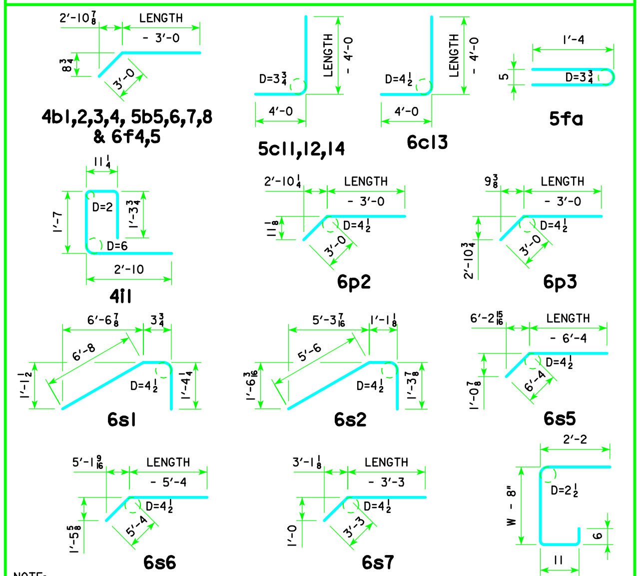
BILL OF REINFORCING FOR ONE HEADWALL 45° SKEW CULVERT SPAN × CULVERT HEIGHT

BAR	LOCATION	SHAPE	12' × 12'			12' × 11'			12' × 10'			12' × 9'			12' × 8'			12' × 7'			12' × 6'			BAR
			NO.	LENGTH	WT.	NO.	LENGTH	WT.	NO.	LENGTH	WT.	NO.	LENGTH	WT.	NO.	LENGTH	WT.	NO.	LENGTH	WT.	NO.	LENGTH	WT.	
5fa	FENCE ANCHOR (GALV.)		2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	2	2'-10	6	5fa
4b1	WINGWALL, B.F.H. LONG		1	74'-8	51	1	68'-10	47	1	63'-0	44	1	57'-2	40	1	51'-4	36	1	45'-6	32	1	39'-8	26	4b1
4b2	WINGWALL, B.F.H. SHORT		1	45'-10	32	1	42'-4	30	1	38'-10	26	1	35'-5	24	1	31'-11	21	1	28'-5	19	1	24'-11	17	4b2
4b3	WINGWALL, B.F.H. LONG		10 VAR.	19'-6 TO 71'-10	314	9 VAR.	19'-6 TO 66'-1	265	8 VAR.	19'-6 TO 60'-3	219	7 VAR.	19'-6 TO 54'-5	177	6 VAR.	19'-6 TO 48'-7	139	5 VAR.	19'-6 TO 42'-9	105	4 VAR.	19'-5 TO 36'-11	75	4b3
4b4	WINGWALL, B.F.H. SHORT		10 VAR.	12'-10 TO 44'-3	194	9 VAR.	12'-10 TO 40'-9	163	8 VAR.	12'-10 TO 37'-3	134	7 VAR.	12'-10 TO 33'-9	109	6 VAR.	12'-10 TO 30'-3	86	5 VAR.	12'-10 TO 26'-9	66	4 VAR.	12'-10 TO 23'-3	48	4b4
5b5	WINGWALL, F.F.H. LONG		1	74'-8	80	1	68'-10	74	1	63'-0	68	1	57'-2	62	1	51'-4	56	1	45'-6	50	1	39'-9	41	5b5
5b6	WINGWALL, F.F.H. SHORT		1	45'-11	50	1	42'-5	47	1	38'-11	41	1	35'-5	37	1	31'-11	33	1	28'-5	30	1	24'-11	26	5b6
5b7	WINGWALL, F.F.H. LONG		11 VAR.	13'-9 TO 71'-11	506	10 VAR.	13'-9 TO 66'-1	428	9 VAR.	13'-9 TO 60'-3	357	8 VAR.	13'-9 TO 54'-5	291	7 VAR.	13'-8 TO 48'-7	232	6 VAR.	13'-8 TO 42'-9	179	5 VAR.	13'-8 TO 36'-11	132	5b7
5b8	WINGWALL, F.F.H. SHORT		11 VAR.	9'-5 TO 44'-4	313	10 VAR.	9'-5 TO 40'-10	264	9 VAR.	9'-5 TO 37'-4	219	8 VAR.	9'-5 TO 33'-10	180	7 VAR.	9'-5 TO 30'-4	145	6 VAR.	9'-4 TO 26'-10	113	5 VAR.	9'-4 TO 23'-4	85	5b8
5b9	INTERIOR WALL, BOTH F.H.		21 VAR.	6'-6 TO 37'-4	480	19 VAR.	6'-6 TO 34'-6	406	17 VAR.	6'-6 TO 31'-9	339	15 VAR.	6'-6 TO 28'-11	277	13 VAR.	6'-7 TO 26'-1	221	11 VAR.	6'-7 TO 23'-3	171	9 VAR.	6'-8 TO 20'-5	127	5b9
4c1	WINGWALL, F.F.V. LONG		72 VAR.	2'-9 TO 15'-0	427	66 VAR.	2'-9 TO 13'-11	367	60 VAR.	2'-9 TO 12'-11	314	54 VAR.	2'-9 TO 11'-11	265	49 VAR.	2'-9 TO 11'-0	225	43 VAR.	2'-9 TO 10'-0	183	37 VAR.	2'-9 TO 9'-0	145	4c1
4c2	WINGWALL, F.F.V. SHORT		43 VAR.	2'-10 TO 14'-10	254	40 VAR.	2'-10 TO 14'-0	225	36 VAR.	2'-10 TO 12'-10	188	33 VAR.	2'-10 TO 12'-0	163	29 VAR.	2'-10 TO 10'-10	132	26 VAR.	2'-10 TO 10'-0	111	22 VAR.	2'-10 TO 8'-10	86	4c2
4c3	WINGWALL, F.F.V. LONG		33 VAR.	9'-7 TO 15'-1	272	27 VAR.	9'-7 TO 14'-0	213	21 VAR.	9'-7 TO 13'-0	158	15 VAR.	9'-7 TO 12'-0	108	---	---	---	---	---	---	---	---	---	4c3
4c4	WINGWALL, F.F.V. SHORT		20 VAR.	9'-7 TO 15'-0	164	17 VAR.	9'-7 TO 14'-1	134	13 VAR.	9'-7 TO 13'-0	98	10 VAR.	9'-7 TO 12'-1	72	---	---	---	---	---	---	---	---	---	4c4
4c5	WINGWALL, F.F.V. LONG		1	13'-9	9	2	12'-9	17	2	11'-9	16	2	10'-9	14	1	9'-9	7	1	8'-9	6	1	7'-9	5	4c5
4c5	WINGWALL, F.F.V. SHORT		2	13'-9	18	1	12'-9	9	2	11'-9	16	1	10'-9	7	2	9'-9	13	1	8'-9	6	2	7'-9	10	4c5
4c6	INTERIOR WALL, BOTH F.V.		2	1'-8	2	2	1'-8	2	2	1'-8	2	2	1'-8	2	2	1'-8	2	2	1'-8	2	2	1'-8	2	4c6
4c7	INTERIOR WALL, BOTH F.V.		66 VAR.	1'-10 TO 12'-5	314	61 VAR.	1'-10 TO 11'-6	272	55 VAR.	1'-10 TO 10'-5	225	50 VAR.	1'-10 TO 9'-6	189	44 VAR.	1'-10 TO 8'-6	152	38 VAR.	1'-10 TO 7'-5	117	33 VAR.	1'-10 TO 6'-6	92	4c7
4c8	INTERIOR WALL, BOTH F.V.		3	12'-7	25	3	11'-7	23	3	10'-7	21	3	9'-7	19	3	8'-7	17	3	7'-7	15	3	6'-7	13	4c8
5c9	WINGWALL, B.F.V. LONG		15 VAR.	2'-9 TO 5'-2	62	15 VAR.	2'-9 TO 5'-2	62	15 VAR.	2'-9 TO 5'-2	62	15 VAR.	2'-9 TO 5'-2	62	15 VAR.	2'-9 TO 5'-2	62	15 VAR.	2'-9 TO 5'-2	62	15 VAR.	2'-9 TO 5'-2	62	5c9
5c10	WINGWALL, B.F.V. SHORT		4 VAR.	2'-10 TO 3'-8	14	4 VAR.	2'-10 TO 3'-8	14	4 VAR.	2'-10 TO 3'-8	14	4 VAR.	2'-10 TO 3'-8	14	4 VAR.	2'-10 TO 3'-8	14	4 VAR.	2'-10 TO 3'-8	14	4 VAR.	2'-10 TO 3'-8	14	5c10
5c11	WINGWALL, B.F.V. LONG		57 VAR.	9'-4 TO 19'-0	842	51 VAR.	9'-4 TO 17'-11	725	45 VAR.	9'-4 TO 16'-11	616	39 VAR.	9'-4 TO 15'-11	514	34 VAR.	9'-4 TO 15'-0	431	28 VAR.	9'-4 TO 14'-0	341	22 VAR.	9'-4 TO 13'-0	256	5c11
5c12	WINGWALL, B.F.V. SHORT		39 VAR.	8'-0 TO 18'-10	546	36 VAR.	8'-0 TO 18'-0	488	32 VAR.	8'-0 TO 16'-10	414	29 VAR.	8'-0 TO 16'-0	363	25 VAR.	8'-0 TO 14'-10	298	22 VAR.	8'-0 TO 14'-0	252	18 VAR.	8'-0 TO 12'-10	196	5c12
6c13	WINGWALL, B.F.V. LONG		47	10'-6	741	41	10'-6	647	35	10'-6	552	29	10'-6	457	24	10'-6	379	18	10'-6	284	12	10'-6	189	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	11	10'-6	173	7	10'-6	110	6c13
5c14	WINGWALL, B.F.V. LONG		1	17'-9	19	2	16'-9	35	2	15'-9	33	2	14'-9	31	1	13'-9	14	1	12'-9	13	1	11'-9	12	5c14
5c14	WINGWALL, B.F.V. SHORT		2	17'-9	37	1	16'-9	17	2	15'-9	33	1	14'-9	15	2	13'-9	29	1	12'-9	13	2	11'-9	25	5c14
4d1	APRON, LONGIT., BOTT.		17	38'-1	432	17	35'-3	400	17	32'-5	368	17	29'-7	336	17	26'-9	304	17	24'-0	273	17	21'-2	240	4d1
4d2	APRON, LONGIT., BOTT. LONG		3	68'-5	142	3	62'-7	130	3	56'-8	118	3	50'-10	106	3	45'-0	95	3	39'-3	79	3	33'-6	67	4d2
4d3	APRON, LONGIT., BOTT. SHORT		3	42'-2	89	3	38'-8	77	3	35'-1	70	3	31'-7	63	3	28'-2	56	3	24'-8	49	3	21'-3	43	4d3
6f1	APRON, LONGIT., TOP		24	38'-1	1373	24	35'-3	1271	24	32'-5	1169	24	29'-7	1066	24	26'-9	964	24	24'-0	865	24	21'-2	763	6f1
6f2	APRON, LONGIT., TOP LONG		15 VAR.	6'-6 TO 34'-10	466	14 VAR.	5'-8 TO 32'-0	396	12 VAR.	6'-11 TO 29'-2	325	11 VAR.	6'-1 TO 26'-4	268	9 VAR.	7'-3 TO 23'-6	208	8 VAR.	6'-5 TO 20'-8	163	7 VAR.	5'-7 TO 17'-10	123	6f2
6f3	APRON, LONGIT., TOP SHORT		9 VAR.	8'-1 TO 35'-2	292	8 VAR.	8'-8 TO 32'-4	246	8 VAR.	5'-9 TO 29'-6	212	7 VAR.	6'-4 TO 26'-8	173	6 VAR.	6'-10 TO 23'-10	138	5 VAR.	7'-4 TO 21'-0	106	4 VAR.	7'-11 TO 18'-2	78	6f3
6f4	APRON, LONGIT., TOP LONG		1	74'-8	116	1	68'-10	107	1	63'-0	98	1	57'-2	89	1	51'-4	80	1	45'-6	72	1	39'-9	60	6f4
6f5	APRON, LONGIT., TOP SHORT		1	45'-11	72	1	42'-5	67	1	38'-11	58	1	35'-5	53	1	31'-11	48	1	28'-5	43	1	24'-11	37	6f5
4i1	PARAPET, VERTICAL		51	6'-8	227	49	6'-8	218	49	6'-8	218	49	6'-8	218	49	6'-8	218	49	6'-8	218	49	6'-8	218	4i1
7j1	PARAPET, HORIZONTAL		4	37'-8	308	4	37'-4	305	4	37'-0	303	4	37'-0	303	4	37'-0	303	4	36'-7	299	4	36'-7	299	7j1
6m1	APRON, TRANS., TOP		19 VAR.	30'-0 TO 33'-5	905	18 VAR.	29'-9 TO 32'-11	847	18 VAR.	29'-6 TO 32'-8	840	18 VAR.	29'-6 TO 32'-8	840	17 VAR.	29'-6 TO 32'-6	792	13 VAR.	29'-3 TO 31'-6	593	10 VAR.	29'-3 TO 30'-11	452	6m1
6m2	APRON, TRANS., TOP		13 VAR.	33'-9 TO 38'-3	703	10 VAR.	33'-2 TO 36'-6	523	7 VAR.	32'-11 TO 35'-2	358	3 VAR.	32'-11 TO 33'-8	150	1 VAR.	24'-11 TO 24'-11	37	5 VAR.	22'-0 TO 25'-0	176	8 VAR.	19'-2 TO 24'-5	262	6m2
6m3	APRON, TRANS., TOP		33 VAR.	9'-11 TO 27'-11	938	33 VAR.	9'-3 TO 27'-3	905	32 VAR.	8'-6 TO 25'-11	827	32 VAR.	7'-11 TO 25'-5	801	31 VAR.	7'-4 TO 24'-3	735	28 VAR.	6'-1 TO 21'-3	575	24 VAR.	5'-6 TO 18'-6	433	6m3
6m4	APRON, TRANS., BOTT.		24 VAR.	28'-11 TO 53'-5	1528	22 VAR.	28'-10 TO 51'-2	1359	20 VAR.	28'-8 TO 48'-11	1196	18 VAR.	28'-8 TO 46'-10	1044	16 VAR.	28'-8 TO 44'-8	898	14 VAR.	28'-7 TO 42'-5	757	12 VAR.	28'-7 TO 40'-4	624	6m4
6p1	CURTAIN, HORIZONTAL		4	35'-4	212	4	35'-2	211	4	35'-1	211	4	35'-1	211	4	35'-1	211	4	34'-11	210	4	34'-11	210	6p1
6p2	CURTAIN, HORIZONTAL LONG		4	42'-4	268	4	39'-2	235	4	36'-0	216	4	32'-10	197	4	29'-8	178	4	26'-6	159	4	23'-4	140	6p2
6p3	CURTAIN, HORIZONTAL SHORT		4	15'-8	94	4	14'-7	88	4	13'-7	82	4	12'-7	76	4	11'-7	70	4	10'-7	64	4	9'-6	57	6p3
6s1	WING SLOPE, BOTH F. LONG		2	8'-4	25	2	8'-4	25	2	8'-4	25	2	8'-4	25	2	8'-4	25	2	8'-4	25	2	8'-4	25	6s1
6s2	WING SLOPE, BOTH F. SHORT		2	7'-11	24	2	7'-11	24	2	7'-11	24	2	7'-11	24	2	7'-11	24	2	7'-11	24	2	7'-11	24	6s2
6s3	WING SLOPE, BOTH F. LONG		2	69'-0	214	2	63'-1	196	2	57'-2	178	2	51'-3	161	2	45'-4	143	2	39'-5	118	2	33'-6	101	6s3
6s4	WING SLOPE, BOTH F. SHORT		2	42'-1	133	2	38'-6	116	2	34'-10	105	2	31'-2	94	2	27'-7	83	2	23'-11	72	2	20'-3	61	6s4
6s5	WING SLOPE, F.F. LONG		1	74'-3	115	1	68'-4	106	1	62'-5	97	1	56'-6	88	1	50'-7	79	1	44'-8	70	1	38'-9	58	6s5
6s6	WING SLOPE, F.F. SHORT		1	47'-1	74	1	43'-5	69	1	39'-10	60	1	36'-2	54	1	32'-6	49	1	28'-11	43	1	25'-3	38	6s6
6s7	INTERIOR WALL, BOTH F.H.		2	38'-8	116	2	35'-9	107	2	32'-10	99	2	29'-10	90	2	26'-10	81	2	23'-11	72	2	20'-11	63	6s7
5t1	CURTAIN, VERTICAL		61	7'-11	504	58	7'-8	464	55	7'-5	425	52	7'-2	389	48	6'-11	346	45	6'-8	313	41	6'-5	274	5t1
ESTIMATED QUANTITIES ONE HEADWALL	REINF. STEEL		15,584 LB			13,866 LB			12,228 LB			10,701 LB			9136 LB			7801 LB			6550 LB			
	CONCRETE	PARAPET Δ	4.0	138.1 CY		3.9	118.5 CY		3.8	100.8 CY		3.8	87.8 CY		3.8	75.6 CY		3.7	62.3 CY		3.7	52.0 CY		
		WINGWALLS	42.1			33.1			25.4			21.1			17.2			12.3			9.4			
		FOOTING *	92.0			81.5			71.6			62.9			54.6			46.3			38.9			

BENT BAR DETAILS



NOTE:
ALL DIMENSIONS ARE OUT TO OUT. D = PIN DIAMETER.

Δ INCLUDES TOP OF WINGWALL QUANTITIES.
* ASSUMES APRON AND FLOOR ARE EQUAL THICKNESS, ADJUST CONCRETE QUANTITIES FOR TRANSITION WHERE APRON AND FLOOR THICKNESS ARE NOT EQUAL.

NOTE:
WEIGHT OF BARS OVER 40'-0 LONG INCLUDES AN ALLOWANCE OF 2'-3 FOR LAP. LENGTHS SHOWN FOR BARS OVER 40'-0 LONG DO NOT INCLUDE LAP.

"SHORT" DENOTES SHORT WINGWALL
"LONG" DENOTES LONG WINGWALL

HEADWALL NOTES:

1. SEE DRAWING TWRCB GI-12 FOR GENERAL INFORMATION, SPECIFICATIONS, AND DESIGN STRESSES.
2. THIS HEADWALL IS BASED ON A 3:1 SLOPE NORMAL TO CENTERLINE OF ROADWAY.
3. THE SIDES OF THE FOOTING ARE TO BE FORMED TO INSURE CORRECT LINE AND GRADE.
4. ALL SLAB AND FLOOR 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'-0 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'-0 BEYOND BACK OF PARAPET.
8. THE "LENGTH" COLUMN REFLECTS TOTAL NUMBER OF FEET NECESSARY TO MEET THESE REQUIREMENTS.

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

Iowa Department of Transportation
Highway Division

STANDARD DESIGN

TWIN REINFORCED CONCRETE BOX CULVERTS

APRIL, 2012

FLARED WING HEADWALLS

45° SKEW

TWH 45-7-12