



# Single Reinforced Concrete Box Culvert Standards - Flared Wing Headwalls

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ENGLISHLRFDDESIGNEDSINGLECULVERTSFWH.DGN - FWH G1-21 - THIS SHEET ISSUED 02-2021.

LATEST REVISION DATE	APPROVED BY BRIDGE ENGINEER		
		Standard Design - Single Reinforced Concrete Box Culverts <b>Flared Wing Headwalls</b> February, 2021	
		Index of Sheets	FWH G1-21



# Single Reinforced Concrete Box Culvert Standards - Flared Wing Headwalls

## General Notes:

- The RCB culvert sections are designed for HL-93 live load and earth fills of varying heights.
- Vertical earth pressure,  $EV=0.120$  kcf.  
Horizontal earth pressure,  $EH_{max} = 0.060$  kcf max,  $EH_{min} = 0.030$  kcf.
- 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.
- 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 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

- 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 Single Reinforced Concrete Box Culvert Standards (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

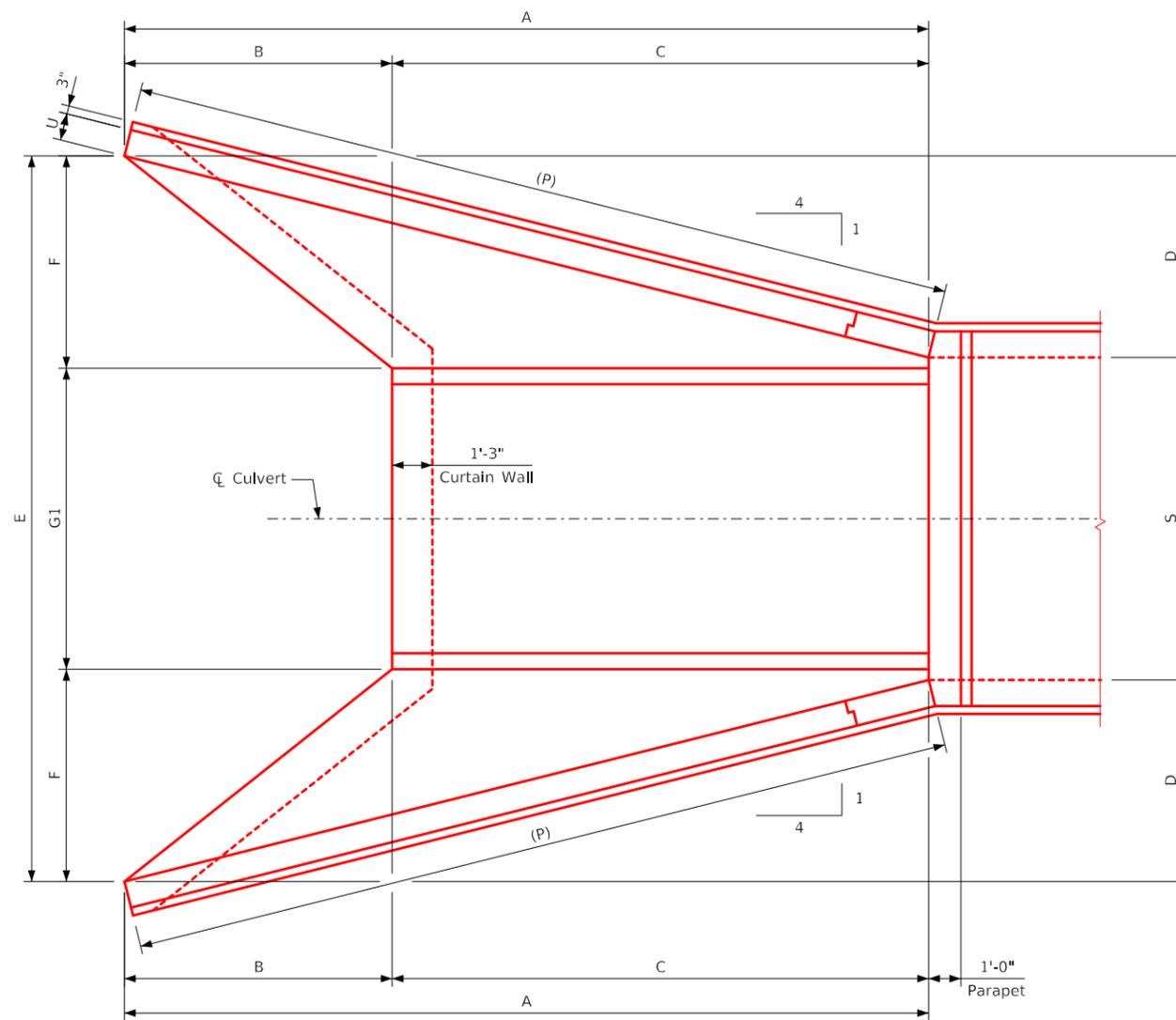
## Design Stresses:

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  <b>Flared Wing Headwalls</b>  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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		<b>Flared Wing Headwalls</b> February, 2021	
		Dimension Plan 0° Skew	FWH 0-1-21

Dimension Table

Table with columns S x H and rows A through W. Each row contains 30 numerical values representing dimensions in feet and inches.

Dimension Table

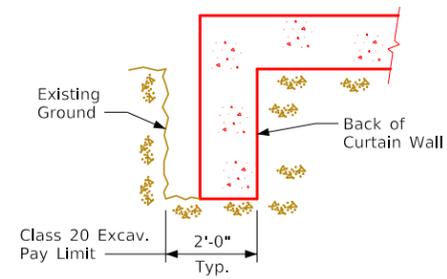
Table with columns S x H and rows A through W. Each row contains 29 numerical values representing dimensions in feet and inches.

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.

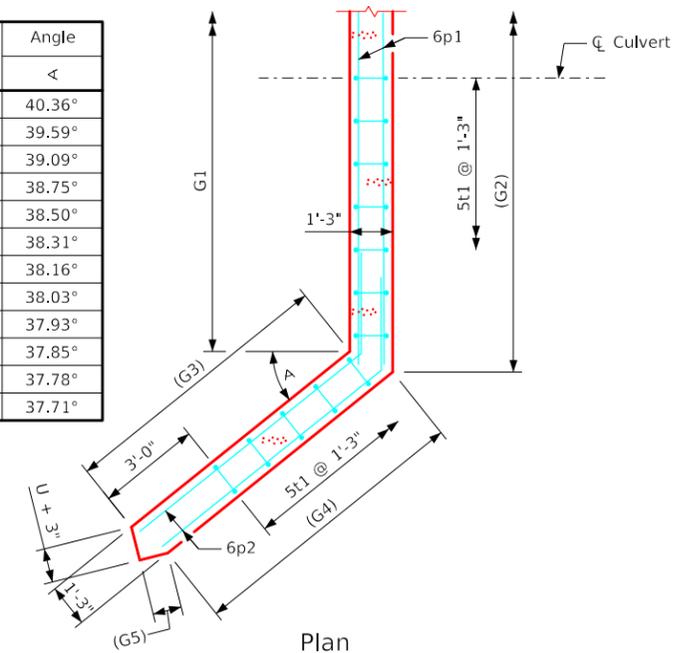
Approval block containing IOWA DOT logo, project title 'Standard Design - Single Reinforced Concrete Box Culverts Flared Wing Headwalls', date 'February, 2021', and title 'Dimension Table 0° Skew' with sheet number 'FWH 0-2-21'. Includes a signature line for 'APPROVED BY BRIDGE ENGINEER'.

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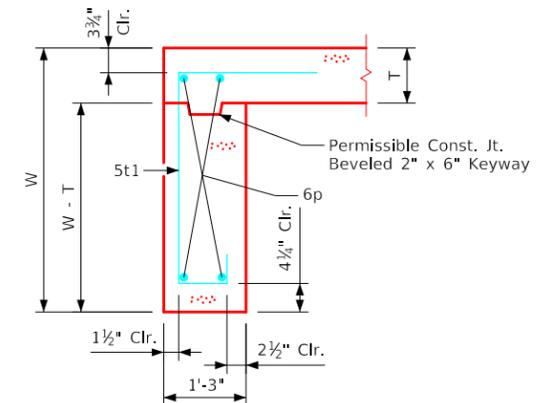


Curtain Wall  
Class 20 Excavation

Culvert Height (H)	Angle
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

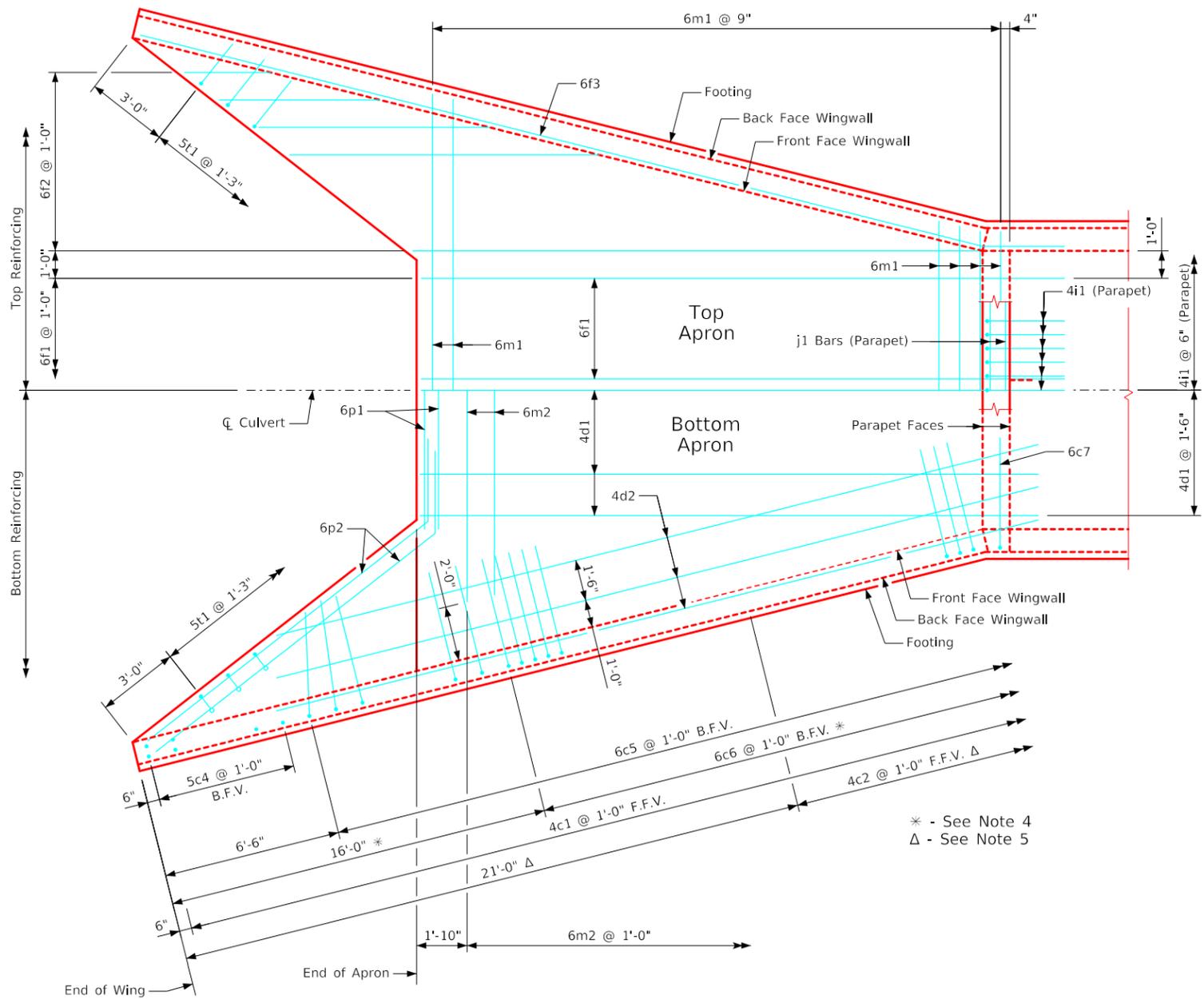


Section

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.

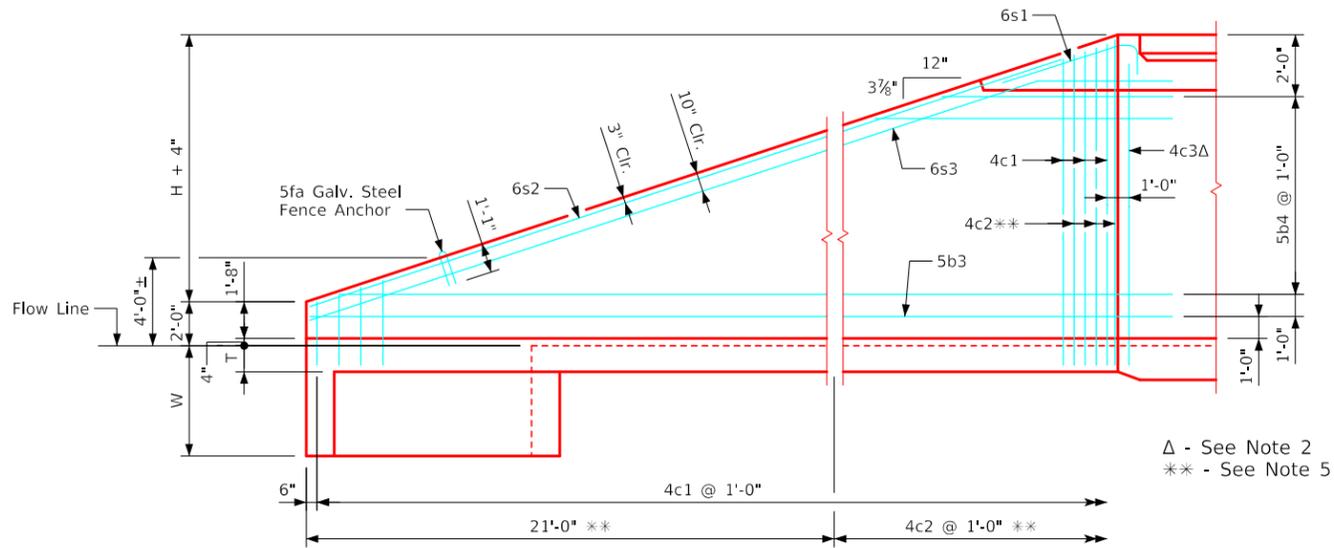


Plan View - Top & Bottom of Apron Reinforcing

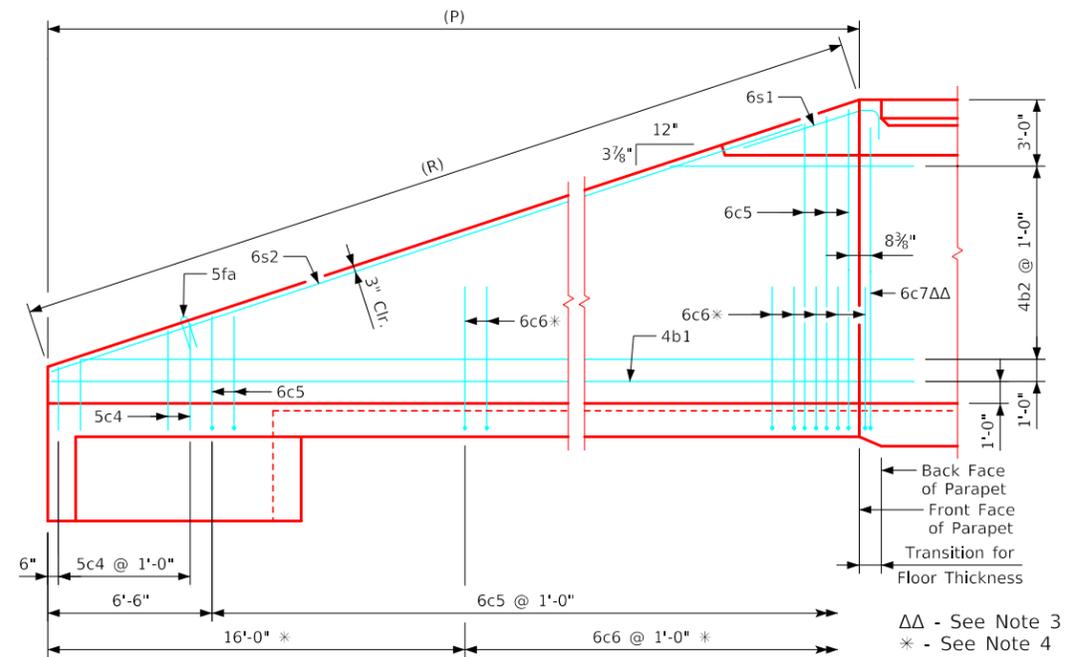
\* - See Note 4  
Δ - See Note 5

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		<b>Flared Wing Headwalls</b> February, 2021	
<b>Apron &amp; Curtain Wall Details</b> 0° Skew		<b>FWH 0-3-21</b>	

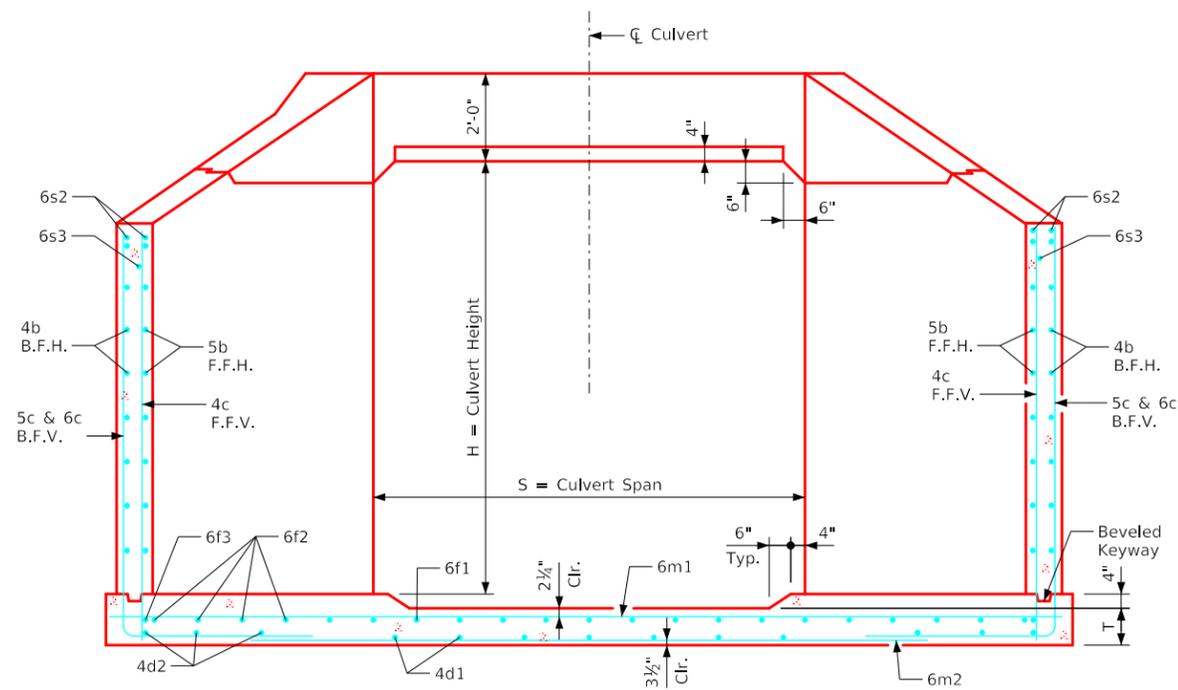
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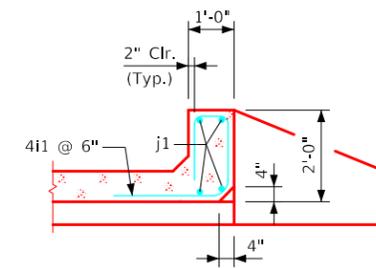
Typical View - Front Face Wingwall Reinforcing



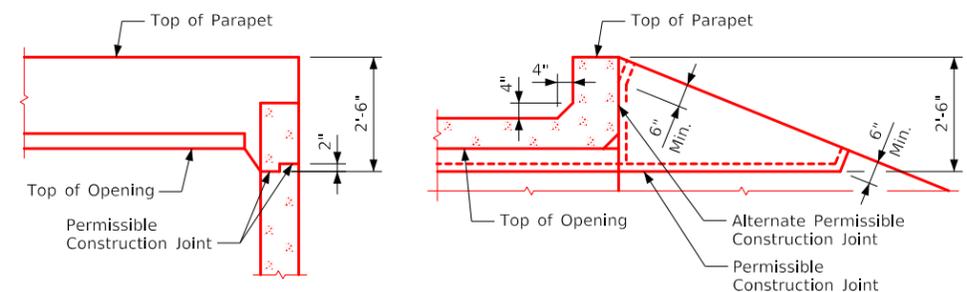
Typical View - Back Face Wingwall Reinforcing



Typical Section - Near Center of Apron



Section thru Parapet



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 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 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 0-2-21.
7. Top of wall slope may be rounded in some instances.

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		Flared Wing Headwalls February, 2021	
		Wingwall & Parapet Details 0° Skew	FWH 0-4-21

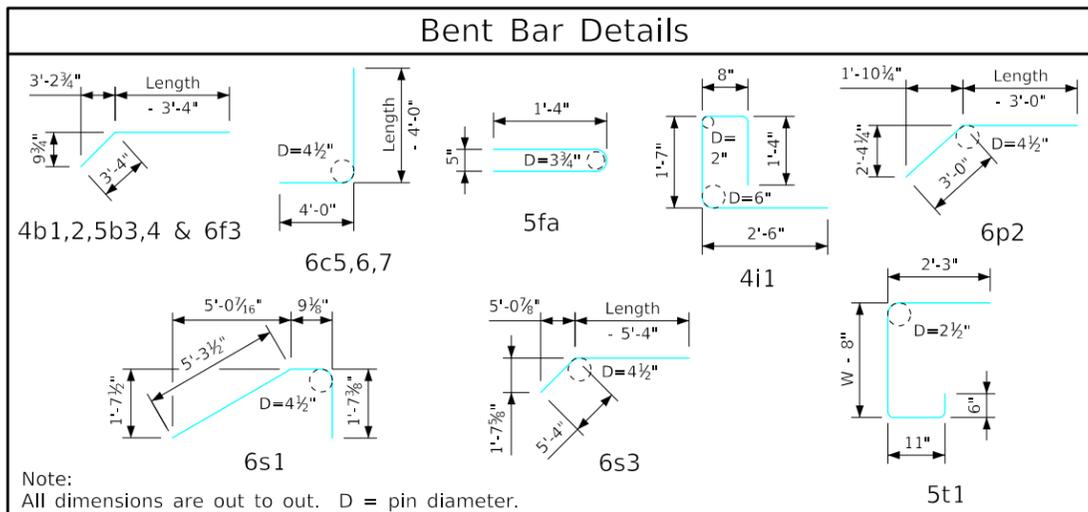


### Bill of Reinforcing for One Headwall 0° Skew Span x Culvert Height

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.		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
Reinf. Steel			4410 LB			3550 LB			2981 LB			2485 LB			
Concrete			30.9 CY			25.9 CY			21.5 CY			17.5 CY			
One Headwall			1.9			1.9			1.9			1.9			
Parapet Δ			6.5			5.0			3.7			2.5			
Wingwalls			22.5			19.0			15.9			13.1			
Apron *															

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 FWH G2-21 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 - Single Reinforced Concrete Box Culverts	
		<h3 style="margin: 0;">Flared Wing Headwalls</h3> February, 2021	
		Quantity Tabulation 16'-0" Span 0° Skew	FWH 0-5-21 Sheet 2 of 2



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

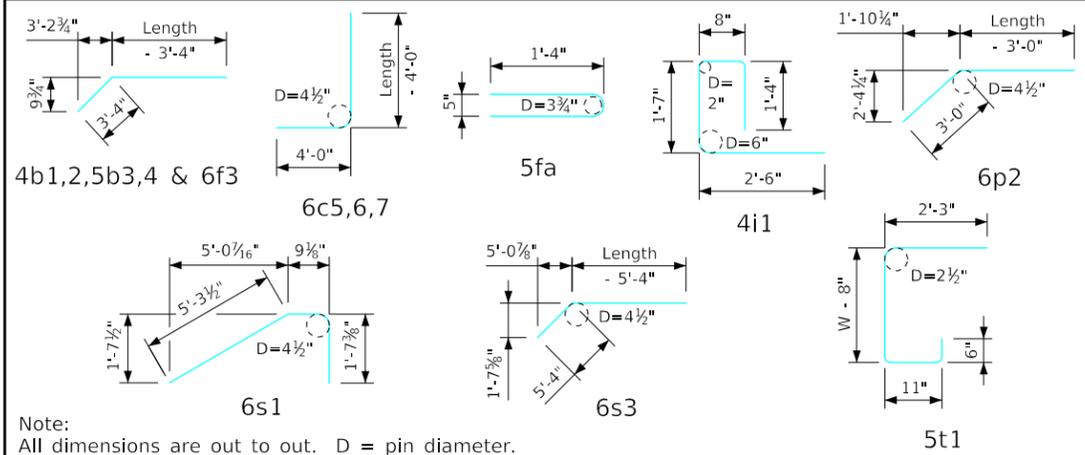
Bar	Location	Shape	14' x 7'			14' x 6'			14' x 5'			14' x 4'			Bar
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	
5fa	Fence Anchor (Galv.)		2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	5fa
4b1	Wingwall, B.F.H.		2	25'-9"	34	2	22'-8"	30	2	19'-7"	26	2	16'-6"	22	4b1
4b2	Wingwall, B.F.H.		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
Reinf. Steel			4158 LB			3322 LB			2778 LB			2302 LB			
Concrete			29.2 CY			24.3 CY			20.1 CY			16.2 CY			
One Headwall			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



#### Headwall Notes:

- See Sheet FWH G2-21 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 - Single Reinforced Concrete Box Culverts	
		<h3 style="margin: 0;">Flared Wing Headwalls</h3> February, 2021	
		Quantity Tabulation 14'-0" Span 0° Skew	FWH 0-6-21 Sheet 2 of 2



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

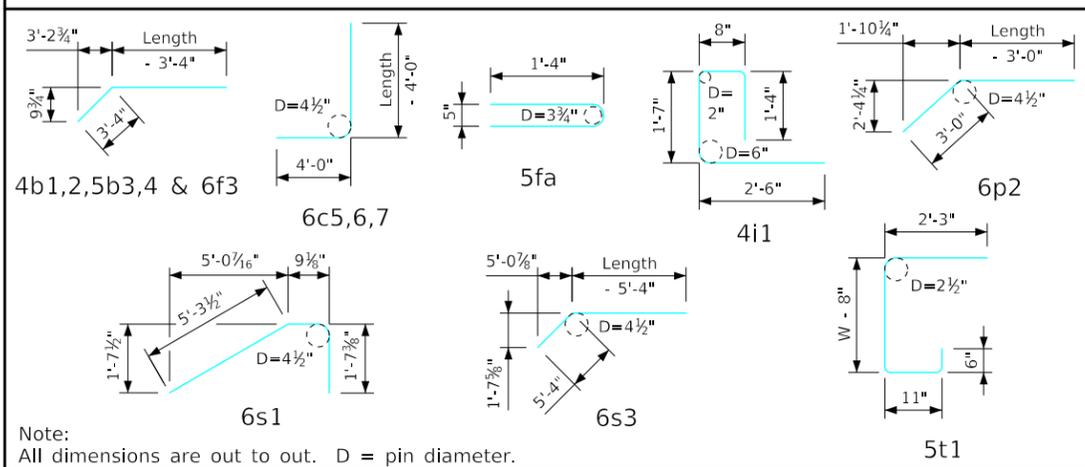
Bar	Location	Shape	12' x 6'			12' x 5'			12' x 4'			Bar		
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.			
5fa	Fence Anchor (Galv.)		2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	5fa		
4b1	Wingwall, B.F.H.		2	22'-8"	30	2	19'-7"	26	2	16'-6"	22	4b1		
4b2	Wingwall, B.F.H.		8 Var.	2 Each 11'-11" to 21'-3"	89	6 Var.	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		
			Reinf. Steel			3045 LB			2521 LB			2064 LB		
Estimated Quantities One Headwall			Concrete			22.8 CY			18.8 CY			15.1 CY		
			Parapet Δ			1.6			1.6			1.6		
			Wingwalls			5.0			3.7			2.5		
			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



### Headwall Notes:

- See Sheet FWH G2-21 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 - Single Reinforced Concrete Box Culverts	
		<h2 style="margin: 0;">Flared Wing Headwalls</h2> February, 2021	
		Quantity Tabulation 12'-0" Span 0° Skew	FWH 0-7-21 Sheet 2 of 2



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

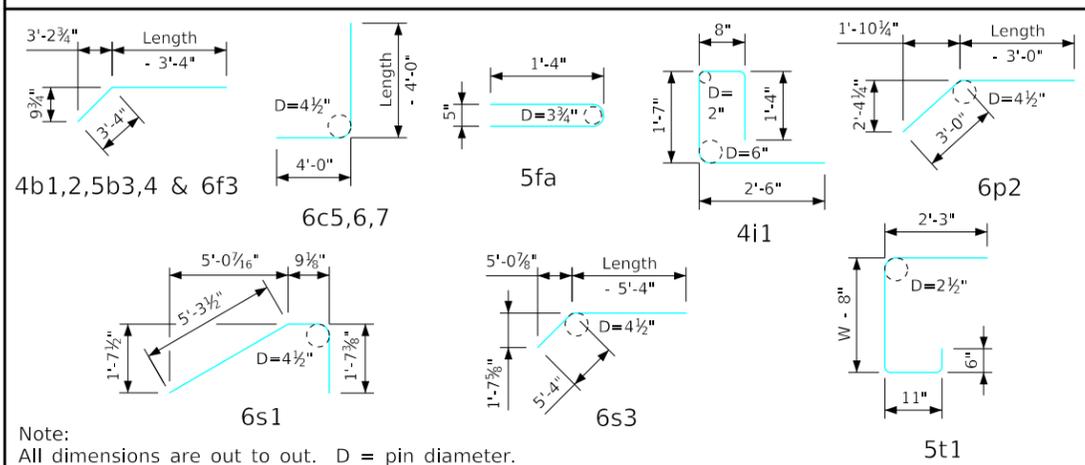
Bar	Location	Shape	10' x 6'			10' x 5'			10' x 4'			Bar		
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.			
5fa	Fence Anchor (Galv.)		2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	5fa		
4b1	Wingwall, B.F.H.		2	22'-8"	30	2	19'-7"	26	2	16'-6"	22	4b1		
4b2	Wingwall, B.F.H.		8 Var.	2 Each 11'-11" to 21'-3"	89	6 Var.	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		
			Reinf. Steel			2819 LB			2319 LB			1884 LB		
Estimated Quantities One Headwall			Concrete			20.5 CY			16.9 CY			13.4 CY		
			Parapet Δ			1.4			1.4			1.4		
			Wingwalls			5.0			3.7			2.5		
			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



### Headwall Notes:

- See Sheet FWH G2-21 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 - Single Reinforced Concrete Box Culverts	
		<h2 style="margin: 0;">Flared Wing Headwalls</h2> February, 2021	
		Quantity Tabulation 10'-0" Span 0° Skew	FWH 0-8-21 Sheet 2 of 2





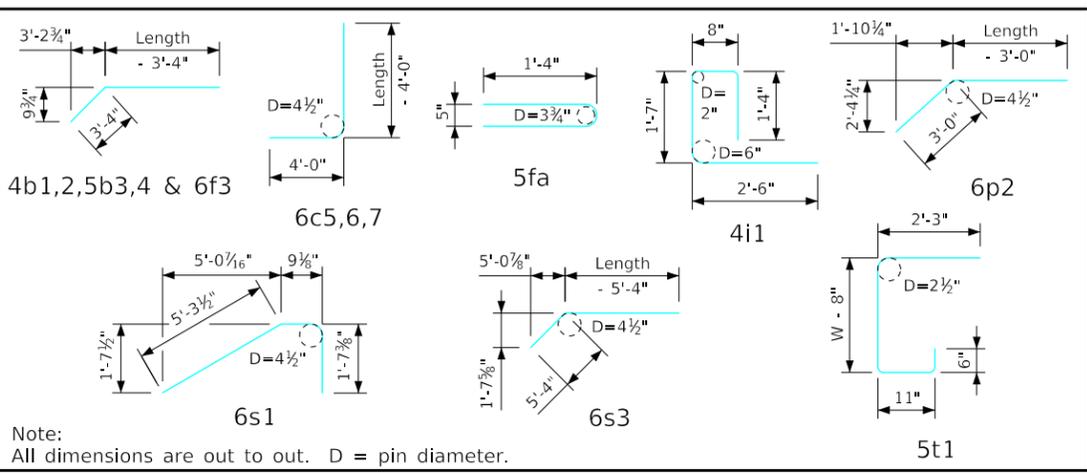
Bill of Reinforcing for One Headwall 0° Skew Span x Culvert Height

Table with columns: Bar, Location, Shape, No., Length, Wt., and sub-categories for 5' x 6', 5' x 5', 5' x 4', 5' x 3', 4' x 4', and 3' x 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.

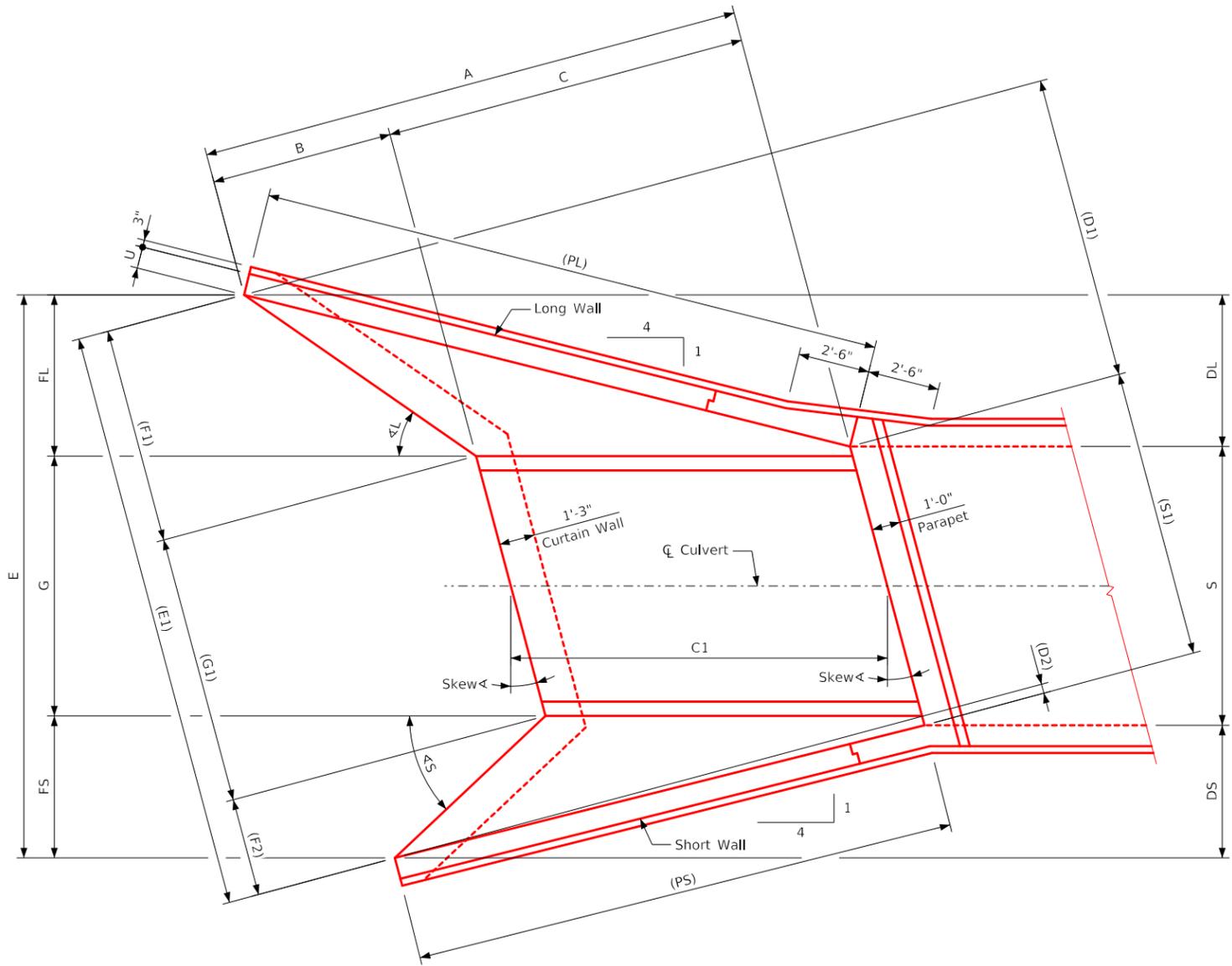
Bent Bar Details



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.

IOWA DOT Standard Design - Single Reinforced Concrete Box Culverts Flared Wing Headwalls February, 2021 Quantity Tabulation 5'-0", 4'-0" & 3'-0" Spans FWH 0-11-21 0° Skew



Plan View

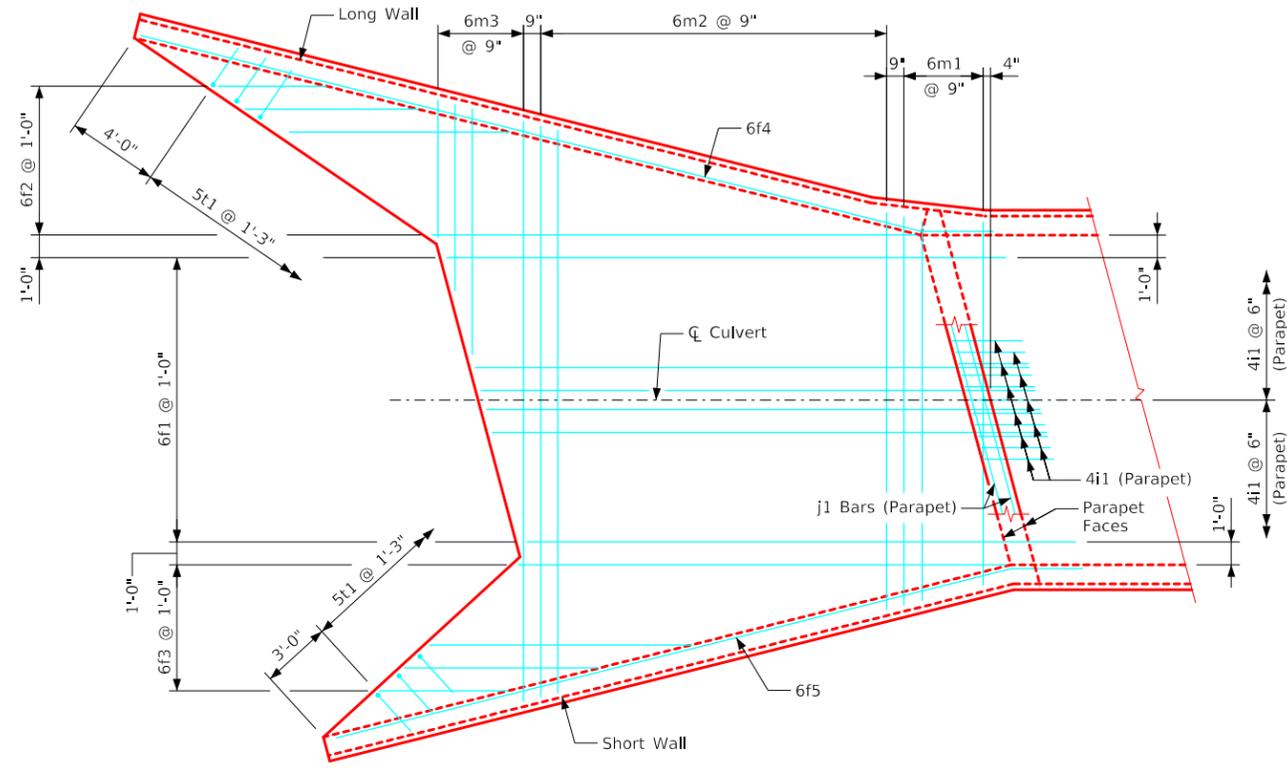
- Notes:
1. See Sheet FWH G2-21 for General Notes, Specifications, and Design Stresses.
  2. See Sheet FWH 15-2-21 for dimensions table.
  3. See Sheet FWH 15-4-21 for Angle L & Angle S.

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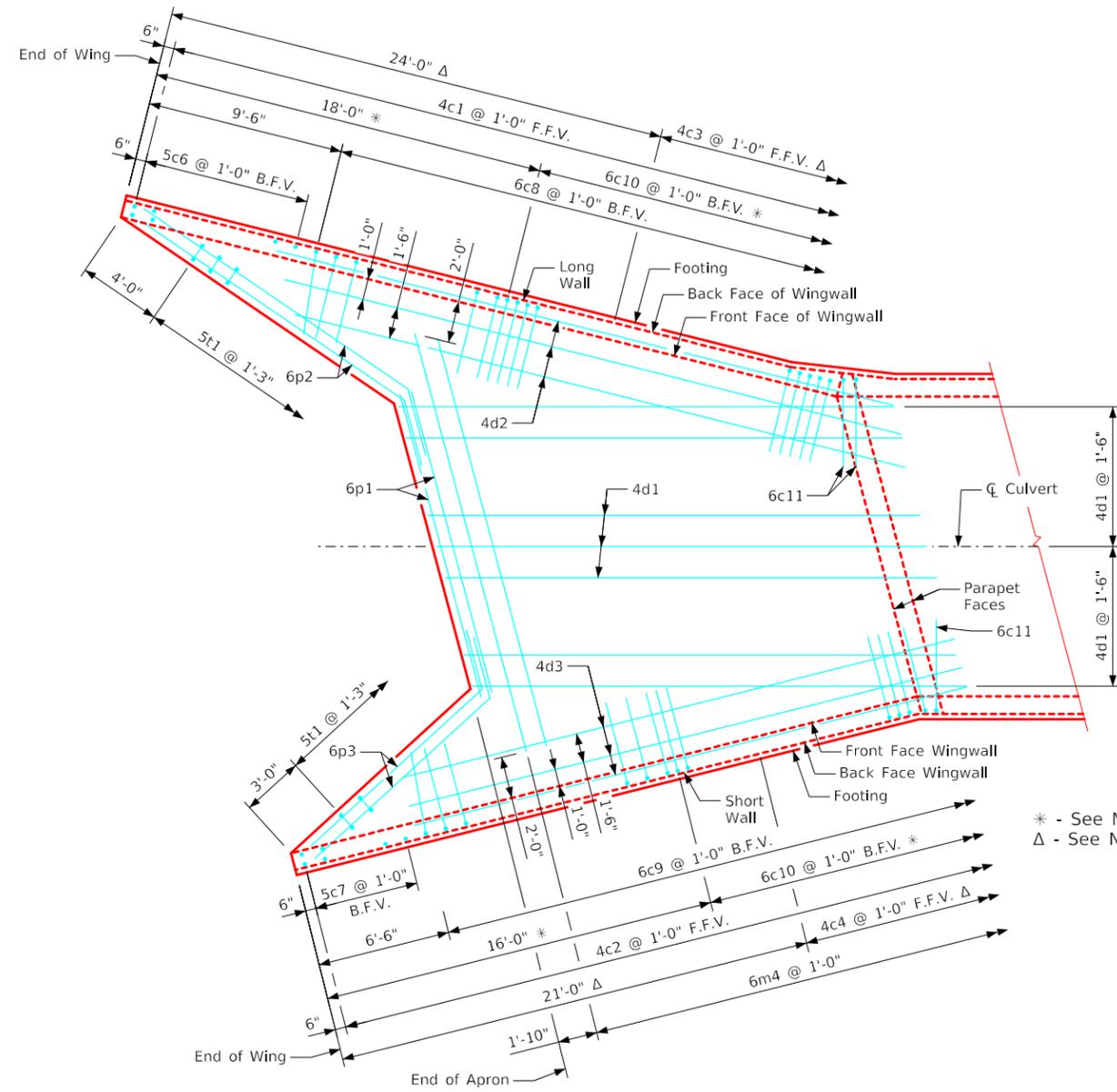
LATEST REVISION DATE	 APPROVED BY BRIDGE ENGINEER	 Standard Design - Single Reinforced Concrete Box Culverts	
		<b>Flared Wing Headwalls</b> February, 2021	
		Dimension Plan 15° Skew	FWH 15-1-21







Plan View - Top of Apron Reinforcing



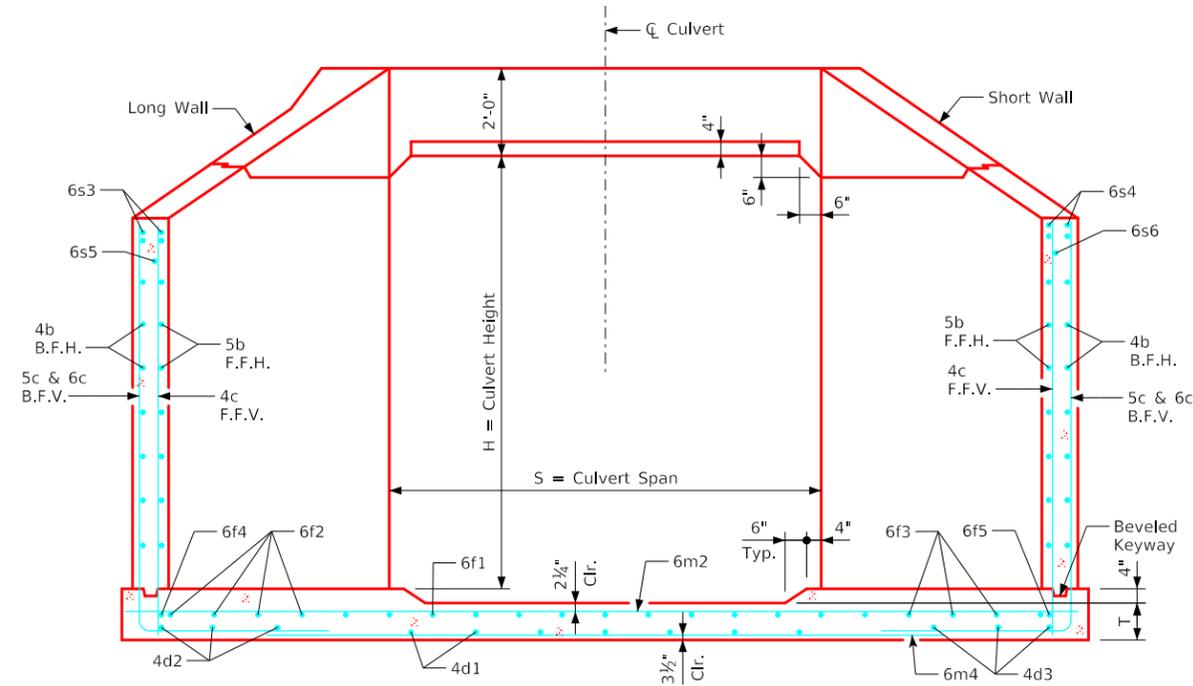
Plan View - Bottom of Apron Reinforcing

Notes:

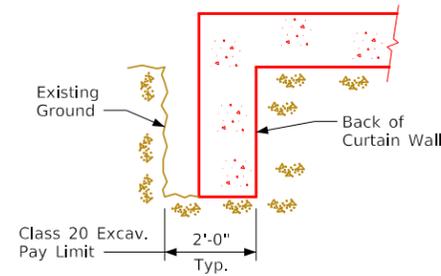
1. Bar spacings and positions shown are similar for all sizes of headwalls in this standard.
2. Wingwall bars consistently referenced from end of wing for all headwalls.
3. Top transverse floor bars are referenced approximately 4" from the back of the parapet for all headwalls.
4. There are no 6c6 bars 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.

LATEST REVISION DATE	 APPROVED BY BRIDGE ENGINEER	 Standard Design - Single Reinforced Concrete Box Culverts	
		<b>Flared Wing Headwalls</b> February, 2021	
		Apron Details 15° Skew	FWH 15-3-21

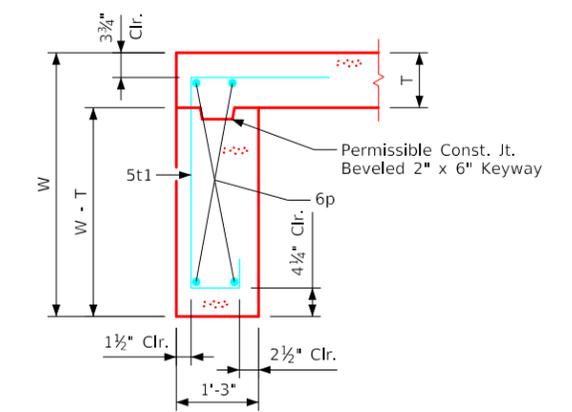
ENGLISHLRFDDESIGNEDSINGLECULVERTSFWH.DGN - FWH 15-4-21 - THIS SHEET ISSUED 02-2021.



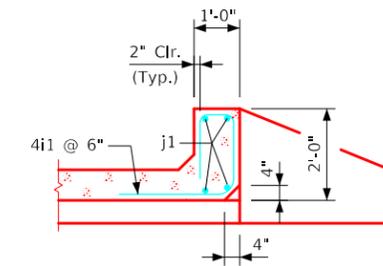
Typical Section - Near Center of Apron



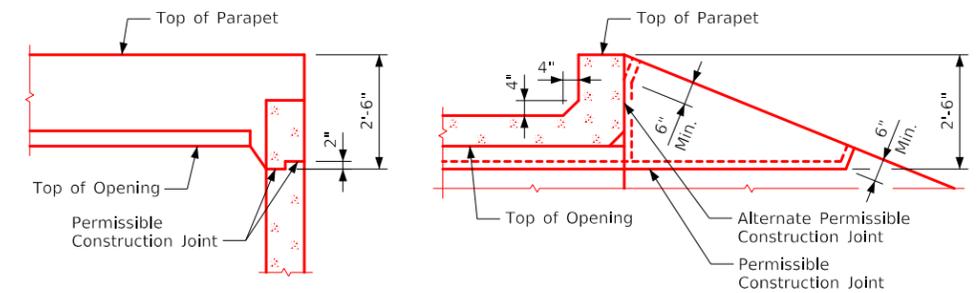
Curtain Wall Class 20 Excavation



Section thru Curtain Wall



Section thru Parapet

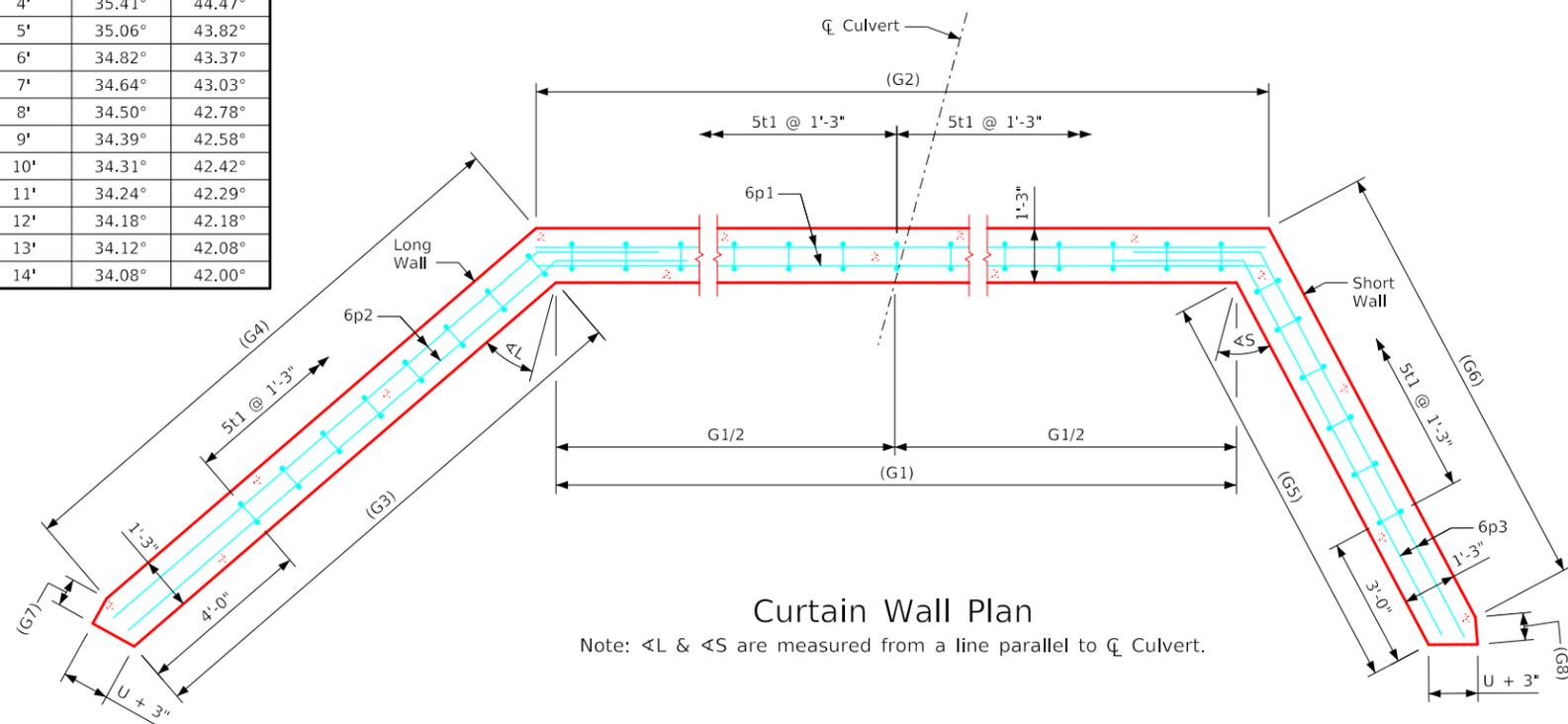


Top of Wingwall Details

Notes:

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

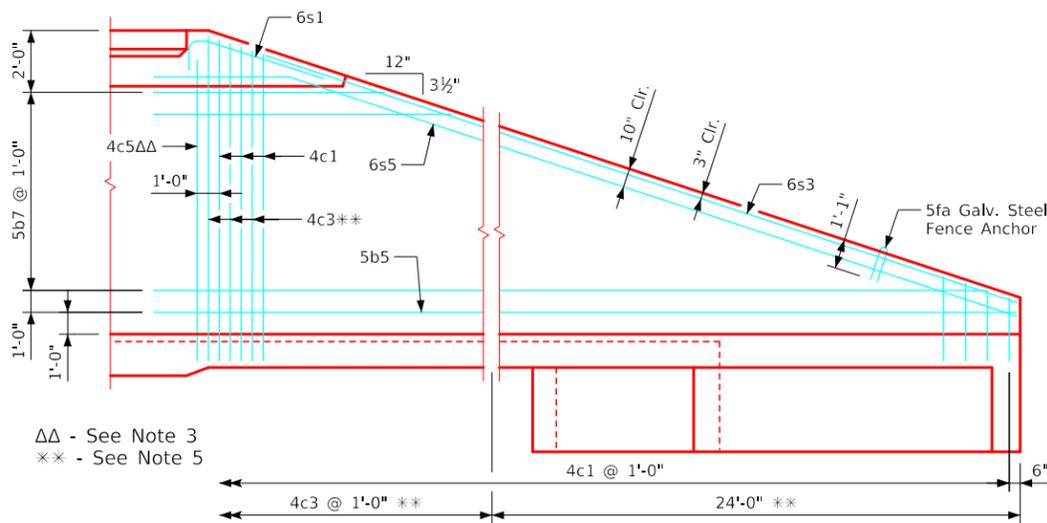
Culvert Height (H)	Angle	
	<L	<S
3'	35.96°	45.50°
4'	35.41°	44.47°
5'	35.06°	43.82°
6'	34.82°	43.37°
7'	34.64°	43.03°
8'	34.50°	42.78°
9'	34.39°	42.58°
10'	34.31°	42.42°
11'	34.24°	42.29°
12'	34.18°	42.18°
13'	34.12°	42.08°
14'	34.08°	42.00°



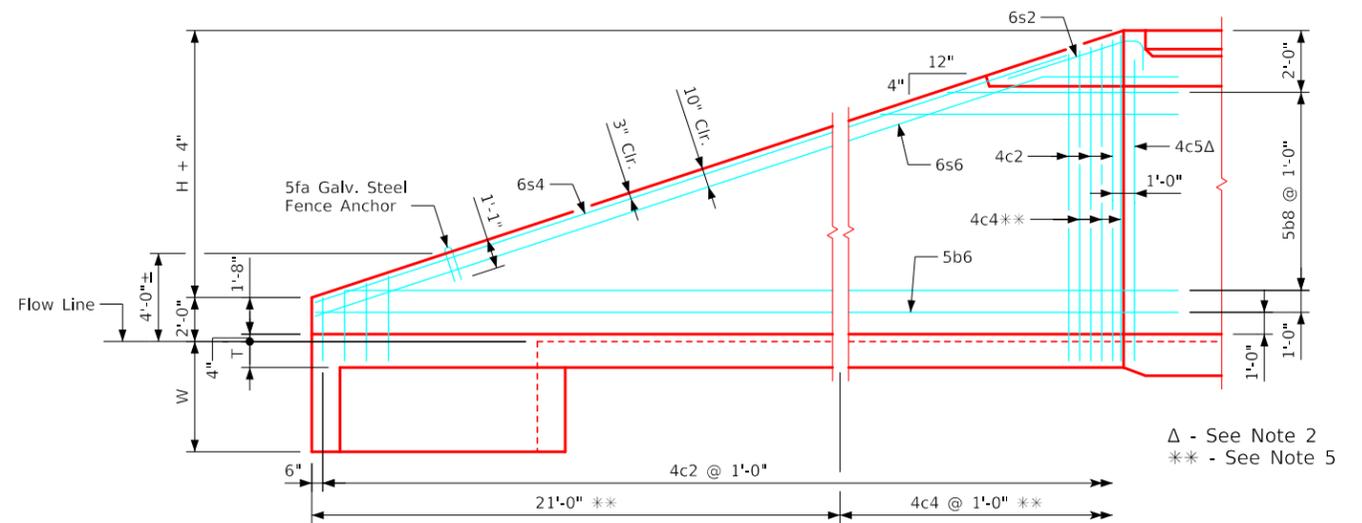
Curtain Wall Plan

Note: <L & <S are measured from a line parallel to Q Culvert.

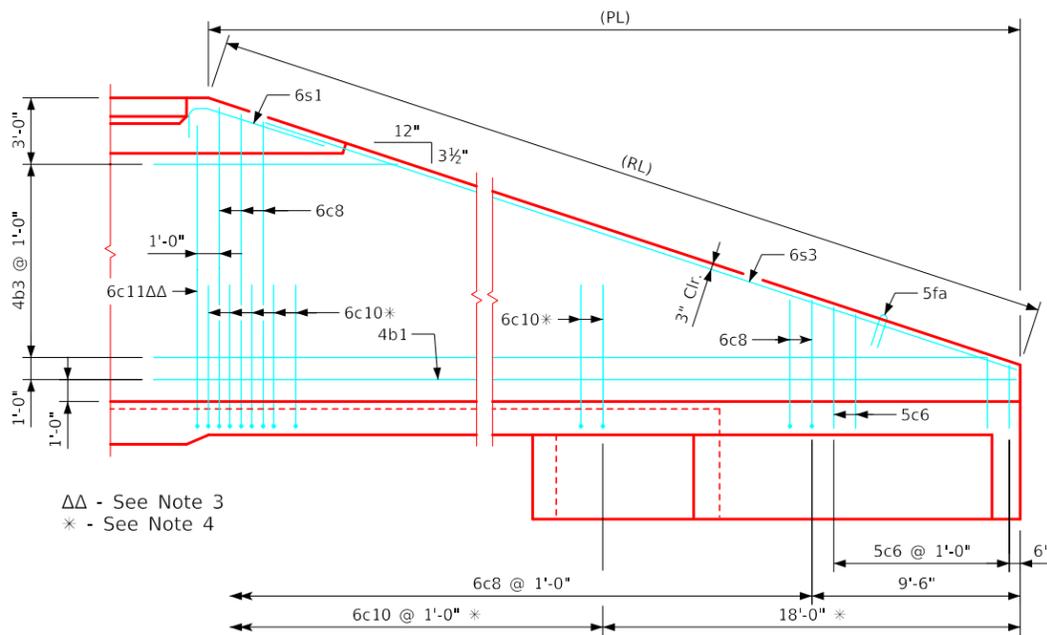
LATEST REVISION DATE	 APPROVED BY BRIDGE ENGINEER	 Standard Design - Single Reinforced Concrete Box Culverts	
		Flared Wing Headwalls February, 2021	
		Parapet & Curtain Wall Details 15° Skew	FWH 15-4-21



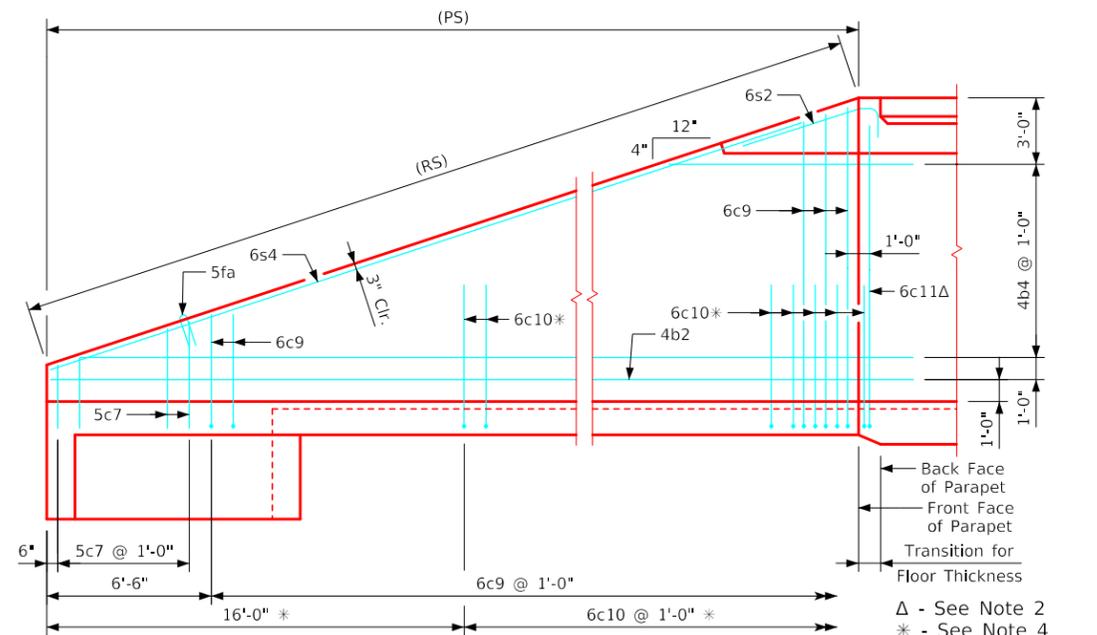
Typical View - Front Face Long Wingwall Reinforcing



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	Standard Design - Single Reinforced Concrete Box Culverts	
		Flared Wing Headwalls February, 2021	
		Wingwall Details 15° Skew	FWH 15-5-21



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

Table with columns: Bar, Location, Shape, and columns for four span lengths (16' x 7', 16' x 6', 16' x 5', 16' x 4'). Each span length column contains sub-columns for No., Length, and Wt. The table lists various reinforcement items like Wingwall, Apron, Parapet, and Curtain with their respective quantities and weights. Summary rows at the bottom provide totals for Reinf. Steel, Concrete, and Parapet quantities.

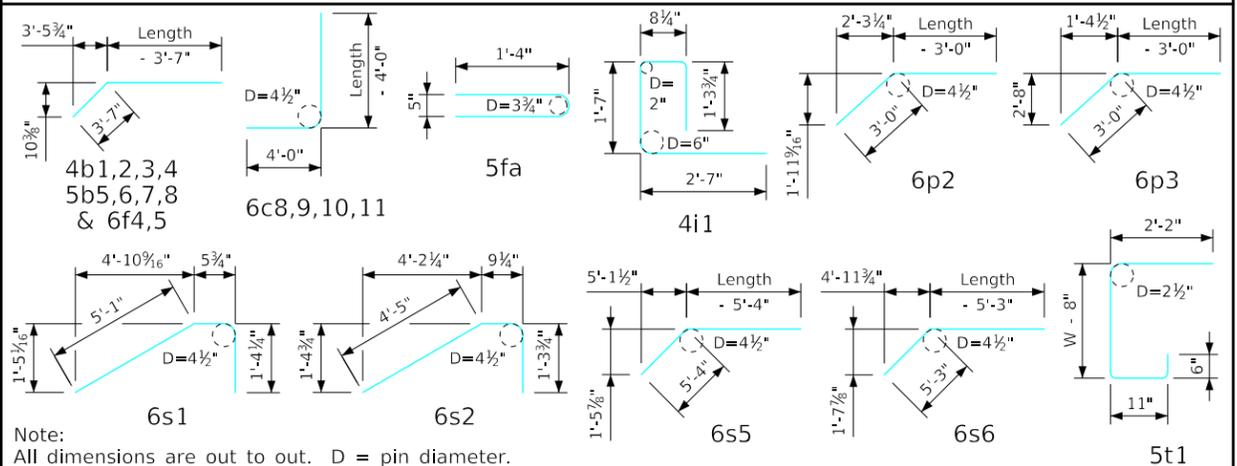
Δ Includes top of wingwall quantities.

\* 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.

IOWADOT 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. Includes signature and date of approval.







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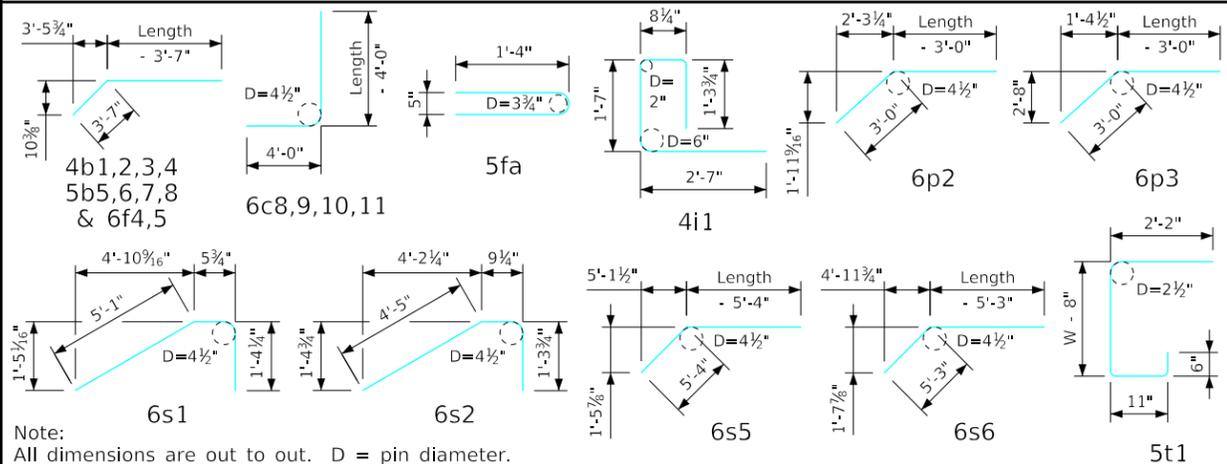
Bill of Reinforcing for One Headwall 15° Skew Span x Culvert Height

Table with columns: Bar, Location, Shape, 12' x 6', 12' x 5', 12' x 4', Bar. Includes sub-headers for No., Length, and Wt. for each size category. Rows list various reinforcement items like Wingwall, Apron, Parapet, and Curtain with their respective quantities and weights.

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.

IOWA DOT logo and project information: 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.



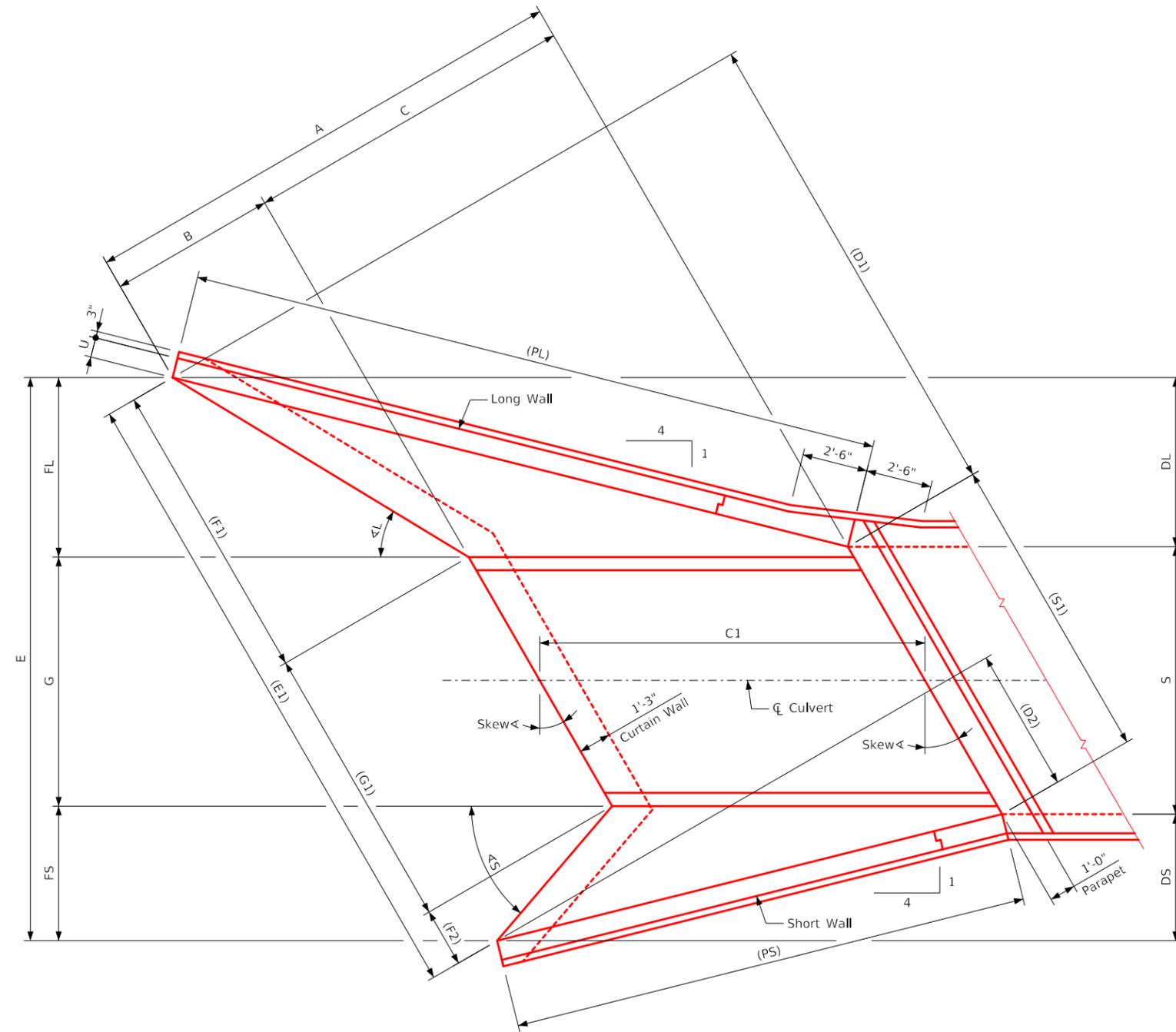








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Plan View

Notes:

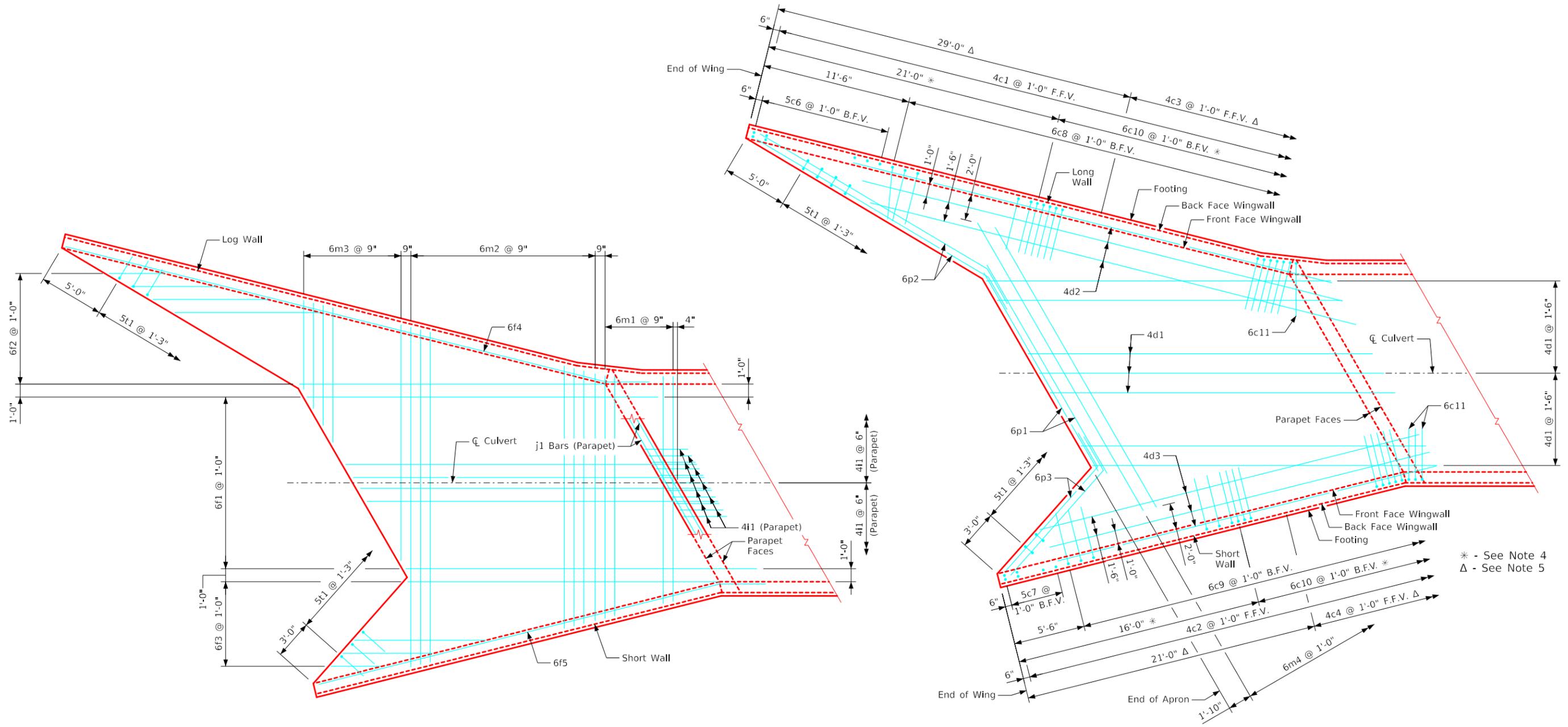
1. See Sheet FWH G2-21 for General Notes, Specifications, and Design Stresses.
2. See Sheet FWH 30-2-21 for dimensions table.
3. See Sheet FWH 30-4-21 for Angle L & Angle S.

LATEST REVISION DATE	 APPROVED BY BRIDGE ENGINEER	 Standard Design - Single Reinforced Concrete Box Culverts	
		Flared Wing Headwalls February, 2021	
		Dimension Plan 30° Skew	FWH 30-1-21





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Plan View - Top of Apron Reinforcing

Plan View - Bottom of Apron Reinforcing

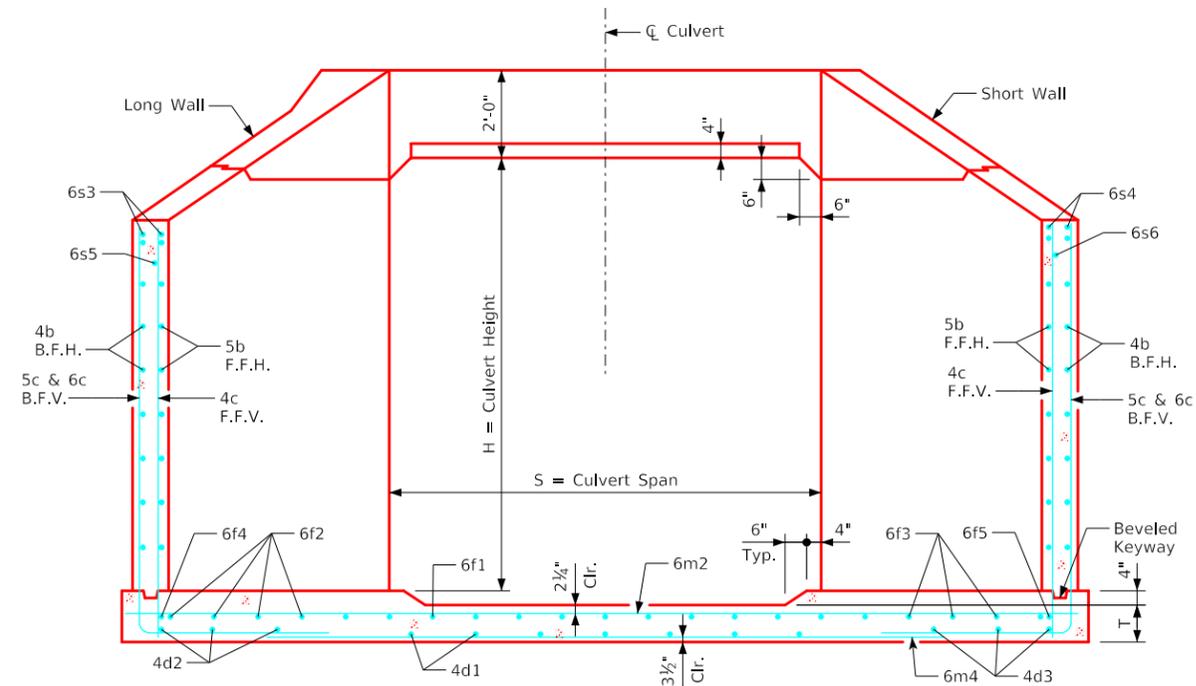
Notes:

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.

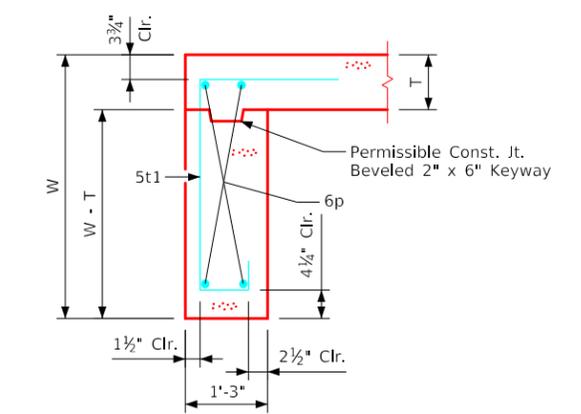
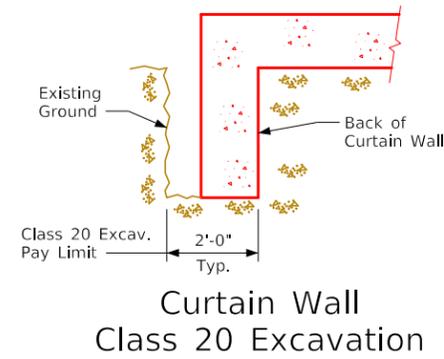
\* - See Note 4  
 Δ - See Note 5

LATEST REVISION DATE	 APPROVED BY BRIDGE ENGINEER	 Standard Design - Single Reinforced Concrete Box Culverts	
		Flared Wing Headwalls February, 2021	
		Apron Details 30° Skew	FWH 30-3-21

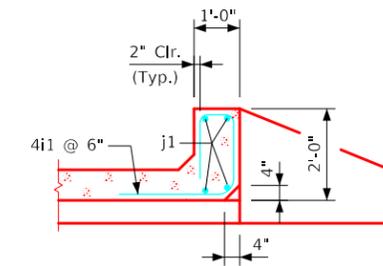
ENGLISHLRFDDESIGNEDSINGLECULVERTSFWH.DGN - FWH 30-4-21 - THIS SHEET ISSUED 02-2021.



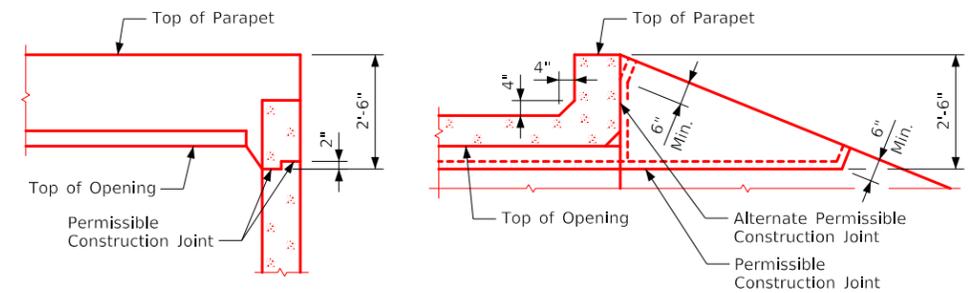
Typical Section - Near Center of Apron



Section thru Curtain Wall

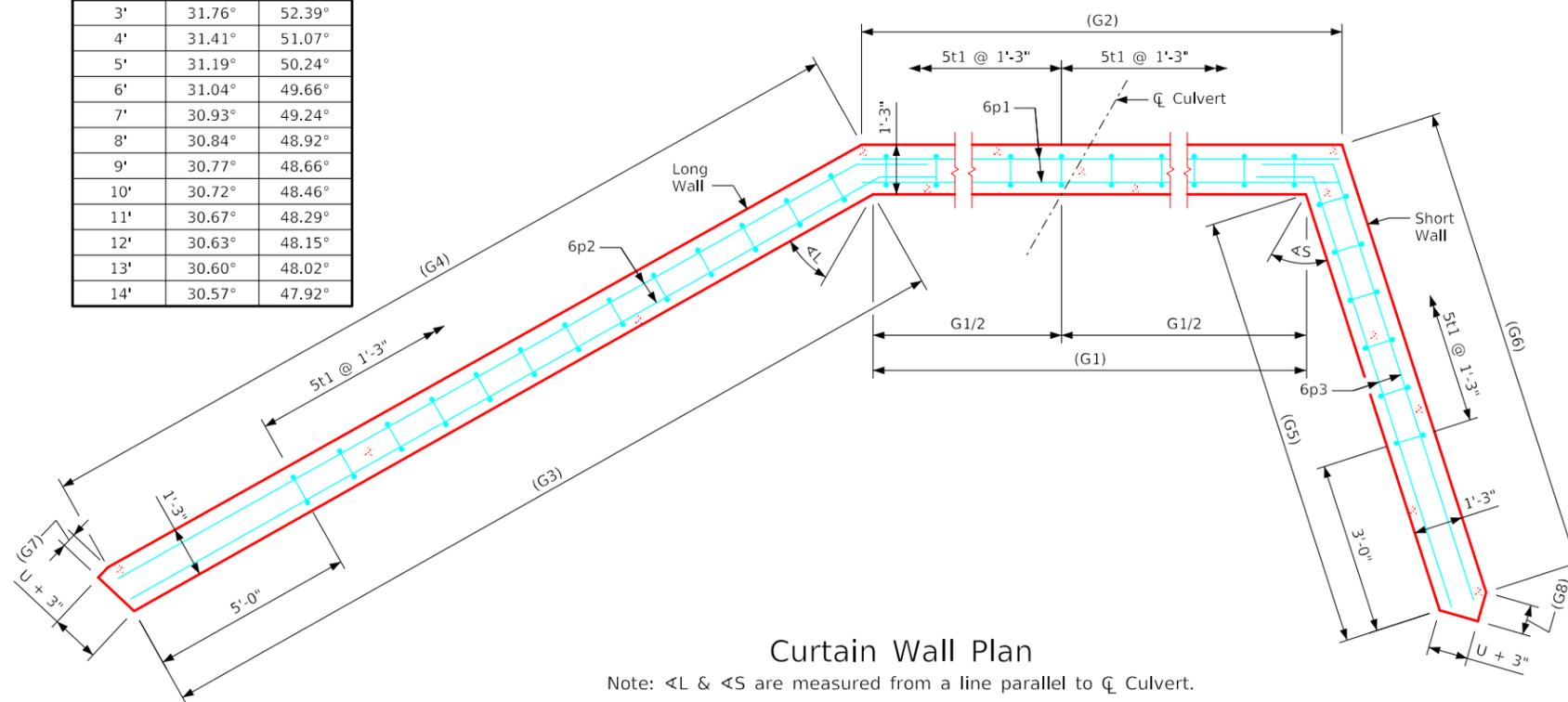


Section thru Parapet



Top of Wingwall Details

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

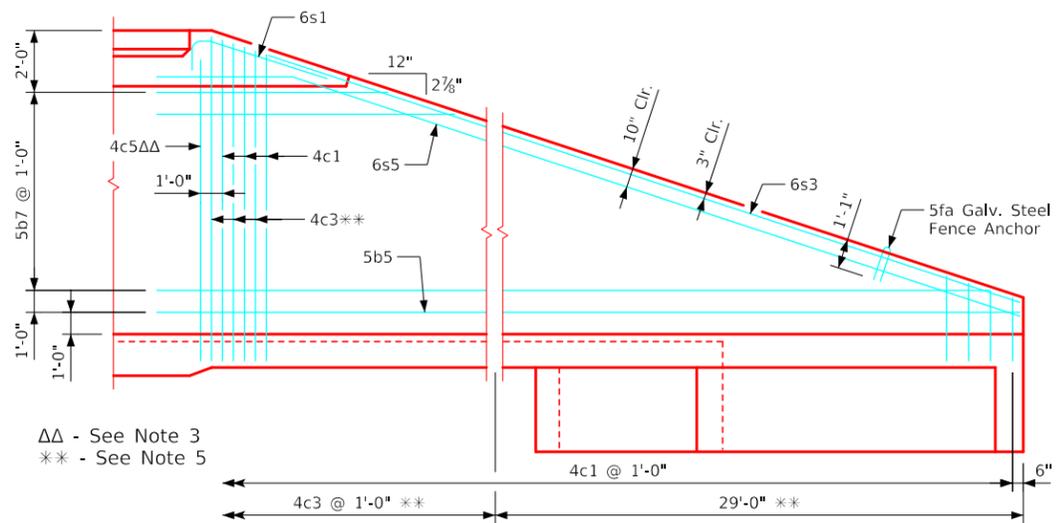
Note: <L & <S are measured from a line parallel to  $\phi$  Culvert.

**Notes:**

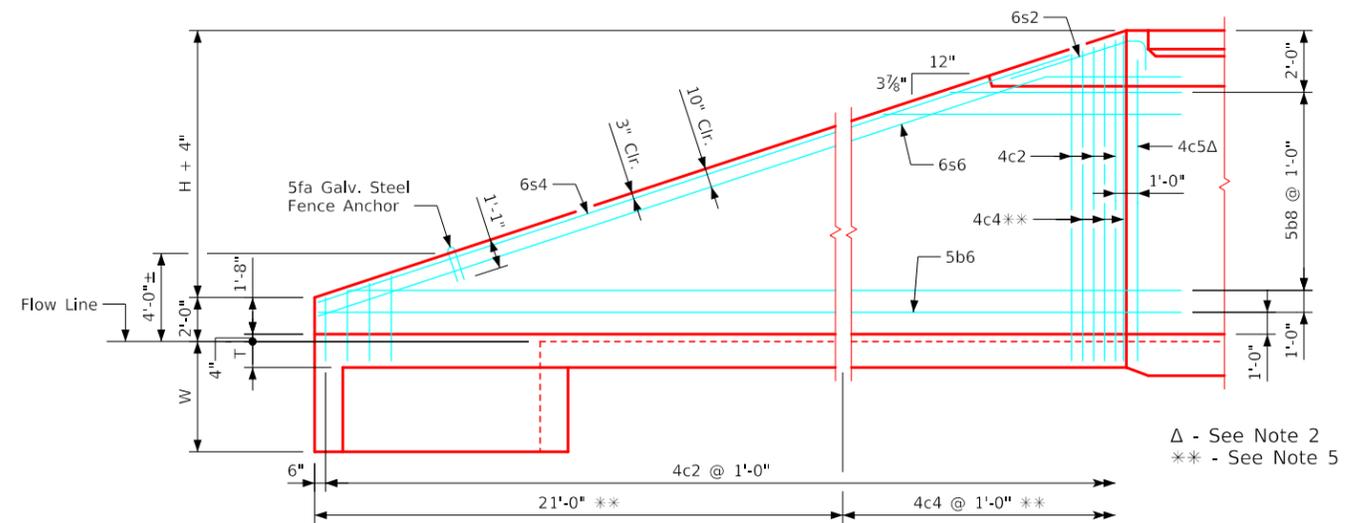
1. See Sheet FWH G2-21 for General Notes, Specifications, and Design Stresses.
2. See Sheet FWH 30-2-21 for dimensions table.

LATEST REVISION DATE	APPROVED BY BRIDGE ENGINEER	<b>IOWADOT</b>	
		Standard Design - Single Reinforced Concrete Box Culverts	
		<b>Flared Wing Headwalls</b>	
		February, 2021	
		Parapet & Curtain Wall Details 30° Skew	FWH 30-4-21

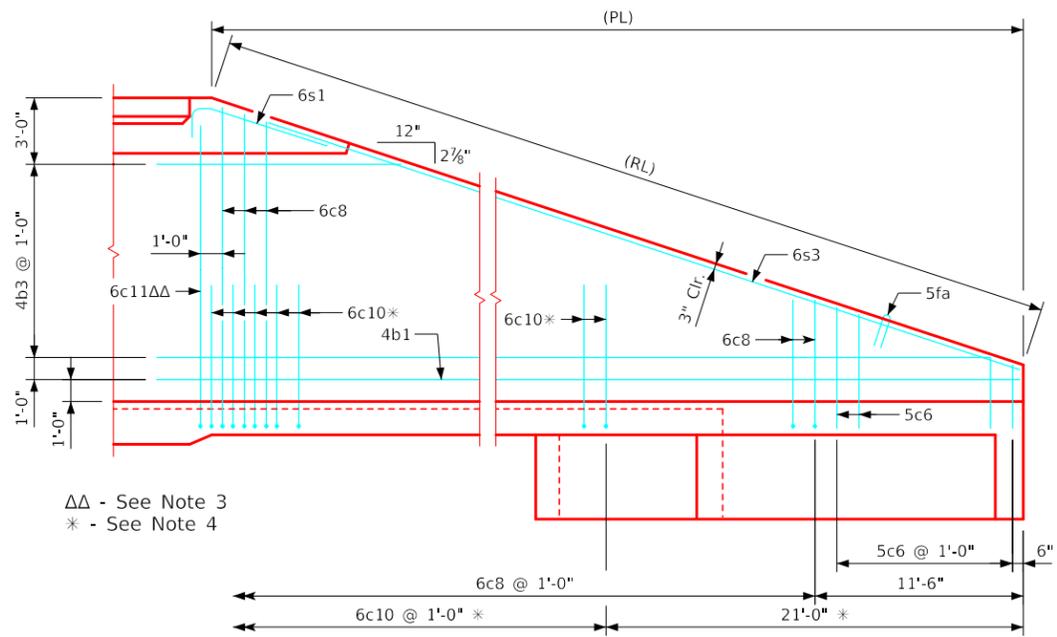
ENGLISHLRFDDESIGNEDSINGLECULVERTSFWH.DGN - FWH 30-5-21 - THIS SHEET ISSUED 02-2021.



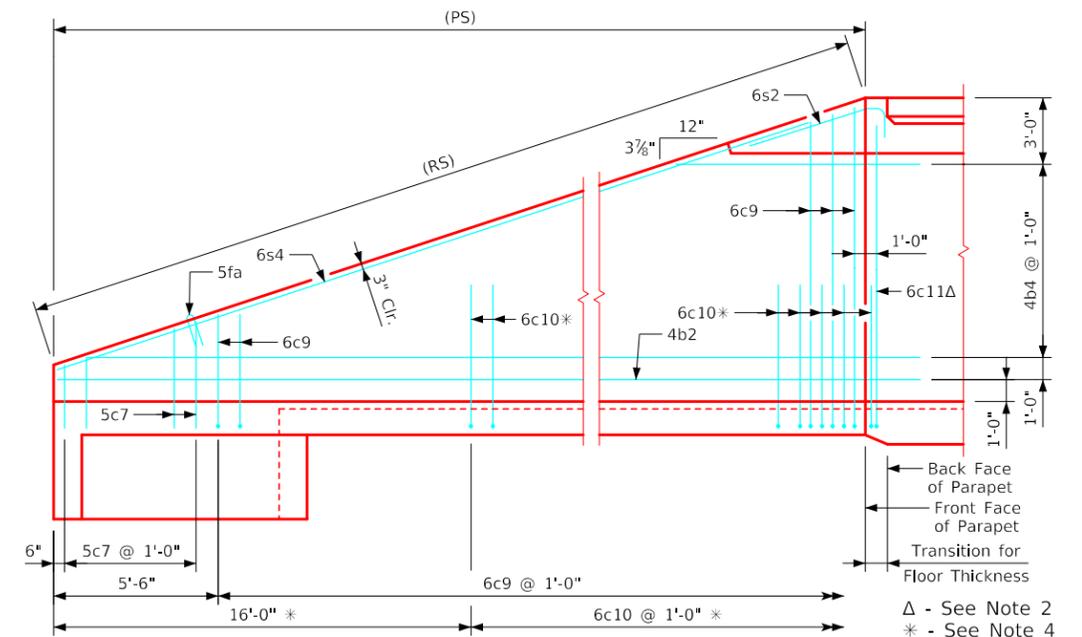
Typical View - Front Face Long Wingwall Reinforcing



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 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	 APPROVED BY BRIDGE ENGINEER	Standard Design - Single Reinforced Concrete Box Culverts	
		Flared Wing Headwalls February, 2021	
		Wingwall Details 30° Skew	FWH 30-5-21















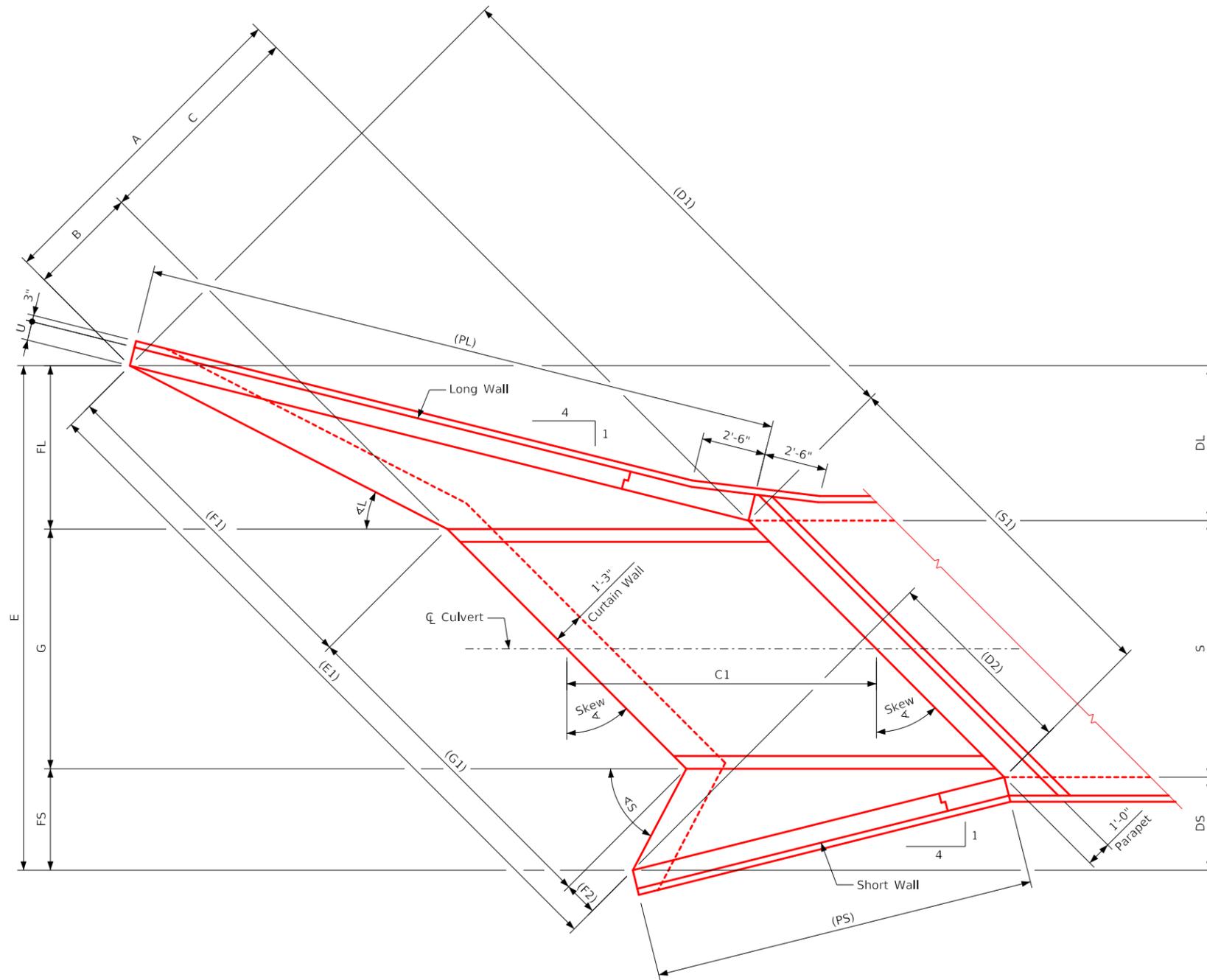








ENGLISHLRFDDESIGNEDSINGLECULVERTSFWH.DGN - FWH 45-1-21 - THIS SHEET ISSUED 02-2021.



Plan View

Notes:

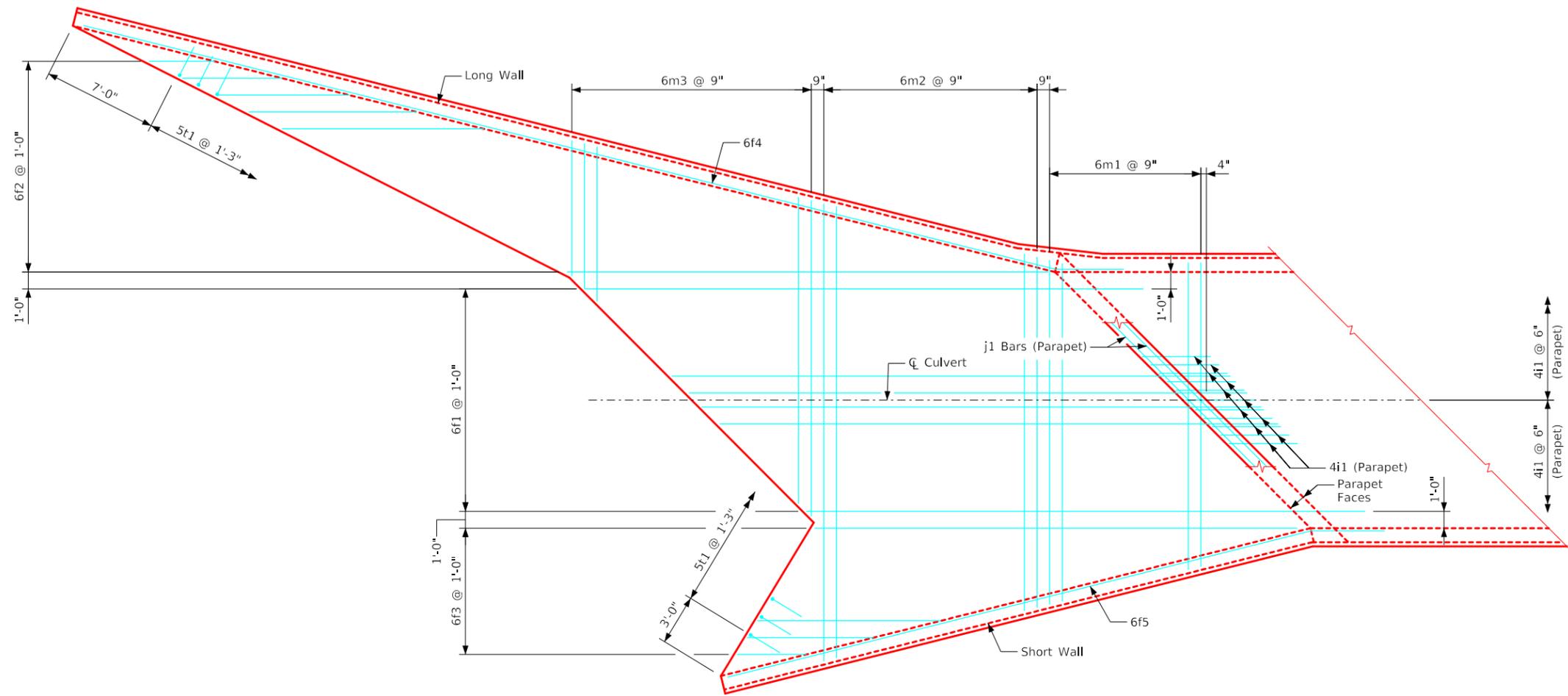
1. See Sheet FWH G2-21 for General Notes, Specifications, and Design Stresses.
2. See Sheet FWH 45-2-21 for dimensions table.
3. See Sheet FWH 45-5-21 for Angle L & Angle S.

LATEST REVISION DATE	 APPROVED BY BRIDGE ENGINEER	 Standard Design - Single Reinforced Concrete Box Culverts	
		<b>Flared Wing Headwalls</b> February, 2021	
		Dimension Plan 45° Skew	FWH 45-1-21





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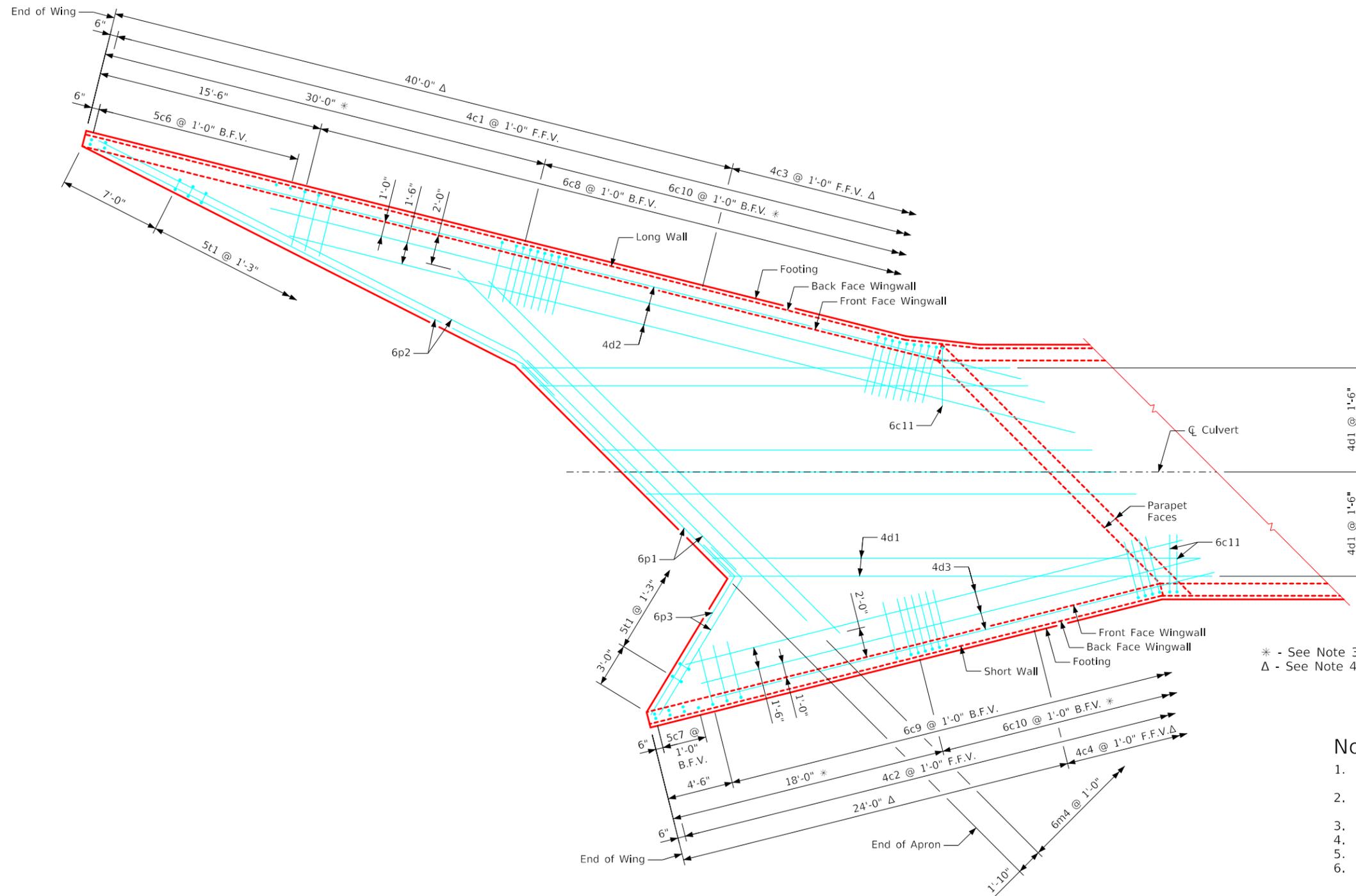
Plan View - Top of Apron Reinforcing

Notes:

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

LATEST REVISION DATE	 APPROVED BY BRIDGE ENGINEER	 Standard Design - Single Reinforced Concrete Box Culverts	
		<b>Flared Wing Headwalls</b> February, 2021	
		Top Apron Detail 45° Skew	FWH 45-3-21

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



\* - See Note 3  
 Δ - See Note 4

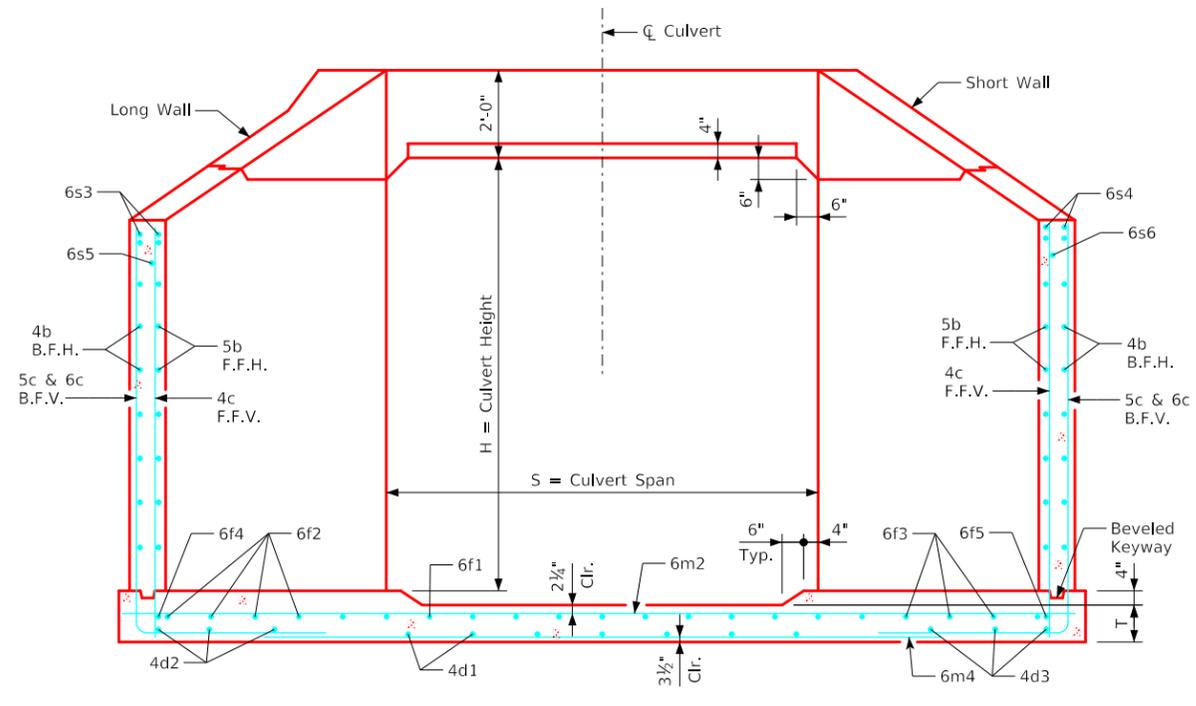
**Notes:**

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.

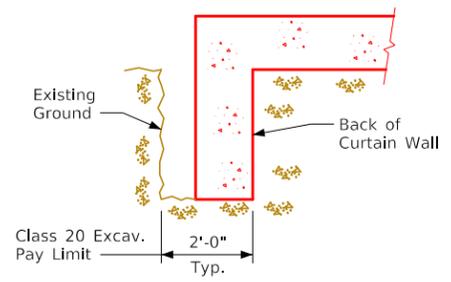
Plan View - Bottom of Apron Reinforcing Bars

LATEST REVISION DATE  APPROVED BY BRIDGE ENGINEER	 Standard Design - Single Reinforced Concrete Box Culverts	
	Flared Wing Headwalls February, 2021	
	Bott. Apron Detail 45° Skew	FWH 45-4-21

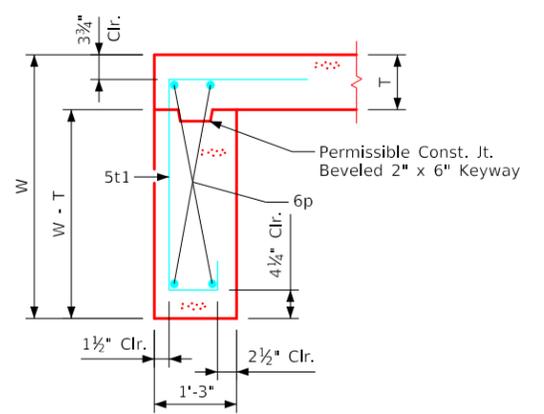
ENGLISHLRFDISIGNEDTWINCULVERTSFHW.DGN - FWH 45-5-21 - THIS SHEET ISSUED 02-2021.



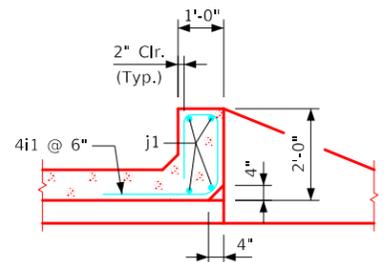
Typical Section - Near Center of Apron



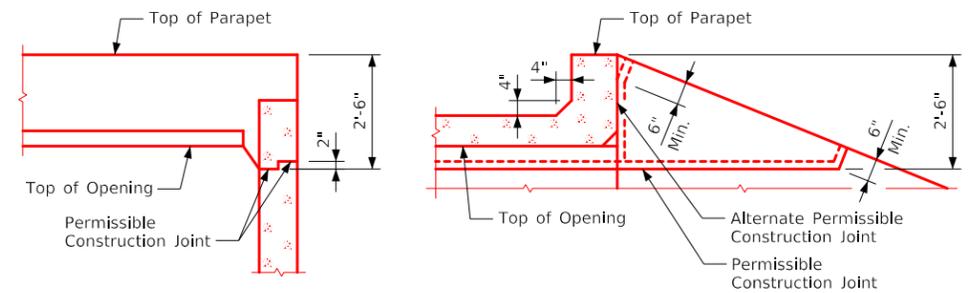
Curtain Wall Class 20 Excavation



Section thru Curtain Wall

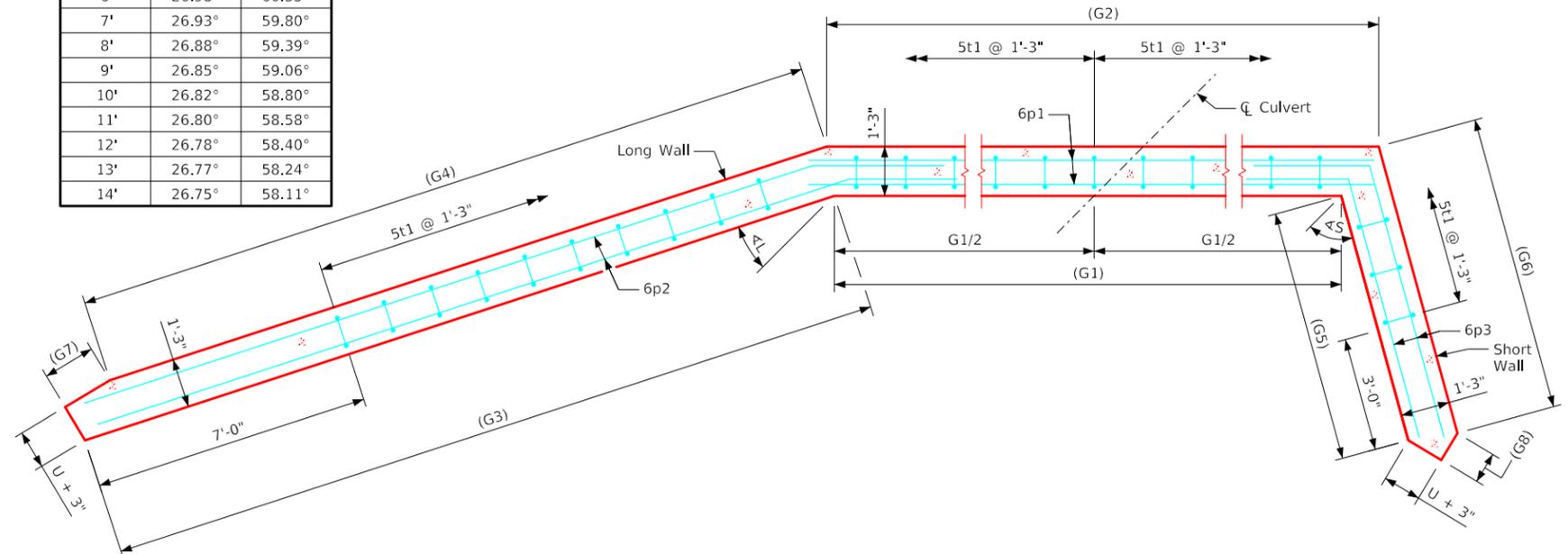


Section thru Parapet



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

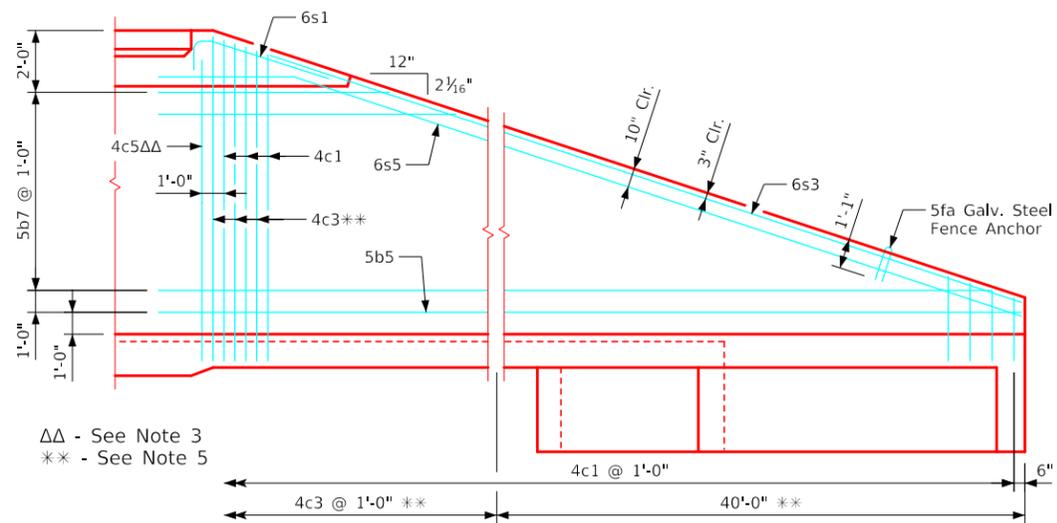
Note: <L & <S are measured from a line parallel to  $\zeta$  Culvert.

Notes:

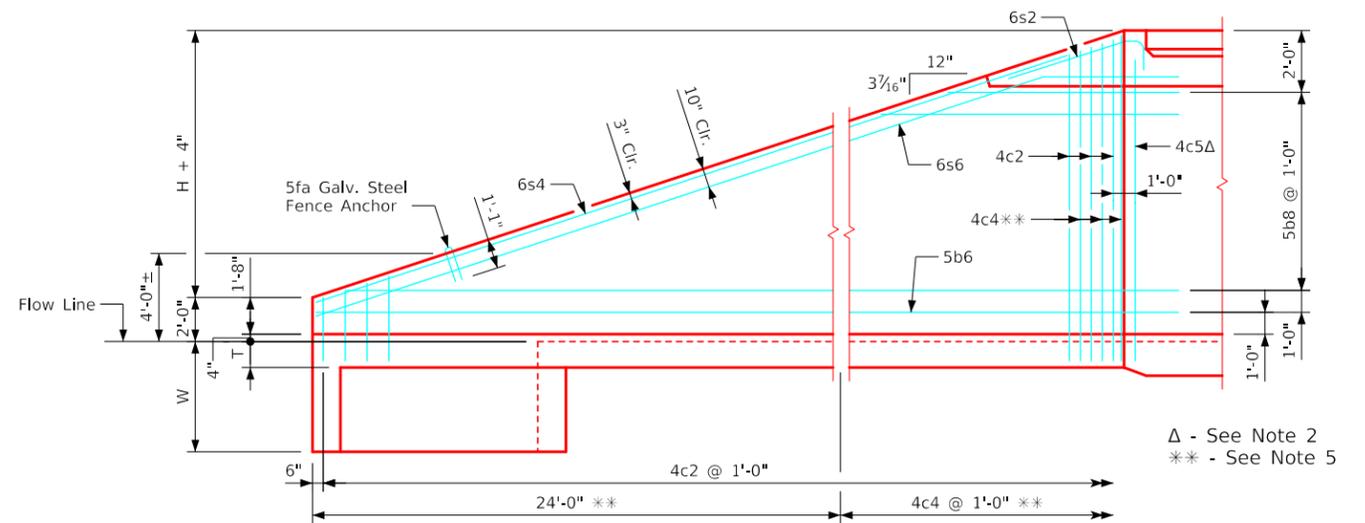
1. See Sheet FWH G2-21 for General Notes, Specifications, and Design Stresses.
2. See Sheet FWH 45-2-21 for dimensions table.

LATEST REVISION DATE  APPROVED BY BRIDGE ENGINEER 	 Standard Design - Single Reinforced Concrete Box Culverts <b>Flared Wing Headwalls</b> February, 2021	
	Parapet & Curtain Wall Details 45° Skew	FWH 45-5-21

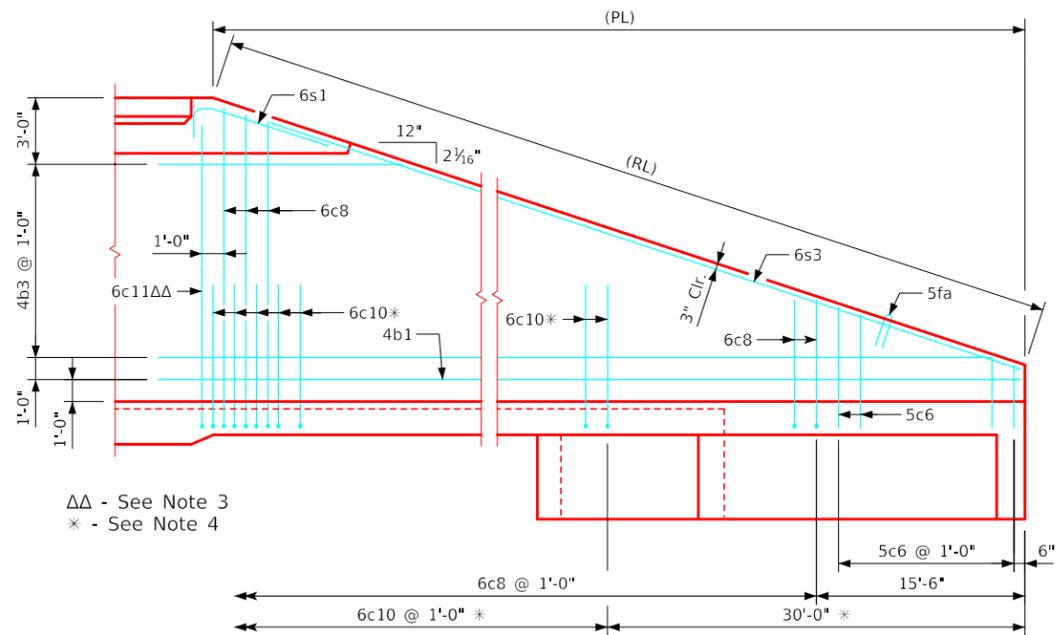
ENGLISHLRFDDESIGNEDSINGLECULVERTSFWH.DGN - FWH 45-6-21 - THIS SHEET ISSUED 02-2021.



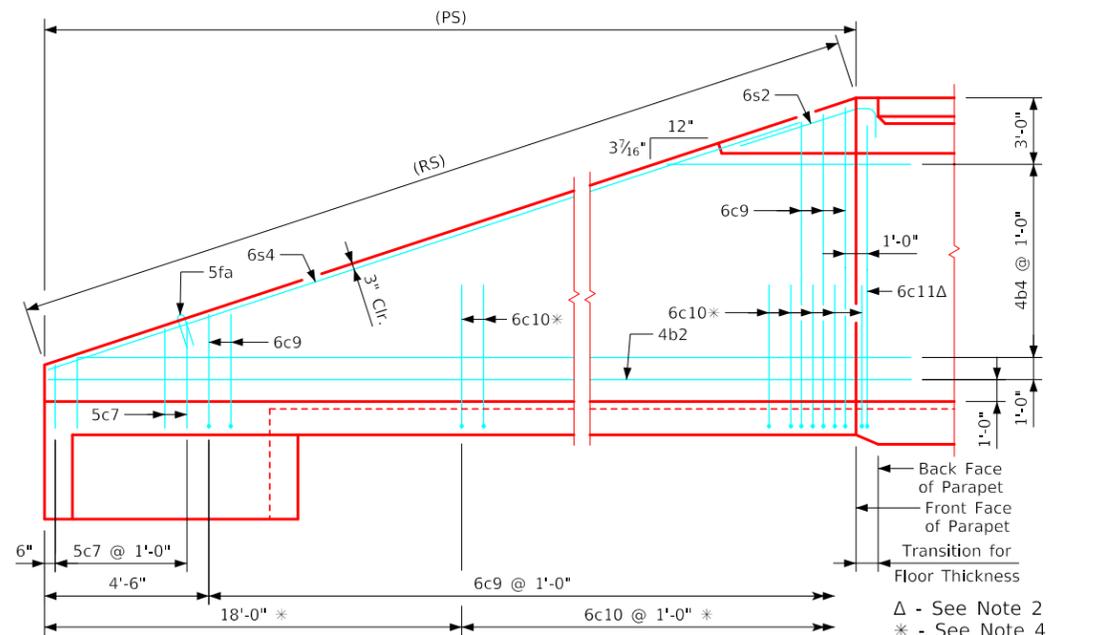
Typical View - Front Face Long Wingwall Reinforcing



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	 APPROVED BY BRIDGE ENGINEER	Standard Design - Single Reinforced Concrete Box Culverts	
		<b>Flared Wing Headwalls</b> February, 2021	
		Wingwall Details 45° Skew	FWH 45-6-21





















