	14'-2	9	4b2
4b3	Wingwall, B.F.H. Long		6 Var.	15'-8 to 36'-7	105	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	1	15'-8	10	4b3
4b4	Wingwall, B.F.H. Short		6 Var.	12'-10 to 28'-4	82	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	1	12'-9	9	4b4
5b5	Wingwall, F.F.H. Long		1	38'-7	40	1	34'-5	36	1	30'-2	31	1	26'-0	27	1	21'-10	23	1	17'-8	18	5b5
5b6	Wingwall, F.F.H. Short		1	29'-9	31	1	26'-8	28	1	23'-6	25	1	20'-5	21	1	17'-4	18	1	14'-2	15	5b6
5b7	Wingwall, F.F.H. Long		7 Var.	11'-7 to 36'-7	176	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	2 Var.	11'-7 to 15'-9	29	5b7
5b8	Wingwall, F.F.H. Short		7 Var.	9'-9 to 28'-4	139	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	2 Var.	9'-8 to 12'-9	23	5b8
4c1	Wingwall, F.F.V. Long		35 Var.	2'-8 to 10'-10	158	31 Var.	2'-8 to 9'-10	129	26 Var.	2'-8 to 8'-8	98	22 Var.	2'-8 to 7'-8	76	18 Var.	2'-8 to 6'-9	57	14 Var.	2'-8 to 5'-9	39	4c1
4c2	Wingwall, F.F.V. Short		26 Var.	2'-8 to 10'-8	116	23 Var.	2'-8 to 9'-9	95	20 Var.	2'-8 to 8'-9	76	17 Var.	2'-8 to 7'-10	60	14 Var.	2'-8 to 6'-10	44	10 Var.	2'-8 to 5'-7	28	4c2
4c3	Wingwall, F.F.V. Long		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4c3
4c4	Wingwall, F.F.V. Short		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4c4
4c5	Wingwall, F.F.V. Long		1	9'-7	6	1	8'-7	6	2	7'-7	10	2	6'-7	9	2	5'-7	7	1	4'-7	3	4c5
4c5	Wingwall, F.F.V. Short		2	9'-7	13	1	8'-7	6	1	7'-7	5	1	6'-7	4	1	5'-7	4	2	4'-7	6	4c5
5c6	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	11 Var.	2'-8 to 5'-1	44	11 Var.	2'-8 to 5'-1	44	5c6
5c7	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	5 Var.	2'-8 to 4'-0	17	5 Var.	2'-8 to 4'-0	17	5c7
6c8	Wingwall, B.F.V. Long		24 Var.	9'-4 to 14'-10	436	20 Var.	9'-4 to 13'-10	348	15 Var.	9'-4 to 12'-8	248	11 Var.	9'-4 to 11'-8	173	7 Var.	9'-4 to 10'-9	106	3 Var.	9'-4 to 9'-9	43	6c8
6c9	Wingwall, B.F.V. Short		21 Var.	8'-4 to 14'-8	363	18 Var.	8'-4 to 13'-9	299	15 Var.	8'-4 to 12'-9	238	12 Var.	8'-4 to 11'-10	182	9 Var.	8'-4 to 10'-10	130	5 Var.	8'-4 to 9'-7	67	6c9
6c10	Wingwall, B.F.V. Long		15	10'-6	237	11	10'-6	173	--	--	--	--	--	--	--	--	--	--	--	--	6c10
6c10	Wingwall, B.F.V. Short		11	10'-6	173	8	10'-6	126	--	--	--	--	--	--	--	--	--	--	--	--	6c10
6c11	Wingwall, B.F.V. Long		1	13'-7	20	1	12'-7	19	2	11'-7	35	2	10'-7	32	2	9'-7	29	1	8'-7	13	6c11
6c11	Wingwall, B.F.V. Short		2	13'-7	41	1	12'-7	19	1	11'-7	17	1	10'-7	16	1	9'-7	14	2	8'-7	26	6c11
4d1	Apron, Longit., Bott.		5	22'-8	76	5	20'-4	68	5	18'-1	60	5	15'-9	53	5	13'-5	45	5	11'-1	37	4d1
4d2	Apron, Longit., Bott. Long		3	32'-1	64	3	27'-11	56	3	23'-9	48	3	19'-7	39	3	15'-4	31	3	11'-2	22	4d2
4d3	Apron, Longit., Bott. Short		3	24'-9	50	3	21'-8	43	3	18'-7	37	3	15'-5	31	3	12'-4	25	3	9'-2	18	4d3
6f1	Apron, Longit., Top		5	22'-8	170	5	20'-4	153	5	18'-1	136	5	15'-9	118	5	13'-5	101	5	11'-1	83	6f1
6f2	Apron, Longit., Top Long		7 Var.	5'-3 to 19'-3	129	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	2 Var.	5'-4 to 7'-8	20	6f2
6f3	Apron, Longit., Top Short		5 Var.	6'-11 to 19'-6	99	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	1	7'-11	12	6f3
6f4	Apron, Longit., Top Long		1	38'-7	58	1	34'-5	52	1	30'-2	45	1	26'-0	39	1	21'-10	33	1	17'-8	27	6f4
6f5	Apron, Longit., Top Short		1	29'-9	45	1	26'-8	40	1	23'-6	35	1	20'-5	31	1	17'-4	26	1	14'-2	21	6f5
4i1	Parapet, Vertical		13	6'-4	55	13	6'-4	55	13	6'-4	55	13	6'-4	55	13	6'-4	55	13	6'-4	55	4i1
7j1	Parapet, Horizontal		4	8'-5	69	4	8'-3	67	4	8'-3	67	4	8'-3	67	4	8'-3	67	4	8'-3	67	7j1
6m1	Apron, Trans., Top		4 Var.	8'-1 to 8'-7	50	4 Var.	7'-11 to 8'-5	49	4 Var.	7'-11 to 8'-5	49	4 Var.	7'-11 to 8'-5	49	4 Var.	7'-11 to 8'-5	49	4 Var.	7'-11 to 8'-5	49	6m1
6m2	Apron, Trans., Top		21 Var.	8'-11 to 16'-5	400	18 Var.	8'-9 to 15'-2	323	15 Var.	8'-9 to 14'-0	256	12 Var.	8'-9 to 12'-11	195	9 Var.	8'-9 to 11'-9	139	6 Var.	8'-9 to 10'-8	87	6m2
6m3	Apron, Trans., Top		4 Var.	6'-7 to 9'-11	50	4 Var.	5'-10 to 9'-2	45	4 Var.	5'-2 to 8'-6	41	4 Var.	4'-6 to 7'-10	37	4 Var.	3'-10 to 7'-2	33	4 Var.	3'-2 to 6'-6	29	6m3
6m4	Apron, Trans., Bott.		16 Var.	1'-11 to 12'-1	168	14 Var.	1'-11 to 10'-9	133	12 Var.	1'-11 to 9'-5	102	10 Var.	1'-11 to 8'-0	74	8 Var.	1'-11 to 6'-8	52	6 Var.	1'-11 to 5'-4	33	6m4
6p1	Curtain, Horizontal		4	7'-1	43	4	7'-1	43	4	7'-1	43	4	7'-1	43	4	7'-1	43	4	7'-0	42	6p1
6p2	Curtain, Horizontal, Long		4	20'-0	120	4	18'-0	108	4	16'-0	96	4	13'-11	84	4	11'-11	72	4	9'-11	60	6p2
6p3	Curtain, Horizontal, Short		4	11'-9	71	4	10'-9	65	4	9'-8	58	4	8'-8	52	4	7'-7	46	4	6'-7	40	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	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	2	6'-11	21	6s2
6s3	Wing Slope, Both F., Long		2	31'-9	95	2	27'-5	82	2	23'-2	70	2	18'-10	57	2	14'-7	44	2	10'-3	31	6s3
6s4	Wing Slope, Both F., Short		2	24'-11	75	2	21'-8	65	2	18'-4	55	2	15'-1	45	2	11'-10	36	2	8'-7	26	6s4
6s5	Wing Slope, F.F. Long		1	37'-10	57	1	33'-7	50	1	29'-3	44	1	25'-0	38	1	20'-8	31	1	16'-5	25	6s5
6s6	Wing Slope, F.F. Short		1	30'-2	45	1	26'-10	40	1	23'-7	35	1	20'-4	31	1	17'-0	26	1	13'-9	21	6s6
5t1	Curtain, Vertical		21	6'-11	151	18	6'-8	125	16	6'-5	107	14	6'-5	94	12	6'-5	80	9	6'-5	60	5t1
	Estimated Quantities One Headwall	Reinf. Steel		4434 LB			3666 LB			2798 LB			2276 LB			1797 LB			1327 LB		
		Concrete Parapet Δ	1.4			1.3			1.3			1.3			1.3			1.3			
		Concrete Wingwalls	10.7	32.1 CY		7.7	25.5 CY		5.9	20.7 CY		4.3	16.6 CY		2.9	13.0 CY		1.8	9.8 CY		
		Concrete Apron ✳	20.0			16.5			13.5			11.0			8.8			6.7			

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

Bent Bar Details



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

Headwall Notes:

1. See Sheet FWH G2-21 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

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IOWA DOT

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
6'-0" Span
30° Skew

FWH
30-11-21

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 30-11-21 - THIS SHEET ISSUED 02-2021.

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

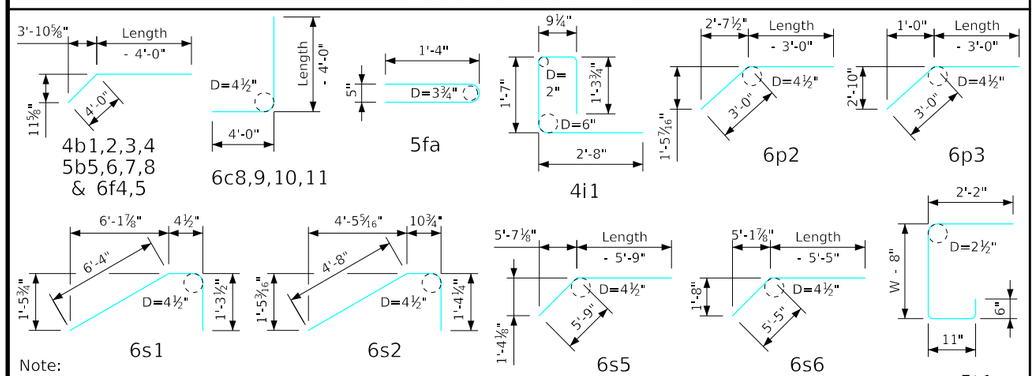
Bar	Location	Shape	5' x 6'			5' x 5'			5' x 4'			5' x 3'			Bar
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	5fa
4b1	Wingwall, B.F.H. Long		1	30'-2	20	1	26'-0	17	1	21'-10	15	1	17'-8	12	4b1
4b2	Wingwall, B.F.H. Short		1	23'-6	16	1	20'-5	14	1	17'-3	12	1	14'-2	9	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	1	15'-8	10	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	1	12'-9	9	4b4
5b5	Wingwall, F.F.H. Long		1	30'-2	31	1	26'-0	27	1	21'-10	23	1	17'-8	18	5b5
5b6	Wingwall, F.F.H. Short		1	23'-6	25	1	20'-5	21	1	17'-4	18	1	14'-2	15	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	2 Var.	11'-7 to 15'-9	29	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	2 Var.	9'-8 to 12'-9	23	5b8
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	14 Var.	2'-8 to 5'-9	39	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	10 Var.	2'-8 to 5'-7	28	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	1	4'-7	3	4c5
4c5	Wingwall, F.F.V. Short		1	7'-7	5	1	6'-7	4	1	5'-7	4	2	4'-7	6	4c5
5c6	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	5c6
5c7	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	5c7
6c8	Wingwall, B.F.V. Long		15 Var.	9'-4 to 12'-8	248	11 Var.	9'-4 to 11'-8	173	7 Var.	9'-4 to 10'-9	106	3 Var.	9'-4 to 9'-9	43	6c8
6c9	Wingwall, B.F.V. Short		15 Var.	8'-4 to 12'-9	238	12 Var.	8'-4 to 11'-10	182	9 Var.	8'-4 to 10'-10	130	5 Var.	8'-4 to 9'-7	67	6c9
6c10	Wingwall, B.F.V. Long		--	--	--	--	--	--	--	--	--	--	--	--	6c10
6c10	Wingwall, B.F.V. Short		--	--	--	--	--	--	--	--	--	--	--	--	6c10
6c11	Wingwall, B.F.V. Long		2	11'-7	35	2	10'-7	32	2	9'-7	29	1	8'-7	13	6c11
6c11	Wingwall, B.F.V. Short		1	11'-7	17	1	10'-7	16	1	9'-7	14	2	8'-7	26	6c11
4d1	Apron, Longit., Bott.		3	18'-1	36	3	15'-9	32	3	13'-5	27	3	11'-1	22	4d1
4d2	Apron, Longit., Bott. Long		3	23'-9	48	3	19'-7	39	3	15'-4	31	3	11'-2	22	4d2
4d3	Apron, Longit., Bott. Short		3	18'-7	37	3	15'-5	31	3	12'-4	25	3	9'-2	18	4d3
6f1	Apron, Longit., Top		4	18'-1	109	4	15'-9	95	4	13'-5	81	4	11'-1	67	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	2 Var.	5'-4 to 7'-8	20	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	1	7'-11	12	6f3
6f4	Apron, Longit., Top Long		1	30'-2	45	1	26'-0	39	1	21'-10	33	1	17'-8	27	6f4
6f5	Apron, Longit., Top Short		1	23'-6	35	1	20'-5	31	1	17'-4	26	1	14'-2	21	6f5
4i1	Parapet, Vertical		11	6'-4	47	11	6'-4	47	11	6'-4	47	11	6'-4	47	4i1
7j1	Parapet, Horizontal		4	7'-1	58	4	7'-1	58	4	7'-1	58	4	7'-1	58	7j1
6m1	Apron, Trans., Top		3 Var.	6'-10 to 7'-2	32	3 Var.	6'-10 to 7'-2	32	3 Var.	6'-10 to 7'-2	32	3 Var.	6'-10 to 7'-2	32	6m1
6m2	Apron, Trans., Top		16 Var.	7'-5 to 13'-0	245	13 Var.	7'-5 to 11'-11	189	10 Var.	7'-5 to 10'-9	136	7 Var.	7'-5 to 9'-8	90	6m2
6m3	Apron, Trans., Top		4 Var.	4'-9 to 8'-1	39	4 Var.	4'-1 to 7'-5	35	4 Var.	3'-5 to 6'-9	31	4 Var.	2'-9 to 6'-1	27	6m3
6m4	Apron, Trans., Bott.		10 Var.	2'-1 to 8'-3	78	8 Var.	2'-1 to 6'-11	54	6 Var.	2'-1 to 5'-6	34	4 Var.	2'-1 to 4'-2	19	6m4
6p1	Curtain, Horizontal		4	5'-11	36	4	5'-11	36	4	5'-11	36	4	5'-10	35	6p1
6p2	Curtain, Horizontal, Long		4	16'-0	96	4	13'-11	84	4	11'-11	72	4	9'-11	60	6p2
6p3	Curtain, Horizontal, Short		4	9'-8	58	4	8'-8	52	4	7'-7	46	4	6'-7	40	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	23'-2	70	2	18'-10	57	2	14'-7	44	2	10'-3	31	6s3
6s4	Wing Slope, Both F., Short		2	18'-4	55	2	15'-1	45	2	11'-10	36	2	8'-7	26	6s4
6s5	Wing Slope, F.F. Long		1	29'-3	44	1	25'-0	38	1	20'-8	31	1	16'-5	25	6s5
6s6	Wing Slope, F.F. Short		1	23'-7	35	1	20'-4	31	1	17'-0	26	1	13'-9	21	6s6
5t1	Curtain, Vertical		16	6'-5	107	14	6'-5	94	12	6'-5	80	9	6'-5	60	5t1
	Estimated Quantities One Headwall	Reinf. Steel		2669 LB			2163 LB			1695 LB			1242 LB		
		Concrete: Parapet Δ	1.2			1.2			1.2			1.2			
		Concrete: Wingwalls	5.9	19.9 CY		4.3	15.9 CY		2.9	12.3 CY		1.8	9.2 CY		
		Concrete: Apron ✳	12.8			10.4			8.2			6.2			

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

Bent Bar Details



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

Headwall Notes:

1. See Sheet FWH G2-21 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

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IOWA DOT

Standard Design - Single Reinforced Concrete Box Culverts

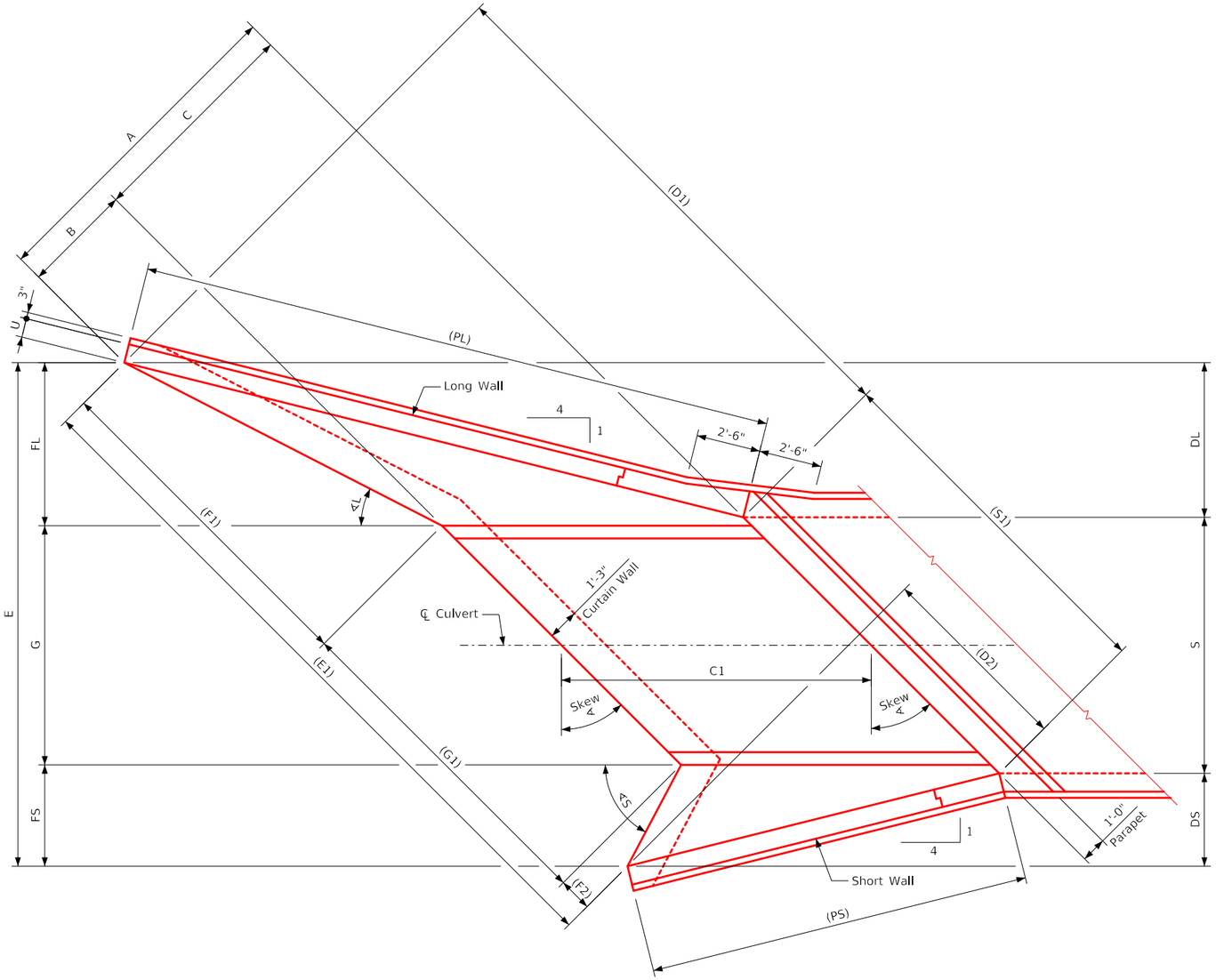
Flared Wing Headwalls

February, 2021

Quantity Tabulation
5'-0" Span
30° Skew

FWH
30-12-21

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Plan View

Notes:

1. See Sheet FWH G2-21 for General Notes, Specifications, and Design Stresses.
2. See Sheet FWH 45-2-21 for dimensions table.
3. See Sheet FWH 45-5-21 for Angle L & Angle S.

LATEST REVISION DATE

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IOWADOT

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Dimension Plan 45° Skew

FWH 45-1-21

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Dimension Table

S x H	16' x 14'	16' x 13'	16' x 12'	16' x 11'	16' x 10'	16' x 9'	16' x 8'	16' x 7'	16' x 6'	16' x 5'	16' x 4'	14' x 14'	14' x 13'	14' x 12'	14' x 11'	14' x 10'	14' x 9'	14' x 8'	14' x 7'	14' x 6'	14' x 5'	14' x 4'	12' x 12'	12' x 11'	12' x 10'	12' x 9'	12' x 8'	12' x 7'	12' x 6'	12' x 5'	12' x 4'	S x H
A	43'-0	40'-0	37'-0	34'-0	31'-0	28'-0	25'-0	22'-0	19'-0	16'-0	13'-0	43'-0	40'-0	37'-0	34'-0	31'-0	28'-0	25'-0	22'-0	19'-0	16'-0	13'-0	37'-0	34'-0	31'-0	28'-0	25'-0	22'-0	19'-0	16'-0	13'-0	A
B	14'-4	13'-4	12'-4	11'-4	10'-4	9'-4	8'-4	7'-4	6'-4	5'-4	4'-4	14'-4	13'-4	12'-4	11'-4	10'-4	9'-4	8'-4	7'-4	6'-4	5'-4	4'-4	12'-4	11'-4	10'-4	9'-4	8'-4	7'-4	6'-4	5'-4	4'-4	B
C	28'-8	26'-8	24'-8	22'-8	20'-8	18'-8	16'-8	14'-8	12'-8	10'-8	8'-8	28'-8	26'-8	24'-8	22'-8	20'-8	18'-8	16'-8	14'-8	12'-8	10'-8	8'-8	24'-8	22'-8	20'-8	18'-8	16'-8	14'-8	12'-8	10'-8	8'-8	C
C1	40'-6½	37'-8½	34'-10⅝	32'-0⅝	29'-2¾	26'-4¾	23'-6⅞	20'-8⅞	17'-11	15'-1	12'-3⅛	40'-6½	37'-8½	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	C1
DL	20'-3¼	18'-10¼	17'-5¼	16'-0⅜	14'-7⅜	13'-2⅜	11'-9⅜	10'-4½	8'-11½	7'-6½	6'-1½	20'-3¼	18'-10¼	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	DL
DS	12'-2	11'-3¾	10'-5⅝	9'-7⅞	8'-9¼	7'-11	7'-0⅞	6'-2⅝	5'-4½	4'-6¼	3'-8⅛	12'-2	11'-3¾	10'-5⅝	9'-7⅞	8'-9¼	7'-11	7'-0⅞	6'-2⅝	5'-4½	4'-6¼	3'-8⅛	10'-5⅝	9'-7⅞	8'-9¼	7'-11	7'-0⅞	6'-2⅝	5'-4½	4'-6¼	3'-8⅛	DS
D1	71'-8	66'-8	61'-8	56'-8	51'-8	46'-8	41'-8	36'-8	31'-8	26'-8	21'-8	71'-8	66'-8	61'-8	56'-8	51'-8	46'-8	41'-8	36'-8	31'-8	26'-8	21'-8	61'-8	56'-8	51'-8	46'-8	41'-8	36'-8	31'-8	26'-8	21'-8	D1
D2	25'-9⅝	24'-0	22'-2⅜	20'-4¾	18'-7¼	16'-9⅝	15'-0	13'-2⅜	11'-4¾	9'-7¼	7'-9⅝	25'-9⅝	24'-0	22'-2⅜	20'-4¾	18'-7¼	16'-9⅝	15'-0	13'-2⅜	11'-4¾	9'-7¼	7'-9⅝	22'-2⅜	20'-4¾	18'-7¼	16'-9⅝	15'-0	13'-2⅜	11'-4¾	9'-7¼	7'-9⅝	D2
E	48'-5¼	46'-2	43'-10⅞	41'-7¾	39'-4⅝	37'-1⅜	34'-10¼	32'-7⅛	30'-4	28'-0⅞	25'-9⅝	46'-5¼	44'-2	41'-10⅞	39'-7¾	37'-4⅝	35'-1⅜	32'-10¼	30'-7⅛	28'-4	26'-0⅞	23'-9⅝	39'-10⅞	37'-7¾	35'-4⅝	33'-1⅜	30'-10¼	28'-7⅛	26'-4	24'-0⅞	21'-9⅝	E
E1	68'-5⅞	65'-3½	62'-1⅛	58'-10¾	55'-8⅜	52'-5⅞	49'-3½	46'-1⅛	42'-10¾	39'-8⅜	36'-5⅞	65'-8	62'-5⅝	59'-3¼	56'-0¾	52'-10⅜	49'-8	46'-5⅝	43'-3¼	40'-0¾	36'-10⅜	33'-8	56'-5¼	53'-2⅛	50'-0½	46'-10	43'-7⅝	40'-5¼	37'-2⅛	34'-0½	30'-10	E1
FL	20'-7¼	19'-2¼	17'-9¼	16'-4⅜	14'-11⅜	13'-6⅜	12'-1⅜	10'-8½	9'-3½	7'-10½	6'-5½	20'-7¼	19'-2¼	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	FL
FS	12'-6	11'-7¾	10'-9⅜	9'-11⅜	9'-1¼	8'-3	7'-4⅞	6'-6⅜	5'-8½	4'-10¼	4'-0⅜	12'-6	11'-7¾	10'-9⅜	9'-11⅜	9'-1¼	8'-3	7'-4⅞	6'-6⅜	5'-8½	4'-10¼	4'-0⅜	10'-9⅜	9'-11⅜	9'-1¼	8'-3	7'-4⅞	6'-6⅜	5'-8½	4'-10¼	4'-0⅜	FS
F1	43'-5⅝	40'-5⅝	37'-5⅝	34'-5⅝	31'-5⅝	28'-5⅝	25'-5⅝	22'-5⅝	19'-5⅝	16'-5⅝	13'-5⅝	43'-5⅝	40'-5⅝	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	F1
F2	3'-4	3'-1⅝	2'-11¼	2'-8⅞	2'-6½	2'-4	2'-1⅝	1'-11¼	1'-8⅞	1'-6½	1'-4	3'-4	3'-1⅝	2'-11¼	2'-8⅞	2'-6½	2'-4	2'-1⅝	1'-11¼	1'-8⅞	1'-6½	1'-4	2'-11¼	2'-8⅞	2'-6½	2'-4	2'-1⅝	1'-11¼	1'-8⅞	1'-6½	1'-4	F2
G	15'-4	15'-4	15'-4	15'-4	15'-4	15'-4	15'-4	15'-4	15'-4	15'-4	15'-4	13'-4	13'-4	13'-4	13'-4	13'-4	13'-4	13'-4	13'-4	13'-4	13'-4	13'-4	11'-4	11'-4	11'-4	11'-4	11'-4	11'-4	11'-4	11'-4	11'-4	G
G1	21'-8¼	21'-8¼	21'-8¼	21'-8¼	21'-8¼	21'-8¼	21'-8¼	21'-8¼	21'-8¼	21'-8¼	21'-8¼	18'-10¼	18'-10¼	18'-10¼	18'-10¼	18'-10¼	18'-10¼	18'-10¼	18'-10¼	18'-10¼	18'-10¼	18'-10¼	16'-0⅜	16'-0⅜	16'-0⅜	16'-0⅜	16'-0⅜	16'-0⅜	16'-0⅜	16'-0⅜	16'-0⅜	G1
G2	22'-10½	22'-10½	22'-10½	22'-10⅜	22'-10⅜	22'-10⅜	22'-10¼	22'-10⅛	22'-10	22'-9⅞	22'-9⅝	20'-0⅝	20'-0½	20'-0½	20'-0½	20'-0⅜	20'-0⅜	20'-0¼	20'-0¼	20'-0⅛	19'-11⅞	19'-11¾	17'-2⅝	17'-2½	17'-2½	17'-2⅜	17'-2⅜	17'-2¼	17'-2⅛	17'-2	17'-1¾	G2
G3	45'-9¼	42'-7⅞	39'-5⅜	36'-3½	33'-1½	29'-11½	26'-9⅝	23'-7⅝	20'-5¾	17'-3¾	14'-1⅞	45'-9¼	42'-7⅞	39'-5⅜	36'-3½	33'-1½	29'-11½	26'-9⅝	23'-7⅝	20'-5¾	17'-3¾	14'-1⅞	39'-5⅜	36'-3½	33'-1½	29'-11½	26'-9⅝	23'-7⅝	20'-5¾	17'-3¾	14'-1⅞	G3
G4	46'-3⅛	42'-11⅜	39'-9½	36'-3	32'-8½	29'-6⅝	26'-4⅝	22'-10¼	19'-8⅜	16'-6½	13'-4¾	46'-3⅛	42'-11⅜	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	G4
G5	14'-8⅝	13'-8⅝	12'-8½	11'-7⅞	10'-7⅝	9'-7½	8'-7¼	7'-7	6'-6¾	5'-6⅝	4'-6⅜	14'-8⅝	13'-8⅝	12'-8½	11'-7⅞	10'-7⅝	9'-7½	8'-7¼	7'-7	6'-6¾	5'-6⅝	4'-6⅜	12'-8½	11'-7⅞	10'-7⅝	9'-7½	8'-7¼	7'-7	6'-6¾	5'-6⅝	4'-6⅜	G5
G6	16'-5½	15'-2⅜	14'-2⅛	13'-0½	11'-10⅜	10'-10½	9'-10⅜	8'-8¾	7'-8½	6'-8⅜	5'-8⅜	16'-5½	15'-2⅜	14'-2⅛	13'-0½	11'-10⅜	10'-10½	9'-10⅜	8'-8¾	7'-8½	6'-8⅜	5'-8⅜	14'-2⅛	13'-0½	11'-10⅜	10'-10½	9'-10⅜	8'-8¾	7'-8½	6'-8⅜	5'-8⅜	G6
G7	--	1⅝	1⅝	6⅛	10½	10½	10½	1'-2¾	1'-2¾	1'-2⅝	1'-2⅝	--	1⅝	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	G7
G8	4	6⅛	6⅛	7⅛	8¼	8¼	8¼	9¼	9¼	9⅜	9⅜	4	6⅛	6⅛	7⅛	8¼	8¼	8¼	9¼	9¼	9⅜	9⅜	6⅛	7⅛	8¼	8¼	8¼	9¼	9¼	9⅜	9⅜	G8
PL	83'-6⅞	77'-9	71'-11	66'-1	60'-3	54'-5⅛	48'-7⅛	42'-9⅛	36'-11⅛	31'-1⅛	25'-3¼	83'-6⅞	77'-9	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	PL
PS	50'-1¾	46'-7¾	43'-1¾	39'-7¾	36'-1⅞	32'-7⅞	29'-1⅞	25'-7⅞	22'-1⅞	18'-7⅞	15'-1⅞	50'-1¾	46'-7¾	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	PS
RL	84'-9⅝	78'-10⅝	72'-11⅝	67'-0⅝	61'-1⅝	55'-2⅝	49'-3⅝	43'-4⅝	37'-5⅝	31'-6⅝	25'-7⅝	84'-9⅝	78'-10⅝	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	RL
RS	52'-1⅞	48'-6¼	44'-10½	41'-2⅞	37'-7¼	33'-11½	30'-3⅞	26'-8¼	23'-0½	19'-4⅞	15'-9¼	52'-1⅞	48'-6¼	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	RS
S1	22'-7½	22'-7½	22'-7½	22'-7½	22'-7½	22'-7½	22'-7½	22'-7½	22'-7½	22'-7½	22'-7½	19'-9⅝	19'-9⅝	19'-9⅝	19'-9⅝	19'-9⅝	19'-9⅝	19'-9⅝	19'-9⅝	19'-9⅝	19'-9⅝	19'-9⅝	16'-11⅝	16'-11⅝	16'-11⅝	16'-11⅝	16'-11⅝	16'-11⅝	16'-11⅝	16'-11⅝	16'-11⅝	S1
T	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	T
U	1'-2	1'-0	1'-0	11	10	10	10	9	9	9	9	1'-2	1'-0	1'-0	11	10	10	10	9	9	9	9	1'-0	11	10	10	10	9	9	9	9	U
W	5'-6	5'-3	5'-0	4'-9	4'-6	4'-3	4'-0	3'-9	3'-6	3'-6	3'-6	5'-6	5'-3	5'-0	4'-9	4'-6	4'-3	4'-0	3'-9	3'-6	3'-6	3'-6	5'-0	4'-9	4'-6	4'-3	4'-0	3'-9	3'-6	3'-6	3'-6	W

Notes:

1. See Sheet FWH G2-21 for General Notes, Specifications, and Design Stresses.
2. See Sheet FWH 45-1-21 and sheets FWH 45-3-21 thru 45-6-21 for location of certain dimensions tabulated.
3. Dimensions are in feet and inches unless otherwise noted.

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWA DOT

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Dimension Table
45° Skew

FWH 45-2-21

Sheet 1 of 2

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 45-2-21 S1 - THIS SHEET ISSUED 02-2021.

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Dimension Table

S x H	10' x 12'	10' x 11'	10' x 10'	10' x 9'	10' x 8'	10' x 7'	10' x 6'	10' x 5'	10' x 4'	8' x 10'	8' x 9'	8' x 8'	8' x 7'	8' x 6'	8' x 5'	8' x 4'	6' x 8'	6' x 7'	6' x 6'	6' x 5'	6' x 4'	6' x 3'	5' x 6'	5' x 5'	5' x 4'	5' x 3'	S x H
A	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	25'-0	22'-0	19'-0	16'-0	13'-0	10'-0	19'-0	16'-0	13'-0	10'-0	A
B	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	8'-4	7'-4	6'-4	5'-4	4'-4	3'-4	6'-4	5'-4	4'-4	3'-4	B
C	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	16'-8	14'-8	12'-8	10'-8	8'-8	6'-8	12'-8	10'-8	8'-8	6'-8	C
C1	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	23'-6⅞	20'-8⅞	17'-11	15'-1	12'-3⅛	9'-5⅛	17'-11	15'-1	12'-3⅛	9'-5⅛	C1
DL	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	11'-9⅜	10'-4½	8'-11½	7'-6½	6'-1½	4'-8⅝	8'-11½	7'-6½	6'-1½	4'-8⅝	DL
DS	10'-5⅜	9'-7⅞	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	7'-0⅞	6'-2⅝	5'-4½	4'-6¼	3'-8⅛	2'-10	5'-4½	4'-6¼	3'-8⅛	2'-10	DS
D1	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	41'-8	36'-8	31'-8	26'-8	21'-8	16'-8	31'-8	26'-8	21'-8	16'-8	D1
D2	22'-2⅜	20'-4¾	18'-7¼	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	15'-0	13'-2⅜	11'-4¾	9'-7¼	7'-9⅝	6'-0	11'-4¾	9'-7¼	7'-9⅝	6'-0	D2
E	37'-10⅞	35'-7¾	33'-4⅝	31'-1⅜	28'-10¼	26'-7⅛	24'-4	22'-0⅞	19'-9⅝	31'-4⅝	29'-1⅜	26'-10¼	24'-7⅛	22'-4	20'-0⅞	17'-9⅝	24'-10¼	22'-7⅛	20'-4	18'-0⅞	15'-9⅝	13'-6½	19'-4	17'-0⅞	14'-9⅝	12'-6½	E
E1	53'-7¼	50'-4⅞	47'-2½	44'-0⅛	40'-9¾	37'-7¼	34'-4⅞	31'-2½	28'-0⅛	44'-4⅝	41'-2⅛	37'-11¾	34'-9⅜	31'-7	28'-4⅝	25'-2⅛	35'-1⅜	31'-11⅜	28'-9	25'-6⅝	22'-4¼	19'-1⅜	27'-4	24'-1⅝	20'-11¼	17'-8⅝	E1
FL	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	12'-1⅜	10'-8½	9'-3½	7'-10½	6'-5½	5'-0⅝	9'-3½	7'-10½	6'-5½	5'-0⅝	FL
FS	10'-9⅝	9'-11⅜	9'-1¼	8'-3	7'-4⅞	6'-6⅜	5'-8½	4'-10¼	4'-0⅛	9'-1¼	8'-3	7'-4⅞	6'-6⅜	5'-8½	4'-10¼	4'-0⅛	7'-4⅞	6'-6⅜	5'-8½	4'-10¼	4'-0⅛	3'-2	5'-8½	4'-10¼	4'-0⅛	3'-2	FS
F1	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	25'-5⅝	22'-5⅝	19'-5⅝	16'-5⅝	13'-5⅝	10'-5⅝	19'-5⅝	16'-5⅝	13'-5⅝	10'-5⅝	F1
F2	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	2'-1⅜	1'-11¼	1'-8⅞	1'-6½	1'-4	1'-1⅜	1'-8⅞	1'-6½	1'-4	1'-1⅜	F2
G	9'-4	9'-4	9'-4	9'-4	9'-4	9'-4	9'-4	9'-4	9'-4	7'-4	7'-4	7'-4	7'-4	7'-4	7'-4	5'-4	5'-4	5'-4	5'-4	5'-4	5'-4	5'-4	4'-4	4'-4	4'-4	4'-4	G
G1	13'-2⅜	13'-2⅜	13'-2⅜	13'-2⅜	13'-2⅜	13'-2⅜	13'-2⅜	13'-2⅜	13'-2⅜	10'-4½	10'-4½	10'-4½	10'-4½	10'-4½	10'-4½	10'-4½	7'-6½	7'-6½	7'-6½	7'-6½	7'-6½	7'-6½	6'-1½	6'-1½	6'-1½	6'-1½	G1
G2	14'-4⅝	14'-4⅝	14'-4½	14'-4½	14'-4⅜	14'-4⅜	14'-4¼	14'-4	14'-3¾	11'-6⅝	11'-6½	11'-6½	11'-6⅜	11'-6¼	11'-6⅛	11'-5⅞	8'-8½	8'-8½	8'-8⅜	8'-8⅛	8'-7⅞	8'-7⅝	7'-3⅜	7'-3¼	7'-3	7'-2⅝	G2
G3	39'-5⅜	36'-3½	33'-1½	29'-11½	26'-9⅝	23'-7⅝	20'-5¾	17'-3¾	14'-1⅞	33'-1½	29'-11½	26'-9⅝	23'-7⅝	20'-5¾	17'-3¾	14'-1⅞	26'-9⅝	23'-7⅝	20'-5¾	17'-3¾	14'-1⅞	10'-11⅞	20'-5¾	17'-3¾	14'-1⅞	10'-11⅞	G3
G4	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	26'-4⅝	22'-10¼	19'-8⅜	16'-6½	13'-4¾	10'-2⅞	19'-8⅜	16'-6½	13'-4¾	10'-2⅞	G4
G5	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	8'-7¼	7'-7	6'-6¾	5'-6⅝	4'-6⅜	3'-6¼	6'-6¾	5'-6⅝	4'-6⅜	3'-6¼	G5
G6	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	9'-10⅜	8'-8¾	7'-8½	6'-8⅜	5'-8⅛	4'-8	7'-8½	6'-8⅜	5'-8⅛	4'-8	G6
G7	1⅝	6⅛	10½	10½	10½	1'-2¾	1'-2¾	1'-2⅝	1'-2⅝	10½	10½	10½	1'-2¾	1'-2¾	1'-2⅝	1'-2⅝	10½	1'-2¾	1'-2¾	1'-2⅝	1'-2⅝	1'-2⅜	1'-2¾	1'-2⅝	1'-2⅝	1'-2⅜	G7
G8	6⅛	7⅛	8¼	8¼	8¼	9¼	9¼	9⅜	9⅜	8¼	8¼	8¼	9¼	9¼	9⅜	9⅜	8¼	9¼	9¼	9⅜	9⅜	9½	9¼	9⅜	9⅜	9½	G8
PL	71'-11	66'-1	60'-3	54'-5½	48'-7⅞	42'-9⅛	36'-11⅜	31'-1½	25'-3¼	60'-3	54'-5½	48'-7⅞	42'-9⅛	36'-11⅜	31'-1½	25'-3¼	48'-7⅞	42'-9⅛	36'-11⅜	31'-1⅛	25'-3¼	19'-5¼	36'-11⅜	31'-1⅛	25'-3¼	19'-5¼	PL
PS	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	29'-1⅞	25'-7⅞	22'-1⅞	18'-7⅞	15'-1⅞	11'-8	22'-1⅞	18'-7⅞	15'-1⅞	11'-8	PS
RL	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	49'-3⅝	43'-4⅝	37'-5⅝	31'-6⅝	25'-7⅝	19'-8⅝	37'-5⅝	31'-6⅝	25'-7⅝	19'-8⅝	RL
RS	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	30'-3⅞	26'-8¼	23'-0½	19'-4⅞	15'-9¼	12'-1½	23'-0½	19'-4⅞	15'-9¼	12'-1½	RS
S1	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	8'-5⅞	8'-5⅞	8'-5⅞	8'-5⅞	8'-5⅞	8'-5⅞	7'-0⅞	7'-0⅞	7'-0⅞	7'-0⅞	S1
T	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	1'-0	1'-0	1'-0	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	10	10	10	9	9	9	9	10	9	9	9	9	9	9	9	9	9	U
W	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	4'-0	3'-9	3'-6	3'-6	3'-6	3'-6	3'-6	3'-6	3'-6	3'-6	W

Notes:

1. See Sheet FWH G2-21 for General Notes, Specifications, and Design Stresses.
2. See Sheet FWH 45-1-21 and sheets FWH 45-3-21 thru 45-6-21 for location of certain dimensions tabulated.
3. Dimensions are in feet and inches unless otherwise noted.

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

IOWADOT

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

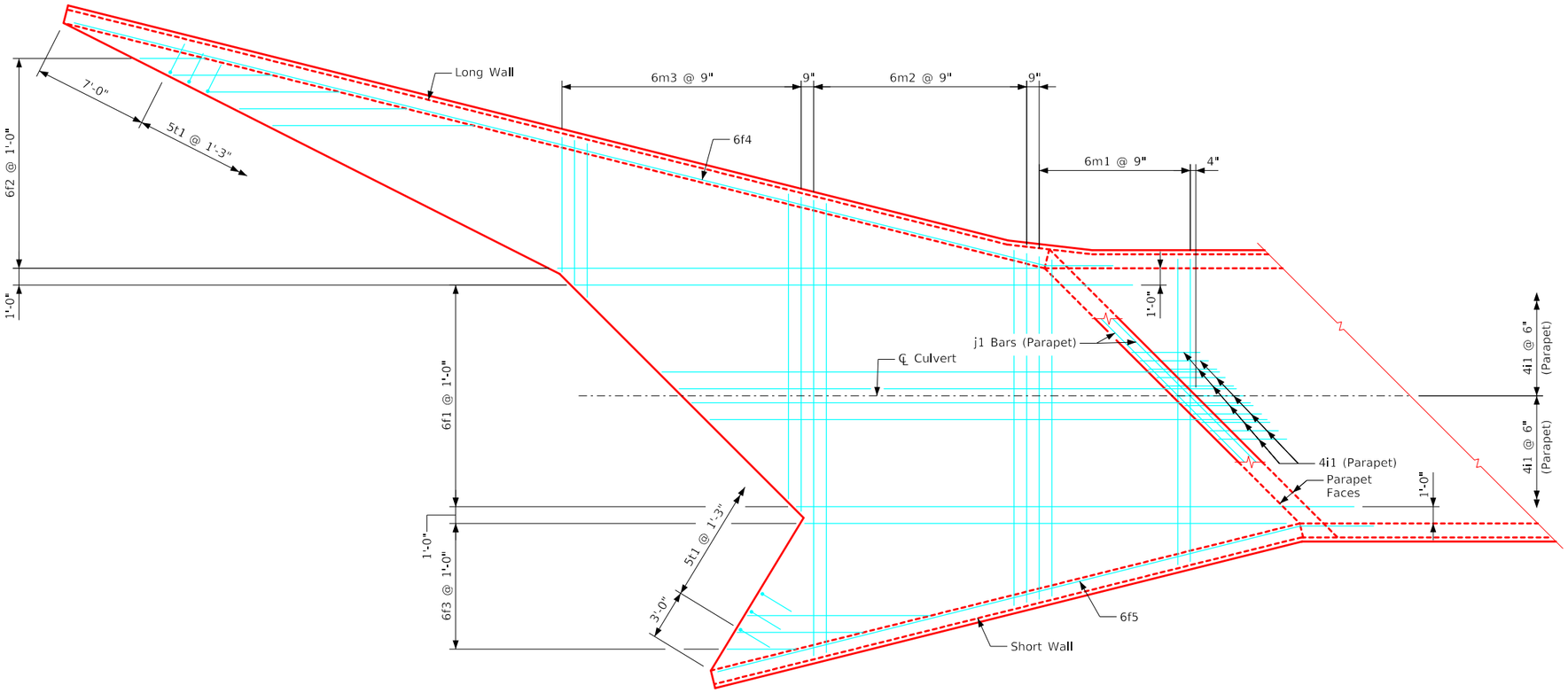
February, 2021

Dimension Table
45° Skew

FWH 45-2-21

Sheet 2 of 2

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 45-2-21 S2 - THIS SHEET ISSUED 02-2021.



Plan View - Top of Apron Reinforcing

Notes:

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

LATEST REVISION DATE

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IOWADOT

Standard Design - Single Reinforced Concrete Box Culverts

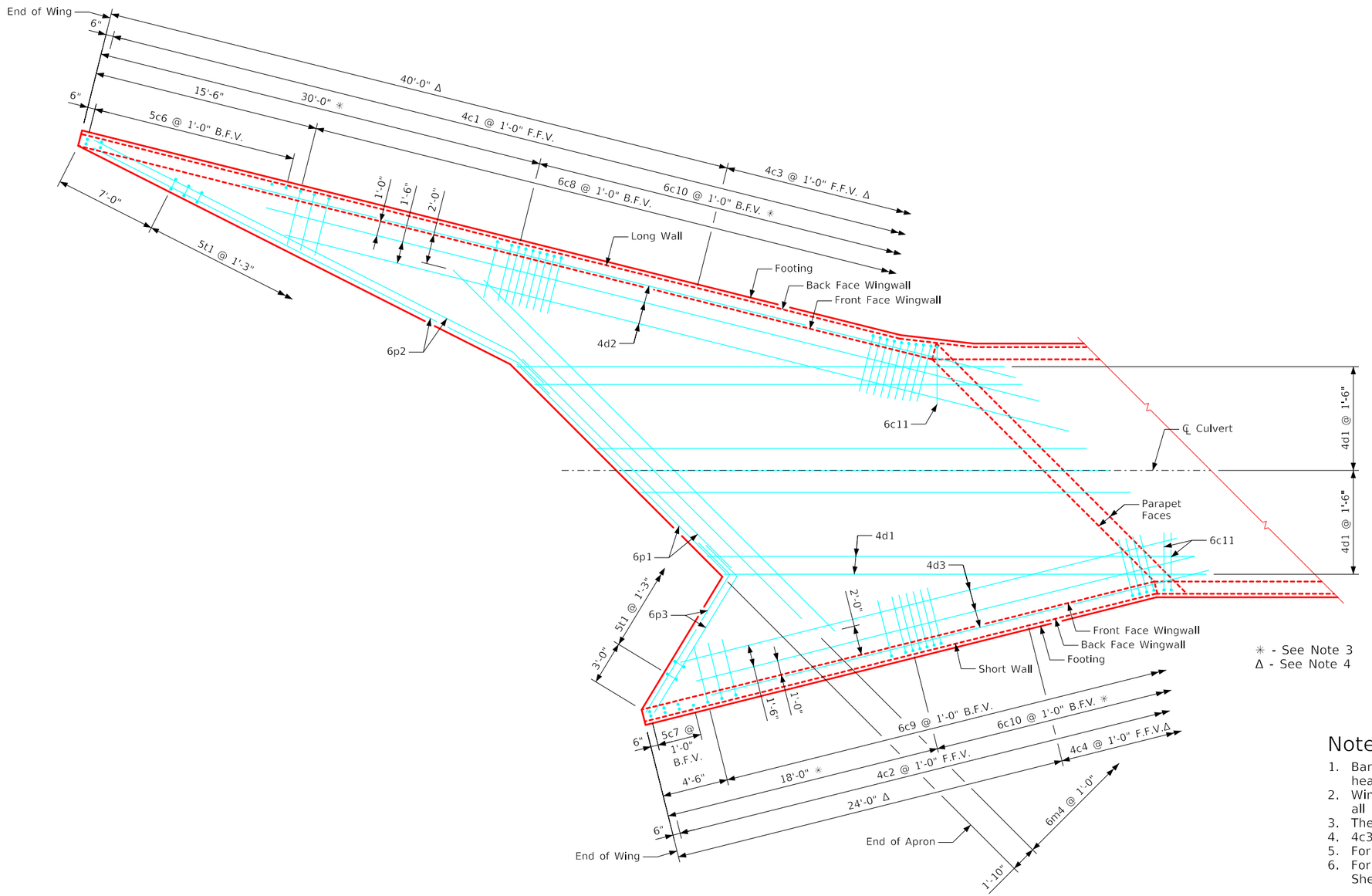
Flared Wing Headwalls

February, 2021

Top Apron Detail
45° Skew

FWH 45-3-21

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 45-3-21 - THIS SHEET ISSUED 02-2021.



✳ - See Note 3
Δ - See Note 4

Plan View - Bottom of Apron Reinforcing Bars

Notes:

1. Bar spacings and positions shown are similar for all sizes of headwalls in this standard.
2. Wingwall bars consistently referenced from end of wing for all headwalls.
3. There are no 6c10 bars in the 3' thru 6' height headwalls.
4. 4c3 & 4c4 bars used only in the 9' thru 14' height headwalls.
5. For dimension table see Sheet FWH 45-2-21.
6. For reinforcing in curtain wall see Curtain Wall Details on Sheet FWH 45-5-21.

LATEST REVISION DATE

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Standard Design - Single Reinforced Concrete Box Culverts

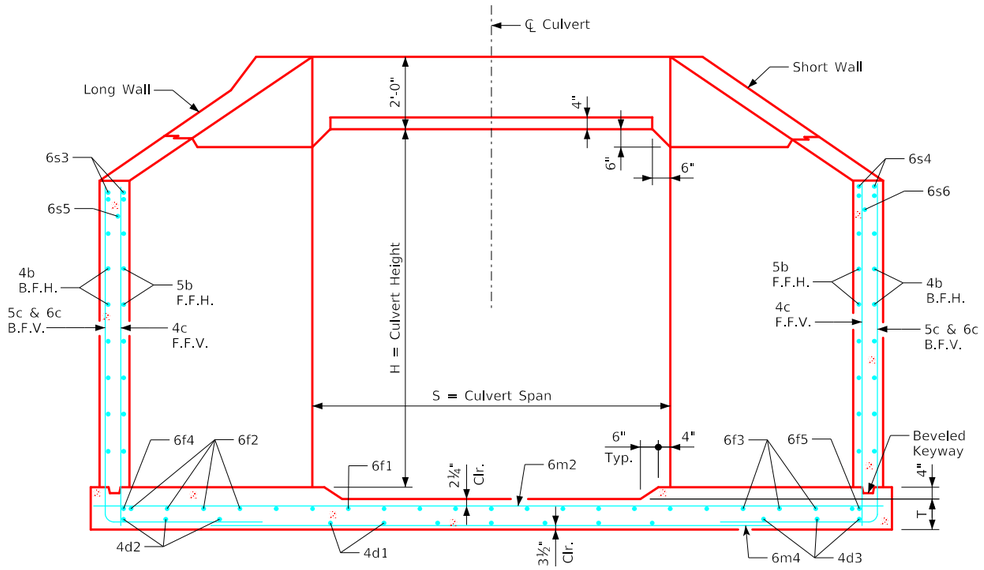
Flared Wing Headwalls

February, 2021

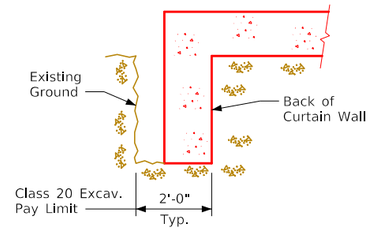
Bott. Apron Detail
45° Skew

FWH 45-4-21

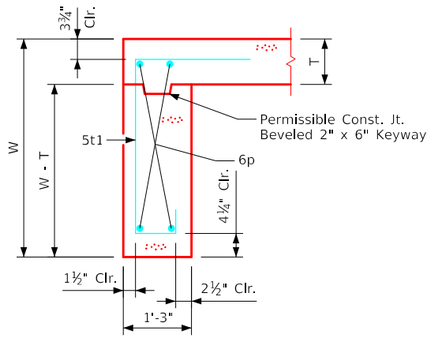
ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 45-4-21 - THIS SHEET ISSUED 02-2021.



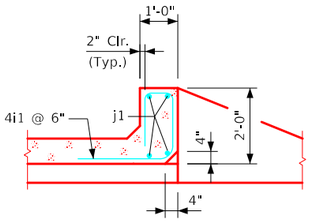
Typical Section - Near Center of Apron



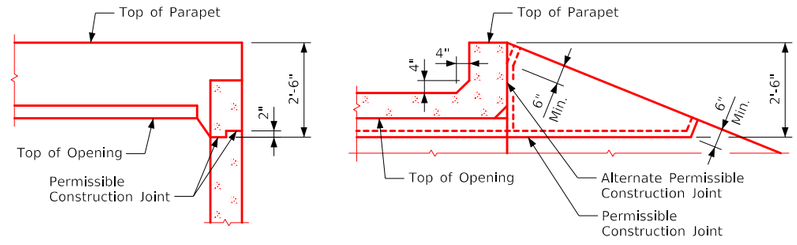
Curtain Wall
Class 20 Excavation



Section thru Curtain Wall

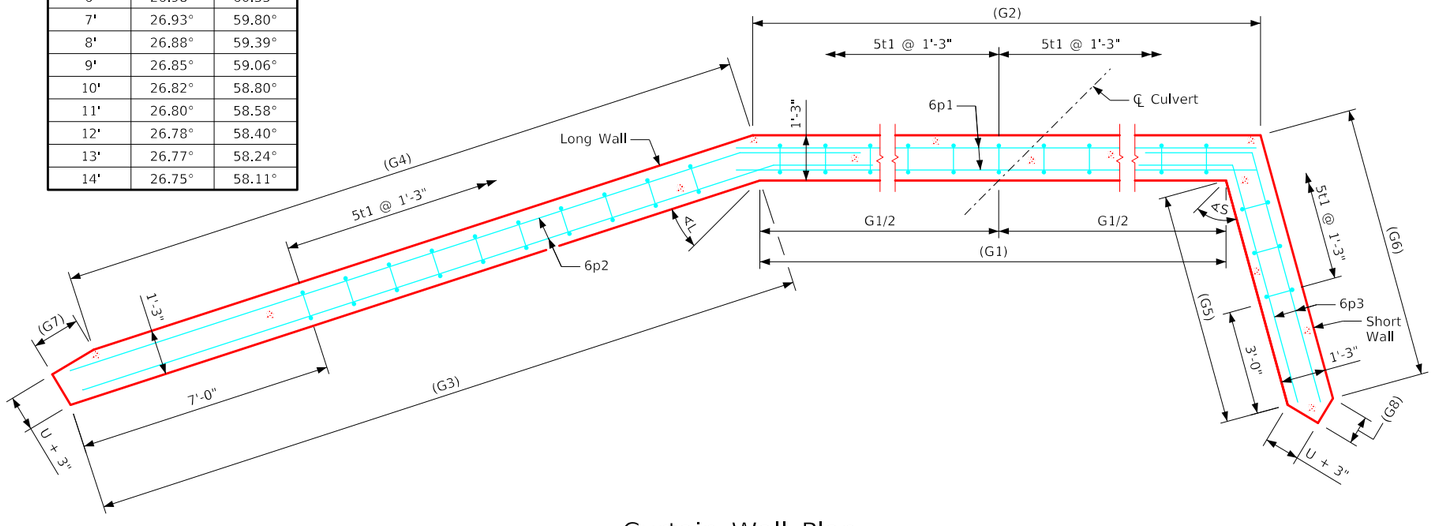


Section thru Parapet



Top of Wingwall Details

Culvert Height (H)	Angle	
	∢L	∢S
3'	27.34°	63.85°
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°
13'	26.77°	58.24°
14'	26.75°	58.11°



Curtain Wall Plan

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

Notes:

1. See Sheet FWH G2-21 for General Notes, Specifications, and Design Stresses.
2. See Sheet FWH 45-2-21 for dimensions table.

LATEST REVISION DATE

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Standard Design - Single Reinforced Concrete Box Culverts

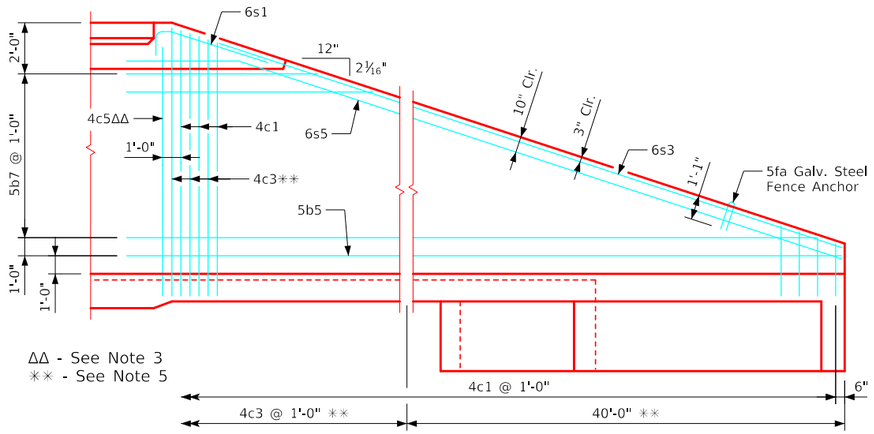
Flared Wing Headwalls

February, 2021

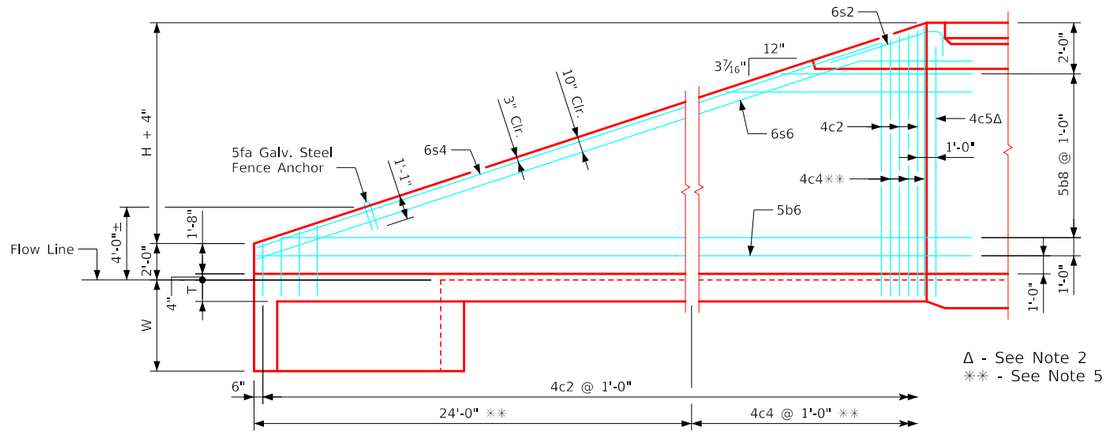
Parapet & Curtain Wall Details 45° Skew

FWH 45-5-21

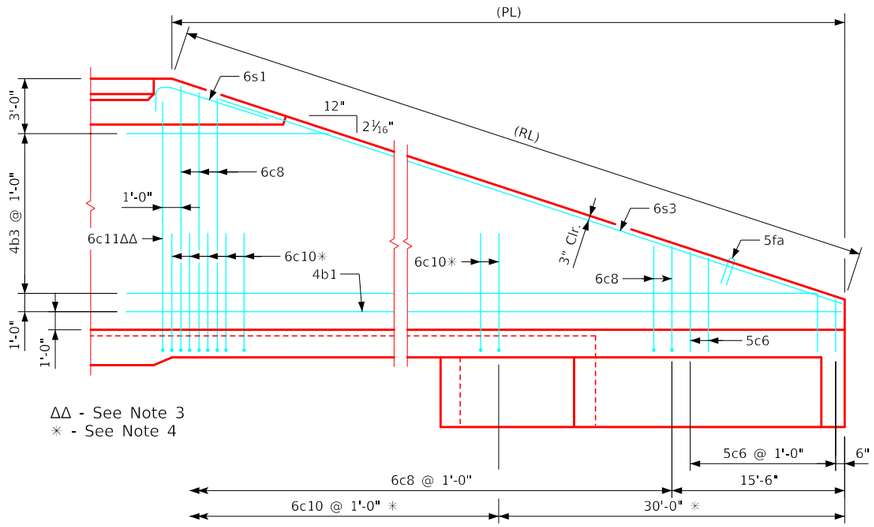
ENGLISHLRFDSIGNEDTWINCULVERTSFWH.DGN - FWH 45-5-21 - THIS SHEET ISSUED 02-2021.



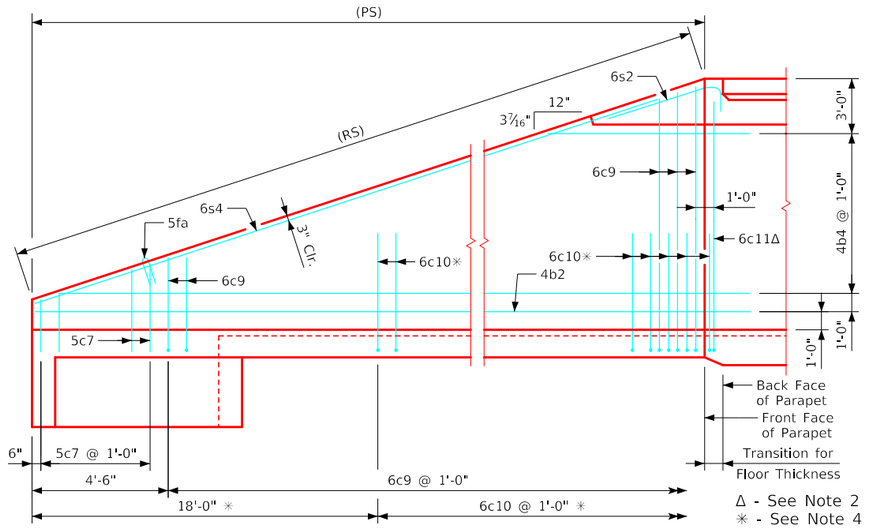
Typical View - Front Face Long Wingwall Reinforcing



Typical View - Front Face Short Wingwall Reinforcing



Typical View - Back Face Long Wingwall Reinforcing



Typical View - Back Face Short Wingwall Reinforcing

Notes:

1. Bar spacings and positions shown are similar for all sizes of headwalls in this standard.
2. Two 4c5 & two 6c11 bars for 4', 6', 8', 10', 12' & 14' height headwalls. One 4c5 & one 6c11 bar for 3', 5', 7', 9', 11' & 13' height headwalls.
3. Two 4c5 & two 6c11 for 3' ,4', 5', 9', 10' & 11' height headwalls. One 4c5 & one 6c11 bar for 6', 7', 8', 12', 13' & 14' height headwalls.
4. Not applicable for 3' thru 6' height headwalls.
5. Not applicable for 3' thru 8' height headwalls.
6. For dimension table, see sheet FWH 45-2-21.
7. Top of wall slope may be rounded in some instances.

LATEST REVISION DATE

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IOWADOT

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Wingwall Details 45° Skew

FWH 45-6-21

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

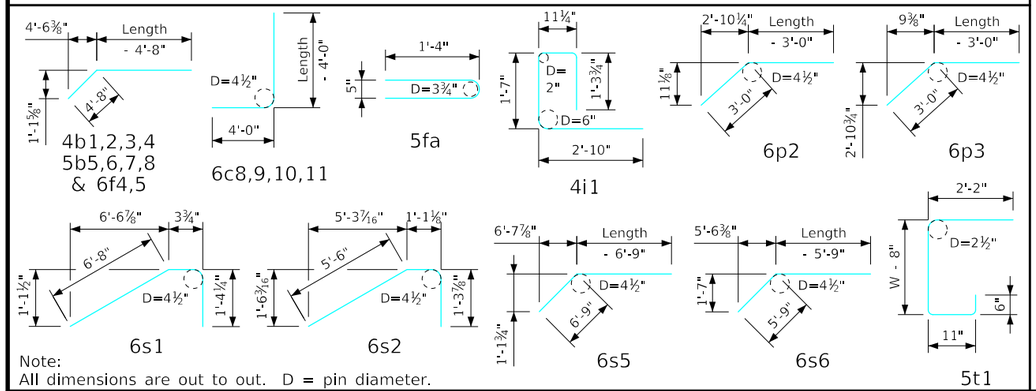
Bar	Location	Shape	16' x 14'			16' x 13'			16' x 12'			16' x 11'			16' x 10'			16' x 9'			16' x 8'			Bar
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	5fa
4b1	Wingwall, B.F.H. Long		1	87'-11	60	1	82'-1	56	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	54'-6	38	1	51'-0	36	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		12 Var.	21'-2 to 85'-2	439	11 Var.	21'-2 to 79'-4	381	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		12 Var.	14'-6 to 52'-11	277	11 Var.	14'-6 to 49'-5	240	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	88'-0	94	1	82'-2	88	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	54'-7	59	1	51'-1	56	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		13 Var.	15'-5 to 85'-3	703	12 Var.	15'-5 to 79'-5	611	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		13 Var.	11'-1 to 53'-0	445	12 Var.	11'-1 to 49'-6	387	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
4c1	Wingwall, F.F.V. Long		84 Var.	2'-9 to 17'-0	554	78 Var.	2'-9 to 16'-0	488	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		50 Var.	2'-10 to 16'-10	328	47 Var.	2'-10 to 16'-0	296	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		45 Var.	9'-7 to 17'-1	401	39 Var.	9'-7 to 16'-1	334	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		27 Var.	9'-7 to 17'-0	240	24 Var.	9'-7 to 16'-1	206	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	15'-9	11	1	14'-9	10	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	15'-9	21	1	14'-9	10	2	13'-9	18	1	12'-9	9	2	11'-9	16	1	10'-9	7	2	9'-9	13	4c5
5c6	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	15 Var.	2'-9 to 5'-2	62	15 Var.	2'-9 to 5'-2	62	5c6
5c7	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	4 Var.	2'-10 to 3'-8	14	4 Var.	2'-10 to 3'-8	14	5c7
6c8	Wingwall, B.F.V. Long		69 Var.	9'-4 to 21'-0	1572	63 Var.	9'-4 to 20'-0	1388	57 Var.	9'-4 to 19'-0	1213	51 Var.	9'-4 to 17'-11	1044	45 Var.	9'-4 to 16'-11	887	39 Var.	9'-4 to 15'-11	740	34 Var.	9'-4 to 15'-0	621	6c8
6c9	Wingwall, B.F.V. Short		46 Var.	8'-0 to 20'-10	996	43 Var.	8'-0 to 20'-0	904	39 Var.	8'-0 to 18'-10	786	36 Var.	8'-0 to 18'-0	703	32 Var.	8'-0 to 16'-10	597	29 Var.	8'-0 to 16'-0	523	25 Var.	8'-0 to 14'-10	429	6c9
6c10	Wingwall, B.F.V. Long		55	10'-6	867	49	10'-6	773	43	10'-6	678	37	10'-6	584	31	10'-6	489	25	10'-6	394	20	10'-6	315	6c10
6c10	Wingwall, B.F.V. Short		33	10'-6	520	30	10'-6	473	26	10'-6	410	23	10'-6	363	19	10'-6	300	16	10'-6	252	12	10'-6	189	6c10
6c11	Wingwall, B.F.V. Long		1	19'-9	30	1	18'-9	28	1	17'-9	27	2	16'-9	50	2	15'-9	47	2	14'-9	44	1	13'-9	21	6c11
6c11	Wingwall, B.F.V. Short		2	19'-9	59	1	18'-9	28	2	17'-9	53	1	16'-9	25	2	15'-9	47	1	14'-9	22	2	13'-9	41	6c11
4d1	Apron, Longit., Bott.		11	44'-2	342	11	41'-4	321	11	38'-6	283	11	35'-8	262	11	32'-10	241	11	30'-0	220	11	27'-2	200	4d1
4d2	Apron, Longit., Bott. Long		3	80'-6	166	3	74'-8	154	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	49'-7	104	3	46'-1	97	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		15	44'-2	1050	15	41'-4	986	15	38'-6	867	15	35'-8	804	15	32'-10	740	15	30'-0	676	15	27'-2	612	6f1
6f2	Apron, Longit., Top Long		18 Var.	6'-2 to 40'-5	633	17 Var.	5'-4 to 37'-8	549	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		11 Var.	7'-1 to 40'-10	399	10 Var.	7'-7 to 38'-0	342	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	88'-0	136	1	82'-2	127	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	54'-7	86	1	51'-1	80	1	47'-7	75	1	44'-1	70	1	40'-7	65	1	37'-1	56	1	33'-7	50	6f5
4i1	Parapet, Vertical		33	6'-8	147	33	6'-8	147	33	6'-8	147	33	6'-8	147	33	6'-8	147	33	6'-8	147	33	6'-8	147	4i1
10j1	Parapet, Horizontal		4	25'-5	437	4	24'-11	429	4	24'-11	429	4	24'-8	425	4	24'-6	422	4	24'-6	422	4	24'-6	422	10j1
6m1	Apron, Trans., Top		12 Var.	20'-3 to 22'-3	383	12 Var.	19'-11 to 21'-11	377	12 Var.	19'-11 to 21'-11	377	12 Var.	19'-9 to 21'-9	374	12 Var.	19'-7 to 21'-7	371	12 Var.	19'-7 to 21'-7	371	12 Var.	19'-7 to 21'-7	371	6m1
6m2	Apron, Trans., Top		33 Var.	22'-6 to 34'-6	1413	30 Var.	22'-2 to 33'-0	1243	26 Var.	22'-2 to 31'-6	1048	22 Var.	22'-0 to 29'-10	856	18 Var.	21'-10 to 28'-2	676	15 Var.	21'-10 to 27'-1	551	11 Var.	21'-10 to 25'-7	392	6m2
6m3	Apron, Trans., Top		21 Var.	11'-10 to 23'-1	551	20 Var.	11'-1 to 21'-9	493	21 Var.	9'-11 to 21'-2	490	21 Var.	9'-3 to 20'-6	469	21 Var.	8'-7 to 19'-10	448	20 Var.	8'-0 to 18'-8	401	21 Var.	6'-10 to 18'-1	393	6m3
6m4	Apron, Trans., Bott.		28 Var.	16'-2 to 45'-0	1304	26 Var.	16'-2 to 42'-10	1163	24 Var.	16'-2 to 40'-9	1030	22 Var.	16'-2 to 38'-7	905	20 Var.	16'-2 to 36'-6	791	18 Var.	16'-2 to 34'-4	683	16 Var.	16'-2 to 32'-2	581	6m4
6p1	Curtain, Horizontal		4	22'-7	136	4	22'-7	136	4	22'-7	136	4	22'-7	136	4	22'-7	136	4	22'-7	136	4	22'-7	136	6p1
6p2	Curtain, Horizontal, Long		4	48'-8	307	4	45'-6	288	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	17'-8	106	4	16'-8	100	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	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	2	7'-11	24	2	7'-11	24	6s2
6s3	Wing Slope, Both F., Long		2	80'-5	249	2	74'-6	231	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	48'-11	154	2	45'-4	143	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	86'-6	134	1	80'-7	125	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	54'-11	86	1	51'-3	81	1	47'-8	75	1	44'-0	70	1	40'-4	64	1	36'-9	55	1	33'-1	50	6s6
5t1	Curtain, Vertical		61	8'-5	535	57	8'-2	486	54	7'-11	446	50	7'-8	400	48	7'-5	371	44	7'-2	329	41	6'-11	296	5t1
	Estimated Quantities One Headwall	Reinf. Steel	16,703 LB			15,022 LB			13,389 LB			11,864 LB			10,433 LB			9072 LB			7699 LB			
		Concrete Parapet Δ	3.2	148.6 CY		3.0	125.0 CY		3.0	111.0 CY		2.9	94.8 CY		2.8	80.2 CY		2.8	69.3 CY		2.8	59.2 CY		
		Concrete Wingwalls	51.3			38.5			33.4			26.3			20.2			16.8			13.7			
		Concrete Apron ✳	94.1			83.5			74.6			65.6			57.2			49.7			42.7			

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

Bent Bar Details



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

Headwall Notes:

1. See Sheet FWH G2-21 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", "f1", "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

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
16'-0" Span
45° Skew

FWH 45-7-21

Sheet 1 of 2

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 45-7-21 S1 - THIS SHEET ISSUED 02-2021.

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

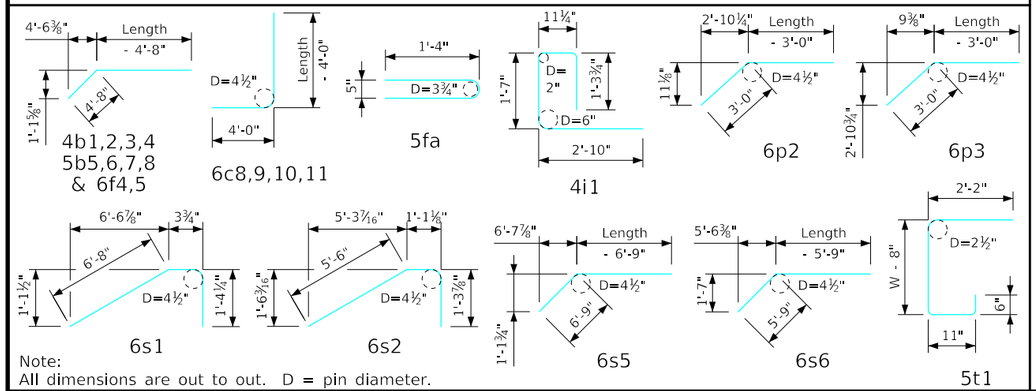
Bar	Location	Shape	16' x 7'			16' x 6'			16' x 5'			16' x 4'			Bar
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	5fa
4b1	Wingwall, B.F.H. Long		1	47'-2	33	1	41'-4	29	1	35'-6	24	1	29'-8	20	4b1
4b2	Wingwall, B.F.H. Short		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
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
5c6	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	5c6
5c7	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	5c7
6c8	Wingwall, B.F.V. Long		28 Var.	9'-4 to 14'-0	491	22 Var.	9'-4 to 13'-0	369	16 Var.	9'-4 to 11'-11	255	10 Var.	9'-4 to 10'-11	152	6c8
6c9	Wingwall, B.F.V. Short		22 Var.	8'-0 to 14'-0	363	18 Var.	8'-0 to 12'-10	282	15 Var.	8'-0 to 12'-0	225	11 Var.	8'-0 to 10'-10	156	6c9
6c10	Wingwall, B.F.V. Long		14	10'-6	221	--	--	--	--	--	--	--	--	--	6c10
6c10	Wingwall, B.F.V. Short		9	10'-6	142	--	--	--	--	--	--	--	--	--	6c10
6c11	Wingwall, B.F.V. Long		1	12'-9	19	1	11'-9	18	2	10'-9	32	2	9'-9	29	6c11
6c11	Wingwall, B.F.V. Short		1	12'-9	19	2	11'-9	35	1	10'-9	16	2	9'-9	29	6c11
4d1	Apron, Longit., Bott.		11	24'-5	179	11	21'-7	159	11	18'-9	138	11	15'-11	117	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		15	24'-5	550	15	21'-7	486	15	18'-9	422	15	15'-11	359	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		33	6'-8	147	33	6'-8	147	33	6'-8	147	33	6'-8	147	4i1
10j1	Parapet, Horizontal		4	24'-3	417	4	24'-3	417	4	24'-3	417	4	24'-3	417	10j1
6m1	Apron, Trans., Top		12 Var.	19'-5 to 21'-5	368	12 Var.	19'-5 to 21'-5	368	12 Var.	19'-5 to 21'-5	368	8 Var.	19'-5 to 20'-8	241	6m1
6m2	Apron, Trans., Top		7 Var.	21'-8 to 23'-11	240	3 Var.	21'-8 to 22'-5	99	--	--	--	4 Var.	13'-8 to 15'-11	89	6m2
6m3	Apron, Trans., Top		21 Var.	6'-2 to 17'-5	372	21 Var.	5'-7 to 16'-10	354	20 Var.	5'-0 to 15'-9	312	17 Var.	3'-11 to 12'-11	215	6m3
6m4	Apron, Trans., Bott.		14 Var.	16'-2 to 30'-1	486	12 Var.	16'-2 to 27'-11	397	10 Var.	16'-2 to 25'-10	315	8 Var.	16'-2 to 23'-8	239	6m4
6p1	Curtain, Horizontal		4	22'-7	136	4	22'-7	136	4	22'-6	135	4	22'-6	135	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
5t1	Curtain, Vertical		37	6'-8	257	34	6'-5	228	31	6'-5	207	28	6'-5	187	5t1
	Estimated Quantities One Headwall	Reinf. Steel	6520 LB			5233 LB			4373 LB			3590 LB			
		Concrete Parapet Δ	2.7	48.3 CY		2.7	40.0 CY		2.7	32.9 CY		2.7	26.5 CY		
		Concrete Wingwalls	9.8			7.5			5.5			3.8			
		Concrete Apron ✳	35.8			29.8			24.7			20.0			

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

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

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

Bent Bar Details



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

Headwall Notes:

1. See Sheet FWH G2-21 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

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
16'-0" Span
45° Skew

FWH 45-7-21

Sheet 2 of 2

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 45-7-21 S2 - THIS SHEET ISSUED 02-2021.

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

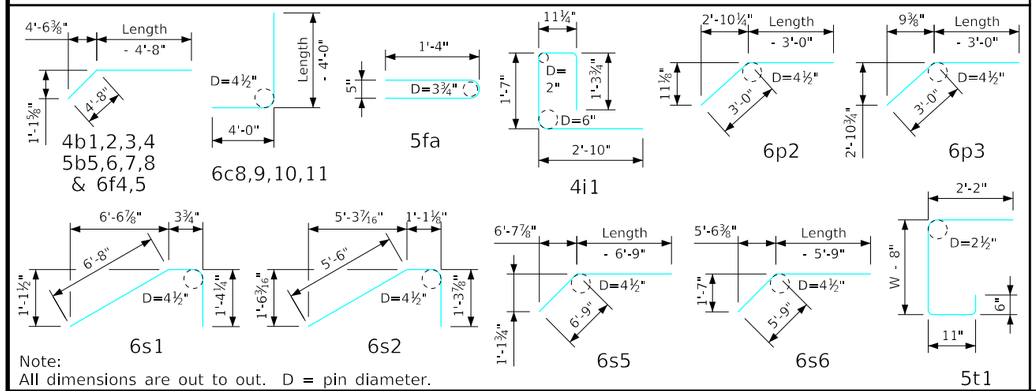
Bar	Location	Shape	14' x 14'			14' x 13'			14' x 12'			14' x 11'			14' x 10'			14' x 9'			14' x 8'			Bar
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	5fa
4b1	Wingwall, B.F.H. Long		1	87'-11	60	1	82'-1	56	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	54'-6	38	1	51'-0	36	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		12 Var.	21'-2 to 85'-2	439	11 Var.	21'-2 to 79'-4	381	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		12 Var.	14'-6 to 52'-11	277	11 Var.	14'-6 to 49'-5	240	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	88'-0	94	1	82'-2	88	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	54'-7	59	1	51'-1	56	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		13 Var.	15'-5 to 85'-3	703	12 Var.	15'-5 to 79'-5	611	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		13 Var.	11'-1 to 53'-0	445	12 Var.	11'-1 to 49'-6	387	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
4c1	Wingwall, F.F.V. Long		84 Var.	2'-9 to 17'-0	554	78 Var.	2'-9 to 16'-0	488	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		50 Var.	2'-10 to 16'-10	328	47 Var.	2'-10 to 16'-0	296	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		45 Var.	9'-7 to 17'-1	401	39 Var.	9'-7 to 16'-1	334	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		27 Var.	9'-7 to 17'-0	240	24 Var.	9'-7 to 16'-1	206	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	15'-9	11	1	14'-9	10	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	15'-9	21	1	14'-9	10	2	13'-9	18	1	12'-9	9	2	11'-9	16	1	10'-9	7	2	9'-9	13	4c5
5c6	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	15 Var.	2'-9 to 5'-2	62	15 Var.	2'-9 to 5'-2	62	5c6
5c7	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	4 Var.	2'-10 to 3'-8	14	4 Var.	2'-10 to 3'-8	14	5c7
6c8	Wingwall, B.F.V. Long		69 Var.	9'-4 to 21'-0	1572	63 Var.	9'-4 to 20'-0	1388	57 Var.	9'-4 to 19'-0	1213	51 Var.	9'-4 to 17'-11	1044	45 Var.	9'-4 to 16'-11	887	39 Var.	9'-4 to 15'-11	740	34 Var.	9'-4 to 15'-0	621	6c8
6c9	Wingwall, B.F.V. Short		46 Var.	8'-0 to 20'-10	996	43 Var.	8'-0 to 20'-0	904	39 Var.	8'-0 to 18'-10	786	36 Var.	8'-0 to 18'-0	703	32 Var.	8'-0 to 16'-10	597	29 Var.	8'-0 to 16'-0	523	25 Var.	8'-0 to 14'-10	429	6c9
6c10	Wingwall, B.F.V. Long		55	10'-6	867	49	10'-6	773	43	10'-6	678	37	10'-6	584	31	10'-6	489	25	10'-6	394	20	10'-6	315	6c10
6c10	Wingwall, B.F.V. Short		33	10'-6	520	30	10'-6	473	26	10'-6	410	23	10'-6	363	19	10'-6	300	16	10'-6	252	12	10'-6	189	6c10
6c11	Wingwall, B.F.V. Long		1	19'-9	30	1	18'-9	28	1	17'-9	27	2	16'-9	50	2	15'-9	47	2	14'-9	44	1	13'-9	21	6c11
6c11	Wingwall, B.F.V. Short		2	19'-9	59	1	18'-9	28	2	17'-9	53	1	16'-9	25	2	15'-9	47	1	14'-9	22	2	13'-9	41	6c11
4d1	Apron, Longit., Bott.		9	44'-2	280	9	41'-4	263	9	38'-6	231	9	35'-8	214	9	32'-10	197	9	30'-0	180	9	27'-2	163	4d1
4d2	Apron, Longit., Bott. Long		3	80'-6	166	3	74'-8	154	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	49'-7	104	3	46'-1	97	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		13	44'-2	910	13	41'-4	854	13	38'-6	752	13	35'-8	696	13	32'-10	641	13	30'-0	586	13	27'-2	530	6f1
6f2	Apron, Longit., Top Long		18 Var.	6'-2 to 40'-5	633	17 Var.	5'-4 to 37'-8	549	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		11 Var.	7'-1 to 40'-10	399	10 Var.	7'-7 to 38'-0	342	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	88'-0	136	1	82'-2	127	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	54'-7	86	1	51'-1	80	1	47'-7	75	1	44'-1	70	1	40'-7	65	1	37'-1	56	1	33'-7	50	6f5
4i1	Parapet, Vertical		29	6'-8	129	29	6'-8	129	29	6'-8	129	29	6'-8	129	29	6'-8	129	29	6'-8	129	29	6'-8	129	4i1
10j1	Parapet, Horizontal		4	22'-7	389	4	22'-1	380	4	22'-1	380	4	21'-11	377	4	21'-8	373	4	21'-8	373	4	21'-8	373	10j1
6m1	Apron, Trans., Top		11 Var.	18'-0 to 19'-10	313	11 Var.	17'-8 to 19'-6	307	11 Var.	17'-8 to 19'-6	307	11 Var.	17'-6 to 19'-4	304	11 Var.	17'-4 to 19'-2	302	11 Var.	17'-4 to 19'-2	302	11 Var.	17'-4 to 19'-2	302	6m1
6m2	Apron, Trans., Top		36 Var.	20'-1 to 33'-3	1442	32 Var.	19'-9 to 31'-5	1230	28 Var.	19'-9 to 29'-11	1044	25 Var.	19'-7 to 28'-7	904	21 Var.	19'-5 to 26'-11	731	17 Var.	19'-5 to 25'-5	572	13 Var.	19'-5 to 23'-11	423	6m2
6m3	Apron, Trans., Top		18 Var.	11'-7 to 21'-2	443	18 Var.	10'-10 to 20'-5	422	18 Var.	10'-3 to 19'-10	407	18 Var.	9'-1 to 18'-7	374	18 Var.	8'-5 to 17'-11	356	18 Var.	7'-10 to 17'-4	340	18 Var.	7'-3 to 16'-10	326	6m3
6m4	Apron, Trans., Bott.		28 Var.	13'-4 to 42'-2	1178	26 Var.	13'-4 to 40'-0	1045	24 Var.	13'-4 to 37'-11	924	22 Var.	13'-4 to 35'-9	811	20 Var.	13'-4 to 33'-8	706	18 Var.	13'-4 to 31'-6	606	16 Var.	13'-4 to 29'-4	513	6m4
6p1	Curtain, Horizontal		4	19'-9	119	4	19'-9	119	4	19'-9	119	4	19'-9	119	4	19'-9	119	4	19'-9	119	4	19'-9	119	6p1
6p2	Curtain, Horizontal, Long		4	48'-8	307	4	45'-6	288	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	17'-8	106	4	16'-8	100	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	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	2	7'-11	24	2	7'-11	24	6s2
6s3	Wing Slope, Both F., Long		2	80'-5	249	2	74'-6	231	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	48'-11	154	2	45'-4	143	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	86'-6	134	1	80'-7	125	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	54'-11	86	1	51'-3	81	1	47'-8	75	1	44'-0	70	1	40'-4	64	1	36'-9	55	1	33'-1	50	6s6
5t1	Curtain, Vertical		59	8'-5	518	55	8'-2	468	52	7'-11	429	48	7'-8	384	46	7'-5	356	42	7'-2	314	39	6'-11	281	5t1
	Estimated Quantities One Headwall	Reinf. Steel		16,126 LB			14,458 LB			12,858 LB			11,398 LB			10,000 LB			8657 LB			7308 LB		
		Concrete Parapet Δ	3.0	144.2 CY		2.8	120.9 CY		2.8	107.1 CY		2.7	91.3 CY		2.6	76.9 CY		2.6	66.3 CY		2.6	56.5 CY		
		Concrete Wingwalls	51.3			38.5			33.4			26.3			20.2			16.8			13.7			
		Concrete Apron ✳	89.9			79.6			70.9			62.3			54.1			46.9			40.2			

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

Bent Bar Details



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

Headwall Notes:

1. See Sheet FWH G2-21 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", "f1", "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

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
14'-0" Span
45° Skew

FWH 45-8-21

Sheet 1 of 2

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 45-8-21 S1 - THIS SHEET ISSUED 02-2021.

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

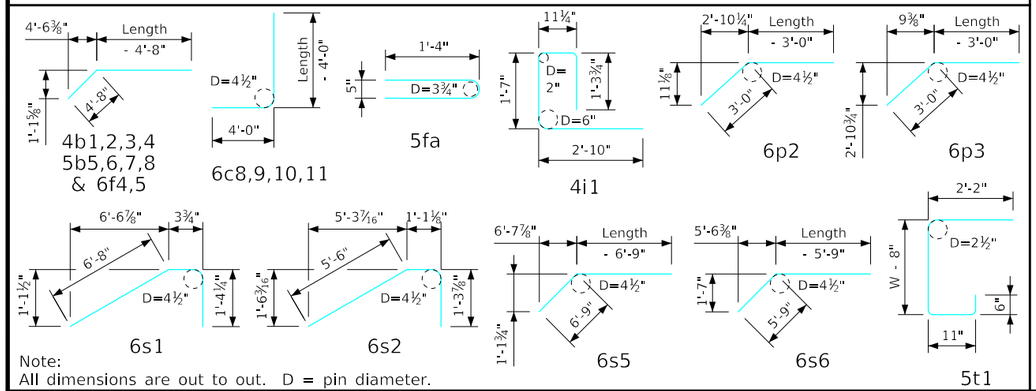
Bar	Location	Shape	14' x 7'			14' x 6'			14' x 5'			14' x 4'			Bar
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	5fa
4b1	Wingwall, B.F.H. Long		1	47'-2	33	1	41'-4	29	1	35'-6	24	1	29'-8	20	4b1
4b2	Wingwall, B.F.H. Short		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
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
5c6	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	5c6
5c7	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	5c7
6c8	Wingwall, B.F.V. Long		28 Var.	9'-4 to 14'-0	491	22 Var.	9'-4 to 13'-0	369	16 Var.	9'-4 to 11'-11	255	10 Var.	9'-4 to 10'-11	152	6c8
6c9	Wingwall, B.F.V. Short		22 Var.	8'-0 to 14'-0	363	18 Var.	8'-0 to 12'-10	282	15 Var.	8'-0 to 12'-0	225	11 Var.	8'-0 to 10'-10	156	6c9
6c10	Wingwall, B.F.V. Long		14	10'-6	221	--	--	--	--	--	--	--	--	--	6c10
6c10	Wingwall, B.F.V. Short		9	10'-6	142	--	--	--	--	--	--	--	--	--	6c10
6c11	Wingwall, B.F.V. Long		1	12'-9	19	1	11'-9	18	2	10'-9	32	2	9'-9	29	6c11
6c11	Wingwall, B.F.V. Short		1	12'-9	19	2	11'-9	35	1	10'-9	16	2	9'-9	29	6c11
4d1	Apron, Longit., Bott.		9	24'-5	147	9	21'-7	130	9	18'-9	113	9	15'-11	96	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		13	24'-5	477	13	21'-7	421	13	18'-9	366	13	15'-11	311	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		29	6'-8	129	29	6'-8	129	29	6'-8	129	29	6'-8	129	4i1
10j1	Parapet, Horizontal		4	21'-5	369	4	21'-5	369	4	21'-5	369	4	21'-5	369	10j1
6m1	Apron, Trans., Top		11 Var.	17'-2 to 19'-0	299	11 Var.	17'-2 to 19'-0	299	11 Var.	17'-2 to 19'-0	299	9 Var.	17'-2 to 18'-8	242	6m1
6m2	Apron, Trans., Top		9 Var.	19'-3 to 22'-3	280	6 Var.	19'-3 to 21'-2	182	2 Var.	19'-3 to 19'-8	58	2 Var.	13'-5 to 14'-2	41	6m2
6m3	Apron, Trans., Top		18 Var.	6'-7 to 16'-2	308	18 Var.	5'-5 to 15'-0	276	18 Var.	4'-10 to 14'-5	260	16 Var.	4'-3 to 12'-9	204	6m3
6m4	Apron, Trans., Bott.		14 Var.	13'-4 to 27'-3	427	12 Var.	13'-4 to 25'-1	346	10 Var.	13'-4 to 23'-0	273	8 Var.	13'-4 to 20'-10	205	6m4
6p1	Curtain, Horizontal		4	19'-9	119	4	19'-9	119	4	19'-8	118	4	19'-8	118	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
5t1	Curtain, Vertical		35	6'-8	243	32	6'-5	214	29	6'-5	194	26	6'-5	174	5t1
	Estimated Quantities One Headwall	Reinf. Steel		6166 LB			4927 LB			4091 LB			3333 LB		
		Concrete Parapet Δ	2.5	45.9 CY		2.5	37.8 CY		2.5	31.0 CY		2.5	24.8 CY		
		Concrete Wingwalls	9.8			7.5			5.5			3.8			
		Concrete Apron ✳	33.6			27.8			23.0			18.5			

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.

Headwall Notes:

1. See Sheet FWH G2-21 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

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
14'-0" Span
45° Skew

FWH 45-8-21

Sheet 2 of 2

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 45-8-21 S2 - THIS SHEET ISSUED 02-2021.

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

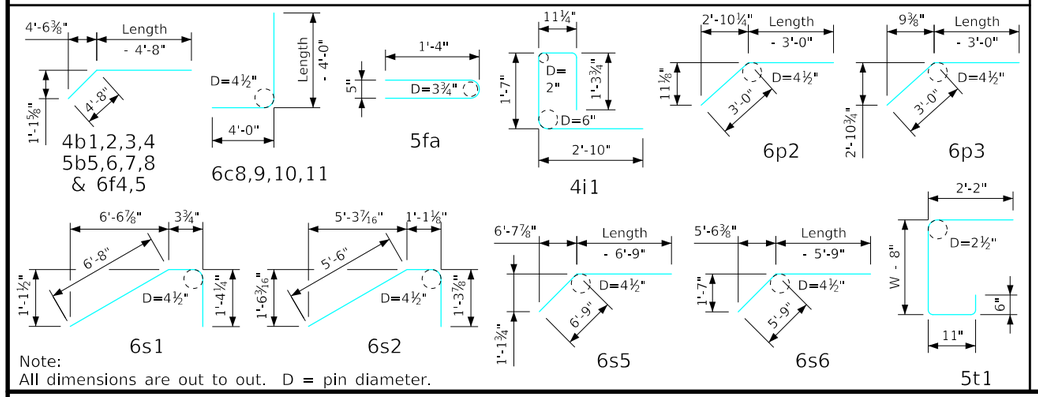
Bar	Location	Shape	12' x 12'			12' x 11'			12' x 10'			12' x 9'			12' x 8'			12' x 7'			Bar
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	5fa
4b1	Wingwall, B.F.H. Long		1	76'-3	53	1	70'-6	49	1	64'-8	45	1	58'-10	41	1	53'-0	37	1	47'-2	33	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	1	30'-1	20	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	5 Var.	21'-2 to 44'-5	111	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	5 Var.	14'-6 to 28'-5	72	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	1	47'-2	52	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	1	30'-1	31	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	6 Var.	15'-4 to 44'-5	189	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	6 Var.	11'-0 to 28'-6	124	5b8
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	43 Var.	2'-9 to 10'-0	183	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	26 Var.	2'-10 to 10'-0	111	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	1	8'-9	6	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	1	8'-9	6	4c5
5c6	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	15 Var.	2'-9 to 5'-2	62	5c6
5c7	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	4 Var.	2'-10 to 3'-8	14	5c7
6c8	Wingwall, B.F.V. Long		57 Var.	9'-4 to 19'-0	1213	51 Var.	9'-4 to 17'-11	1044	45 Var.	9'-4 to 16'-11	887	39 Var.	9'-4 to 15'-11	740	34 Var.	9'-4 to 15'-0	621	28 Var.	9'-4 to 14'-0	491	6c8
6c9	Wingwall, B.F.V. Short		39 Var.	8'-0 to 18'-10	786	36 Var.	8'-0 to 18'-0	703	32 Var.	8'-0 to 16'-10	597	29 Var.	8'-0 to 16'-0	523	25 Var.	8'-0 to 14'-10	429	22 Var.	8'-0 to 14'-0	363	6c9
6c10	Wingwall, B.F.V. Long		43	10'-6	678	37	10'-6	584	31	10'-6	489	25	10'-6	394	20	10'-6	315	14	10'-6	221	6c10
6c10	Wingwall, B.F.V. Short		26	10'-6	410	23	10'-6	363	19	10'-6	300	16	10'-6	252	12	10'-6	189	9	10'-6	142	6c10
6c11	Wingwall, B.F.V. Long		1	17'-9	27	2	16'-9	50	2	15'-9	47	2	14'-9	44	1	13'-9	21	1	12'-9	19	6c11
6c11	Wingwall, B.F.V. Short		2	17'-9	53	1	16'-9	25	2	15'-9	47	1	14'-9	22	2	13'-9	41	1	12'-9	19	6c11
4d1	Apron, Longit., Bott.		9	38'-6	231	9	35'-8	214	9	32'-10	197	9	30'-0	180	9	27'-2	163	9	24'-5	147	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	3	39'-9	80	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	3	25'-1	50	4d3
6f1	Apron, Longit., Top		11	38'-6	636	11	35'-8	589	11	32'-10	542	11	30'-0	496	11	27'-2	449	11	24'-5	403	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	8 Var.	6'-5 to 20'-8	163	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	5 Var.	7'-4 to 21'-0	106	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	1	47'-2	74	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	1	30'-1	45	6f5
4i1	Parapet, Vertical		25	6'-8	111	25	6'-8	111	25	6'-8	111	25	6'-8	111	25	6'-8	111	25	6'-8	111	4i1
9j1	Parapet, Horizontal		4	19'-3	262	4	19'-1	260	4	18'-10	256	4	18'-10	256	4	18'-10	256	4	18'-7	253	9j1
6m1	Apron, Trans., Top		10 Var.	15'-5 to 17'-1	244	10 Var.	15'-3 to 16'-11	242	10 Var.	15'-1 to 16'-9	239	10 Var.	15'-1 to 16'-9	239	10 Var.	15'-1 to 16'-9	239	10 Var.	14'-11 to 16'-7	237	6m1
6m2	Apron, Trans., Top		31 Var.	17'-5 to 28'-8	1073	27 Var.	17'-3 to 27'-0	897	23 Var.	17'-1 to 25'-4	733	19 Var.	17'-1 to 23'-10	584	16 Var.	17'-1 to 22'-8	478	12 Var.	16'-11 to 21'-0	342	6m2
6m3	Apron, Trans., Top		15 Var.	10'-1 to 18'-0	316	15 Var.	9'-5 to 17'-4	301	15 Var.	8'-9 to 16'-8	286	16 Var.	7'-7 to 16'-1	284	15 Var.	7'-1 to 14'-11	248	15 Var.	6'-5 to 14'-3	233	6m3
6m4	Apron, Trans., Bott.		24 Var.	10'-6 to 35'-1	822	22 Var.	10'-6 to 32'-11	717	20 Var.	10'-6 to 30'-10	621	18 Var.	10'-6 to 28'-8	529	16 Var.	10'-6 to 26'-6	445	14 Var.	10'-6 to 24'-5	367	6m4
6p1	Curtain, Horizontal		4	16'-11	102	4	16'-11	102	4	16'-11	102	4	16'-11	102	4	16'-11	102	4	16'-11	102	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	4	26'-6	159	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	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	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	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	2	39'-0	117	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	2	23'-6	71	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	1	45'-1	71	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	1	29'-5	44	6s6
5t1	Curtain, Vertical		50	7'-11	413	46	7'-8	368	44	7'-5	340	40	7'-2	299	37	6'-11	267	33	6'-8	229	5t1
	Estimated Quantities One Headwall	Reinf. Steel		12,346 LB			10,887 LB			9517 LB			8216 LB			6907 LB			5792 LB		
		Concrete Parapet Δ	2.6			2.5			2.4			2.4			2.4			2.3			
		Concrete Wingwalls	33.4	103.3 CY		26.3	87.7 CY		20.2	73.6 CY		16.8	63.3 CY		13.7	53.8 CY		9.8	43.4 CY		
		Concrete Apron ✳	67.3			58.9			51.0			44.1			37.7			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.

Headwall Notes:

1. See Sheet FWH G2-21 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

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
12'-0" Span
45° Skew

FWH 45-9-21

Sheet 1 of 2

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 45-9-21 S1 - THIS SHEET ISSUED 02-2021.

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

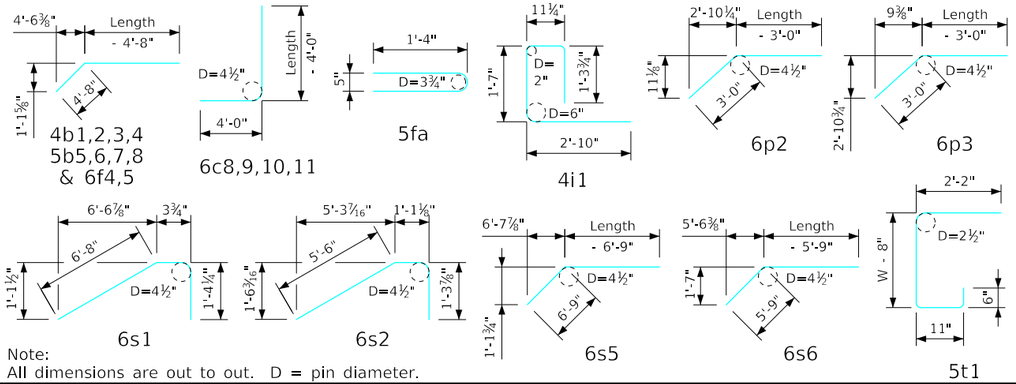
Bar	Location	Shape	12' x 6' No.	12' x 6' Length	12' x 6' Wt.	12' x 5' No.	12' x 5' Length	12' x 5' Wt.	12' x 4' No.	12' x 4' Length	12' x 4' Wt.	Bar
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	5fa
4b1	Wingwall, B.F.H. Long		1	41'-4	29	1	35'-6	24	1	29'-8	20	4b1
4b2	Wingwall, B.F.H. Short		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
4c1	Wingwall, F.F.V. Long		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		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	7'-9	5	2	6'-9	9	2	5'-9	8	4c5
4c5	Wingwall, F.F.V. Short		2	7'-9	10	1	6'-9	5	2	5'-9	8	4c5
5c6	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	5c6
5c7	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	5c7
6c8	Wingwall, B.F.V. Long		22 Var.	9'-4 to 13'-0	369	16 Var.	9'-4 to 11'-11	255	10 Var.	9'-4 to 10'-11	152	6c8
6c9	Wingwall, B.F.V. Short		18 Var.	8'-0 to 12'-10	282	15 Var.	8'-0 to 12'-0	225	11 Var.	8'-0 to 10'-10	156	6c9
6c10	Wingwall, B.F.V. Long		--	--	--	--	--	--	--	--	--	6c10
6c10	Wingwall, B.F.V. Short		--	--	--	--	--	--	--	--	--	6c10
6c11	Wingwall, B.F.V. Long		1	11'-9	18	2	10'-9	32	2	9'-9	29	6c11
6c11	Wingwall, B.F.V. Short		2	11'-9	35	1	10'-9	16	2	9'-9	29	6c11
4d1	Apron, Longit., Bott.		9	21'-7	130	9	18'-9	113	9	15'-11	96	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		11	21'-7	357	11	18'-9	310	11	15'-11	263	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		25	6'-8	111	25	6'-8	111	25	6'-8	111	4i1
9j1	Parapet, Horizontal		4	18'-7	253	4	18'-7	253	4	18'-7	253	9j1
6m1	Apron, Trans., Top		10 Var.	14'-11 to 16'-7	237	10 Var.	14'-11 to 16'-7	237	10 Var.	14'-11 to 16'-7	237	6m1
6m2	Apron, Trans., Top		8 Var.	16'-11 to 19'-6	219	4 Var.	16'-11 to 18'-0	105	--	--	--	6m2
6m3	Apron, Trans., Top		15 Var.	5'-10 to 13'-8	220	16 Var.	4'-8 to 13'-1	213	16 Var.	4'-1 to 12'-6	199	6m3
6m4	Apron, Trans., Bott.		12 Var.	10'-6 to 22'-3	295	10 Var.	10'-6 to 20'-2	230	8 Var.	10'-6 to 18'-0	171	6m4
6p1	Curtain, Horizontal		4	16'-11	102	4	16'-11	102	4	16'-10	101	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
5t1	Curtain, Vertical		30	6'-5	201	27	6'-5	181	24	6'-5	161	5t1
	Estimated Quantities One Headwall	Reinf. Steel		4567 LB			3767 LB			3036 LB		
		Concrete Parapet Δ	2.3	35.6 CY		2.3	29.1 CY		2.3	23.1 CY		
		Concrete Wingwalls	7.5			5.5			3.8			
		Concrete Apron ✳	25.8			21.3			17.0			

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

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

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

Bent Bar Details



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

Headwall Notes:

1. See Sheet FWH G2-21 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

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
12'-0" Span
45° Skew

FWH 45-9-21

Sheet 2 of 2

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 45-9-21 S2 - THIS SHEET ISSUED 02-2021.

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

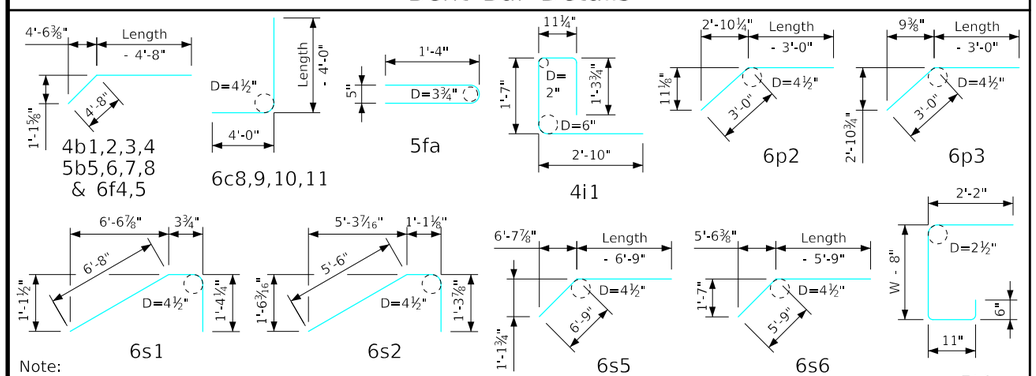
Bar	Location	Shape	10' x 12'			10' x 11'			10' x 10'			10' x 9'			10' x 8'			10' x 7'			Bar
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	5fa
4b1	Wingwall, B.F.H. Long		1	76'-3	53	1	70'-6	49	1	64'-8	45	1	58'-10	41	1	53'-0	37	1	47'-2	33	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	1	30'-1	20	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	5 Var.	21'-2 to 44'-5	111	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	5 Var.	14'-6 to 28'-5	72	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	1	47'-2	52	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	1	30'-1	31	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	6 Var.	15'-4 to 44'-5	189	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	6 Var.	11'-0 to 28'-6	124	5b8
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	43 Var.	2'-8 to 9'-11	181	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	26 Var.	2'-9 to 9'-11	110	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	1	8'-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	1	8'-8	6	4c5
5c6	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	15 Var.	2'-8 to 5'-1	61	5c6
5c7	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	4 Var.	2'-9 to 3'-7	13	5c7
6c8	Wingwall, B.F.V. Long		57 Var.	9'-3 to 18'-11	1206	51 Var.	9'-3 to 17'-10	1037	45 Var.	9'-3 to 16'-10	881	39 Var.	9'-3 to 15'-10	735	34 Var.	9'-3 to 14'-11	617	28 Var.	9'-3 to 13'-11	487	6c8
6c9	Wingwall, B.F.V. Short		39 Var.	7'-11 to 18'-9	781	36 Var.	7'-11 to 17'-11	698	32 Var.	7'-11 to 16'-9	593	29 Var.	7'-11 to 15'-11	519	25 Var.	7'-11 to 14'-9	426	22 Var.	7'-11 to 13'-11	361	6c9
6c10	Wingwall, B.F.V. Long		43	10'-6	678	37	10'-6	584	31	10'-6	489	25	10'-6	394	20	10'-6	315	14	10'-6	221	6c10
6c10	Wingwall, B.F.V. Short		26	10'-6	410	23	10'-6	363	19	10'-6	300	16	10'-6	252	12	10'-6	189	9	10'-6	142	6c10
6c11	Wingwall, B.F.V. Long		1	17'-8	27	2	16'-8	50	2	15'-8	47	2	14'-8	44	1	13'-8	21	1	12'-8	19	6c11
6c11	Wingwall, B.F.V. Short		2	17'-8	53	1	16'-8	25	2	15'-8	47	1	14'-8	22	2	13'-8	41	1	12'-8	19	6c11
4d1	Apron, Longit., Bott.		7	38'-6	180	7	35'-8	167	7	32'-10	154	7	30'-0	140	7	27'-2	127	7	24'-5	114	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	3	39'-9	80	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	3	25'-1	50	4d3
6f1	Apron, Longit., Top		9	38'-6	520	9	35'-8	482	9	32'-10	444	9	30'-0	406	9	27'-2	367	9	24'-5	330	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	8 Var.	6'-5 to 20'-8	163	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	5 Var.	7'-4 to 21'-0	106	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	1	47'-2	74	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	1	30'-1	45	6f5
4i1	Parapet, Vertical		21	6'-8	94	21	6'-8	94	21	6'-8	94	21	6'-8	94	21	6'-8	94	21	6'-8	94	4i1
9j1	Parapet, Horizontal		4	16'-5	223	4	16'-3	221	4	16'-0	218	4	16'-0	218	4	16'-0	218	4	15'-9	214	9j1
6m1	Apron, Trans., Top		8 Var.	13'-2 to 14'-5	166	8 Var.	13'-0 to 14'-3	164	8 Var.	12'-10 to 14'-1	162	8 Var.	12'-10 to 14'-1	162	8 Var.	12'-10 to 14'-1	162	8 Var.	12'-8 to 13'-11	160	6m1
6m2	Apron, Trans., Top		34 Var.	14'-8 to 27'-0	1064	30 Var.	14'-6 to 25'-4	897	26 Var.	14'-4 to 23'-8	742	23 Var.	14'-4 to 22'-7	638	19 Var.	14'-4 to 21'-1	505	15 Var.	14'-2 to 19'-5	378	6m2
6m3	Apron, Trans., Top		13 Var.	9'-11 to 16'-8	260	13 Var.	9'-3 to 16'-0	247	13 Var.	8'-7 to 15'-4	233	12 Var.	8'-0 to 14'-2	200	13 Var.	6'-10 to 13'-7	199	13 Var.	6'-2 to 12'-11	186	6m3
6m4	Apron, Trans., Bott.		24 Var.	7'-8 to 32'-3	719	22 Var.	7'-8 to 30'-1	624	20 Var.	7'-8 to 28'-0	536	18 Var.	7'-8 to 25'-10	453	16 Var.	7'-8 to 23'-8	377	14 Var.	7'-8 to 21'-7	308	6m4
6p1	Curtain, Horizontal		4	14'-1	85	4	14'-1	85	4	14'-1	85	4	14'-1	85	4	14'-1	85	4	14'-1	85	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	4	26'-6	159	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	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	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	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	2	39'-0	117	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	2	23'-6	71	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	1	45'-1	71	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	1	29'-5	44	6s6
5t1	Curtain, Vertical		48	7'-11	396	44	7'-8	352	42	7'-5	325	38	7'-2	284	35	6'-11	252	31	6'-8	216	5t1
	Estimated Quantities One Headwall	Reinf. Steel		11,819 LB			10,396 LB			9064 LB			7800 LB			6521 LB			5442 LB		
		Concrete Parapet Δ	2.4			2.3			2.2			2.2			2.2			2.1			
		Concrete Wingwalls	33.4	96.6 CY		26.3	81.7 CY		20.2	68.2 CY		16.8	58.5 CY		13.7	49.5 CY		9.8	39.7 CY		
		Concrete Apron ✳	60.8			53.1			45.8			39.5			33.6			27.8			

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

Bent Bar Details



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

Headwall Notes:

1. See Sheet FWH G2-21 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

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
10'-0" Span
45° Skew

FWH
45-10-21
Sheet 1 of 2

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 45-10-21 S1 - THIS SHEET ISSUED 02-2021.

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

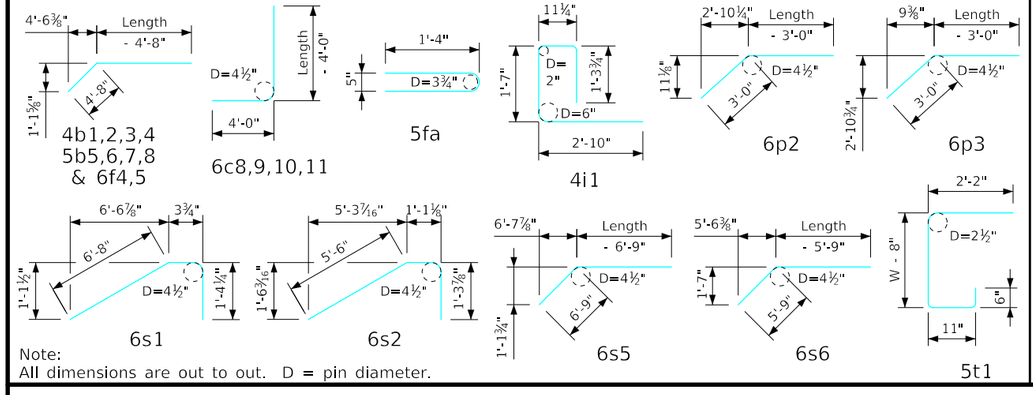
Bar	Location	Shape	10' x 6' No.	10' x 6' Length	10' x 6' Wt.	10' x 5' No.	10' x 5' Length	10' x 5' Wt.	10' x 4' No.	10' x 4' Length	10' x 4' Wt.	Bar
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	5fa
4b1	Wingwall, B.F.H. Long		1	41'-4	29	1	35'-6	24	1	29'-8	20	4b1
4b2	Wingwall, B.F.H. Short		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
4c1	Wingwall, F.F.V. Long		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		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	7'-8	5	2	6'-8	9	2	5'-8	8	4c5
4c5	Wingwall, F.F.V. Short		2	7'-8	10	1	6'-8	4	2	5'-8	8	4c5
5c6	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	5c6
5c7	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	5c7
6c8	Wingwall, B.F.V. Long		22 Var.	9'-3 to 12'-11	366	16 Var.	9'-3 to 11'-10	253	10 Var.	9'-3 to 10'-10	151	6c8
6c9	Wingwall, B.F.V. Short		18 Var.	7'-11 to 12'-9	279	15 Var.	7'-11 to 11'-11	223	11 Var.	7'-11 to 10'-9	154	6c9
6c10	Wingwall, B.F.V. Long		--	--	--	--	--	--	--	--	--	6c10
6c10	Wingwall, B.F.V. Short		--	--	--	--	--	--	--	--	--	6c10
6c11	Wingwall, B.F.V. Long		1	11'-8	18	2	10'-8	32	2	9'-8	29	6c11
6c11	Wingwall, B.F.V. Short		2	11'-8	35	1	10'-8	16	2	9'-8	29	6c11
4d1	Apron, Longit., Bott.		7	21'-7	101	7	18'-9	88	7	15'-11	74	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		9	21'-7	292	9	18'-9	253	9	15'-11	215	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		21	6'-8	94	21	6'-8	94	21	6'-8	94	4i1
9j1	Parapet, Horizontal		4	15'-9	214	4	15'-9	214	4	15'-9	214	9j1
6m1	Apron, Trans., Top		8 Var.	12'-8 to 13'-11	160	8 Var.	12'-8 to 13'-11	160	8 Var.	12'-8 to 13'-11	160	6m1
6m2	Apron, Trans., Top		11 Var.	14'-2 to 17'-11	265	8 Var.	14'-2 to 16'-9	186	4 Var.	14'-2 to 15'-3	88	6m2
6m3	Apron, Trans., Top		13 Var.	5'-7 to 12'-4	175	12 Var.	5'-0 to 11'-3	146	13 Var.	3'-11 to 10'-8	142	6m3
6m4	Apron, Trans., Bott.		12 Var.	7'-8 to 19'-5	244	10 Var.	7'-8 to 17'-4	188	8 Var.	7'-8 to 15'-2	137	6m4
6p1	Curtain, Horizontal		4	14'-1	85	4	14'-1	85	4	14'-0	84	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
5t1	Curtain, Vertical		28	6'-5	187	25	6'-5	167	22	6'-5	147	5t1
	Estimated Quantities One Headwall	Reinf. Steel		4248 LB			3484 LB			2792 LB		
		Concrete Parapet Δ	2.1	32.4 CY		2.1	26.3 CY		2.1	20.8 CY		
		Concrete Wingwalls	7.5			5.5			3.8			
		Concrete Apron ✳	22.8			18.7			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

Bent Bar Details



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

Headwall Notes:

1. See Sheet FWH G2-21 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

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
10'-0" Span
45° Skew

FWH
45-10-21
Sheet 2 of 2

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 45-10-21 S2 - THIS SHEET ISSUED 02-2021.

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

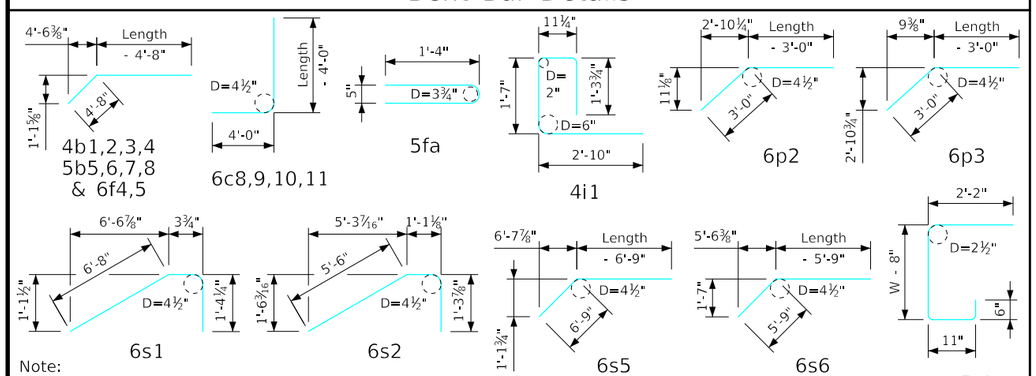
Bar	Location	Shape	8' x 10'			8' x 9'			8' x 8'			8' x 7'			8' x 6'			8' x 5'			8' x 4'			Bar
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	5fa
4b1	Wingwall, B.F.H. Long		1	64'-8	45	1	58'-10	41	1	53'-0	37	1	47'-2	33	1	41'-4	29	1	35'-6	24	1	29'-8	20	4b1
4b2	Wingwall, B.F.H. Short		1	40'-7	29	1	37'-1	25	1	33'-7	22	1	30'-1	20	1	26'-7	18	1	23'-1	15	1	19'-7	13	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	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		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	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	64'-8	70	1	58'-10	64	1	53'-0	58	1	47'-2	52	1	41'-4	46	1	35'-6	37	1	29'-9	31	5b5
5b6	Wingwall, F.F.H. Short		1	40'-7	45	1	37'-1	39	1	33'-7	35	1	30'-1	31	1	26'-7	28	1	23'-1	24	1	19'-7	20	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	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		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	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
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	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		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	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		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	1	7'-7	5	2	6'-7	9	2	5'-7	7	4c5
4c5	Wingwall, F.F.V. Short		2	11'-7	15	1	10'-7	7	2	9'-7	13	1	8'-7	6	2	7'-7	10	1	6'-7	4	2	5'-7	7	4c5
5c6	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	15 Var.	2'-7 to 5'-0	59	15 Var.	2'-7 to 5'-0	59	15 Var.	2'-7 to 5'-0	59	5c6
5c7	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	4 Var.	2'-8 to 3'-6	13	4 Var.	2'-8 to 3'-6	13	4 Var.	2'-8 to 3'-6	13	5c7
6c8	Wingwall, B.F.V. Long		45 Var.	9'-2 to 16'-9	876	39 Var.	9'-2 to 15'-9	730	34 Var.	9'-2 to 14'-10	613	28 Var.	9'-2 to 13'-10	484	22 Var.	9'-2 to 12'-10	363	16 Var.	9'-2 to 11'-9	251	10 Var.	9'-2 to 10'-9	150	6c8
6c9	Wingwall, B.F.V. Short		32 Var.	7'-10 to 16'-8	589	29 Var.	7'-10 to 15'-10	515	25 Var.	7'-10 to 14'-8	422	22 Var.	7'-10 to 13'-10	358	18 Var.	7'-10 to 12'-8	277	15 Var.	7'-10 to 11'-10	222	11 Var.	7'-10 to 10'-8	153	6c9
6c10	Wingwall, B.F.V. Long		31	10'-6	489	25	10'-6	394	20	10'-6	315	14	10'-6	221	--	--	--	--	--	--	--	--	--	6c10
6c10	Wingwall, B.F.V. Short		19	10'-6	300	16	10'-6	252	12	10'-6	189	9	10'-6	142	--	--	--	--	--	--	--	--	--	6c10
6c11	Wingwall, B.F.V. Long		2	15'-7	47	2	14'-7	44	1	13'-7	20	1	12'-7	19	1	11'-7	17	2	10'-7	32	2	9'-7	29	6c11
6c11	Wingwall, B.F.V. Short		2	15'-7	47	1	14'-7	22	2	13'-7	41	1	12'-7	19	2	11'-7	35	1	10'-7	16	2	9'-7	29	6c11
4d1	Apron, Longit., Bott.		5	32'-10	110	5	30'-0	100	5	27'-2	91	5	24'-5	82	5	21'-7	72	5	18'-9	63	5	15'-11	53	4d1
4d2	Apron, Longit., Bott. Long		3	57'-2	119	3	51'-5	108	3	45'-7	96	3	39'-9	80	3	33'-11	68	3	28'-1	56	3	22'-3	45	4d2
4d3	Apron, Longit., Bott. Short		3	35'-7	71	3	32'-1	64	3	28'-7	57	3	25'-1	50	3	21'-7	43	3	18'-1	36	3	14'-7	29	4d3
6f1	Apron, Longit., Top		7	32'-10	345	7	30'-0	315	7	27'-2	286	7	24'-5	257	7	21'-7	227	7	18'-9	197	7	15'-11	167	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	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		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	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	64'-8	101	1	58'-10	92	1	53'-0	83	1	47'-2	74	1	41'-4	66	1	35'-6	53	1	29'-9	45	6f4
6f5	Apron, Longit., Top Short		1	40'-7	65	1	37'-1	56	1	33'-7	50	1	30'-1	45	1	26'-7	40	1	23'-1	35	1	19'-7	29	6f5
4i1	Parapet, Vertical		17	6'-8	76	17	6'-8	76	17	6'-8	76	17	6'-8	76	17	6'-8	76	17	6'-8	76	17	6'-8	76	4i1
7j1	Parapet, Horizontal		4	13'-2	108	4	13'-2	108	4	13'-2	108	4	12'-11	106	4	12'-11	106	4	12'-11	106	4	12'-11	106	7j1
6m1	Apron, Trans., Top		7 Var.	10'-7 to 11'-8	117	7 Var.	10'-7 to 11'-8	117	7 Var.	10'-7 to 11'-8	117	7 Var.	10'-5 to 11'-6	115	7 Var.	10'-5 to 11'-6	115	7 Var.	10'-5 to 11'-6	115	7 Var.	10'-5 to 11'-6	115	6m1
6m2	Apron, Trans., Top		29 Var.	11'-11 to 22'-5	748	25 Var.	11'-11 to 20'-11	616	21 Var.	11'-11 to 19'-5	494	17 Var.	11'-9 to 17'-9	377	14 Var.	11'-9 to 16'-8	299	10 Var.	11'-9 to 15'-2	202	6 Var.	11'-9 to 13'-8	115	6m2
6m3	Apron, Trans., Top		10 Var.	8'-5 to 13'-5	164	10 Var.	7'-10 to 12'-10	155	10 Var.	7'-3 to 12'-4	147	10 Var.	6'-7 to 11'-8	137	10 Var.	5'-5 to 10'-6	120	10 Var.	4'-10 to 9'-11	111	10 Var.	4'-3 to 9'-4	102	6m3
6m4	Apron, Trans., Bott.		20 Var.	4'-11 to 25'-2	452	18 Var.	4'-10 to 23'-0	376	16 Var.	4'-10 to 20'-10	308	14 Var.	4'-11 to 18'-9	249	12 Var.	4'-11 to 16'-7	194	10 Var.	4'-11 to 14'-6	146	8 Var.	4'-10 to 12'-4	103	6m4
6p1	Curtain, Horizontal		4	11'-3	68	4	11'-3	68	4	11'-3	68	4	11'-3	68	4	11'-3	68	4	11'-3	68	4	11'-2	67	6p1
6p2	Curtain, Horizontal, Long		4	36'-0	216	4	32'-10	197	4	29'-8	178	4	26'-6	159	4	23'-4	140	4	20'-2	121	4	17'-0	102	6p2
6p3	Curtain, Horizontal, Short		4	13'-7	82	4	12'-7	76	4	11'-7	70	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	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	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	2	33'-1	99	2	27'-2	82	2	21'-3	64	6s3
6s4	Wing Slope, Both F., Short		2	34'-5	103	2	30'-9	92	2	27'-1	81	2	23'-6	71	2	19'-10	60	2	16'-2	49	2	12'-7	38	6s4
6s5	Wing Slope, F.F. Long		1	62'-10	98	1	56'-11	89	1	51'-0	80	1	45'-1	71	1	39'-2	59	1	33'-3	50	1	27'-5	41	6s5
6s6	Wing Slope, F.F. Short		1	40'-4	64	1	36'-9	55	1	33'-1	50	1	29'-5	44	1	25'-10	39	1	22'-2	33	1	18'-6	28	6s6
5t1	Curtain, Vertical		40	7'-5	309	36	7'-2	269	33	6'-11	238	29	6'-8	202	26	6'-5	174	23	6'-5	154	20	6'-5	134	5t1
	Estimated Quantities One Headwall	Reinf. Steel		8548 LB			7302 LB			6053 LB			5014 LB			3870 LB			3133 LB			2467 LB		
		Concrete Parapet Δ	2.0			2.0			2.0			1.9			1.9			1.9			1.9			
		Concrete Wingwalls	20.2	63.2 CY		16.8	54.0 CY		13.7	45.5 CY		9.8	36.3 CY		7.5	29.4 CY		5.5	23.8 CY		3.8	18.7 CY		
		Concrete Apron ✳	41.0			35.2			29.8			24.6			20.0			16.4			13.0			

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

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

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

Bent Bar Details



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

Headwall Notes:

1. See Sheet FWH G2-21 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

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
8'-0" Span
45° Skew

FWH
45-11-21

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 45-11-21 - THIS SHEET ISSUED 02-2021.

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

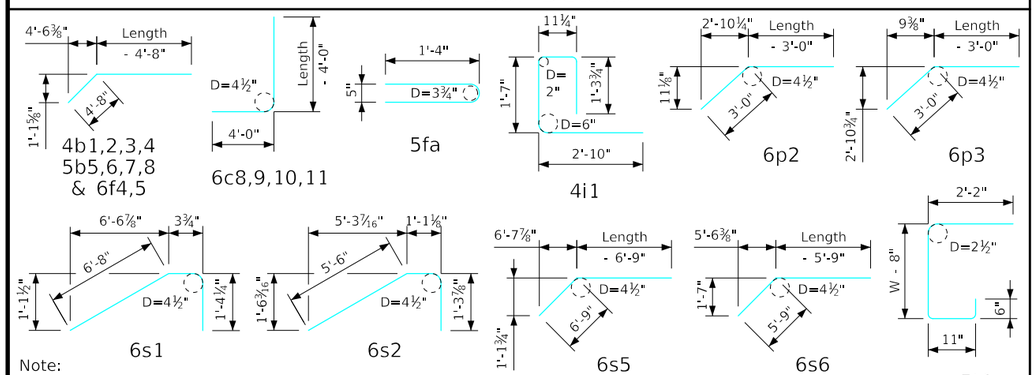
Bar	Location	Shape	6' x 8'			6' x 7'			6' x 6'			6' x 5'			6' x 4'			6' x 3'			Bar
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	5fa
4b1	Wingwall, B.F.H. Long		1	53'-0	37	1	47'-2	33	1	41'-4	29	1	35'-6	24	1	29'-8	20	1	23'-10	16	4b1
4b2	Wingwall, B.F.H. Short		1	33'-7	22	1	30'-1	20	1	26'-7	18	1	23'-1	15	1	19'-7	13	1	16'-1	11	4b2
4b3	Wingwall, B.F.H. Long		6 Var.	21'-2 to 50'-3	146	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	1	21'-1	14	4b3
4b4	Wingwall, B.F.H. Short		6 Var.	14'-6 to 31'-11	93	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	1	14'-6	10	4b4
5b5	Wingwall, F.F.H. Long		1	53'-0	58	1	47'-2	52	1	41'-4	46	1	35'-6	37	1	29'-9	31	1	23'-11	25	5b5
5b6	Wingwall, F.F.H. Short		1	33'-7	35	1	30'-1	31	1	26'-7	28	1	23'-1	24	1	19'-7	20	1	16'-1	17	5b6
5b7	Wingwall, F.F.H. Long		7 Var.	15'-4 to 50'-3	244	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	2 Var.	15'-4 to 21'-1	38	5b7
5b8	Wingwall, F.F.H. Short		7 Var.	11'-1 to 32'-0	157	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	2 Var.	11'-0 to 14'-6	27	5b8
4c1	Wingwall, F.F.V. Long		49 Var.	2'-7 to 10'-10	220	43 Var.	2'-7 to 9'-10	178	37 Var.	2'-7 to 8'-10	141	31 Var.	2'-7 to 7'-9	107	25 Var.	2'-7 to 6'-9	78	19 Var.	2'-7 to 5'-9	53	4c1
4c2	Wingwall, F.F.V. Short		29 Var.	2'-8 to 10'-8	129	26 Var.	2'-8 to 9'-10	109	22 Var.	2'-8 to 8'-8	83	19 Var.	2'-8 to 7'-10	67	15 Var.	2'-8 to 6'-8	47	12 Var.	2'-8 to 5'-10	34	4c2
4c3	Wingwall, F.F.V. Long		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4c3
4c4	Wingwall, F.F.V. Short		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4c4
4c5	Wingwall, F.F.V. Long		1	9'-7	6	1	8'-7	6	1	7'-7	5	2	6'-7	9	2	5'-7	7	2	4'-7	6	4c5
4c5	Wingwall, F.F.V. Short		2	9'-7	13	1	8'-7	6	2	7'-7	10	1	6'-7	4	2	5'-7	7	1	4'-7	3	4c5
5c6	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	15 Var.	2'-7 to 5'-0	59	15 Var.	2'-7 to 5'-0	59	5c6
5c7	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	4 Var.	2'-8 to 3'-6	13	4 Var.	2'-8 to 3'-6	13	5c7
6c8	Wingwall, B.F.V. Long		34 Var.	9'-2 to 14'-10	613	28 Var.	9'-2 to 13'-10	484	22 Var.	9'-2 to 12'-10	363	16 Var.	9'-2 to 11'-9	251	10 Var.	9'-2 to 10'-9	150	4 Var.	9'-2 to 9'-9	57	6c8
6c9	Wingwall, B.F.V. Short		25 Var.	7'-10 to 14'-8	422	22 Var.	7'-10 to 13'-10	358	18 Var.	7'-10 to 12'-8	277	15 Var.	7'-10 to 11'-10	222	11 Var.	7'-10 to 10'-8	153	8 Var.	7'-10 to 9'-10	106	6c9
6c10	Wingwall, B.F.V. Long		20	10'-6	315	14	10'-6	221	--	--	--	--	--	--	--	--	--	--	--	--	6c10
6c10	Wingwall, B.F.V. Short		12	10'-6	189	9	10'-6	142	--	--	--	--	--	--	--	--	--	--	--	--	6c10
6c11	Wingwall, B.F.V. Long		1	13'-7	20	1	12'-7	19	1	11'-7	17	2	10'-7	32	2	9'-7	29	2	8'-7	26	6c11
6c11	Wingwall, B.F.V. Short		2	13'-7	41	1	12'-7	19	2	11'-7	35	1	10'-7	16	2	9'-7	29	1	8'-7	13	6c11
4d1	Apron, Longit., Bott.		5	27'-2	91	5	24'-5	82	5	21'-7	72	5	18'-9	63	5	15'-11	53	5	13'-1	44	4d1
4d2	Apron, Longit., Bott. Long		3	45'-7	96	3	39'-9	80	3	33'-11	68	3	28'-1	56	3	22'-3	45	3	16'-5	33	4d2
4d3	Apron, Longit., Bott. Short		3	28'-7	57	3	25'-1	50	3	21'-7	43	3	18'-1	36	3	14'-7	29	3	11'-1	22	4d3
6f1	Apron, Longit., Top		5	27'-2	204	5	24'-5	183	5	21'-7	162	5	18'-9	141	5	15'-11	120	5	13'-1	98	6f1
6f2	Apron, Longit., Top Long		9 Var.	7'-3 to 23'-6	208	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	2 Var.	7'-3 to 9'-4	25	6f2
6f3	Apron, Longit., Top Short		6 Var.	6'-10 to 23'-10	138	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	2 Var.	6'-2 to 9'-8	24	6f3
6f4	Apron, Longit., Top Long		1	53'-0	83	1	47'-2	74	1	41'-4	66	1	35'-6	53	1	29'-9	45	1	23'-11	36	6f4
6f5	Apron, Longit., Top Short		1	33'-7	50	1	30'-1	45	1	26'-7	40	1	23'-1	35	1	19'-7	29	1	16'-1	24	6f5
4i1	Parapet, Vertical		13	6'-8	58	13	6'-8	58	13	6'-8	58	13	6'-8	58	13	6'-8	58	13	6'-8	58	4i1
7j1	Parapet, Horizontal		4	10'-4	84	4	10'-1	82	4	10'-1	82	4	10'-1	82	4	10'-1	82	4	10'-1	82	7j1
6m1	Apron, Trans., Top		6 Var.	8'-4 to 9'-3	79	6 Var.	8'-2 to 9'-1	78	6 Var.	8'-2 to 9'-1	78	6 Var.	8'-2 to 9'-1	78	6 Var.	8'-2 to 9'-1	78	6 Var.	8'-2 to 9'-1	78	6m1
6m2	Apron, Trans., Top		24 Var.	9'-7 to 18'-2	500	20 Var.	9'-5 to 16'-6	389	16 Var.	9'-5 to 15'-0	293	12 Var.	9'-5 to 13'-6	207	8 Var.	9'-5 to 12'-0	129	5 Var.	9'-5 to 10'-11	76	6m2
6m3	Apron, Trans., Top		7 Var.	7'-1 to 10'-5	92	7 Var.	6'-5 to 9'-9	85	7 Var.	5'-10 to 9'-2	79	8 Var.	4'-8 to 8'-7	80	8 Var.	4'-1 to 8'-0	73	7 Var.	3'-6 to 6'-11	55	6m3
6m4	Apron, Trans., Bott.		16 Var.	2'-1 to 18'-1	242	14 Var.	2'-1 to 15'-11	189	12 Var.	2'-1 to 13'-9	143	10 Var.	2'-1 to 11'-8	103	8 Var.	2'-1 to 9'-6	70	6 Var.	2'-1 to 7'-5	43	6m4
6p1	Curtain, Horizontal		4	8'-5	51	4	8'-5	51	4	8'-5	51	4	8'-5	51	4	8'-4	50	4	8'-4	50	6p1
6p2	Curtain, Horizontal, Long		4	29'-8	178	4	26'-6	159	4	23'-4	140	4	20'-2	121	4	17'-0	102	4	13'-10	83	6p2
6p3	Curtain, Horizontal, Short		4	11'-7	70	4	10'-7	64	4	9'-6	57	4	8'-6	51	4	7'-6	45	4	6'-6	39	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	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	2	7'-11	24	6s2
6s3	Wing Slope, Both F., Long		2	44'-11	142	2	39'-0	117	2	33'-1	99	2	27'-2	82	2	21'-3	64	2	15'-4	46	6s3
6s4	Wing Slope, Both F., Short		2	27'-1	81	2	23'-6	71	2	19'-10	60	2	16'-2	49	2	12'-7	38	2	8'-11	27	6s4
6s5	Wing Slope, F.F. Long		1	51'-0	80	1	45'-1	71	1	39'-2	59	1	33'-3	50	1	27'-5	41	1	21'-5	32	6s5
6s6	Wing Slope, F.F. Short		1	33'-1	50	1	29'-5	44	1	25'-10	39	1	22'-2	33	1	18'-6	28	1	14'-11	22	6s6
5t1	Curtain, Vertical		31	6'-11	224	27	6'-8	188	24	6'-5	161	21	6'-5	141	18	6'-5	120	14	6'-5	94	5t1
	Estimated Quantities One Headwall	Reinf. Steel		5745 LB			4730 LB			3598 LB			2899 LB			2262 LB			1674 LB		
		Concrete Parapet Δ	1.8			1.6			1.6			1.6			1.6			1.6			
		Concrete Wingwalls	13.7	43.1 CY		9.8	34.0 CY		7.5	27.4 CY		5.5	21.9 CY		3.8	17.0 CY		2.3	12.7 CY		
		Concrete Apron ✳	27.6			22.6			18.3			14.8			11.6			8.8			

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

Bent Bar Details



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

Headwall Notes:

1. See Sheet FWH G2-21 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

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
6'-0" Span
45° Skew

FWH
45-12-21

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 45-12-21 - THIS SHEET ISSUED 02-2021.

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

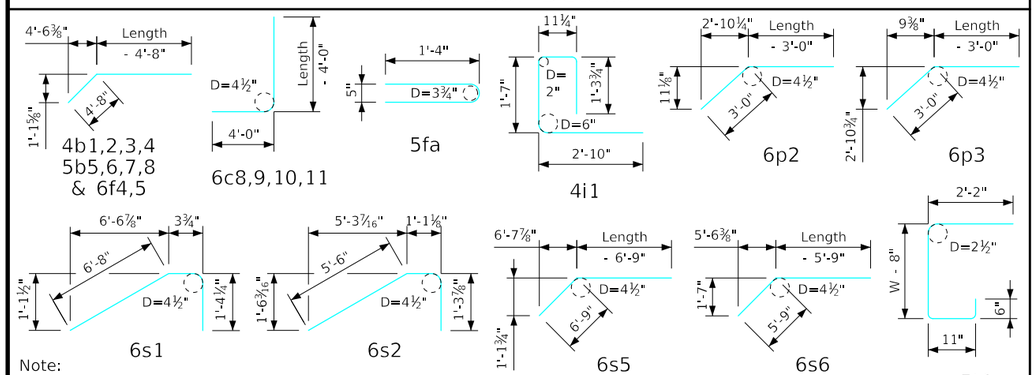
Bar	Location	Shape	5' x 6'			5' x 5'			5' x 4'			5' x 3'			Bar
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	5fa
4b1	Wingwall, B.F.H. Long		1	41'-4	29	1	35'-6	24	1	29'-8	20	1	23'-10	16	4b1
4b2	Wingwall, B.F.H. Short		1	26'-7	18	1	23'-1	15	1	19'-7	13	1	16'-1	11	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	1	21'-1	14	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	1	14'-6	10	4b4
5b5	Wingwall, F.F.H. Long		1	41'-4	46	1	35'-6	37	1	29'-9	31	1	23'-11	25	5b5
5b6	Wingwall, F.F.H. Short		1	26'-7	28	1	23'-1	24	1	19'-7	20	1	16'-1	17	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	2 Var.	15'-4 to 21'-1	38	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	2 Var.	11'-0 to 14'-6	27	5b8
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	19 Var.	2'-7 to 5'-9	53	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	12 Var.	2'-8 to 5'-10	34	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	2	4'-7	6	4c5
4c5	Wingwall, F.F.V. Short		2	7'-7	10	1	6'-7	4	2	5'-7	7	1	4'-7	3	4c5
5c6	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	5c6
5c7	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	5c7
6c8	Wingwall, B.F.V. Long		22 Var.	9'-2 to 12'-10	363	16 Var.	9'-2 to 11'-9	251	10 Var.	9'-2 to 10'-9	150	4 Var.	9'-2 to 9'-9	57	6c8
6c9	Wingwall, B.F.V. Short		18 Var.	7'-10 to 12'-8	277	15 Var.	7'-10 to 11'-10	222	11 Var.	7'-10 to 10'-8	153	8 Var.	7'-10 to 9'-10	106	6c9
6c10	Wingwall, B.F.V. Long		--	--	--	--	--	--	--	--	--	--	--	--	6c10
6c10	Wingwall, B.F.V. Short		--	--	--	--	--	--	--	--	--	--	--	--	6c10
6c11	Wingwall, B.F.V. Long		1	11'-7	17	2	10'-7	32	2	9'-7	29	2	8'-7	26	6c11
6c11	Wingwall, B.F.V. Short		2	11'-7	35	1	10'-7	16	2	9'-7	29	1	8'-7	13	6c11
4d1	Apron, Longit., Bott.		3	21'-7	43	3	18'-9	38	3	15'-11	32	3	13'-1	26	4d1
4d2	Apron, Longit., Bott. Long		3	33'-11	68	3	28'-1	56	3	22'-3	45	3	16'-5	33	4d2
4d3	Apron, Longit., Bott. Short		3	21'-7	43	3	18'-1	36	3	14'-7	29	3	11'-1	22	4d3
6f1	Apron, Longit., Top		4	21'-7	130	4	18'-9	113	4	15'-11	96	4	13'-1	79	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	2 Var.	7'-3 to 9'-4	25	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	2 Var.	6'-2 to 9'-8	24	6f3
6f4	Apron, Longit., Top Long		1	41'-4	66	1	35'-6	53	1	29'-9	45	1	23'-11	36	6f4
6f5	Apron, Longit., Top Short		1	26'-7	40	1	23'-1	35	1	19'-7	29	1	16'-1	24	6f5
4i1	Parapet, Vertical		11	6'-8	49	11	6'-8	49	11	6'-8	49	11	6'-8	49	4i1
7j1	Parapet, Horizontal		4	8'-8	71	4	8'-8	71	4	8'-8	71	4	8'-8	71	7j1
6m1	Apron, Trans., Top		5 Var.	7'-0 to 7'-9	55	5 Var.	7'-0 to 7'-9	55	5 Var.	7'-0 to 7'-9	55	5 Var.	7'-0 to 7'-9	55	6m1
6m2	Apron, Trans., Top		18 Var.	8'-0 to 14'-5	303	14 Var.	8'-0 to 12'-11	220	10 Var.	8'-0 to 11'-5	146	6 Var.	8'-0 to 9'-11	81	6m2
6m3	Apron, Trans., Top		6 Var.	5'-5 to 8'-3	62	6 Var.	4'-10 to 7'-8	56	6 Var.	4'-3 to 7'-1	51	6 Var.	3'-8 to 6'-6	46	6m3
6m4	Apron, Trans., Bott.		10 Var.	2'-9 to 12'-4	113	8 Var.	2'-9 to 10'-3	78	6 Var.	2'-9 to 8'-1	49	4 Var.	2'-9 to 6'-0	26	6m4
6p1	Curtain, Horizontal		4	7'-0	42	4	7'-0	42	4	7'-0	42	4	6'-11	42	6p1
6p2	Curtain, Horizontal, Long		4	23'-4	140	4	20'-2	121	4	17'-0	102	4	13'-10	83	6p2
6p3	Curtain, Horizontal, Short		4	9'-6	57	4	8'-6	51	4	7'-6	45	4	6'-6	39	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	33'-1	99	2	27'-2	82	2	21'-3	64	2	15'-4	46	6s3
6s4	Wing Slope, Both F., Short		2	19'-10	60	2	16'-2	49	2	12'-7	38	2	8'-11	27	6s4
6s5	Wing Slope, F.F. Long		1	39'-2	59	1	33'-3	50	1	27'-5	41	1	21'-5	32	6s5
6s6	Wing Slope, F.F. Short		1	25'-10	39	1	22'-2	33	1	18'-6	28	1	14'-11	22	6s6
5t1	Curtain, Vertical		22	6'-5	147	19	6'-5	127	16	6'-5	107	12	6'-5	80	5t1
	Estimated Quantities One Headwall	Reinf. Steel		3434 LB			2744 LB			2127 LB			1551 LB		
		Concrete Parapet Δ	1.5	26.4 CY		1.5	21.0 CY		1.5	16.3 CY		1.5	12.0 CY		
		Concrete Wingwalls	7.5			5.5			3.8			2.3			
		Concrete Apron ✳	17.4			14.0			11.0			8.2			

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

Bent Bar Details



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

Headwall Notes:

1. See Sheet FWH G2-21 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.
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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.
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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

Standard Design - Single Reinforced Concrete Box Culverts

Flared Wing Headwalls

February, 2021

Quantity Tabulation
5'-0" Span
45° Skew

FWH
45-13-21

ENGLISHLRFDSIGNEDSINGLECULVERTSFWH.DGN - FWH 45-13-21 - THIS SHEET ISSUED 02-2021.