

ENGLISHLRFDDESIGNEDTWINCULVERTSWH.DGN - TWFWH 45-8-21 51 - THIS SHEET ISSUED 02-2021.

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

Bar	Location	Shape	10' x 12'			10' x 11'			10' x 10'			10' x 9'			10' x 8'			Bar		
			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	5fa		
4b1	Wingwall, B.F.H. Long		1	76'-3"	53	1	70'-6"	49	1	64'-8"	45	1	58'-10"	41	1	53'-0"	37	4b1		
4b2	Wingwall, B.F.H. Short		1	47'-6"	33	1	44'-0"	31	1	40'-7"	29	1	37'-1"	25	1	33'-7"	22	4b2		
4b3	Wingwall, B.F.H. Long		10 Var.	21'-2 to 73'-6	326	9 Var.	21'-2 to 67'-8	275	8 Var.	21'-2 to 61'-11	228	7 Var.	21'-2 to 56'-1	185	6 Var.	21'-2 to 50'-3	146	4b3		
4b4	Wingwall, B.F.H. Short		10 Var.	14'-6 to 45'-11	205	9 Var.	14'-6 to 42'-5	173	8 Var.	14'-6 to 38'-11	143	7 Var.	14'-6 to 35'-5	117	6 Var.	14'-6 to 31'-11	93	4b4		
5b5	Wingwall, F.F.H. Long		1	76'-4"	82	1	70'-6"	76	1	64'-8"	70	1	58'-10"	64	1	53'-0"	58	5b5		
5b6	Wingwall, F.F.H. Short		1	47'-7"	52	1	44'-1"	48	1	40'-7"	45	1	37'-1"	39	1	33'-7"	35	5b6		
5b7	Wingwall, F.F.H. Long		11 Var.	15'-5 to 73'-7	526	10 Var.	15'-5 to 67'-9	446	9 Var.	15'-5 to 61'-11	373	8 Var.	15'-5 to 56'-1	306	7 Var.	15'-4 to 50'-3	244	5b7		
5b8	Wingwall, F.F.H. Short		11 Var.	11'-1 to 46'-0	333	10 Var.	11'-1 to 42'-6	282	9 Var.	11'-1 to 39'-0	235	8 Var.	11'-1 to 35'-6	194	7 Var.	11'-1 to 32'-0	157	5b8		
5b9	Interior Wall, Both F.H.		21 Var.	6'-11 to 37'-9	489	19 Var.	6'-11 to 34'-11	415	17 Var.	6'-11 to 32'-2	346	15 Var.	6'-11 to 29'-4	284	13 Var.	7'-0 to 26'-6	227	5b9		
4c1	Wingwall, F.F.V. Long		72 Var.	2'-8 to 14'-11	423	66 Var.	2'-8 to 13'-10	364	60 Var.	2'-8 to 12'-10	311	54 Var.	2'-8 to 11'-10	262	49 Var.	2'-8 to 10'-11	222	4c1		
4c2	Wingwall, F.F.V. Short		43 Var.	2'-9 to 14'-9	251	40 Var.	2'-9 to 13'-11	223	36 Var.	2'-9 to 12'-9	186	33 Var.	2'-9 to 11'-11	162	29 Var.	2'-9 to 10'-9	131	4c2		
4c3	Wingwall, F.F.V. Long		33 Var.	9'-6 to 15'-0	270	27 Var.	9'-6 to 13'-11	211	21 Var.	9'-6 to 12'-11	157	15 Var.	9'-6 to 11'-11	107	--	--	--	4c3		
4c4	Wingwall, F.F.V. Short		20 Var.	9'-6 to 14'-11	163	17 Var.	9'-6 to 14'-0	133	13 Var.	9'-6 to 12'-11	97	10 Var.	9'-6 to 12'-0	72	--	--	--	4c4		
4c5	Wingwall, F.F.V. Long		1	13'-8"	9	2	12'-8"	17	2	11'-8"	16	2	10'-8"	14	1	9'-8"	6	4c5		
4c5	Wingwall, F.F.V. Short		2	13'-8"	18	1	12'-8"	8	2	11'-8"	16	1	10'-8"	7	2	9'-8"	13	4c5		
4c6	Interior Wall, Both F.V.		2	4'-0"	5	2	4'-0"	5	2	4'-0"	5	2	4'-0"	5	2	4'-0"	5	4c6		
4c7	Interior Wall, Both F.V.		66 Var.	1'-9 to 12'-4	310	61 Var.	1'-9 to 11'-5	268	55 Var.	1'-9 to 10'-4	222	50 Var.	1'-9 to 9'-5	186	44 Var.	1'-9 to 8'-5	149	4c7		
4c8	Interior Wall, Both F.V.		3	12'-4"	25	3	11'-6"	23	3	10'-6"	21	3	9'-6"	19	3	8'-6"	17	4c8		
5e9	Wingwall, B.F.V. Long		15 Var.	2'-8 to 5'-1	61	15 Var.	2'-8 to 5'-1	61	15 Var.	2'-8 to 5'-1	61	15 Var.	2'-8 to 5'-1	61	15 Var.	2'-8 to 5'-1	61	5e9		
5e10	Wingwall, B.F.V. Short		4 Var.	2'-9 to 3'-7	13	4 Var.	2'-9 to 3'-7	13	4 Var.	2'-9 to 3'-7	13	4 Var.	2'-9 to 3'-7	13	4 Var.	2'-9 to 3'-7	13	5e10		
5e11	Wingwall, B.F.V. Long		57 Var.	9'-3 to 18'-11	837	51 Var.	9'-3 to 17'-10	720	45 Var.	9'-3 to 16'-10	612	39 Var.	9'-3 to 15'-10	510	34 Var.	9'-3 to 14'-11	428	5e11		
5e12	Wingwall, B.F.V. Short		49 Var.	7'-11 to 18'-9	542	36 Var.	7'-11 to 17'-11	485	32 Var.	7'-11 to 16'-9	412	29 Var.	7'-11 to 15'-11	360	25 Var.	7'-11 to 14'-9	296	5e12		
6c13	Wingwall, B.F.V. Long		37	10'-6"	741	41	10'-6"	647	35	10'-6"	552	29	10'-6"	457	24	10'-6"	379	6c13		
6c13	Wingwall, B.F.V. Short		28	10'-6"	442	25	10'-6"	394	21	10'-6"	331	18	10'-6"	284	14	10'-6"	221	6c13		
5c14	Wingwall, B.F.V. Long		1	17'-8"	18	2	16'-8"	35	2	15'-8"	33	2	14'-8"	31	1	13'-8"	14	5c14		
5c14	Wingwall, B.F.V. Short		2	17'-8"	37	1	16'-8"	17	2	15'-8"	33	1	14'-8"	15	2	13'-8"	29	5c14		
4d1	Apron, Longit., Bott.		15	38'-6"	386	13	35'-8"	310	13	32'-10"	285	13	30'-0"	261	13	27'-2"	236	4d1		
4d2	Apron, Longit., Bott. Long		3	68'-10"	143	3	63'-0"	131	3	57'-2"	119	3	51'-5"	108	3	45'-7"	96	4d2		
4d3	Apron, Longit., Bott. Short		3	42'-7"	90	3	39'-1"	78	3	35'-7"	71	3	32'-1"	64	3	28'-7"	57	4d3		
6f1	Apron, Longit., Top		20	38'-6"	1157	20	35'-8"	1071	20	32'-10"	986	20	30'-0"	901	20	27'-2"	816	6f1		
6f2	Apron, Longit., Top Long		15 Var.	6'-7 to 34'-10	467	14 Var.	5'-8 to 32'-0	396	12 Var.	6'-11 to 29'-2	325	11 Var.	6'-1 to 26'-4	268	9 Var.	7'-3 to 23'-6	208	6f2		
6f3	Apron, Longit., Top Short		9 Var.	8'-1 to 35'-2	292	8 Var.	8'-8 to 32'-4	246	8 Var.	5'-9 to 29'-6	212	7 Var.	6'-4 to 26'-8	173	6 Var.	6'-10 to 23'-10	138	6f3		
6f4	Apron, Longit., Top Long		1	76'-4"	118	1	70'-6"	110	1	64'-8"	101	1	58'-10"	92	1	53'-0"	83	6f4		
6f5	Apron, Longit., Top Short		1	47'-7"	75	1	44'-1"	70	1	40'-7"	65	1	37'-1"	56	1	33'-7"	50	6f5		
4j1	Parapet, Vertical		43	6'-8"	191	41	6'-8"	183	41	6'-8"	183	41	6'-8"	183	41	6'-8"	183	4j1		
7j1	Parapet, Horizontal		4	32'-0"	262	4	31'-8"	259	4	31'-4"	256	4	31'-4"	256	4	31'-4"	256	7j1		
6m1	Apron, Trans., Top		16 Var.	25'-6 to 28'-4	647	16 Var.	25'-3 to 28'-1	641	16 Var.	25'-0 to 27'-10	635	16 Var.	25'-0 to 27'-10	635	16 Var.	25'-0 to 27'-10	635	6m1		
6m2	Apron, Trans., Top		19 Var.	28'-8 to 35'-5	914	15 Var.	28'-5 to 33'-8	699	11 Var.	28'-2 to 31'-11	496	7 Var.	28'-2 to 30'-5	308	4 Var.	28'-2 to 29'-3	172	6m2		
6m3	Apron, Trans., Top		27 Var.	10'-1 to 24'-9	706	27 Var.	9'-5 to 24'-0	678	27 Var.	8'-8 to 23'-4	649	28 Var.	7'-7 to 22'-9	638	27 Var.	7'-0 to 21'-7	580	6m3		
6m4	Apron, Trans., Bott.		24 Var.	23'-3 to 47'-10	1310	22 Var.	23'-2 to 45'-6	1156	20 Var.	23'-0 to 43'-4	1011	18 Var.	23'-0 to 41'-2	875	16 Var.	23'-0 to 39'-0	745	6m4		
6p1	Curtain, Horizontal		4	29'-8"	178	4	29'-6"	177	4	29'-5"	177	4	29'-5"	177	4	29'-5"	177	6p1		
6p2	Curtain, Horizontal, Long		4	42'-4"	269	4	39'-2"	235	4	36'-0"	216	4	32'-10"	197	4	29'-8"	178	6p2		
6p3	Curtain, Horizontal, Short		4	15'-8"	94	4	14'-7"	88	4	13'-7"	82	4	12'-7"	76	4	11'-7"	70	6p3		
6s1	Wing Slope, Both F., Long		2	8'-4"	25	2	8'-4"	25	2	8'-4"	25	2	8'-4"	25	2	8'-4"	25	6s1		
6s2	Wing Slope, Both F., Short		2	7'-11"	24	2	7'-11"	24	2	7'-11"	24	2	7'-11"	24	2	7'-11"	24	6s2		
6s3	Wing Slope, Both F., Long		2	68'-7"	213	2	62'-8"	196	2	56'-9"	178	2	50'-10"	160	2	44'-11"	142	6s3		
6s4	Wing Slope, Both F., Short		2	41'-8"	132	2	38'-0"	114	2	34'-5"	103	2	30'-9"	92	2	27'-1"	81	6s4		
6s5	Wing Slope, F.F. Long		1	74'-8"	116	1	68'-9"	107	1	62'-10"	98	1	56'-11"	89	1	51'-0"	80	6s5		
6s6	Wing Slope, F.F. Short		1	47'-8"	75	1	44'-0"	70	1	40'-4"	64	1	36'-9"	55	1	33'-1"	50	6s6		
6s7	Interior Wall, Both F.H.		2	39'-1"	117	2	36'-2"	109	2	33'-3"	100	2	30'-3"	91	2	27'-3"	82	6s7		
5t1	Curtain, Vertical		57	7'-11"	471	54	7'-8"	432	51	7'-5"	395	48	7'-2"	359	44	6'-11"	317	5t1		
Estimated Quantities			Reinf. Steel			14,742 LB			3,4			9989 LB			3,4			8490 LB		
One Headwall			Concrete			126.4 CY			3,5			91.2 CY			2,1			67.8 CY		
			Parapet Δ			3,5			25,4			54,6			47,2					
			Wingwalls			33,1			62,4			79,1			17,2					
			Apron *			71,2														

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

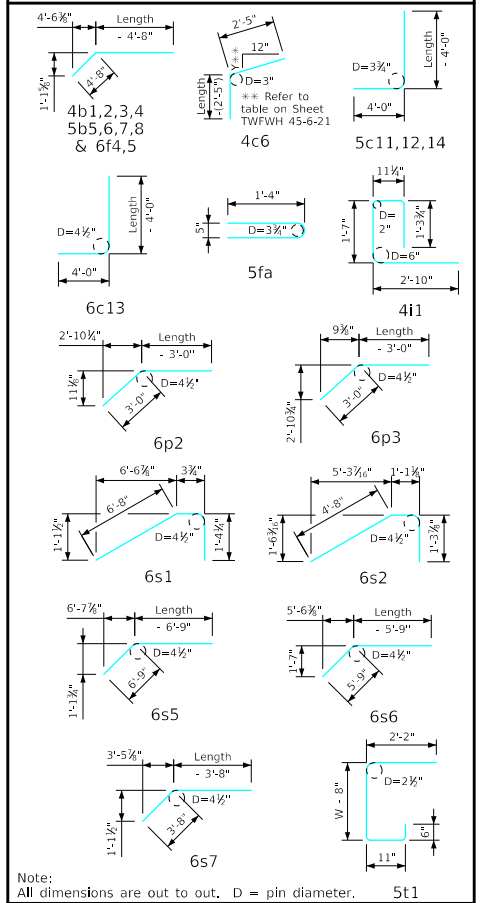
Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

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

Headwall Notes:

- 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", "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.
- Dimensions are in feet and inches unless otherwise noted.

Bent Bar Details



LATEST REVISION DATE	APPROVED BY BRIDGE ENGINEER	 Standard Design - Twin Reinforced Concrete Box Culverts <h3 style="margin: 0;">Flared Wing Headwalls</h3> February, 2021 <h2 style="margin: 0;">Quantity Tabulation</h2> 10'-0" Span 45° Skew	TWFWH 45-8-21 Sheet 1 of 2
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