



Twin Reinforced Concrete Box Culvert Standards

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		Standard Design Twin Reinforced Concrete Box Culverts July, 2020	
		Index of Sheets	TWRCB G1-20



Twin Reinforced Concrete Box Culvert Standards

General Notes:

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

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

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

11. Reinforcing bar clearances will be as follows:
Edge clearances: 2" except
Top of floor 2¼" to near transverse reinforcing bar
Bottom of floor 3½" to near transverse reinforcing bar
End clearances:
Vertical top 2"
Vertical bottom 3" or 3½" if overall height of the culvert is not to a full inch
Transverse 2"
12. All construction joints shall be formed with a beveled keyway except at bell joints.
13. All beveled keyways shall be centered.
14. Keyway size shall be 2"x4" except as follows:
Keyway between the floor and wall shall be 2"x6" when the wall is greater than 10 inches wide.
15. Keyway dimensions shown on the plans are based on nominal dimensions unless stated otherwise. In addition, the bevel used on the keyway shall be limited to a maximum of 10 degrees from vertical.
16. If 0' of fill is specified, details for paving notch and reference to epoxy coating of slab reinforcing steel, if applicable, shall be included in the final plans.
17. All dimensions are in feet and inches unless otherwise noted or shown.
18. See current Standard Specifications regarding concrete form removal.
19. These culvert standards label all reinforcing steel with English notation (5a1 is ⅝ inch diameter bar). English reinforcing steel received in the field may display the following "bar designation". The "bar designation" is the stamped impression on the reinforcing bars, and is equivalent to the bar diameter in millimeters.

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

20. In the event the slab thickness at the barrel end section exceeds 18 inches, the culvert parapet shall extend a minimum of 6 inches above the top of the culvert slab. Refer to the Culvert Design Manual for instructions. These details are to be included in the design plans to address these situations.

Specifications:

Design:

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

Construction:

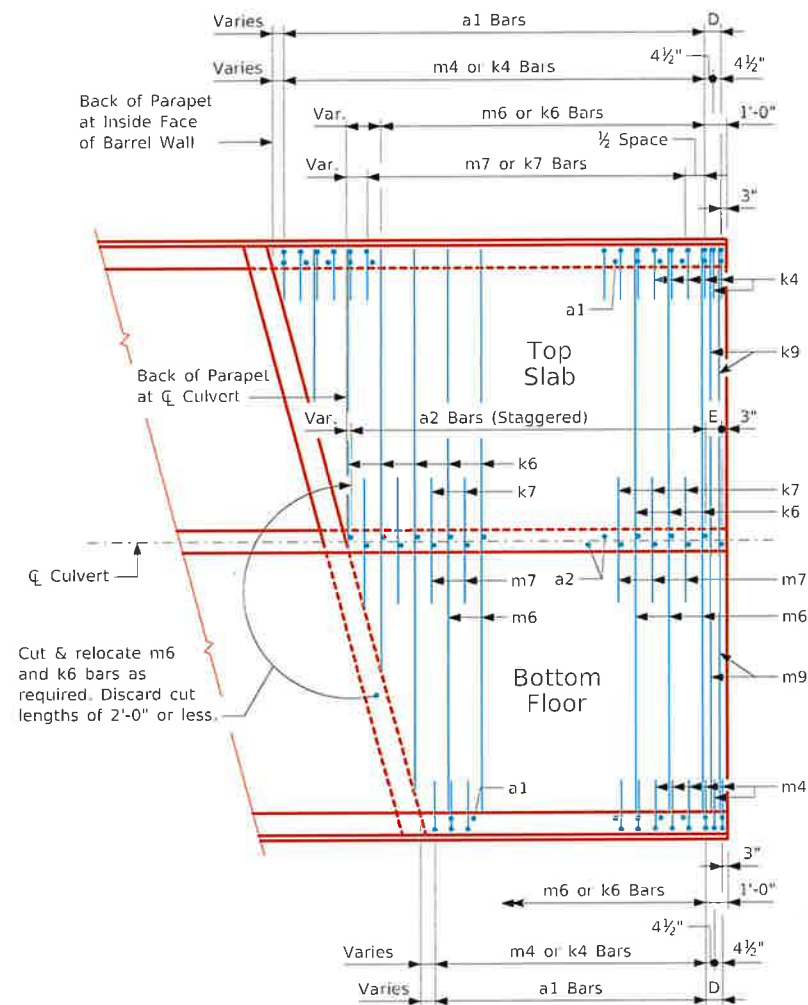
Iowa Department of Transportation Standard Specifications for Highway and Bridge Construction, current series, plus applicable General Supplemental Specifications, Developmental Specifications, Supplemental Specifications and Special Provisions

Design Stresses:

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

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		General Notes & Specifications	TWRCB G2-20



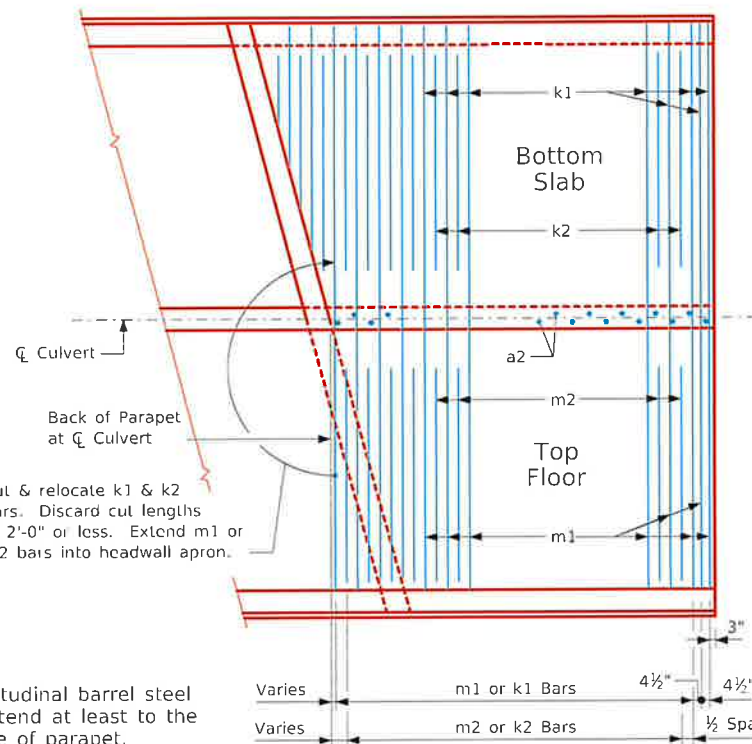
Note:
All longitudinal barrel steel shall extend at least to the backface of parapet.

End Section Plan Views
(Keyways not shown)

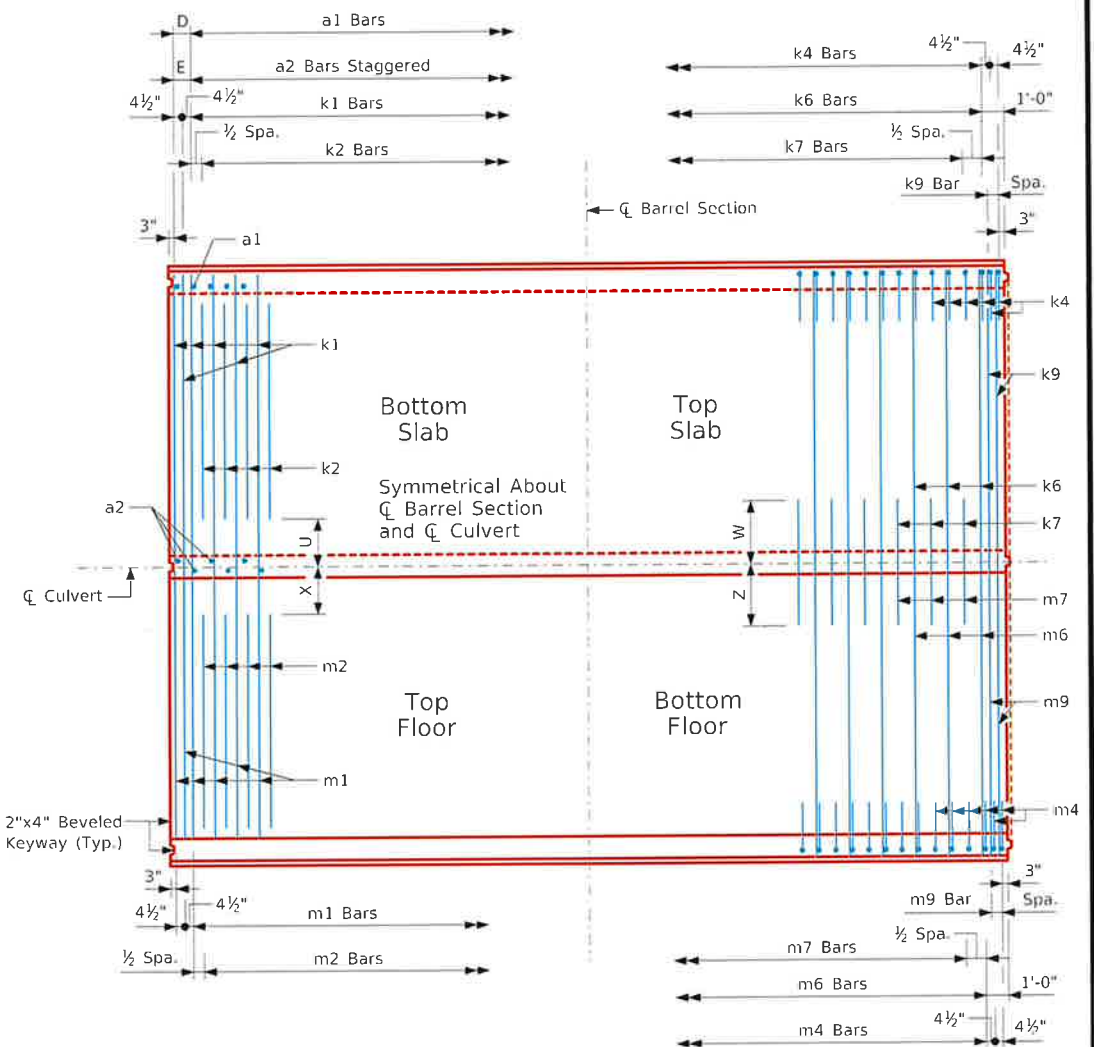
Note:
End section details shown are for a 15° skew barrel. Use for skews of 30° & 45° by increasing the number of transverse reinforcing bars required to be cut and relocated.

5r1 Bars - One Const. Jt.

Span	No.	Weight (LB)
8'-0"	18	66
10'-0"	22	80
12'-0"	26	95

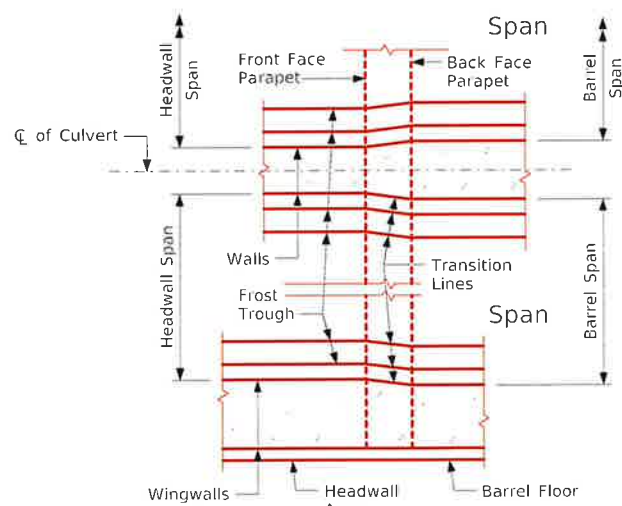


Note:
Typical for lengths of 38', 35', 32', 29', and 26'. These lengths are shown as typical because all transverse and vertical reinforcing steel spacing repeats in 3'-0" intervals.

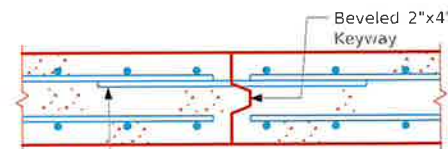


Standard Section Plan View
(Keyway is to be omitted when bell joints are used)

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



Transition Wall Details



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

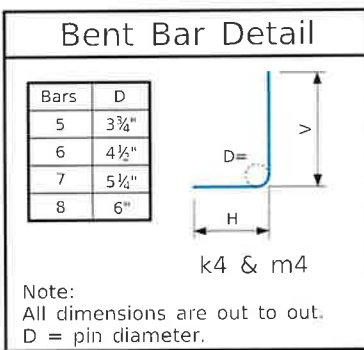
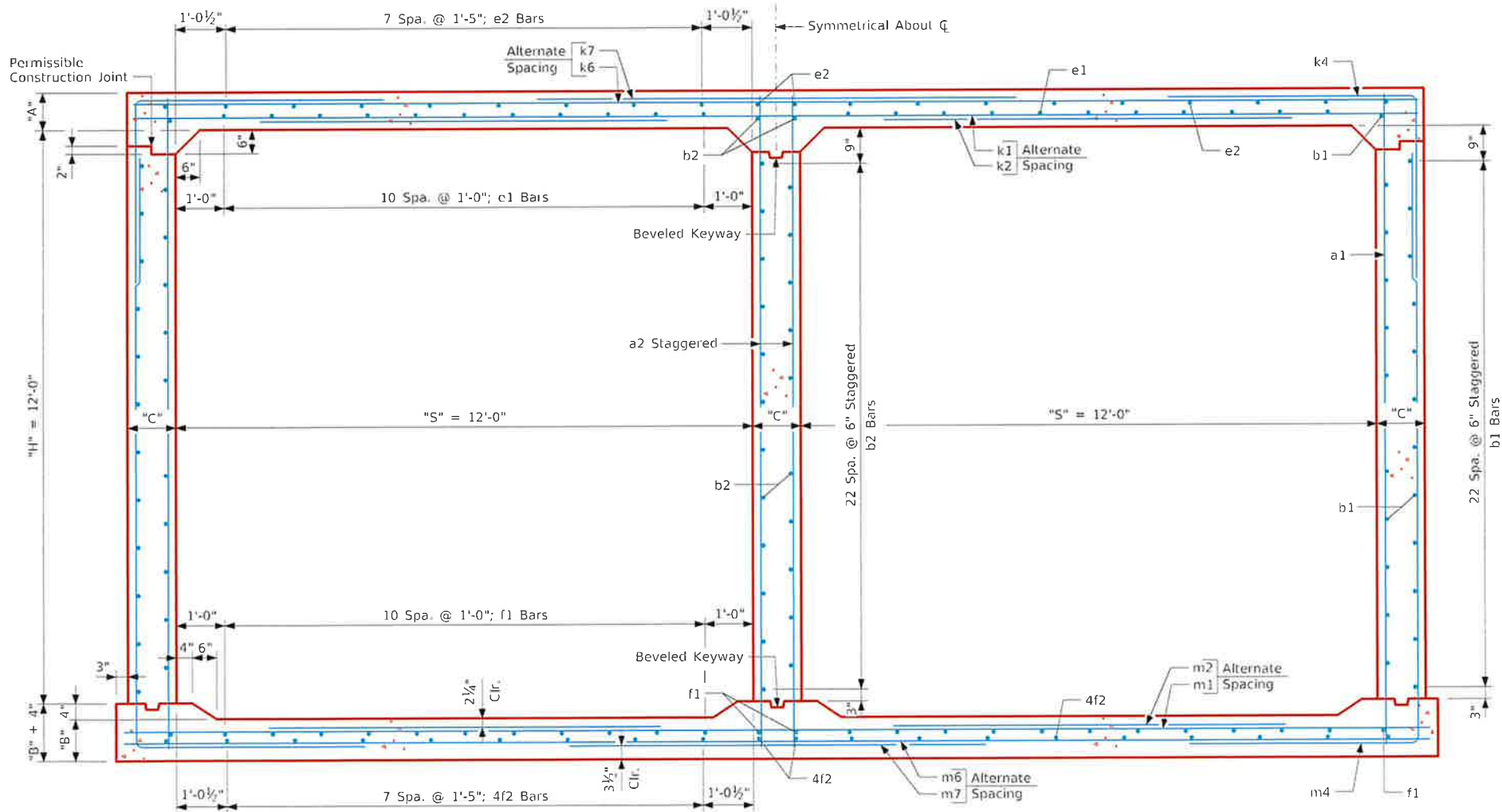
Top Slab Construction Joint Detail

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		Standard Design Twin Reinforced Concrete Box Culverts July, 2020	
		Typical Culvert Barrel Details	TWRCB G3-20

Variable Dimensions and Quantities for Twin 12' x 12' Barrel Sections

Dimensions												Bar List																																											
												a1			a2			b1			b2			e1			e2			f1			f2			k1			k2			k4					k6			k7			k9		
Fill	S	H	A	B	C	D	E	U	W	X	Z	Size	Sp.	L	Size	Sp.	L	Size	Sp.	No.	Size	Sp.	No.	Size	Sp.	No.	Size	Sp.	No.	Size	Sp.	No.	Size	Sp.	L	Size	Sp.	L	Size	Sp.	L	H	V	Size	Sp.	L	Size	Sp.	L	Size	Sp.	L			
0	12	12	14.5	13	12	9	9	0'-3	7'-9	2'-5	7'-6	4	12	14'-2	7	9	14'-2	4	6	48	4	6	25	4	12	22	5	17	20	4	12	26	4	17	20	6	18	26'-8	6	18	13'-1	6	9	12'-1	8'-0	4'-1	5	18	26'-8	6	18	15'-6	6	4.5	26'-8
1	12	12	13	12.5	12	6	9	0'-10	7'-4	2'-6	5'-7	4	6	14'-0	7	9	14'-0	4	6	48	4	6	25	4	12	22	4	17	20	4	12	26	4	17	20	6	18	26'-8	6	18	12'-6	6	9	11'-6	7'-7	3'-11	4	9	26'-8	4	9	14'-8	4	4.5	26'-8
2	12	12	10	10.5	12	9	9	2'-1	7'-0	2'-10	4'-6	4	9	13'-7	7	9	13'-7	4	6	48	4	6	25	5	12	22	4	17	20	4	12	26	4	17	20	6	12	26'-8	5	12	10'-4	7	9	10'-4	6'-4	4'-0	5	12	26'-8	6	12	14'-0	6	4.5	26'-8
3	12	12	9	10	12	9	9	2'-7	5'-3	3'-3	4'-4	4	9	13'-6	7	9	13'-6	4	6	48	4	6	25	4	12	22	4	17	20	4	12	26	4	17	20	6	12	26'-8	5	12	8'-10	7	9	9'-6	5'-6	4'-0	4	12	26'-8	7	12	10'-6	7	4.5	26'-8
4	12	12	9	10	12	9	9	2'-11	4'-9	3'-3	4'-1	4	9	13'-6	7	9	13'-6	4	6	48	4	6	25	4	12	22	4	17	20	4	12	26	4	17	20	5	9	26'-8	4	9	8'-3	7	9	9'-1	5'-1	4'-0	4	12	26'-8	7	12	9'-6	7	4.5	26'-8
5-7	12	12	9.5	11.5	12	9	9	2'-7	4'-7	3'-3	4'-2	4	9	13'-8	7	9	13'-8	4	6	48	4	6	25	4	12	22	4	17	20	4	12	26	4	17	20	5	12	26'-8	5	12	9'-4	7	9	8'-11	4'-11	4'-0	5	12	26'-8	7	12	9'-2	7	4.5	26'-8
8-10	12	12	11	13.5	12	9	9	2'-6	4'-2	3'-2	4'-2	6	9	13'-11	7	9	13'-11	4	6	48	4	6	25	4	12	22	4	17	20	4	12	26	4	17	20	5	12	26'-8	5	12	9'-8	6	9	8'-3	4'-6	3'-9	5	9	26'-8	6	9	8'-4	6	4.5	26'-8
11-13	12	12	12.5	15	12	9	9	2'-9	4'-2	2'-10	4'-3	6	9	14'-2	7	9	14'-2	4	6	48	4	6	25	4	12	22	4	17	20	4	12	26	4	17	20	5	9	26'-8	4	9	9'-1	6	9	8'-4	4'-5	3'-11	5	9	26'-8	6	9	8'-4	6	4.5	26'-8
14-16	12	12	14	16.5	12.5	9	9	2'-4	4'-3	2'-8	4'-5	6	9	14'-5	7	9	14'-5	4	6	48	4	6	25	4	12	22	4	17	20	4	12	26	4	17	20	7	18	26'-9	6	18	10'-0	5	6	8'-0	4'-5	3'-7	4	9	26'-9	7	9	8'-6	7	4.5	26'-9
17-19	12	12	16	18.5	13.5	9	6	2'-4	4'-5	2'-2	4'-7	5	12	14'-9	6	6	14'-9	4	6	48	4	6	25	4	12	22	4	17	20	4	12	26	4	17	20	6	12	27'-0	5	12	10'-5	7	9	9'-0	4'-6	4'-6	4	9	27'-0	7	9	8'-10	7	4.5	27'-0
20-22	12	12	18	20.5	14	9	9	1'-11	4'-7	1'-9	4'-9	5	12	15'-1	8	9	15'-1	4	6	48	4	6	25	4	12	22	4	17	20	4	12	26	4	17	20	6	12	27'-2	5	12	11'-4	6	6	9'-4	4'-8	4'-8	4	9	27'-2	7	9	9'-2	7	4.5	27'-2
23-25	12	12	19.5	22.5	15	6	9	1'-8	4'-8	1'-7	4'-11	4	6	15'-5	8	9	15'-5	4	6	48	4	6	25	4	12	22	4	17	20	5	12	26	4	17	20	6	12	27'-5	5	12	11'-11	8	12	10'-4	5'-2	5'-2	4	9	27'-5	7	9	9'-4	7	4.5	27'-5

	Bar List																				Quantities							
	m1				m2			m4					m6			m7			m9			Concrete (CY/FT)				Steel (LB/FT)		
Fill	Size	Sp.	L	Size	Sp.	L	Size	Sp.	L	H	V	Size	Sp.	L	Size	Sp.	L	Size	Sp.	L	Size	Sp.	L	Slab	Floor	Walls	Total	
0	5	12	27'-2	5	12	9'-10	7	9	20'-4	7'-10	12'-6	5	12	27'-2	5	12	15'-0	5	4.5	27'-2	1.277	1.169	1.289	3.735	526.89			
1	5	12	27'-2	5	12	9'-8	6	9	19'-4	6'-10	12'-6	4	12	27'-2	6	12	11'-2	6	4.5	27'-2	1.152	1.127	1.289	3.568	490.63			
2	5	9	27'-2	5	9	8'-5	7	9	17'-6	5'-2	12'-4	4	9	27'-2	6	9	9'-0	6	4.5	27'-2	0.902	0.957	1.289	3.148	556.42			
3	5	9	27'-2	5	9	7'-7	7	9	17'-1	4'-10	12'-3	5	12	27'-2	7	12	8'-8	7	4.5	27'-2	0.819	0.915	1.289	3.023	533.18			
4	5	9	27'-2	5	9	7'-7	7	9	16'-11	4'-8	12'-3	5	9	27'-2	6	9	8'-2	6	4.5	27'-2	0.819	0.915	1.289	3.023	526.08			
5-7	6	12	27'-2	5	12	7'-10	7	9	17'-2	4'-9	12'-5	5	9	27'-2	6	9	8'-4	6	4.5	27'-2	0.861	1.042	1.289	3.192	532.47			
8-10	5	9	27'-2	4	9	8'-7	6	9	17'-2	4'-7	12'-7	5	9	27'-2	6	9	8'-4	6	4.5	27'-2	0.986	1.212	1.289	3.487	523.00			
11-13	6	12	27'-2	5	12	9'-3	6	9	17'-3	4'-7	12'-8	5	9	27'-2	6	9	8'-6	6	4.5	27'-2	1.111	1.339	1.289	3.739	539.03			
14-16	6	12	27'-3	5	12	10'-1	5	6	17'-5	4'-7	12'-10	4	9	27'-3	7	9	8'-10	7	4.5	27'-3	1.243	1.474	1.342	4.059	539.42			
17-19	6	12	27'-6	5	12	10'-11	7	9	17'-7	4'-7	13'-0	4	9	27'-6	7	9	9'-2	7	4.5	27'-6	1.427	1.662	1.449	4.538	569.74			
20-22	7	18	27'-8	7	18	11'-10	6	6	17'-11	4'-9	13'-2	4	9	27'-8	7	9	9'-6	7	4.5	27'-8	1.605	1.844	1.503	4.952	606.16			
23-25	7	18	27'-11	7	18	12'-2	8	12	18'-2	4'-10	13'-4	4	9	27'-11	7	9	9'-10	7	4.5	27'-11	1.752	2.037	1.610	5.399	628.87			



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

LATEST REVISION DATE


APPROVED BY BRIDGE ENGINEER


Standard Design
Twin Reinforced Concrete
Box Culverts
July, 2020

Culvert Barrel
Details
12' x 12' Barrel Sections

TWRCB
12-12-20

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Twin Reinforced Concrete Box Culvert Standards - Flared Wing Headwalls

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Class 2 exposure condition is utilized for the slab design in 0' fill instances.
- All slab and floor reinforcing steel is to be supported at intervals of not more than 3'-0" in either direction as outlined in the Standard Specifications.
- The clear distance from face of concrete to near edge or end of reinforcing bar to be 2" unless otherwise noted.
- Except for dowel bars 5r1 in slab, longitudinal reinforcing is not to extend thru the construction joints.
- Floor of barrel is to be finished smooth. Sides of footing are to be formed to ensure correct line and grade.
- The permissible construction joint at the top of the walls may be lowered at the Contractor's option with Engineer's approval.
- The reinforcement supplied for this structure shall be Grade 60 reinforcement in accordance with the Standard Specifications. The design stresses are based on ASTM A706 Grade 60 reinforcement.
- The vertical bars in the walls may be spliced above the footing at the Contractor's option as follows:

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

- This splice, if used, will be at the Contractor's expense.
- Reinforcing bar clearances will be as follows:
Edge clearances: 2" except
Top of floor 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"
 - All construction joints shall be formed with a beveled keyway except at bell joints.
 - All beveled keyways shall be centered.
 - Keyway size shall be 2"x4" except as follows:
Keyway between the floor and wall shall be 2"x6" when the wall is greater than 10 inches wide.
 - Keyway dimensions shown on the plans are based on nominal dimensions unless stated otherwise. In addition, the bevel used on the keyway shall be limited to a maximum of 10 degrees from vertical.
 - If 0' of fill is specified, details for paving notch and reference to epoxy coating of slab reinforcing steel, if applicable, shall be included in the final plans.
 - All dimensions are in feet and inches unless otherwise noted or shown.
 - Dimensions with parenthesis () indicate a reference dimension.
 - See current Standard Specifications regarding concrete form removal.
 - These culvert standards label all reinforcing steel with English notation (5a1 is ½ inch diameter bar). English reinforcing steel received in the field may display the following "bar designation". The "bar designation" is the stamped impression on the reinforcing bars, and is equivalent to the bar diameter in millimeters.

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

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

Index for Twin Culvert Standards:

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

Specifications:

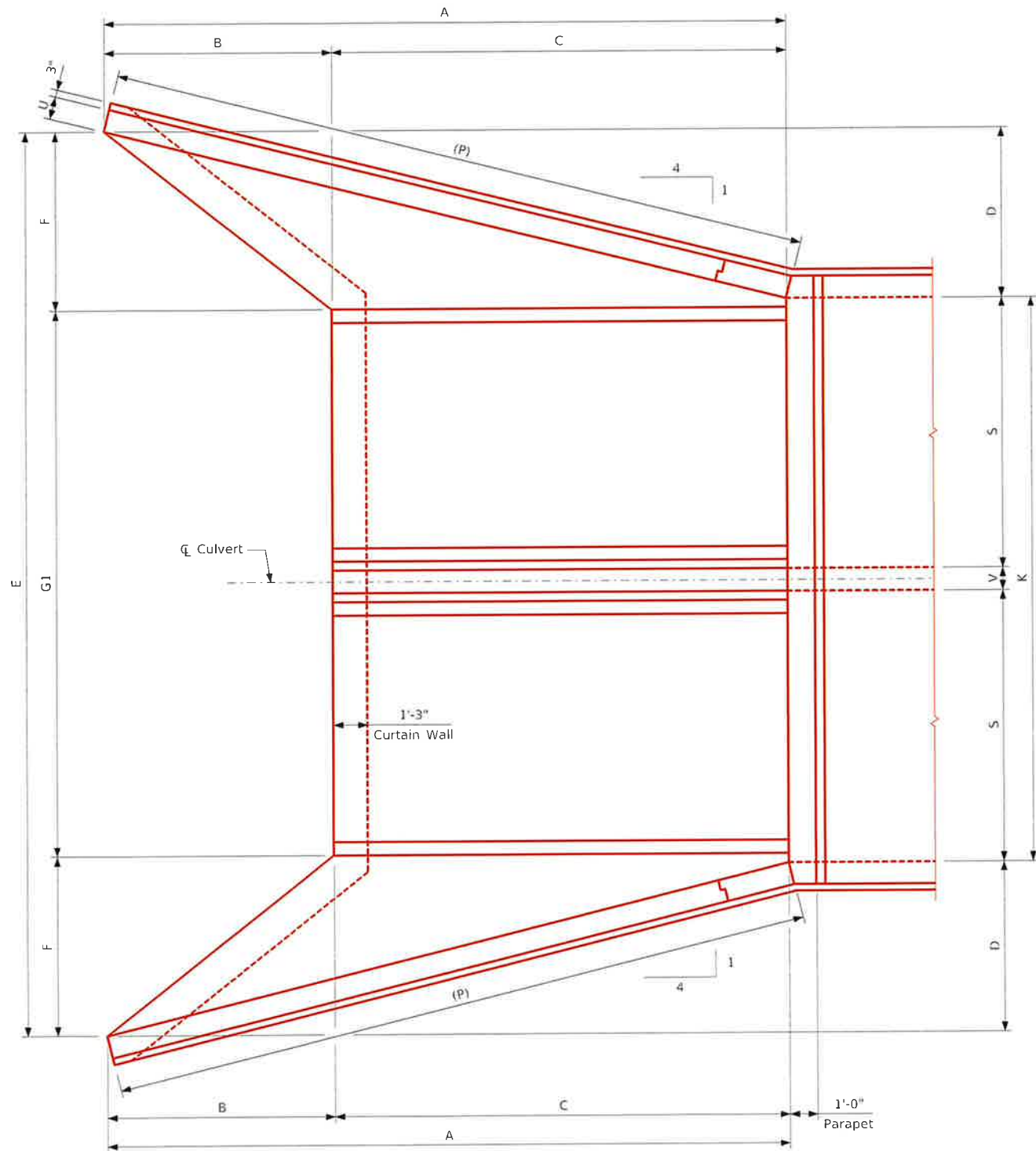
Design:
AASHTO LRFD Bridge Design Specifications, 8th Ed., Series of 2017.

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

Design Stresses:

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

LATEST REVISION DATE	 APPROVED BY BRIDGE ENGINEER		
		Standard Design - Twin Reinforced Concrete Box Culverts	
		Flared Wing Headwalls	
		February, 2021	
		Index of Sheets, General Notes & Specifications	TWFWH G1-21



Plan View

Dimension Table

S x H	12' x 12'	12' x 11'	12' x 10'	12' x 9'	12' x 8'	12' x 7'	12' x 6'	12' x 5'	12' x 4'	10' x 12'	10' x 11'	10' x 10'	10' x 9'	10' x 8'	10' x 7'	S x H
A	37'-0	34'-0	31'-0	28'-0	25'-0	22'-0	19'-0	16'-0	13'-0	37'-0	34'-0	31'-0	28'-0	25'-0	22'-0	A
B	12'-4	11'-4	10'-4	9'-4	8'-4	7'-4	6'-4	5'-4	4'-4	12'-4	11'-4	10'-4	9'-4	8'-4	7'-4	B
C	24'-8	22'-8	20'-8	18'-8	16'-8	14'-8	12'-8	10'-8	8'-8	24'-8	22'-8	20'-8	18'-8	16'-8	14'-8	C
D	9'-3	8'-6	7'-9	7'-0	6'-3	5'-6	4'-9	4'-0	3'-3	9'-3	8'-6	7'-9	7'-0	6'-3	5'-6	D
E	43'-6	41'-11	40'-4	38'-10	37'-4	35'-9	34'-3	32'-9	31'-3	39'-6	37'-11	36'-4	34'-10	33'-4	31'-9	E
F	9'-7	8'-10	8'-1	7'-4	6'-7	5'-10	5'-1	4'-4	3'-7	9'-7	8'-10	8'-1	7'-4	6'-7	5'-10	F
G1	24'-4	24'-3	24'-2	24'-2	24'-2	24'-1	24'-1	24'-1	24'-1	20'-4	20'-3	20'-2	20'-2	20'-2	20'-1	G1
G2	25'-6½	25'-5½	25'-4¾	25'-4¾	25'-4½	25'-3½	25'-3½	25'-3¼	25'-3¼	21'-6½	21'-5½	21'-4¾	21'-4¾	21'-4½	21'-3½	G2
G3	15'-7¾	14'-4¾	13'-1¾	11'-10¾	10'-7½	9'-4½	8'-1½	6'-10½	5'-7½	15'-7¾	14'-4¾	13'-1¾	11'-10¾	10'-7½	9'-4½	G3
G4	16'-5¾	15'-0½	13'-7	12'-4	11'-1½	9'-7½	8'-4¾	7'-1¾	5'-11	16'-5¾	15'-0½	13'-7	12'-4	11'-1½	9'-7½	G4
G5	3¾	5¾	7¾	7¾	7¾	9¾	9¾	9¾	9¾	3¾	5¾	7¾	7¾	7¾	9¾	G5
K	25'-0	24'-11	24'-10	24'-10	24'-10	24'-9	24'-9	24'-9	24'-9	21'-0	20'-11	20'-10	20'-10	20'-10	20'-9	K
P	38'-1½	35'-0½	31'-11½	28'-10¾	25'-9¾	22'-8¾	19'-7	16'-5¾	13'-4¾	38'-1½	35'-0½	31'-11½	28'-10¾	25'-9¾	22'-8¾	P
R1	40'-1	36'-10	33'-7	30'-4	27'-1	23'-10	20'-7	17'-4	14'-1	40'-1	36'-10	33'-7	30'-4	27'-1	23'-10	R1
R2	27'-0½	24'-9¼	22'-6½	20'-3¼	18'-0¾	15'-10¾	13'-7¾	11'-4¾	9'-2	27'-0½	24'-9¼	22'-6½	20'-3¼	18'-0¾	15'-10¾	R2
T	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-1	1'-1	1'-1	1'-1	1'-1	1'-1	T
U	1'-0	11	10	10	10	9	9	9	9	1'-0	11	10	10	10	9	U
V	1'-0	11	10	10	10	9	9	9	9	1'-0	11	10	10	10	9	V
W	5'-0	4'-9	4'-6	4'-3	4'-0	3'-9	3'-6	3'-6	3'-6	5'-0	4'-9	4'-6	4'-3	4'-0	3'-9	W

Dimension Table

S x H	10' x 6'	10' x 5'	10' x 4'	8' x 10'	8' x 9'	8' x 8'	8' x 7'	8' x 6'	8' x 5'	8' x 4'	S x H
A	19'-0	16'-0	13'-0	31'-0	28'-0	25'-0	22'-0	19'-0	16'-0	13'-0	A
B	6'-4	5'-4	4'-4	10'-4	9'-4	8'-4	7'-4	6'-4	5'-4	4'-4	B
C	12'-8	10'-8	8'-8	20'-8	18'-8	16'-8	14'-8	12'-8	10'-8	8'-8	C
D	4'-9	4'-0	3'-3	7'-9	7'-0	6'-3	5'-6	4'-9	4'-0	3'-3	D
E	30'-3	28'-9	27'-3	32'-4	30'-10	29'-4	27'-9	26'-3	24'-9	23'-3	E
F	5'-1	4'-4	3'-7	8'-1	7'-4	6'-7	5'-10	5'-1	4'-4	3'-7	F
G1	20'-1	20'-1	20'-1	16'-2	16'-2	16'-2	16'-1	16'-1	16'-1	16'-1	G1
G2	21'-3¾	21'-3¾	21'-3¾	17'-4¾	17'-4¾	17'-4¾	17'-3½	17'-3¾	17'-3¾	17'-3¾	G2
G3	8'-1½	6'-10½	5'-7½	13'-1¾	11'-10¾	10'-7½	9'-4½	8'-1½	6'-10½	5'-7½	G3
G4	8'-4¾	7'-1¾	5'-11	13'-7	12'-4	11'-1¾	9'-7¾	8'-4¾	7'-1¾	5'-11	G4
G5	9¾	9¾	9¾	7¾	7¾	7¾	9¾	9¾	9¾	9¾	G5
K	20'-9	20'-9	20'-9	16'-10	16'-10	16'-10	16'-9	16'-9	16'-9	16'-9	K
P	19'-7	16'-5¾	13'-4¾	31'-11½	28'-10¾	25'-9¾	22'-8¾	19'-7	16'-5¾	13'-4¾	P
R1	20'-7	17'-4	14'-1	33'-7	30'-4	27'-1	23'-10	20'-7	17'-4	14'-1	R1
R2	13'-7¾	11'-4¾	9'-2	22'-6½	20'-3¾	18'-0¾	15'-10¾	13'-7¾	11'-4¾	9'-2	R2
T	1'-1	1'-1	1'-1	1'-0	1'-0	1'-0	1'-0	1'-0	1'-0	1'-0	T
U	9	9	9	10	10	10	9	9	9	9	U
V	9	9	9	10	10	10	9	9	9	9	V
W	3'-6	3'-6	3'-6	4'-6	4'-3	4'-0	3'-9	3'-6	3'-6	3'-6	W

Notes:

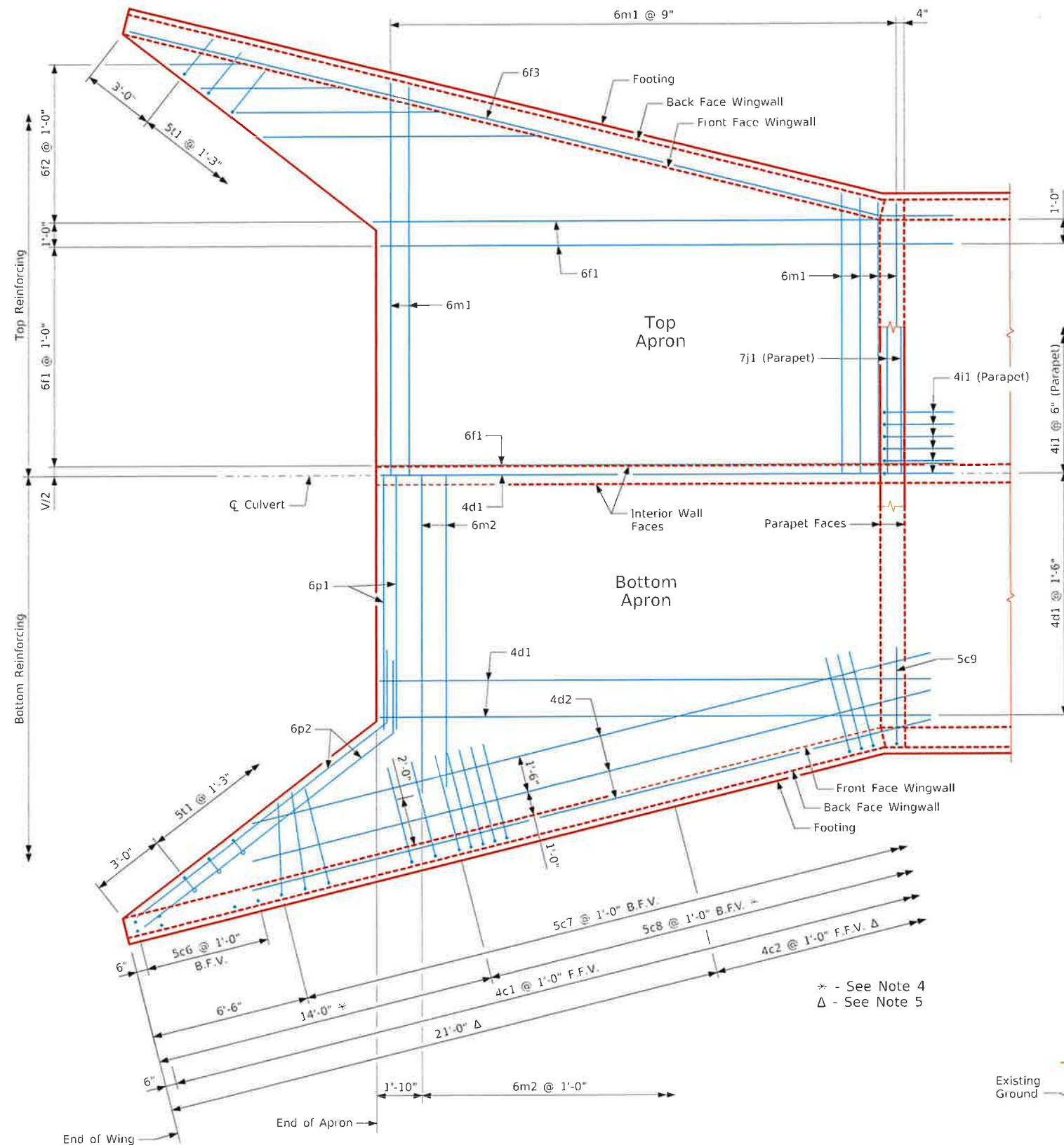
- See Sheet TWFWH G1-21 for General Notes, Specifications, and Design Stresses.
- See Sheet TWFWH 0-2-21 and TWFWH 0-3-21 for location of certain dimensions tabulated.
- Dimensions are in feet and inches unless otherwise noted.

LATEST REVISION DATE

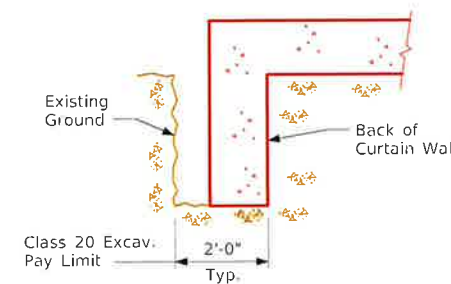

APPROVED BY BRIDGE ENGINEER


Standard Design - Twin Reinforced Concrete Box Culverts
Flared Wing Headwalls
February, 2021
Dimension Plan & Table
0° Skew
TWFWH
0-1-21

ENGLISHLRFDDESIGNEDTWINCULVERTS.DGN - TWFH 0-2-21 - THIS SHEET ISSUED 02-2021.

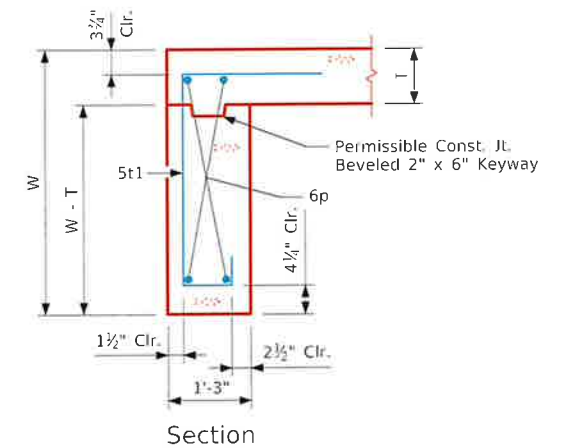
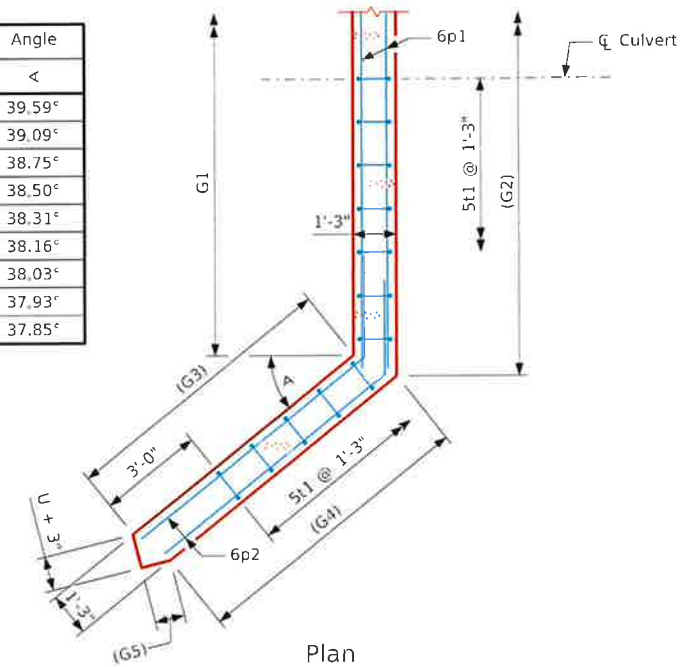


Plan View - Top & Bottom of Apron Reinforcing



Curtain Wall
Class 20 Excavation

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

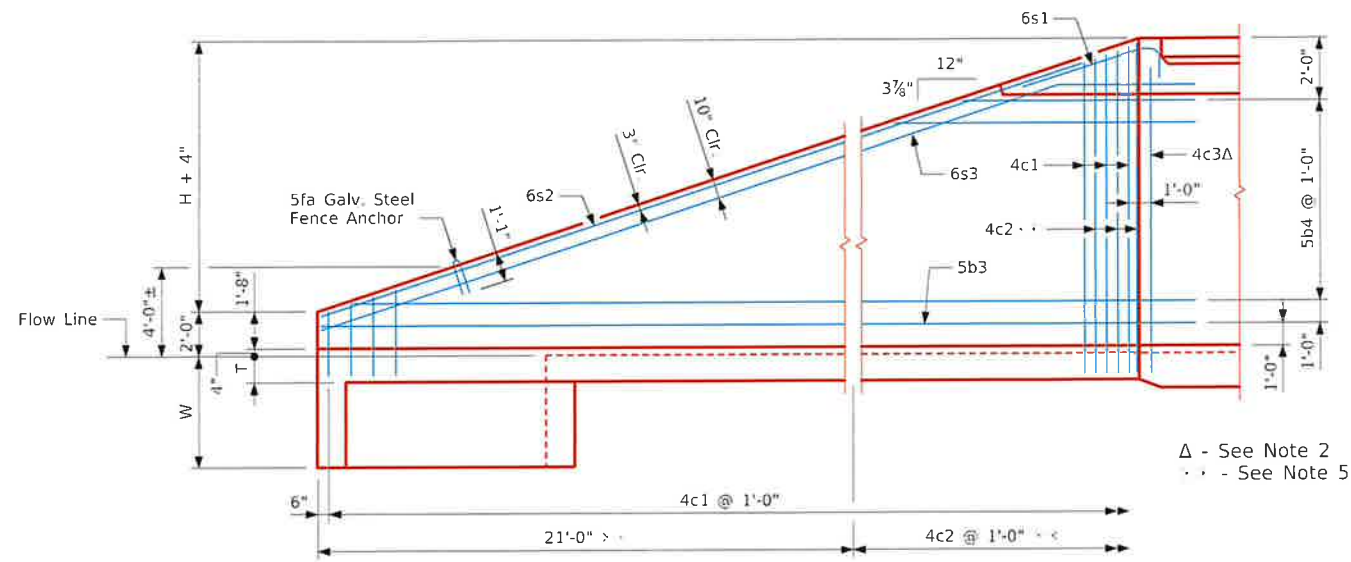


Curtain Wall Details

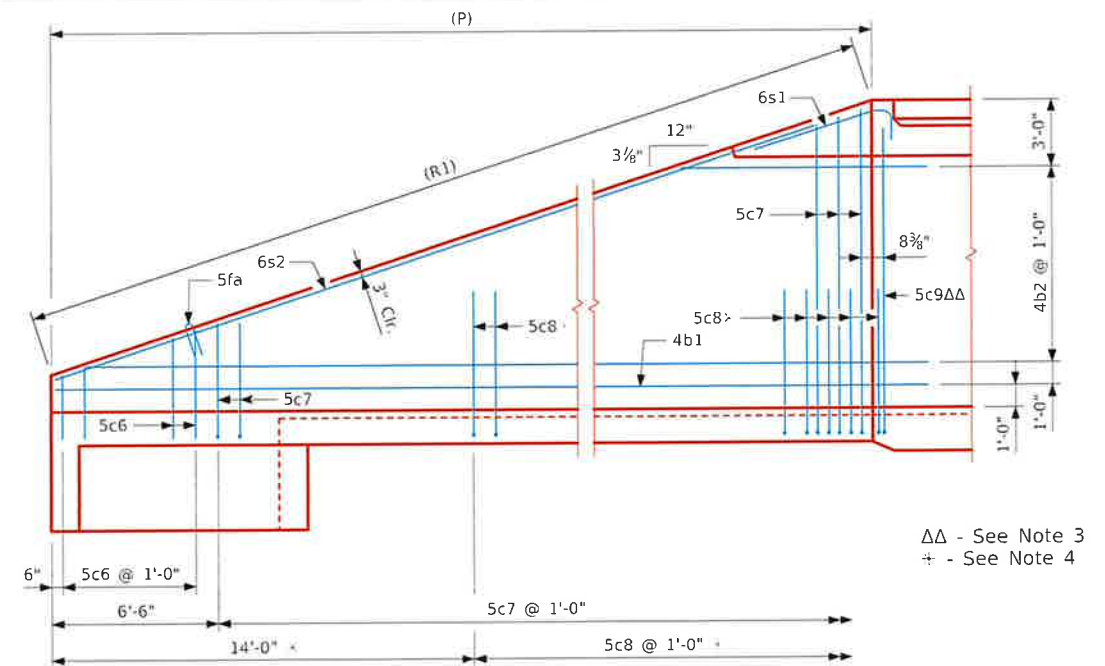
Notes:

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

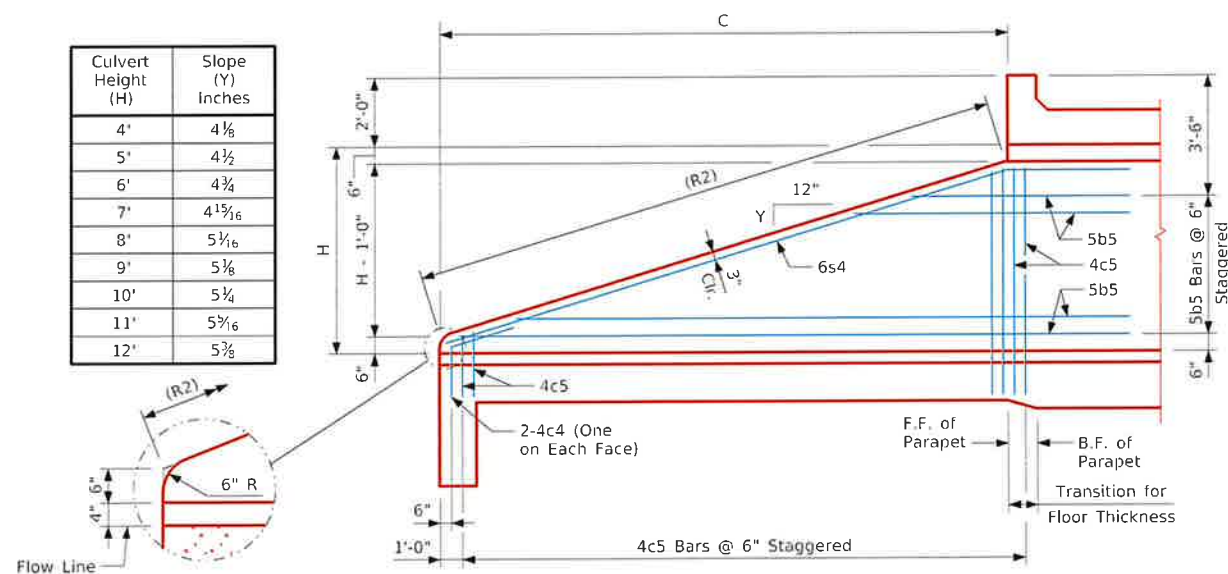
LATEST REVISION DATE	 APPROVED BY BRIDGE ENGINEER		
		Standard Design - Twin Reinforced Concrete Box Culverts	
		Flared Wing Headwalls	
		February, 2021	
		Apron & Curtain Wall Details 0° Skew	TWFWH 0-2-21



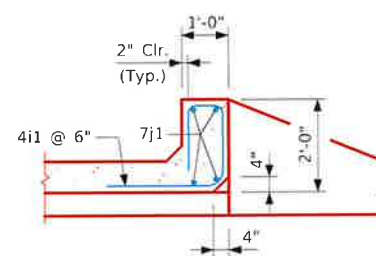
Typical View - Front Face Wingwall Reinforcing



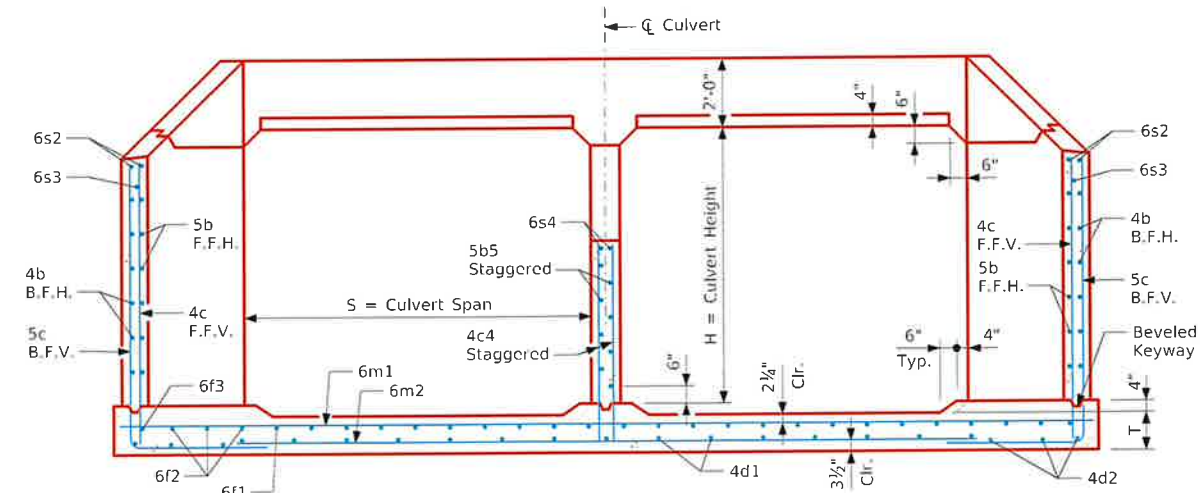
Typical View - Back Face Wingwall Reinforcing



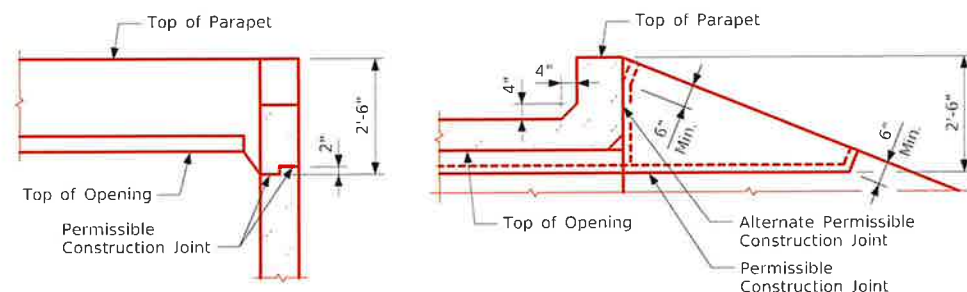
Typical View - Interior Wall



Section thru Parapet



Typical Section - Near Center of Apron



Top of Wingwall Details

Notes:

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

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

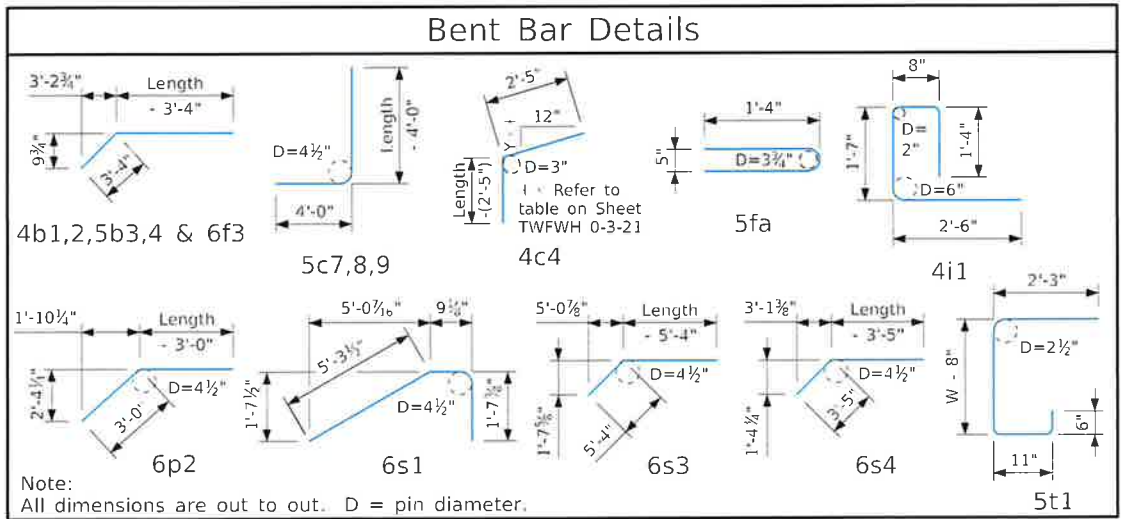
Bill of Reinforcing for One Headwall 0° Skew Span x Culvert Height																					
Bar	Location	Shape	12' x 12"			12' x 11"			12' x 10'			12' x 9'			12' x 8'			12' x 7'			Bar
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	
5fa	Fence Anchor (Galv.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	5fa
4b1	Wingwall, B.F.H.		2	41'-2	58	2	38'-1	51	2	35'-0	47	2	31'-11	43	2	28'-10	39	2	25'-9	34	4b1
4b2	Wingwall, B.F.H.		20 Var.	2 Each 11'-11 to 39'-9	345	18 Var.	2 Each 11'-11 to 36'-8	292	16 Var.	2 Each 11'-11 to 33'-7	243	14 Var.	2 Each 11'-11 to 30'-6	198	12 Var.	2 Each 11'-11 to 27'-5	158	10 Var.	2 Each 11'-11 to 24'-4	121	4b2
5b3	Wingwall, F.F.H.		2	41'-3	91	2	38'-2	80	2	35'-1	73	2	32'-0	67	2	28'-11	60	2	25'-9	54	5b3
5b4	Wingwall, F.F.H.		22 Var.	2 Each 8'-10 to 39'-10	558	20 Var.	2 Each 8'-10 to 36'-9	475	18 Var.	2 Each 8'-11 to 33'-8	400	16 Var.	2 Each 8'-11 to 30'-7	330	14 Var.	2 Each 8'-11 to 27'-6	266	12 Var.	2 Each 8'-11 to 24'-4	208	5b4
5b5	Interior Wall, Both F.H.		21 Var.	5'-2 to 27'-8	360	19 Var.	5'-3 to 25'-8	306	17 Var.	5'-3 to 23'-7	256	15 Var.	5'-3 to 21'-7	210	13 Var.	5'-4 to 19'-7	169	11 Var.	5'-5 to 17'-7	132	5b5
4c1	Wingwall, F.F.V.		76 Var.	2 Each 2'-10 to 14'-10	448	70 Var.	2 Each 2'-10 to 13'-10	390	64 Var.	2 Each 2'-10 to 12'-11	337	58 Var.	2 Each 2'-10 to 11'-11	286	52 Var.	2 Each 2'-10 to 10'-11	239	46 Var.	2 Each 2'-10 to 10'-0	197	4c1
4c2	Wingwall, F.F.V.		36 Var.	2 Each 9'-6 to 15'-0	295	30 Var.	2 Each 9'-6 to 14'-0	235	24 Var.	2 Each 9'-6 to 13'-1	181	18 Var.	2 Each 9'-6 to 12'-1	130	--	--	--	--	--	--	4c2
4c3	Wingwall, F.F.V.		4	13'-9	37	4	12'-9	34	2	11'-9	16	2	10'-9	14	2	9'-9	13	2	8'-9	12	4c3
4c4	Interior Wall, Both F.V.		2	4'-2	6	2	4'-2	6	2	4'-2	6	2	4'-2	6	2	4'-2	6	2	4'-2	6	4c4
4c5	Interior Wall, Both F.V.		50 Var.	2'-0 to 12'-11	249	46 Var.	2'-0 to 11'-11	214	42 Var.	2'-0 to 10'-11	181	38 Var.	1'-11 to 9'-11	150	34 Var.	1'-11 to 8'-11	123	30 Var.	1'-11 to 7'-10	98	4c5
5c6	Wingwall, B.F.V.		12 Var.	2 Each 2'-10 to 4'-6	46	12 Var.	2 Each 2'-10 to 4'-6	46	12 Var.	2 Each 2'-10 to 4'-6	46	12 Var.	2 Each 2'-10 to 4'-6	46	12 Var.	2 Each 2'-10 to 4'-6	46	12 Var.	2 Each 2'-10 to 4'-6	46	5c6
5c7	Wingwall, B.F.V.		64 Var.	2 Each 8'-10 to 18'-10	923	58 Var.	2 Each 8'-10 to 17'-10	807	52 Var.	2 Each 8'-10 to 16'-11	698	46 Var.	2 Each 8'-10 to 15'-11	594	40 Var.	2 Each 8'-10 to 14'-11	495	34 Var.	2 Each 8'-10 to 14'-0	405	5c7
5c8	Wingwall, B.F.V.		50	10'-6	548	44	10'-6	482	38	10'-6	416	32	10'-6	350	26	10'-6	285	20	10'-6	219	5c8
5c9	Wingwall, B.F.V.		4	17'-9	74	4	16'-9	70	2	15'-9	33	2	14'-9	31	2	13'-9	29	2	12'-9	27	5c9
4d1	Apron, Longit., Bott.		17	27'-11	317	17	25'-11	294	17	23'-11	272	17	21'-11	249	17	19'-11	226	17	17'-11	203	4d1
4d2	Apron, Longit., Bott.		6	36'-3	145	6	33'-2	133	6	30'-1	121	6	27'-0	108	6	23'-11	96	6	20'-10	84	4d2
6f1	Apron, Longit., Top		24	27'-11	1006	24	25'-11	934	24	23'-11	862	24	21'-11	790	24	19'-11	718	24	17'-11	646	6f1
6f2	Apron, Longit., Top		16 Var.	2 Each 5'-10 to 24'-10	368	16 Var.	2 Each 3'-10 to 22'-10	320	14 Var.	2 Each 4'-6 to 20'-10	266	12 Var.	2 Each 5'-3 to 18'-10	217	10 Var.	2 Each 5'-11 to 16'-10	171	10 Var.	2 Each 3'-11 to 14'-10	141	6f2
6f3	Apron, Longit., Top		2	41'-3	131	2	38'-2	115	2	35'-1	105	2	32'-0	96	2	28'-11	87	2	25'-9	77	6f3
4i1	Parapet, Vertical		51	6'-1	207	49	6'-1	199	49	6'-1	199	49	6'-1	199	49	6'-1	199	49	6'-1	199	4i1
7j1	Parapet, Horizontal		4	26'-8	218	4	26'-5	216	4	26'-2	214	4	26'-2	214	4	26'-2	214	4	25'-11	212	7j1
6m1	Apron, Trans., Top		34 Var.	26'-10 to 39'-3	1687	31 Var.	26'-7 to 37'-10	1500	29 Var.	26'-4 to 36'-10	1376	26 Var.	26'-4 to 35'-9	1212	23 Var.	26'-4 to 34'-7	1052	21 Var.	26'-1 to 33'-7	941	6m1
6m2	Apron, Trans., Bott.		24 Var.	20'-9 to 32'-3	955	22 Var.	20'-8 to 31'-2	856	20 Var.	20'-7 to 30'-1	761	18 Var.	20'-7 to 29'-1	671	16 Var.	20'-7 to 28'-1	585	14 Var.	20'-6 to 27'-0	499	6m2
6p1	Curtain, Horizontal		4	25'-3	152	4	25'-2	151	4	25'-1	151	4	25'-1	151	4	25'-1	151	4	25'-0	150	6p1
6p2	Curtain, Horizontal		8	18'-7	223	8	17'-4	208	8	16'-1	193	8	14'-10	178	8	13'-7	163	8	12'-4	148	6p2
6s1	Wing Slope, Both F.		4	7'-8	46	4	7'-8	46	4	7'-8	46	4	7'-8	46	4	7'-8	46	4	7'-8	46	6s1
6s2	Wing Slope, Both F.		4	37'-1	223	4	33'-10	203	4	30'-7	184	4	27'-4	164	4	24'-1	145	4	20'-10	125	6s2
6s3	Wing Slope, F.F.		2	43'-2	137	2	39'-11	120	2	36'-8	110	2	33'-5	100	2	30'-2	91	2	26'-11	81	6s3
6s4	Interior Wall, Both F.		2	30'-3	91	2	28'-0	84	2	25'-9	77	2	23'-6	71	2	21'-4	64	2	19'-1	57	6s4
5t1	Curtain, Vertical		41	8'-0	342	39	7'-9	315	37	7'-6	289	35	7'-3	265	33	7'-0	241	31	6'-9	218	5t1
	Estimated Quantities One Headwall	Reinf. Steel	10,292 LB			9188 LB			8165 LB			7192 LB			6183 LB			5392 LB			
		Concrete	Parapet Δ	2.8	88.2 CY	2.7	75.7 CY	2.6	64.7 CY	2.6	56.6 CY	2.6	46.4 CY	2.5	39.3 CY						
			Wingwalls	28.1		21.9		16.9		14.0		11.4		8.1							
			Apron	57.3		51.1		45.2		40.0		32.4		28.7							

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

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

Headwall Notes:

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



LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

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

Quantity Tabulation
12'-0" Span
0° Skew

TWFWH
0-4-21
Sheet 1 of 2