



Triple Reinforced Concrete Box Culvert Standards



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		Index of Sheets	TRRCB G1-20



Triple Reinforced Concrete Box Culvert Standards

General Notes:

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

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

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

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

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

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

Specifications:



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

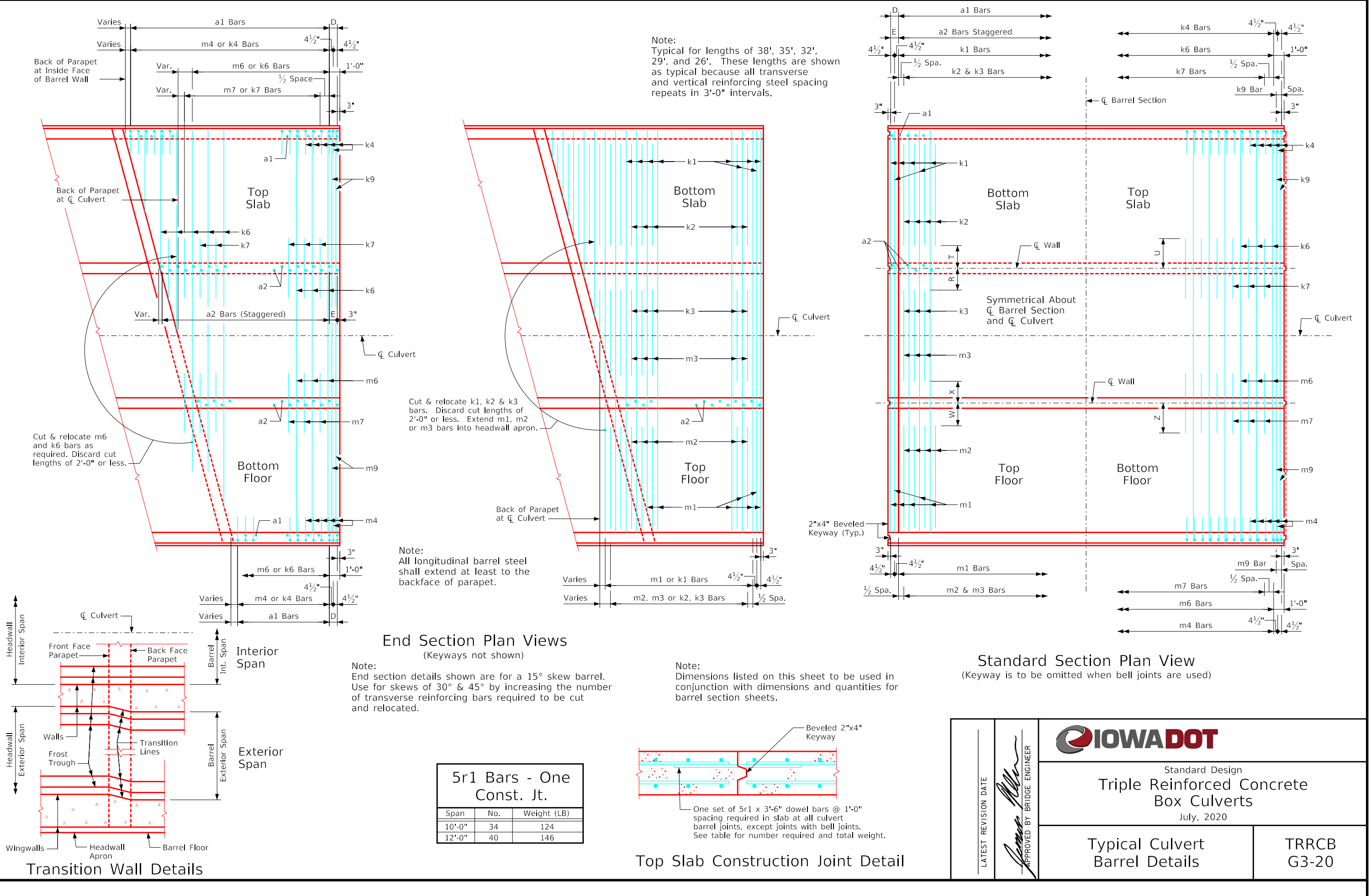
Construction:
Iowa Department of Transportation Standard Specifications for Highway and Bridge Construction, current series, plus applicable General Supplemental Specifications, Developmental Specifications, Supplemental Specifications and Special Provisions

Design Stresses:

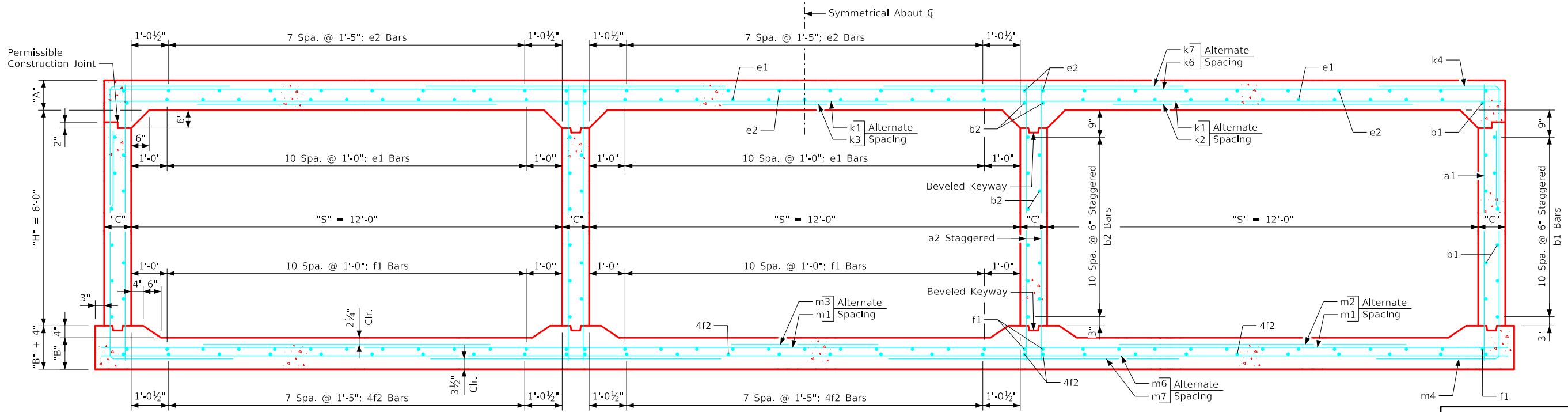
Design stresses for the following materials are in accordance with the AASHTO LRFD Bridge Design Specifications, 8th Ed., Series of 2017:
Reinforcing steel in accordance with AASHTO LRFD Section 5, Grade 60.
Concrete in accordance with AASHTO LRFD Section 5, f'c = 4.0 ksi.

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Triple 12' x 6' Barrel Section

Notes:

1. Dimensions listed on this sheet to be used in conjunction with Sheet TRRCB 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.

Bent Bar Detail


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

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

Variable Dimensions and Quantities for Triple 12' x 6' Barrel Sections																																																									
Dimensions														Bar List																																											
														a1		a2		b1		b2		e1		e2		f1		f2		k1		k2		k3		k4				k6		k7															
Fill	S	H	A	B	C	D	E	R	T	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	Size	Sp.	L											
0	12	6	14	11.5	9	9	9	0'-0	0'-0	7'-7	2'-9	4'-4	4'-3	4	12	8'-0	6	9	8'-0	4	6	24	4	6	26	4	12	33	4	17	30	4	12	39	4	17	30	6	18	38'-8	6	18	12'-9	4	18	12'-9	4	6	7'-2	3'-7	3'-7	5	18	38'-8	6	18	15'-2
1	12	6	13	11	9	9	9	0'-8	0'-2	7'-1	2'-8	4'-5	4'-3	4	12	7'-11	6	9	7'-11	4	6	24	4	6	26	4	12	33	4	17	30	4	12	39	4	17	30	6	18	38'-8	6	18	12'-9	4	18	11'-5	6	12	7'-10	3'-11	3'-11	5	18	38'-8	6	18	14'-8
2	12	6	10	10	9	9	9	2'-2	1'-11	5'-11	3'-7	5'-2	4'-1	4	9	7'-7	7	9	7'-7	4	6	24	4	6	26	4	12	33	4	17	30	4	12	39	4	17	30	6	12	38'-8	5	12	10'-0	4	12	8'-5	6	9	7'-4	3'-8	3'-8	5	18	38'-8	8	18	13'-11
3-6	12	6	9	10	9	9	9	3'-11	2'-6	4'-8	3'-4	5'-2	4'-0	4	9	7'-6	6	9	7'-6	4	6	24	4	6	26	4	12	33	4	17	30	4	12	39	4	17	30	5	9	38'-8	4	9	8'-8	4	9	4'-11	6	9	7'-2	3'-7	3'-7	5	9	38'-8	5	9	10'-1
7-8	12	6	10	11	9	9	9	5'-2	2'-11	3'-11	3'-1	5'-2	3'-9	4	9	7'-8	6	9	7'-8	4	6	24	4	6	26	4	12	33	4	17	30	4	12	39	4	17	30	5	9	38'-8	4	9	8'-3	4	9	2'-5	6	9	6'-7	2'-11	3'-8	5	9	38'-8	5	9	8'-3
9-10	12	6	11	12.5	9	9	9	5'-2	2'-9	3'-10	2'-9	5'-2	3'-10	4	12	7'-10	6	9	7'-10	4	6	24	4	6	26	4	12	33	4	17	30	4	12	39	4	17	30	5	9	38'-8	4	9	8'-9	4	9	2'-5	5	6	5'-11	2'-7	3'-4	4	9	38'-8	6	9	8'-0
11-12	12	6	12	14	9	9	9	5'-2	2'-9	3'-10	2'-8	4'-3	3'-9	4	12	8'-1	6	9	8'-1	4	6	24	4	6	26	4	12	33	4	17	30	4	12	39	4	17	30	6	12	38'-8	5	12	8'-11	4	12	2'-5	5	6	6'-0	2'-7	3'-5	5	12	38'-8	7	12	8'-1
13-15	12	6	13.5	15.5	9	6	9	4'-1	2'-5	3'-10	2'-3	4'-2	3'-10	4	6	8'-4	6	9	8'-4	4	6	24	4	6	26	4	12	33	4	17	30	4	12	39	4	17	30	6	12	38'-8	5	12	10'-0	4	12	4'-7	4	6	5'-8	2'-6	3'-2	5	12	38'-8	7	12	8'-2
16-17	12	6	14.5	16.5	9	9	9	4'-0	1'-10	3'-10	2'-0	4'-1	3'-10	5	12	8'-6	6	9	8'-6	4	6	24	4	6	26	4	12	33	4	17	30	4	12	39	4	17	30	7	18	38'-8	7	18	11'-1	4	18	4'-9	4	6	5'-9	2'-6	3'-3	5	9	38'-8	6	9	8'-3
18-19	12	6	15.5	17.5	9	9	9	3'-11	1'-9	3'-11	1'-10	4'-9	3'-11	5	12	8'-8	6	9	8'-8	4	6	24	4	6	26	4	12	33	4	17	30	4	12	39	4	17	30	7	18	38'-8	7	18	11'-2	4	18	4'-11	4	6	5'-11	2'-7	3'-4	5	9	38'-8	6	9	8'-5
20-21	12	6	16.5	19	9	9	9	3'-10	1'-4	3'-11	1'-3	4'-7	4'-0	4	9	8'-10	6	9	8'-10	4	6	24	4	6	26	4	12	33	4	17	30	4	12	39	4	17	30	5	9	38'-8	5	9	11'-7	4	9	5'-1	4	6	6'-0	2'-7	3'-5	5	9	38'-8	6	9	8'-6
22-23	12	6	18	20	9	9	9	4'-0	1'-1	4'-0	1'-2	4'-8	4'-1	4	9	9'-1	6	9	9'-1	4	6	24	4	6	26	4	12	33	4	17	30	4	12	39	4	17	30	5	9	38'-8	5	9	11'-10	4	9	4'-9	4	6	6'-3	2'-8	3'-7	5	9	38'-8	6	9	8'-9
24-25	12	6	19.5	21.5	9	9	9	4'-4	1'-0	4'-1	1'-0	4'-9	4'-2	4	9	9'-4	6	9	9'-4	4	6	24	4	6	26	4	12	33	4	17	30	4	12	39	4	17	30	6	12	38'-8	6	12	11'-11	4	12	4'-1	4	6	6'-5	2'-9	3'-8	5	9	38'-8	6	9	8'-11
Fill	Bar List												Quantities																																												
	k9			m1			m2			m3			m4			m6			m7			m9			Concrete (CY/FT)				Steel (LB/FT)																												
Size	Sp.	L	Size	Sp.	L	Size	Sp.	L	Size	Sp.	L	Size	Sp.	L	Size	Sp.	L	Size	Sp.	L	Size	Sp.	L	Slab	Floor	Walls	Total																														
0	6	4.5	38'-8	4	9	39'-2	4	9	8'-10	4	9	4'-1	5	6	11'-1	4'-8	6'-5	4	12	39'-2	6	12	8'-7	6	4.5	39'-2	1.766	1.483	0.618	3.867	476.47																										
1	6	4.5	38'-8	5	12	39'-2	5	12	8'-8	4	12	3'-11	7	12	10'-10	4'-6	6'-4	4	9	39'-2	5	9	8'-7	5	4.5	39'-2	1.646	1.422	0.618	3.686	494.53																										
2	8	4.5	38'-8	5	9	39'-2	4	9	6'-9	4	9	2'-5	6	9	9'-9	3'-6	6'-3	5	9	39'-2	5	9	8'-4	5	4.5	39'-2	1.285	1.301	0.618	3.204	568.68																										
3-6	5	4.5	38'-8	6	12	39'-2	5	12	7'-2	4	12	2'-5	6	9	9'-8	3'-5	6'-3	5	9	39'-2	6	9	8'-2	6	4.5	39'-2	1.165	1.301	0.618	3.084	561.58																										
7-8	5	4.5	38'-8	6	12	39'-2	5	12	7'-11	4	12	2'-5	6	9	9'-5	3'-1	6'-4	5	9	39'-2	6	9	7'-9	6	4.5	39'-2	1.285	1.422	0.618	3.325	551.26																										
9-10	6	4.5	38'-8	6	12	39'-2	5	12	8'-9	4	12	2'-5	5	6	9'-3	2'-9	6'-6	5	12	39'-2	7	12	8'-0	7	4.5	39'-2	1.405	1.605	0.618	3.628	531.18																										
11-12	7	4.5	38'-8	6	12	39'-2	5	12	9'-2	4	12	4'-3	5	6	9'-2	2'-7	6'-7	4	9	39'-2	6	9	7'-11	6	4.5	39'-2	1.526	1.788	0.618	3.932	543.21																										
13-15	7	4.5	38'-8	5	9	39'-2	5	9	10'-5	4	9	4'-5	4	6	9'-4	2'-7	6'-9	5	12	39'-2	7	12	8'-2	7	4.5	39'-2	1.706	1.971	0.618	4.295	549.47																										
16-17	6	4.5	38'-8	5	9	39'-2	5	9	11'-0	4	9	4'-7	4	6	9'-5	2'-7	6'-10	5	12	39'-2	7	12	8'-3	7	4.5	39'-2	1.827	2.093	0.618	4.538	564.34																										
18-19	6	4.5	38'-8	5	9	39'-2	5	9	11'-2	4	9	3'-3	4	6	9'-6	2'-7	6'-11	5	9	39'-2	6	9	8'-6	6	4.5	39'-2	1.947	2.215	0.618	4.780	577.29																										
20-21	6	4.5	38'-8	5	9	39'-2	5	9	11'-9	4	9	3'-7	4	6	9'-8	2'-8	7'-0	5	12	39'-2	7	12	8'-8	7	4.5	39'-2	2.067	2.398	0.618	5.083	568.47																										
22-23	6	4.5	38'-8	6	12	39'-2	6	12	11'-10	4	12	3'-5	4	6	9'-10	2'-9	7'-1	5	9	39'-2	6	9	8'-11	6	4.5	39'-2	2.248	2.520	0.618	5.386	591.74																										
24-25	6	4.5	38'-8	6	12	39'-2	6	12	12'-0	4	12	3'-3	4	6	10'-1	2'-10	7'-3	5	9	39'-2	6	9	9'-1	6	4.5	39'-2	2.428	2.703	0.618	5.749	618.16																										

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER



Standard Design

Triple Reinforced Concrete Box Culverts

July, 2020

Culvert Barrel Details

TRRCB 12-6-20

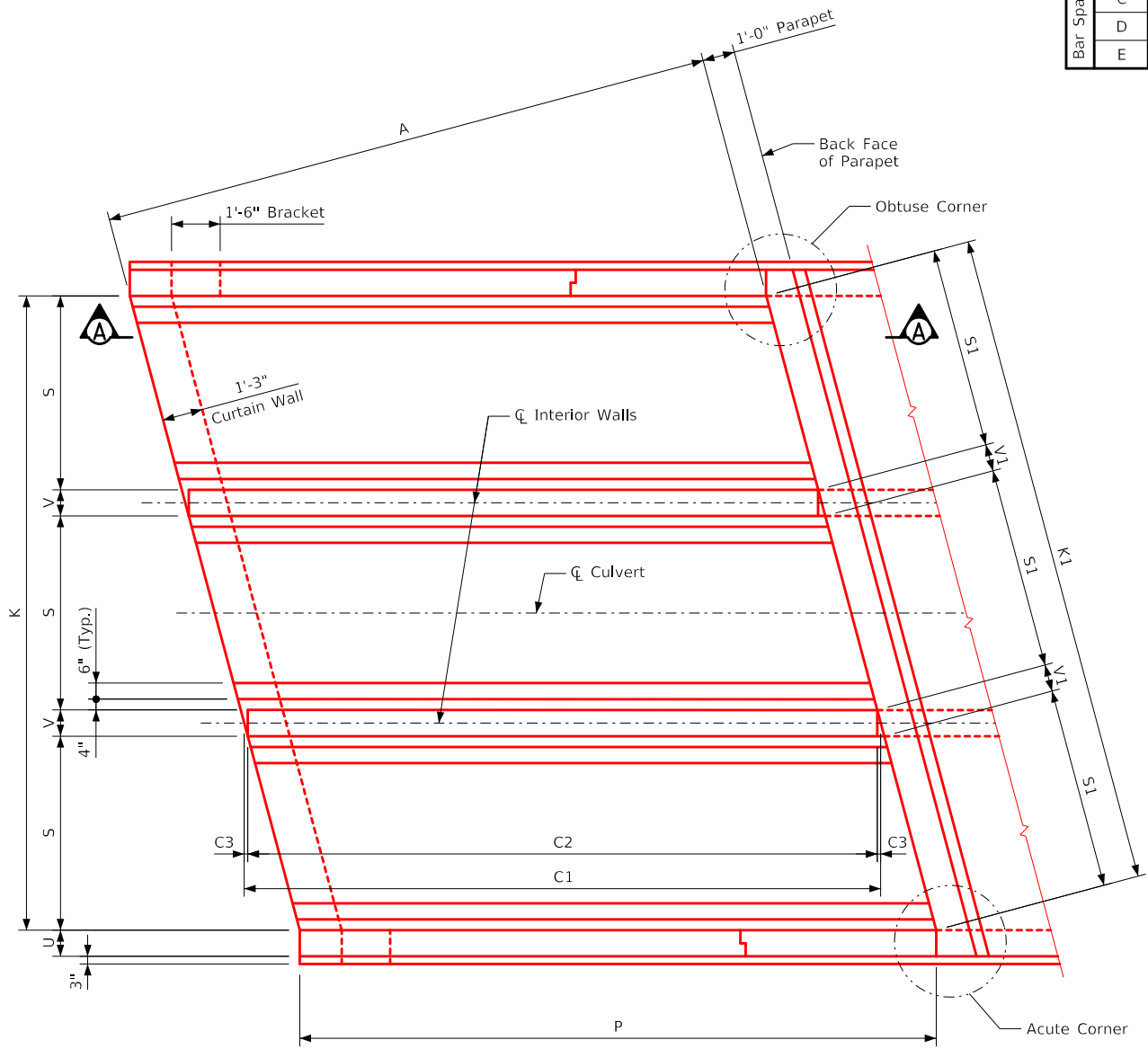


Standard Design
Triple Reinforced Concrete
Box Culverts
July, 2020

Culvert Barrel
Details
12' x 6' Barrel Sections

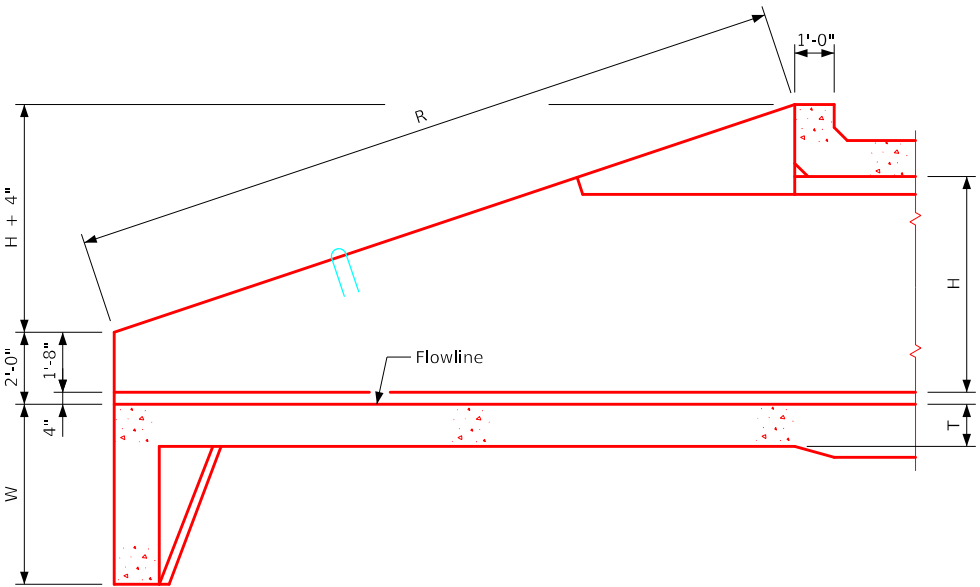
TRRCB
12-6-20

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Plan View


Dimension Table																					
	S x H	12' x 12'	12' x 11'	12' x 10'	12' x 9'	12' x 8'	12' x 7'	12' x 6'	12' x 5'	12' x 4'	10' x 12'	10' x 11'	10' x 10'	10' x 9'	10' x 8'	10' x 7'	10' x 6'	10' x 5'	10' x 4'	S x H	
Headwall Dimensions	A	37'-0	34'-0	31'-0	28'-0	25'-0	22'-0	19'-0	16'-0	13'-0	37'-0	34'-0	31'-0	28'-0	25'-0	22'-0	19'-0	16'-0	13'-0	A	
	C1	38'-3⅝	35'-2⅜	32'-1⅝	28'-11⅞	25'-10⅞	22'-9⅞	19'-8	16'-6¾	13'-5½	38'-3⅝	35'-2⅜	32'-1⅝	28'-11⅞	25'-10⅞	22'-9⅞	19'-8	16'-6¾	13'-5½	C1	
	C2	38'-0⅝	34'-11⅝	31'-10⅝	28'-9⅞	25'-7⅞	22'-6⅞	19'-5½	16'-4¼	13'-3	38'-0⅝	34'-11⅝	31'-10⅝	28'-9⅞	25'-7⅞	22'-6⅞	19'-5½	16'-4¼	13'-3	C2	
	C3	1⅞	1⅞	1⅞	1⅞	1⅞	1⅞	1¼	1¼	1¼	1⅞	1⅞	1⅞	1⅞	1⅞	1⅞	1¼	1¼	1¼	C3	
	H	12'-0	11'-0	10'-0	9'-0	8'-0	7'-0	6'-0	5'-0	4'-0	12'-0	11'-0	10'-0	9'-0	8'-0	7'-0	6'-0	5'-0	4'-0	H	
	K	38'-0	38'-0	37'-8	37'-8	37'-8	37'-6	37'-6	37'-6	37'-6	32'-0	32'-0	31'-8	31'-8	31'-8	31'-6	31'-6	31'-6	31'-6	K	
	K1	39'-4⅞	39'-4⅞	39'-0⅞	39'-0⅞	39'-0⅞	38'-10⅞	38'-10⅞	38'-10⅞	38'-10⅞	33'-1½	33'-1½	32'-9½	32'-9½	32'-9½	32'-7½	32'-7½	32'-7½	32'-7½	K1	
	P	38'-3⅝	35'-2⅜	32'-1⅝	28'-11⅞	25'-10⅞	22'-9⅞	19'-8	16'-6¾	13'-5½	38'-3⅝	35'-2⅜	32'-1⅝	28'-11⅞	25'-10⅞	22'-9⅞	19'-8	16'-6¾	13'-5½	P	
	R	40'-2⅞	36'-11¾	33'-8⅝	30'-5½	27'-2¼	23'-11⅞	20'-8	17'-4⅞	14'-1⅝	40'-2⅞	36'-11¾	33'-8⅝	30'-5½	27'-2¼	23'-11⅞	20'-8	17'-4⅞	14'-1⅝	R	
	R1	39'-7⅞	36'-4	33'-1⅝	29'-10¼	26'-7⅞	23'-4¼	20'-1¼	16'-10⅞	13'-7⅞	39'-7⅞	36'-4	33'-1⅝	29'-10¼	26'-7⅞	23'-4¼	20'-1¼	16'-10⅞	13'-7⅞	R1	
	S	12'-0	12'-0	12'-0	12'-0	12'-0	12'-0	12'-0	12'-0	12'-0	12'-0	10'-0	10'-0	10'-0	10'-0	10'-0	10'-0	10'-0	10'-0	S	
	S1	12'-5⅞	12'-5⅞	12'-5⅞	12'-5⅞	12'-5⅞	12'-5⅞	12'-5⅞	12'-5⅞	12'-5⅞	10'-4¼	10'-4¼	10'-4¼	10'-4¼	10'-4¼	10'-4¼	10'-4¼	10'-4¼	10'-4¼	S1	
	T	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-2	1'-1	1'-1	1'-1	1'-1	1'-1	1'-1	1'-1	1'-1	T	
	U	1'-0	1'-0	10	10	10	10	9	9	9	9	1'-0	1'-0	10	10	10	9	9	9	9	U
	V	1'-0	1'-0	10	10	10	10	9	9	9	9	1'-0	1'-0	10	10	10	9	9	9	9	V
Bar Spacing	V1	1'-0⅝	1'-0⅝	10⅞	10⅞	10⅞	9⅞	9⅞	9⅞	9⅞	1'-0⅝	1'-0⅝	10⅞	10⅞	10⅞	9⅞	9⅞	9⅞	9⅞	V1	
	W	5'-0	4'-9	4'-6	4'-3	4'-0	3'-9	3'-6	3'-6	3'-6	5'-0	4'-9	4'-6	4'-3	4'-0	3'-9	3'-6	3'-6	3'-6	W	
	B	1'-0	1'-0	1'-0	1'-0	1'-0	1'-0	1'-0	9	9	1'-0	1'-0	1'-0	1'-0	1'-0	1'-0	1'-0	1'-0	1'-0	B	
	C	1'-0	1'-0	1'-0	1'-0	9	9	9	1'-0	1'-0	1'-0	1'-0	1'-0	9	9	9	1'-0	1'-0	1'-0	C	
	D	6	6	1'-0	1'-0	1'-0	1'-0	1'-0	9	1'-0	6	6	1'-0	9	1'-0	1'-0	1'-0	1'-0	1'-0	D	
E	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	E		




Elevation Section A-A

- Notes:
- See Sheet TRRCB G2-20 for General Notes, Specifications, and Design Stresses.
 - See Sheets TRPWH 15-2-20 thru 15-5-20 for location of certain dimensions tabulated.
 - Dimensions are in feet and inches unless otherwise noted.

LATEST REVISION DATE

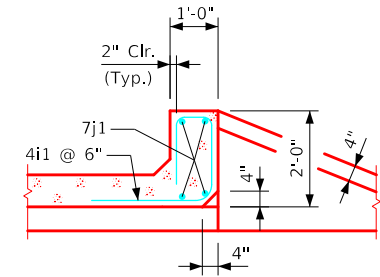

APPROVED BY BRIDGE ENGINEER


Standard Design - Triple Reinforced Concrete Box Culverts
Parallel Wing Headwalls
July, 2020

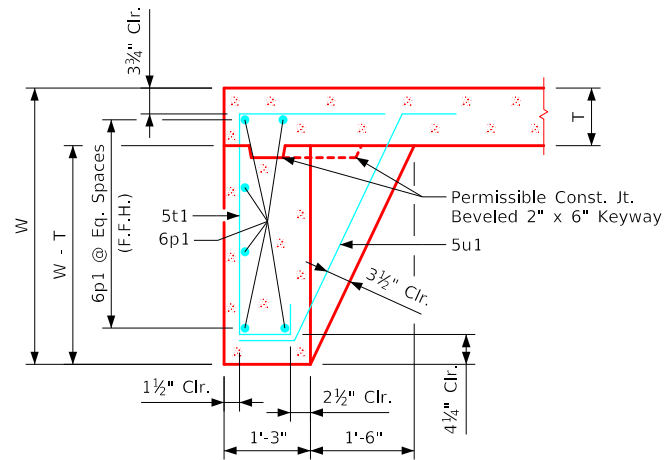
Dimension Table
15° Skew

TRPWH
15-1-20

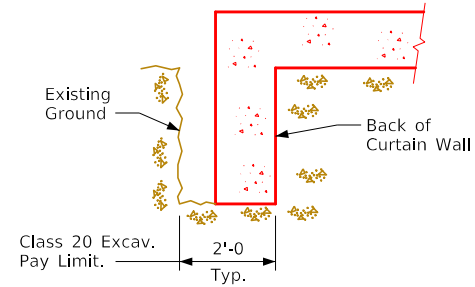
Revised 08-2022: Changed chamfer at top of Interior Walls to 3/4" x 3/4" (was 4" x 4").
ENGLISHLRFDSignedTripleCulverts.DGN - TRPWH 15-2-20 - THIS SHEET ISSUED 07-2020.



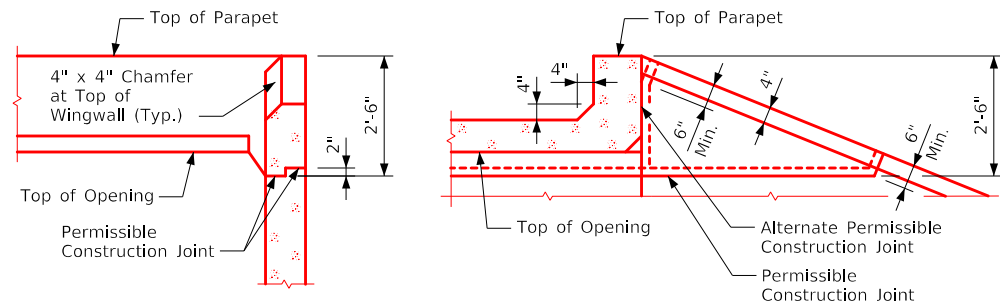
Section thru Parapet



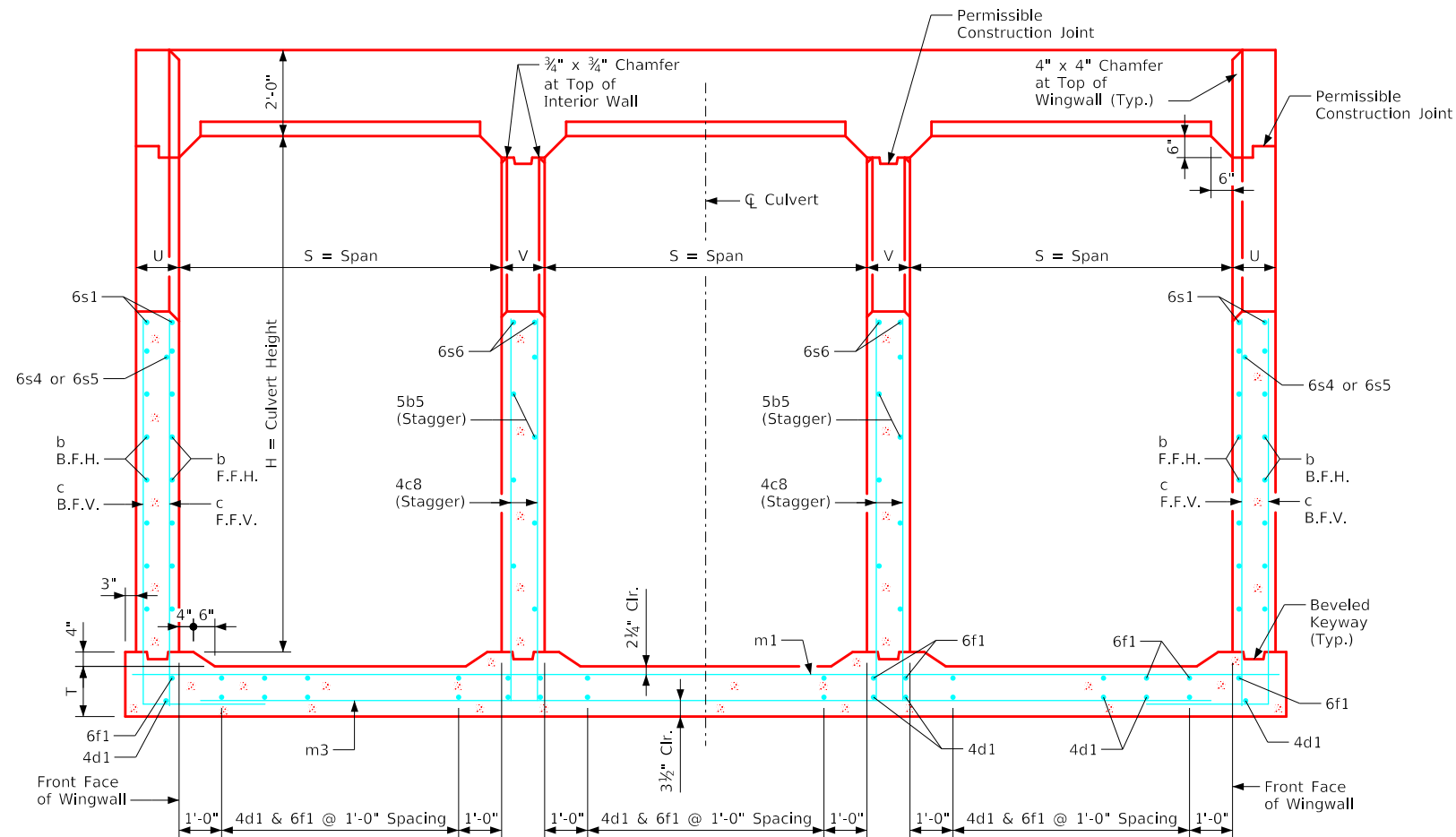
Section thru Curtain Wall



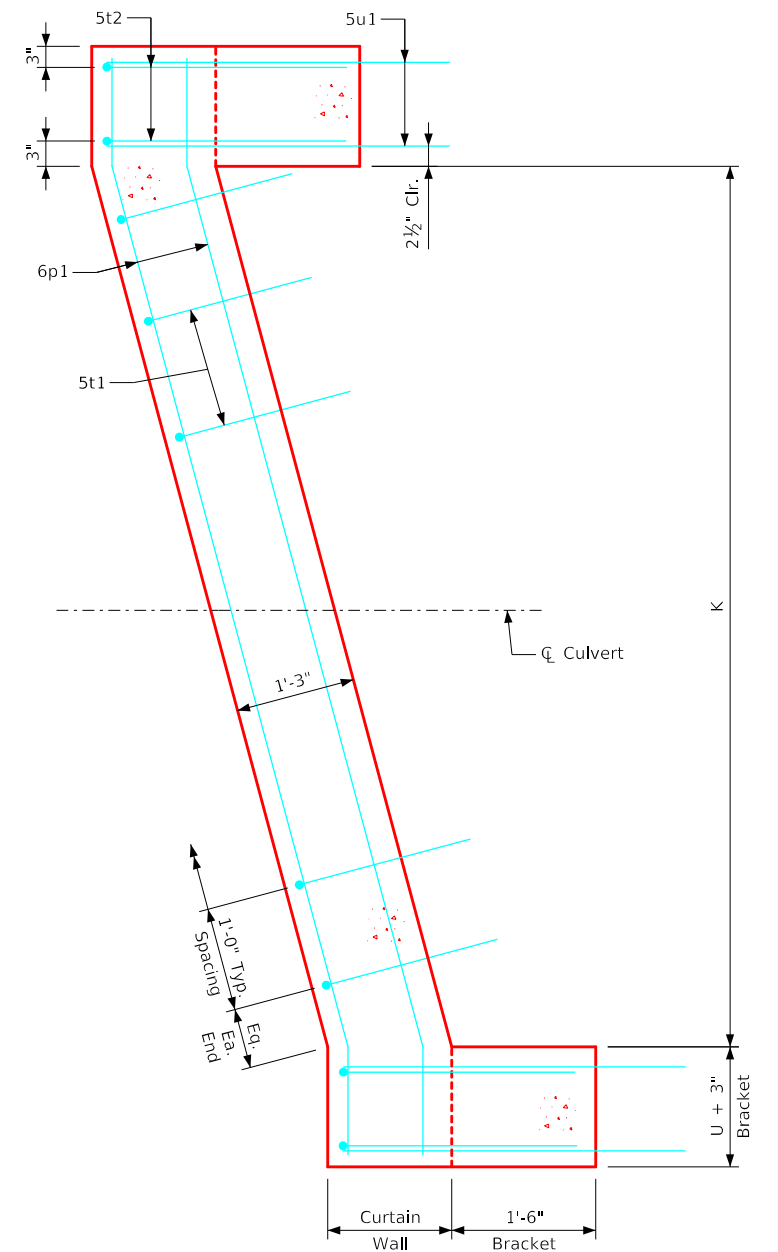
Curtain Wall
Class 20 Excavation



Top of Wingwall Details





Typical Cross Section - thru Headwall



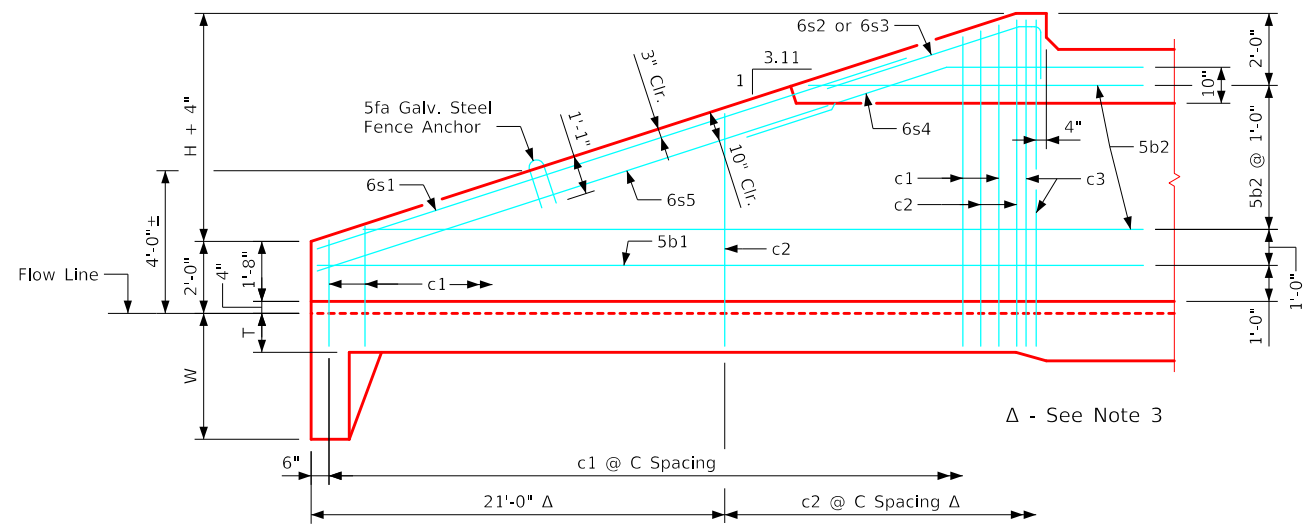
Curtain Wall Detail - Plan View
(Apron is not shown)

Notes:

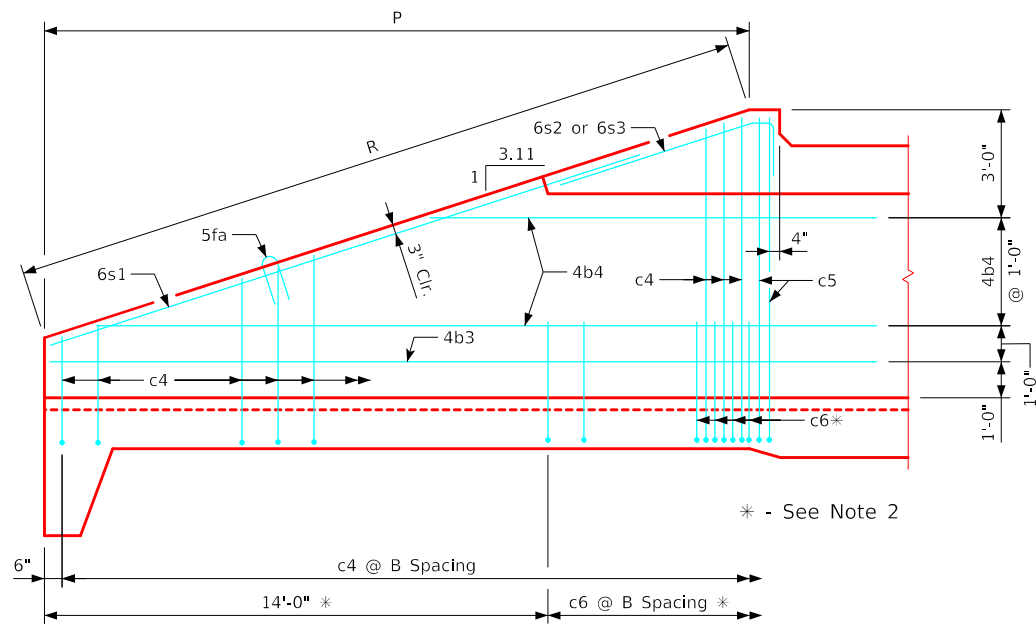
1. See Sheet TRRCB G2-20 for General Notes, Specifications, and Design Stresses.
2. For dimension table see Sheet TRPWH 15-1-20.

August 2022 LATEST REVISION DATE	 APPROVED BY BRIDGE ENGINEER		
		Standard Design - Triple Reinforced Concrete Box Culverts	
		Parallel Wing Headwalls	
		July, 2020	
		Cross Section Details 15° Skew	TRPWH 15-2-20

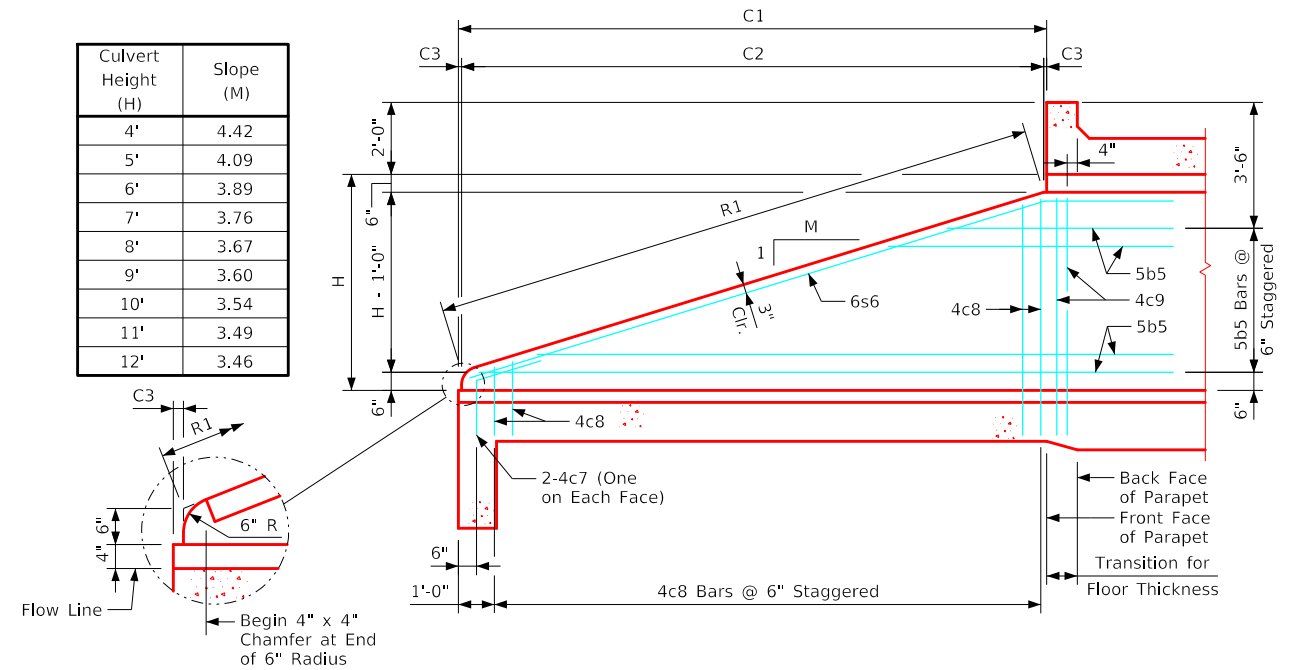
ENGLISHLRFDSDIGNEDTRIPLECULVERTS.DGN - TRPWH 15-3-20 - THIS SHEET ISSUED 07-2020.



Typical View - Front Face Wingwall Reinforcing



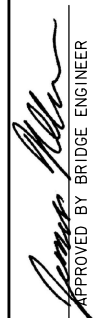

Typical View - Back Face Wingwall Reinforcing



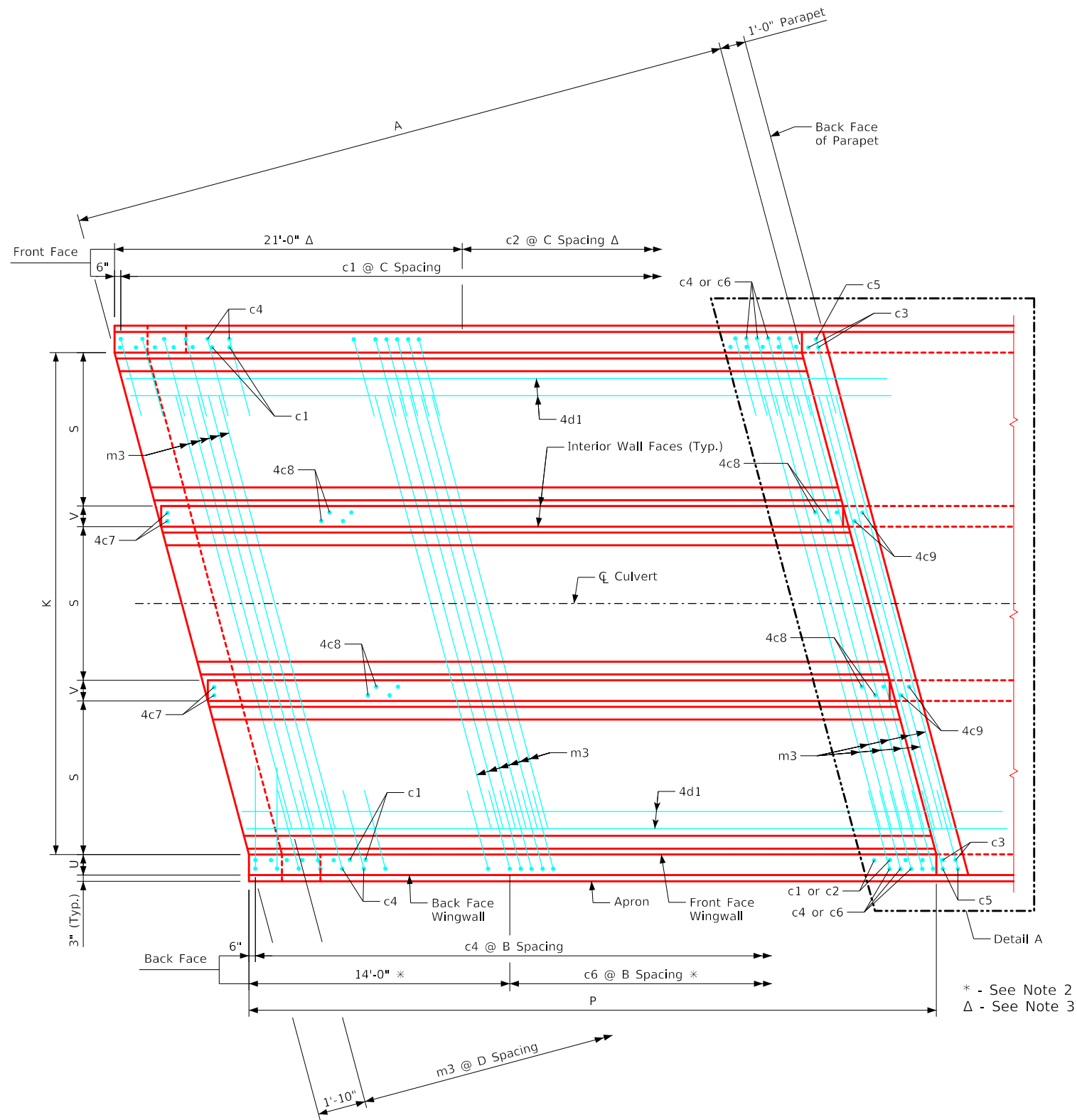
Typical View - Interior Wall

Notes:

1. Bar spacings and positions shown are similar for all sizes of headwalls in this standard.
2. Not applicable for 4' thru 5' height headwalls.
3. Not applicable for 4' thru 8' height headwalls.
4. For headwall dimensions and bar spacing see Sheet TRPWH 15-1-20.
5. Apron m3 bars are to be centered on \mathcal{C} culvert.
6. B.F.V. (c5) and F.F.V. (c3) and interior wall both F.V. (c9) bars are approximately 4" from the back of parapet for all headwalls.

LATEST REVISION DATE	 APPROVED BY BRIDGE ENGINEER		
		Standard Design - Triple Reinforced Concrete Box Culverts	
		Parallel Wing Headwalls	
		July, 2020	
		Wingwall Elevations 15° Skew	TRPWH 15-3-20

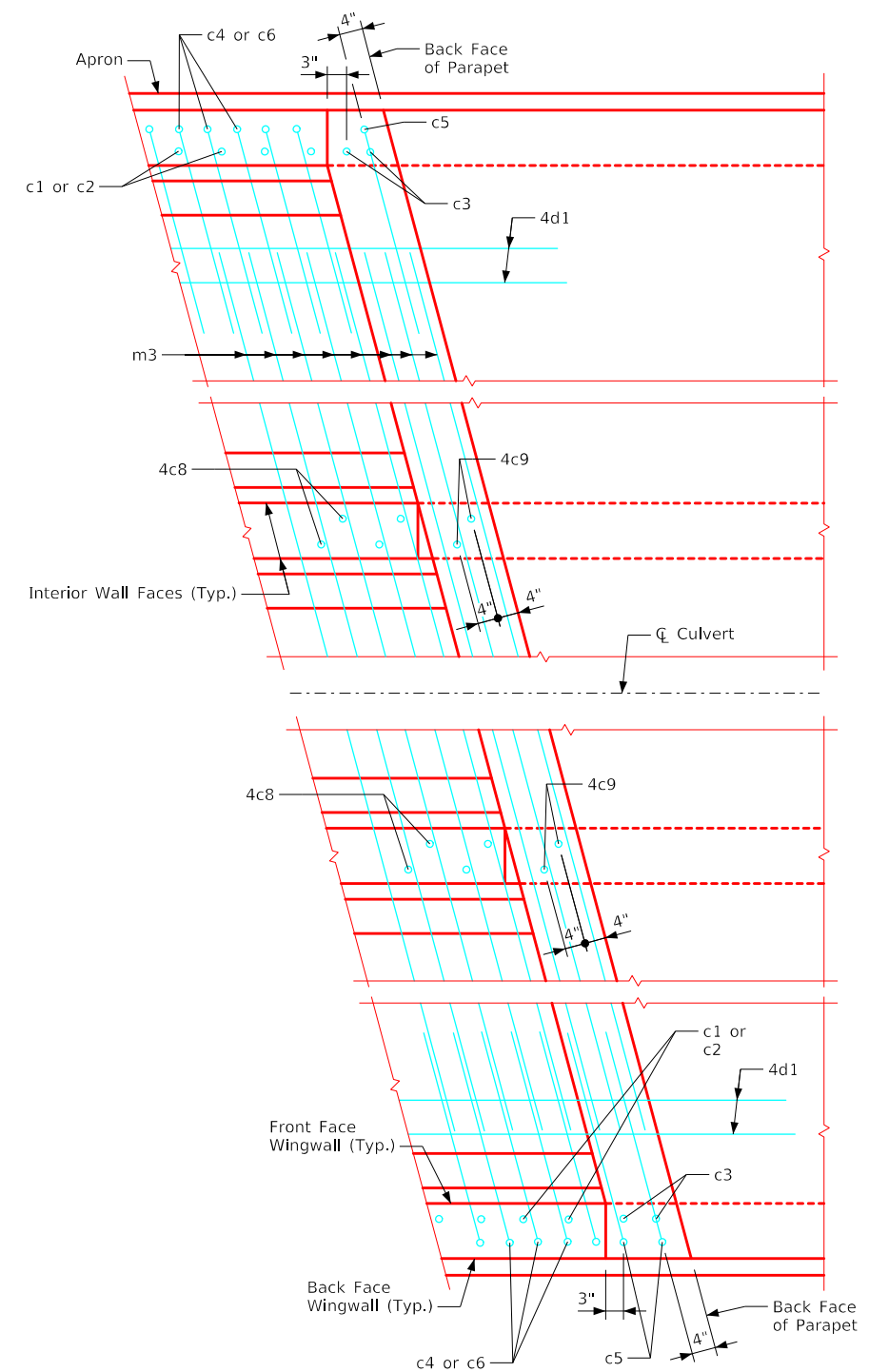
ENGLISHLRFDDESIGNEDTRIPLECULVERTS.DGN - TRPWH 15-4-20 - THIS SHEET ISSUED 07-2020.



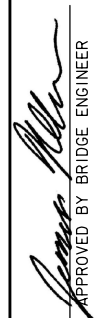

Plan View - Bottom Apron Reinforcing
(Curtain Wall Reinforcing not shown, See Sheet TRPWH 15-2-20)

Notes:

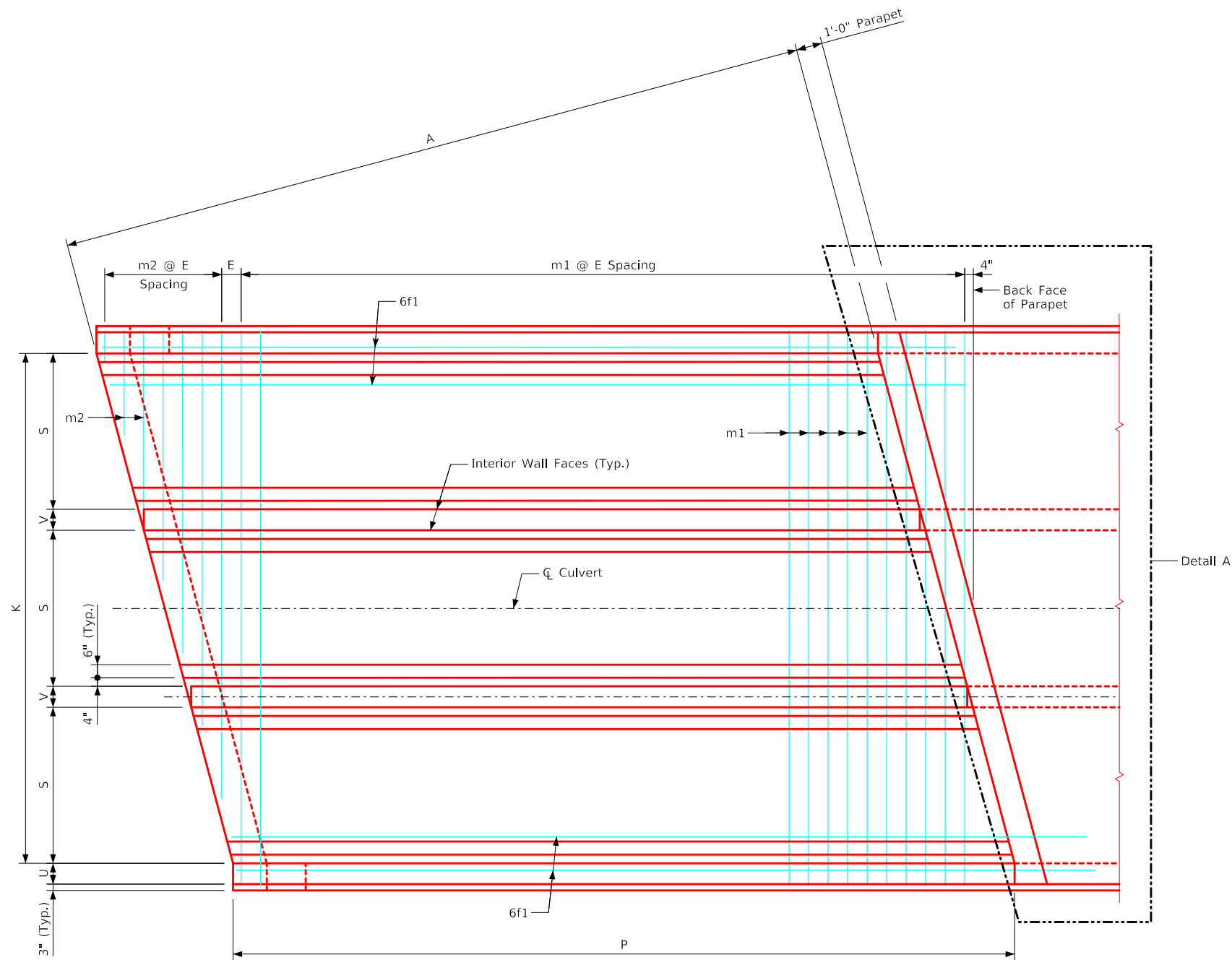
1. Bar spacings and positions shown are similar for all sizes of headwalls in this standard.
2. Not applicable for 4' & 5' height headwalls.
3. Not applicable for 4' thru 8' height headwalls.
4. For headwall dimensions and bar spacing see Sheet TRPWH 15-1-20.
5. Apron m3 bars are to be centered on CL culvert.
6. B.F.V. (c5), F.F.V. (c3) and interior wall both F.V. (c9) bars are approximately 4" from the back of parapet for all headwalls.



Detail A

LATEST REVISION DATE		APPROVED BY BRIDGE ENGINEER		
			Standard Design - Triple Reinforced Concrete Box Culverts	
			Parallel Wing Headwalls	
			July, 2020	
			Bottom Apron Reinforcing 15° Skew	TRPWH 15-4-20

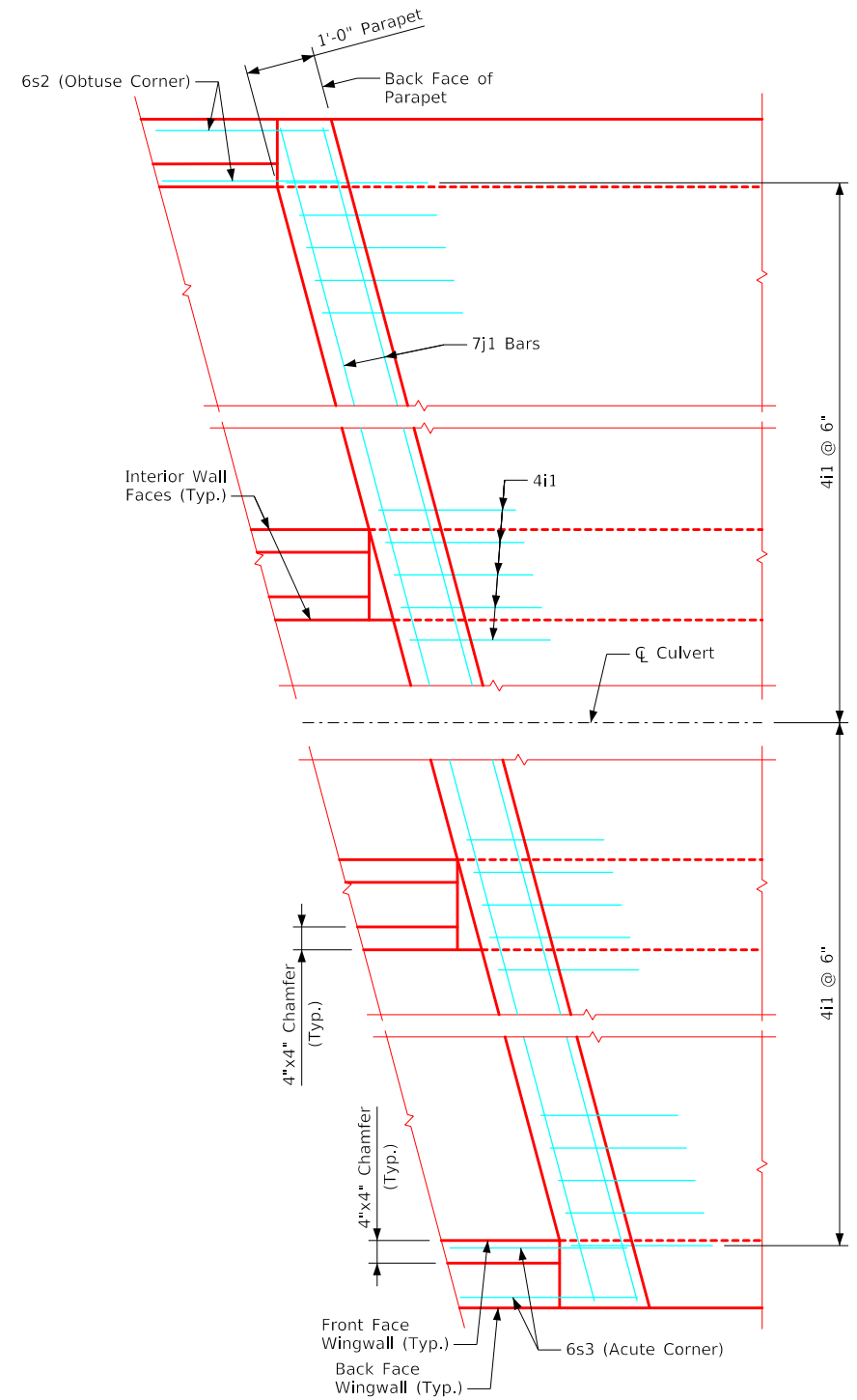
ENGLISHLRFDSignedTRIPLECULVERTS.DGN - TRPWH 15-5-20 - THIS SHEET ISSUED 07-2020.





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

Notes:

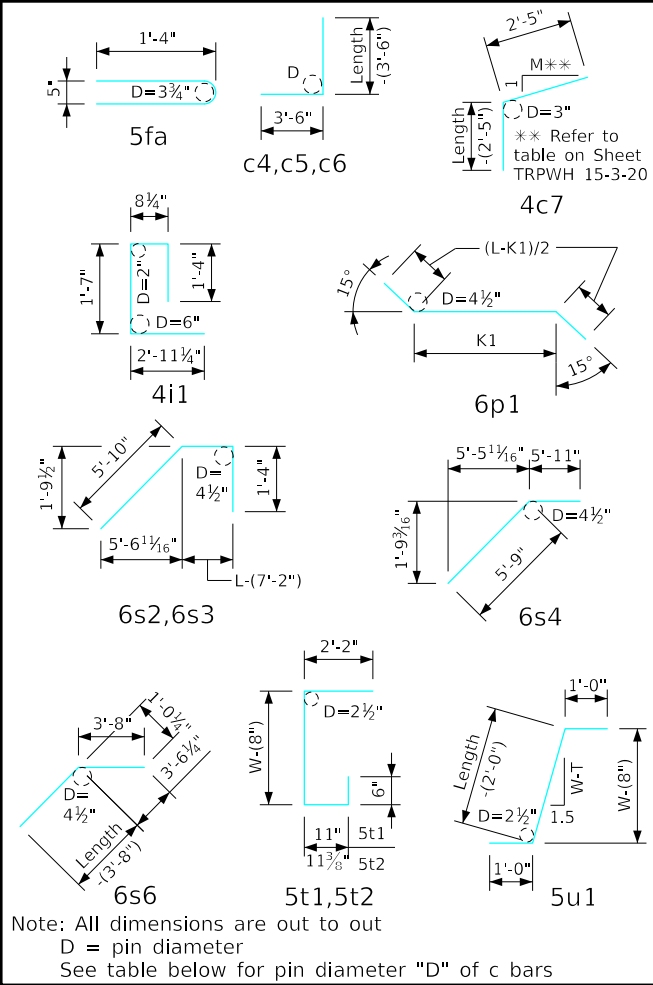
1. Bar spacings and positions shown are similar for all sizes of headwalls in this standard.
2. For headwall dimensions and bar spacing see Sheet TRPWH 15-1-20.
3. Top transverse apron bars are referenced approximately 4" from the back of the parapet for all headwalls.



Detail A
(Showing parapet bars only)



































LATEST REVISION DATE	 APPROVED BY BRIDGE ENGINEER		
		Standard Design - Triple Reinforced Concrete Box Culverts	
		Parallel Wing Headwalls	
		July, 2020	
		Parapet Reinforcing & Top Apron Reinforcing 15° Skew	TRPWH 15-5-20

Bent Bar Details



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

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



Location		Shape	12' x 12'				12' x 11'				12' x 10'				12' x 9'				12' x 8'				12' x 7'			
			Bar	No.	Length	Wt.	Bar	No.	Length	Wt.	Bar	No.	Length	Wt.	Bar	No.	Length	Wt.	Bar	No.	Length	Wt.	Bar	No.	Length	Wt.
Fence Anchor (Galv.)			5fa	2	2'-10	6	5fa	2	2'-10	6	5fa	2	2'-10	6	5fa	2	2'-10	6	5fa	2	2'-10	6	5fa	2	2'-10	6
Wingwall, F.F.H.			5b1	2	41'-7	92	5b1	2	38'-6	80	5b1	2	35'-5	74	5b1	2	32'-4	67	5b1	2	29'-2	61	5b1	2	26'-1	54
Wingwall, F.F.H.			5b2	22 Var.	2 Each 9'-2 to 40'-2	571	5b2	20 Var.	2 Each 9'-2 to 37'-1	482	5b2	18 Var.	2 Each 9'-2 to 34'-0	405	5b2	16 Var.	2 Each 9'-2 to 30'-11	334	5b2	14 Var.	2 Each 9'-2 to 27'-9	270	5b2	12 Var.	2 Each 9'-2 to 24'-8	212
Wingwall, B.F.H.			4b3	2	41'-9	59	4b3	2	38'-8	52	4b3	2	35'-6	47	4b3	2	32'-5	43	4b3	2	29'-3	39	4b3	2	26'-2	35
Wingwall, B.F.H.			4b4	20 Var.	2 Each 12'-5 to 40'-4	356	4b4	18 Var.	2 Each 12'-5 to 37'-3	299	4b4	16 Var.	2 Each 12'-4 to 34'-1	248	4b4	14 Var.	2 Each 12'-4 to 31'-0	203	4b4	12 Var.	2 Each 12'-4 to 27'-11	161	4b4	10 Var.	2 Each 12'-4 to 24'-9	124
Interior Wall, Both F.H.			5b5	42 Var.	2 Each 6'-8 to 41'-2	1051	5b5	38 Var.	2 Each 6'-8 to 38'-1	887	5b5	34 Var.	2 Each 6'-8 to 35'-0	739	5b5	30 Var.	2 Each 6'-8 to 31'-10	602	5b5	26 Var.	2 Each 6'-9 to 28'-9	481	5b5	22 Var.	2 Each 6'-10 to 25'-7	372
Wingwall, F.F.V.			5c1	76 Var.	2 Each 2'-8 to 14'-7	684	5c1	70 Var.	2 Each 2'-8 to 13'-7	593	4c1	64 Var.	2 Each 2'-8 to 12'-8	328	4c1	58 Var.	2 Each 2'-8 to 11'-8	278	4c1	68 Var.	2 Each 2'-8 to 10'-8	303	4c1	60 Var.	2 Each 2'-8 to 9'-8	247
Wingwall, F.F.V.			5c2	36 Var.	2 Each 9'-3 to 14'-9	451	5c2	30 Var.	2 Each 9'-3 to 13'-9	360	4c2	24 Var.	2 Each 9'-3 to 12'-10	177	4c2	16 Var.	2 Each 9'-3 to 11'-6	111	c2	--	--	--	c2	--	--	--
Wingwall, F.F.V. (O)			5c3	2	15'-1	31	5c3	2	14'-1	29	4c3	2	13'-1	17	4c3	2	12'-1	16	4c3	2	11'-1	15	4c3	2	10'-1	13
Wingwall, F.F.V. (A)			5c3	2	15'-1	31	5c3	2	14'-1	29	4c3	2	13'-1	17	4c3	2	12'-1	16	4c3	2	11'-1	15	4c3	2	10'-1	13
Wingwall, B.F.V.			6c4	76 Var.	2 Each 6'-4 to 18'-3	1403	5c4	70 Var.	2 Each 6'-4 to 17'-4	864	5c4	64 Var.	2 Each 6'-4 to 16'-4	757	5c4	58 Var.	2 Each 6'-4 to 15'-5	658	5c4	52 Var.	2 Each 6'-4 to 14'-5	563	5c4	46 Var.	2 Each 6'-4 to 13'-5	474
Wingwall, B.F.V. (O)			6c5	1	18'-7	28	5c5	1	17'-7	18	5c5	1	16'-7	17	5c5	1	15'-7	16	5c5	1	14'-7	15	5c5	1	13'-7	14
Wingwall, B.F.V. (A)			6c5	2	18'-7	56	5c5	2	17'-7	37	5c5	2	16'-7	35	5c5	2	15'-7	33	5c5	2	14'-7	30	5c5	2	13'-7	28
Wingwall, B.F.V.			6c6	50	8'-6	638	5c6	44	8'-6	390	5c6	38	8'-6	337	5c6	30	8'-6	266	5c6	24	8'-6	213	5c6	18	8'-6	160
Interior Wall, Both F.V			4c7	4	3'-10	10	4c7	4	3'-10	10	4c7	4	3'-10	10	4c7	4	3'-10	10	4c7	4	3'-10	10	4c7	4	3'-10	10
Interior Wall, Both F.V			4c8	150 Var.	2 Each 1'-7 to 12'-3	693	4c8	136 Var.	2 Each 1'-7 to 11'-2	579	4c8	124 Var.	2 Each 1'-7 to 10'-2	487	4c8	112 Var.	2 Each 1'-7 to 9'-3	405	4c8	100 Var.	2 Each 1'-7 to 8'-3	328	4c8	88 Var.	2 Each 1'-7 to 7'-3	260
Interior Wall, Both F.V			4c9	4	12'-7	34	4c9	4	11'-7	31	4c9	4	10'-7	28	4c9	4	9'-7	26	4c9	4	8'-7	23	4c9	4	7'-7	20
Apron, Longit., Bott.			4d1	39	41'-7	1146	4d1	39	38'-5	1001	4d1	39	35'-4	921	4d1	39	32'-3	840	4d1	39	29'-2	760	4d1	39	26'-0	677
Apron, Longit., Top			6f1	39	41'-7	2577	6f1	39	38'-5	2250	6f1	39	35'-4	2070	6f1	39	32'-3	1889	6f1	39	29'-2	1709	6f1	39	26'-0	1523
Parapet, Vertical			4i1	77	6'-7	339	4i1	77	6'-7	339	4i1	75	6'-7	330	4i1	75	6'-7	330	4i1	75	6'-7	330	4i1	75	6'-7	330
Parapet, Horiz.			7j1	4	41'-0	355	7j1	4	41'-0	355	7j1	4	40'-4	350	7j1	4	40'-4	350	7j1	4	40'-4	350	7j1	4	40'-0	327
Apron, Trans., Top			5m1	45	40'-2	1999	5m1	41	40'-2	1821	5m1	37	39'-6	1524	5m1	33	39'-6	1360	5m1	29	39'-6	1195	5m1	25	39'-2	1021
Apron, Trans., Top			5m2	14 Var.	2'-7 to 39'-0	304	5m2	14 Var.	2'-3 to 38'-7	298	5m2	13 Var.	4'-4 to 37'-11	286	5m2	13 Var.	3'-11 to 37'-6	281	5m2	13 Var.	3'-6 to 37'-1	275	5m2	13 Var.	3'-0 to 36'-7	268
Apron, Trans., Bott.			5m3	73	38'-1	2900	5m3	67	38'-1	2661	6m3	31	38'-1	1773	5m3	28	37'-4	1090	5m3	25	37'-4	973	5m3	22	37'-0	849
Curtain, Horiz.			6p1	6	41'-6	396	6p1	6	41'-6	396	6p1	6	40'-10	390	6p1	6	40'-10	390	6p1	6	40'-10	390	6p1	5	40'-6	322
Wing Slope, Both F.			6s1	4	36'-8	220	6s1	4	33'-5	201	6s1	4	30'-2	181	6s1	4	26'-11	162	6s1	4	23'-8	142	6s1	4	20'-5	123
Wing Slope, Both F. (O)			6s2	2	7'-9	23	6s2	2	7'-9	23	6s2	2	7'-10	24	6s2	2	7'-10	24	6s2	2	7'-10	24	6s2	2	7'-10	24
Wing Slope, Both F. (A)			6s3	2	8'-0	24	6s3	2	8'-0	24	6s3	2	8'-0	24	6s3	2	8'-0	24	6s3	2	8'-0	24	6s3	2	8'-0	24
Wing Slope, F.F.			6s4	2	11'-8	35	6s4	2	11'-8	35	6s4	2	11'-8	35	6s4	2	11'-8	35	6s4	2	11'-8	35	6s4	2	11'-8	35
Wing Slope, F.F.			6s5	2	34'-2	103	6s5	2	30'-11	93	6s5	2	27'-8	83	6s5	2	24'-5	73	6s5	2	21'-2	64	6s5	2	17'-11	54
Interior Wall, Both F.			6s6	4	43'-1	273	6s6	4	39'-9	239	6s6	4	36'-7	220	6s6	4	33'-4	200	6s6	4	30'-1	181	6s6	4	26'-10	161
Curtain, Vert.			5t1	40	7'-11	330	5t1	40	7'-8	320	5t1	40	7'-5	309	5t1	40	7'-2	299	5t1	40	6'-11	289	5t1	39	6'-8	271
Curtain, Vert. Ends			5t2	4	7'-11	33	5t2	4	7'-8	32	5t2	4	7'-5	31	5t2	4	7'-2	30	5t2	4	6'-11	29	5t2	4	6'-8	28
Bracket, Vert.			5u1	4	6'-7	27	5u1	4	6'-5	27	5u1	4	6'-2	26	5u1	4	5'-11	25	5u1	4	5'-9	24	5u1	4	5'-6	23
Estimated Quantities One Headwall	Reinf. Steel		17,278 LB				14,861 LB				12,306 LB				10,492 LB				9327 LB				8102 LB			
	Concrete	Parapet Δ	3.9	124.1 CY	3.9	112.0 CY	3.7	94.0 CY	3.7	83.7 CY	3.7	73.8 CY	3.6	62.4 CY												
		Wingwalls	33.8		23.7		19.5		15.8		11.1															
		Apron *	80.4		74.2		66.6		60.5		54.3		47.7													

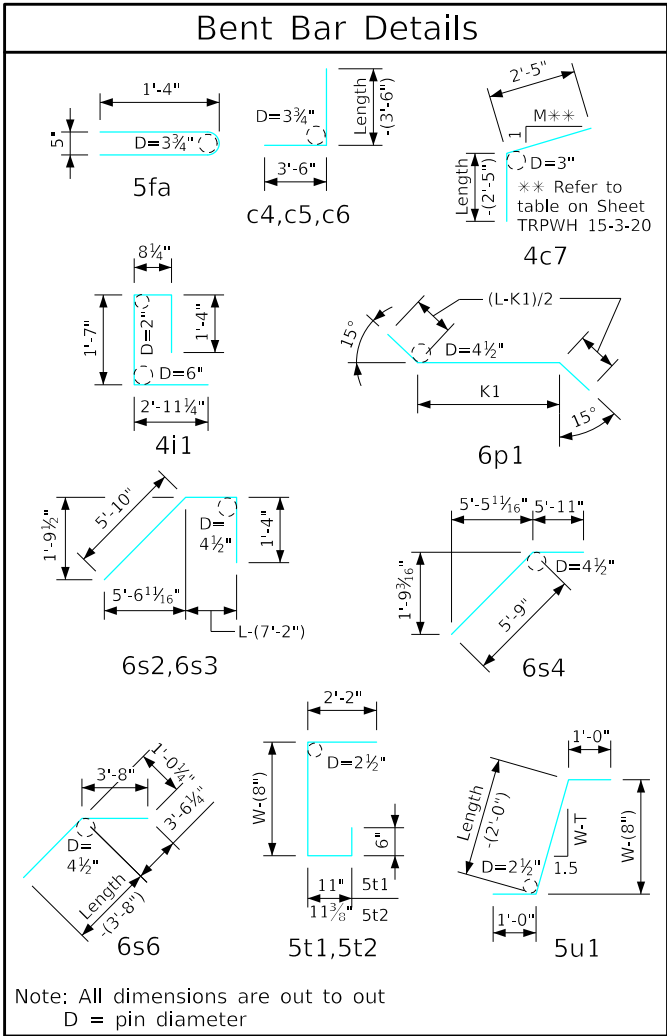
Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap.

(A) - Indicates bar located at acute corner.
(O) - Indicates bar located at obtuse corner.
Refer to Sheet TRPWH 15-1-20 for acute and obtuse corner locations.



































Headwall Notes:

1. This headwall is based on a 3:1 slope normal to centerline of roadway.
2. The sides of the apron are to be formed to ensure correct line and grade.
3. All apron reinforcing steel is to be supported by bar chairs at intervals of not more than 3'-0" in either direction as outlined in the Standard Specifications.
4. Clear distance from face of concrete to near reinforcing bar is to be 2" unless otherwise noted or shown. Clearance to the bottom ends of vertical bars shall be 3 inches.
5. Concrete quantities are estimated from back of parapet.
6. Horizontal tails of bars "b" & "s" estimated to extend 2'-5" beyond back of parapet (into end of barrel). Longitudinal bars "4d1" and "6f1" estimated to project into end section of barrel a minimum of 2'-5" beyond back of parapet. The "length" column reflects total number of feet necessary to meet these requirements.
7. Dimensions are in feet and inches unless otherwise noted.

LATEST REVISION DATE	 APPROVED BY BRIDGE ENGINEER		
		Standard Design - Triple Reinforced Concrete Box Culverts Parallel Wing Headwalls July, 2020	
		Quantity Tabulation 12'-0" Span 15° Skew	TRPWH 15-6-20 Sheet 1 of 2



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

Bill of Reinforcing for One Headwall 15° Skew Span x Culvert Height															
Location		Shape	12' x 6'				12' x 5'				12' x 4'				
			Bar	No.	Length	Wt.	Bar	No.	Length	Wt.	Bar	No.	Length	Wt.	
Fence Anchor (Galv.)			5fa	2	2'-10	6	5fa	2	2'-10	6	5fa	2	2'-10	6	
Wingwall, F.F.H.			5b1	2	23'-0	48	5b1	2	19'-10	41	5b1	2	16'-9	35	
Wingwall, F.F.H.			5b2	10 Var.	2 Each 9'-2 to 21'-7	160	5b2	8 Var.	2 Each 9'-2 to 18'-5	115	5b2	6 Var.	2 Each 9'-2 to 15'-4	77	
Wingwall, B.F.H.			4b3	2	23'-1	31	4b3	2	19'-11	27	4b3	2	16'-10	22	
Wingwall, B.F.H.			4b4	8 Var.	2 Each 12'-4 to 21'-8	91	4b4	6 Var.	2 Each 12'-4 to 18'-6	62	4b4	4 Var.	2 Each 12'-4 to 15'-5	37	
Interior Wall, Both F.H.			5b5	18 Var.	2 Each 6'-11 to 22'-6	276	5b5	14 Var.	2 Each 7'-1 to 19'-4	193	5b5	10 Var.	2 Each 7'-4 to 16'-2	123	
Wingwall, F.F.V.			4c1	52 Var.	2 Each 2'-8 to 8'-9	198	4c1	34 Var.	2 Each 2'-8 to 7'-10	119	4c1	26 Var.	2 Each 2'-8 to 6'-6	80	
Wingwall, F.F.V.			c2	--	--	--	c2	--	--	--	c2	--	--	--	
Wingwall, F.F.V. (O)			4c3	2	9'-1	12	4c3	2	8'-1	11	4c3	2	7'-1	9	
Wingwall, F.F.V. (A)			4c3	2	9'-1	12	4c3	2	8'-1	11	4c3	2	7'-1	9	
Wingwall, B.F.V.			5c4	40 Var.	2 Each 6'-4 to 12'-6	393	5c4	44 Var.	2 Each 6'-4 to 11'-5	407	5c4	36 Var.	2 Each 6'-4 to 10'-6	316	
Wingwall, B.F.V. (O)			5c5	1	12'-7	13	5c5	1	11'-7	12	5c5	1	10'-7	11	
Wingwall, B.F.V. (A)			5c5	2	12'-7	26	5c5	2	11'-7	24	5c5	2	10'-7	22	
Wingwall, B.F.V.			5c6	12	8'-6	106	c6	--	--	--	c6	--	--	--	
Interior Wall, Both F.V			4c7	4	3'-10	10	4c7	4	3'-10	10	4c7	4	3'-10	10	
Interior Wall, Both F.V			4c8	74 Var.	2 Each 1'-7 to 6'-2	192	4c8	62 Var.	2 Each 1'-7 to 5'-3	142	4c8	50 Var.	2 Each 1'-6 to 4'-3	96	
Interior Wall, Both F.V			4c9	4	6'-7	18	4c9	4	5'-7	15	4c9	4	4'-7	12	
Apron, Longit., Bott.			4d1	39	22'-11	597	4d1	39	19'-10	517	4d1	39	16'-8	434	
Apron, Longit., Top			6f1	39	22'-11	1342	6f1	39	19'-10	1162	6f1	39	16'-8	976	
Parapet, Vertical			4i1	75	6'-7	330	4i1	75	6'-7	330	4i1	75	6'-7	330	
Parapet, Horiz.			7j1	4	40'-0	327	7j1	4	40'-0	327	7j1	4	40'-0	327	
Apron, Trans., Top			5m1	21	39'-2	858	5m1	16	39'-2	654	5m1	12	39'-2	490	
Apron, Trans., Top			5m2	13 Var.	2'-7 to 36'-2	263	5m2	14 Var.	2'-2 to 38'-7	298	5m2	13 Var.	4'-7 to 38'-2	290	
Apron, Trans., Bott.			4m3	19	36'-3	460	4m3	21	36'-3	509	4m3	13	36'-3	315	
Curtain, Horiz.			6p1	5	40'-6	322	6p1	5	40'-6	322	6p1	5	40'-6	322	
Wing Slope, Both F.			6s1	4	17'-1	103	6s1	4	13'-10	83	6s1	4	10'-7	64	
Wing Slope, Both F. (O)			6s2	2	7'-10	24	6s2	2	7'-10	24	6s2	2	7'-10	24	
Wing Slope, Both F. (A)			6s3	2	8'-0	24	6s3	2	8'-0	24	6s3	2	8'-0	24	
Wing Slope, F.F.			6s4	2	11'-8	35	6s4	2	11'-8	35	6s4	2	11'-8	35	
Wing Slope, F.F.			6s5	2	14'-8	44	6s5	2	11'-4	34	6s5	2	8'-1	24	
Interior Wall, Both F.			6s6	4	23'-7	142	6s6	4	20'-4	122	6s6	4	17'-1	103	
Curtain, Vert.			5t1	39	6'-5	261	5t1	39	6'-5	261	5t1	39	6'-5	261	
Curtain, Vert. Ends			5t2	4	6'-5	27	5t2	4	6'-5	27	5t2	4	6'-5	27	
Bracket, Vert.			5u1	4	5'-4	22	5u1	4	5'-4	22	5u1	4	5'-4	22	
Estimated Quantities One Headwall	Reinf. Steel		6773 LB				5946 LB				4933 LB				
	Concrete	Parapet Δ	3.6	53.7 CY				3.6	45.8 CY				3.6	38.2 CY	
		Wingwalls	8.4					6.1					4.1		
		Apron *	41.7					36.1					30.5		

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.

(A) - Indicates bar located at acute corner.
(O) - Indicates bar located at obtuse corner.
Refer to Sheet TRPWH 15-1-20 for acute and obtuse corner locations.

Headwall Notes:

1. This headwall is based on a 3:1 slope normal to centerline of roadway.
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			Standard Design - Triple Reinforced Concrete Box Culverts	
			Parallel Wing Headwalls	
			July, 2020	
			Quantity Tabulation 12'-0" Span 15° Skew	TRPWH 15-6-20 Sheet 2 of 2