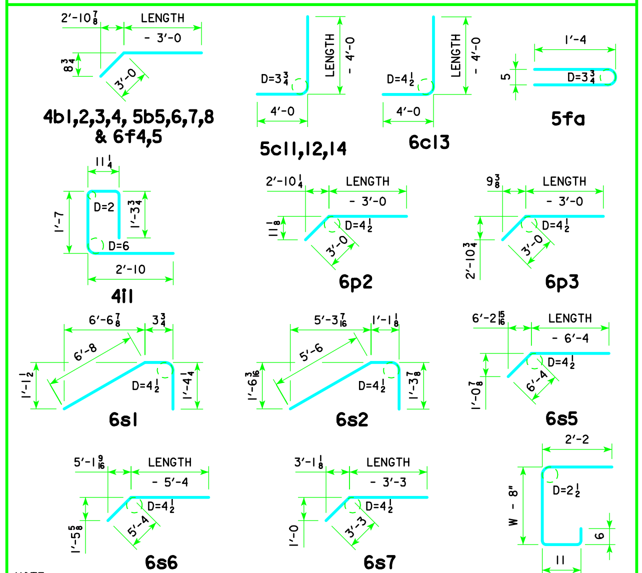
BILL OF REINFORCING FOR ONE HEADWALL 45° SKEW CULVERT SPAN × CULVERT HEIGHT

BAR	LOCATION	SHAPE	10'×7' NO.	10'×7' LENGTH	10'×7' WT.	10'×6' NO.	10'×6' LENGTH	10'×6' WT.	10'×5' NO.	10'×5' LENGTH	10'×5' WT.	10'×4' NO.	10'×4' LENGTH	10'×4' WT.	8'×10' NO.	8'×10' LENGTH	8'×10' WT.	8'×9' NO.	8'×9' LENGTH	8'×9' WT.	8'×8' NO.	8'×8' LENGTH	8'×8' WT.	BAR
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	45'-6	32	1	39'-8	26	1	33'-10	23	1	28'-0	19	1	63'-0	44	1	57'-2	40	1	51'-4	36	4b1
4b2	WINGWALL, B.F.H. SHORT		1	28'-5	19	1	24'-11	17	1	21'-5	14	1	17'-11	12	1	38'-10	26	1	35'-5	24	1	31'-11	21	4b2
4b3	WINGWALL, B.F.H. LONG		5 VAR.	19'-6 TO 42'-9	105	4 VAR.	19'-5 TO 36'-11	75	3 VAR.	19'-5 TO 31'-1	51	2 VAR.	19'-5 TO 25'-3	30	8 VAR.	19'-6 TO 60'-3	219	7 VAR.	19'-6 TO 54'-5	177	6 VAR.	19'-6 TO 48'-7	139	4b3
4b4	WINGWALL, B.F.H. SHORT		5 VAR.	12'-10 TO 26'-9	66	4 VAR.	12'-10 TO 23'-3	48	3 VAR.	12'-10 TO 19'-9	33	2 VAR.	12'-10 TO 16'-3	19	8 VAR.	12'-10 TO 37'-3	134	7 VAR.	12'-10 TO 33'-9	109	6 VAR.	12'-10 TO 30'-3	86	4b4
5b5	WINGWALL, F.F.H. LONG		1	45'-6	50	1	39'-9	41	1	33'-11	35	1	28'-1	29	1	63'-0	68	1	57'-2	62	1	51'-4	56	5b5
5b6	WINGWALL, F.F.H. SHORT		1	28'-5	30	1	24'-11	26	1	21'-5	22	1	17'-11	19	1	38'-11	41	1	35'-5	37	1	31'-11	33	5b6
5b7	WINGWALL, F.F.H. LONG		6 VAR.	13'-8 TO 42'-9	179	5 VAR.	13'-8 TO 36'-11	132	4 VAR.	13'-8 TO 31'-1	93	3 VAR.	13'-8 TO 25'-3	61	9 VAR.	13'-9 TO 60'-3	357	8 VAR.	13'-9 TO 54'-5	291	7 VAR.	13'-8 TO 48'-7	232	5b7
5b8	WINGWALL, F.F.H. SHORT		6 VAR.	9'-4 TO 26'-10	113	5 VAR.	9'-4 TO 23'-4	85	4 VAR.	9'-4 TO 19'-10	61	3 VAR.	9'-4 TO 16'-4	40	9 VAR.	9'-5 TO 37'-4	219	8 VAR.	9'-5 TO 33'-10	180	7 VAR.	9'-5 TO 30'-4	145	5b8
5b9	INTERIOR WALL, BOTH F.H.		11 VAR.	6'-7 TO 23'-3	171	9 VAR.	6'-8 TO 20'-5	127	7 VAR.	6'-10 TO 17'-7	89	5 VAR.	7'-0 TO 14'-8	56	17 VAR.	6'-6 TO 31'-9	339	15 VAR.	6'-6 TO 28'-11	277	13 VAR.	6'-7 TO 26'-1	221	5b9
4c1	WINGWALL, F.F.V. LONG		43 VAR.	2'-8 TO 9'-11	181	37 VAR.	2'-8 TO 8'-11	143	31 VAR.	2'-8 TO 7'-10	109	25 VAR.	2'-8 TO 6'-10	79	60 VAR.	2'-7 TO 12'-9	307	54 VAR.	2'-7 TO 11'-9	259	49 VAR.	2'-7 TO 10'-10	220	4c1
4c2	WINGWALL, F.F.V. SHORT		26 VAR.	2'-9 TO 9'-11	110	22 VAR.	2'-9 TO 8'-9	85	19 VAR.	2'-9 TO 7'-11	68	15 VAR.	2'-9 TO 6'-9	48	36 VAR.	2'-8 TO 12'-8	184	33 VAR.	2'-8 TO 11'-10	160	29 VAR.	2'-8 TO 10'-8	129	4c2
4c3	WINGWALL, F.F.V. LONG		---	---	---	---	---	---	---	---	---	---	---	---	37 VAR.	6'-8 TO 12'-10	241	31 VAR.	6'-8 TO 11'-10	192	---	---	---	4c3
4c4	WINGWALL, F.F.V. SHORT		---	---	---	---	---	---	---	---	---	---	---	---	16 VAR.	8'-6 TO 12'-10	114	13 VAR.	8'-6 TO 11'-11	89	---	---	---	4c4
4c5	WINGWALL, F.F.V. LONG		1	8'-8	6	1	7'-8	5	2	6'-8	9	2	5'-8	8	2	11'-7	15	2	10'-7	14	1	9'-7	6	4c5
4c5	WINGWALL, F.F.V. SHORT		1	8'-8	6	2	7'-8	10	1	6'-8	4	2	5'-8	8	2	11'-7	15	1	10'-7	7	2	9'-7	13	4c5
4c6	INTERIOR WALL, BOTH F.V.		2	1'-7	2	2	1'-7	2	2	1'-7	2	2	1'-7	2	2	1'-6	2	2	1'-6	2	2	1'-6	2	4c6
4c7	INTERIOR WALL, BOTH F.V.		38 VAR.	1'-9 TO 7'-4	115	33 VAR.	1'-9 TO 6'-5	90	27 VAR.	1'-9 TO 5'-4	64	22 VAR.	1'-9 TO 4'-5	45	55 VAR.	1'-8 TO 10'-3	219	50 VAR.	1'-8 TO 9'-4	184	44 VAR.	1'-8 TO 8'-4	147	4c7
4c8	INTERIOR WALL, BOTH F.V.		3	7'-6	15	3	6'-6	13	3	5'-6	11	3	4'-6	9	3	10'-5	21	3	9'-5	19	3	8'-5	17	4c8
5c9	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'-7 TO 5'-0	59	15 VAR.	2'-7 TO 5'-0	59	15 VAR.	2'-7 TO 5'-0	59	5c9
5c10	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'-8 TO 3'-6	13	4 VAR.	2'-8 TO 3'-6	13	4 VAR.	2'-8 TO 3'-6	13	5c10
5c11	WINGWALL, B.F.V. LONG		28 VAR.	9'-3 TO 13'-11	338	22 VAR.	9'-3 TO 12'-11	254	16 VAR.	9'-3 TO 11'-10	176	10 VAR.	9'-3 TO 10'-10	105	45 VAR.	9'-2 TO 16'-9	608	39 VAR.	9'-2 TO 15'-9	507	34 VAR.	9'-2 TO 14'-10	426	5c11
5c12	WINGWALL, B.F.V. SHORT		22 VAR.	7'-11 TO 13'-11	250	18 VAR.	7'-11 TO 12'-9	194	15 VAR.	7'-11 TO 11'-11	155	11 VAR.	7'-11 TO 10'-9	107	32 VAR.	7'-10 TO 16'-8	409	29 VAR.	7'-10 TO 15'-10	358	25 VAR.	7'-10 TO 14'-8	293	5c12
6c13	WINGWALL, B.F.V. LONG		18	10'-6	284	12	10'-6	189	---	---	---	---	---	---	35	10'-6	552	29	10'-6	457	24	10'-6	379	6c13
6c13	WINGWALL, B.F.V. SHORT		11	10'-6	173	7	10'-6	110	---	---	---	---	---	---	21	10'-6	331	18	10'-6	284	14	10'-6	221	6c13
5c14	WINGWALL, B.F.V. LONG		1	12'-8	13	1	11'-8	12	2	10'-8	22	2	9'-8	20	2	15'-7	33	2	14'-7	30	1	13'-7	14	5c14
5c14	WINGWALL, B.F.V. SHORT		1	12'-8	13	2	11'-8	24	1	10'-8	11	2	9'-8	20	2	15'-7	33	1	14'-7	15	2	13'-7	28	5c14
4d1	APRON, LONGIT., BOTT.		13	24'-0	208	13	21'-2	184	13	18'-4	159	13	15'-6	135	11	32'-5	238	11	29'-7	217	11	26'-9	197	4d1
4d2	APRON, LONGIT., BOTT. LONG		3	39'-3	79	3	33'-6	67	3	27'-8	55	3	22'-0	44	3	56'-8	118	3	50'-10	106	3	45'-0	95	4d2
4d3	APRON, LONGIT., BOTT. SHORT		3	24'-8	49	3	21'-3	43	3	17'-10	36	3	14'-5	29	3	35'-1	70	3	31'-7	63	3	28'-2	56	4d3
6f1	APRON, LONGIT., TOP		20	24'-0	721	20	21'-2	636	20	18'-4	551	20	15'-6	466	16	32'-5	779	16	29'-7	711	16	26'-9	643	6f1
6f2	APRON, LONGIT., TOP LONG		8 VAR.	6'-5 TO 20'-8	163	7 VAR.	5'-7 TO 17'-10	123	5 VAR.	6'-10 TO 15'-0	82	4 VAR.	6'-0 TO 12'-2	55	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		5 VAR.	7'-4 TO 21'-0	106	4 VAR.	7'-11 TO 18'-2	78	3 VAR.	8'-6 TO 15'-4	54	2 VAR.	9'-1 TO 12'-6	32	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	45'-6	72	1	39'-9	60	1	33'-11	51	1	28'-1	42	1	63'-0	98	1	57'-2	89	1	51'-4	80	6f4
6f5	APRON, LONGIT., TOP SHORT		1	28'-5	43	1	24'-11	37	1	21'-5	32	1	17'-11	27	1	38'-11	58	1	35'-5	53	1	31'-11	48	6f5
4i1	PARAPET, VERTICAL		41	6'-8	183	41	6'-8	183	41	6'-8	183	41	6'-8	183	33	6'-8	147	33	6'-8	147	33	6'-8	147	4i1
7ji	PARAPET, HORIZONTAL		4	30'-11	253	4	30'-11	253	4	30'-11	253	4	30'-11	253	4	25'-8	210	4	25'-8	210	4	25'-8	210	7ji
6m1	APRON, TRANS., TOP		15 VAR.	24'-9 TO 27'-4	587	12 VAR.	24'-9 TO 26'-9	464	8 VAR.	24'-9 TO 26'-0	305	5 VAR.	24'-9 TO 25'-6	189	13 VAR.	20'-6 TO 22'-9	422	13 VAR.	20'-6 TO 22'-9	422	13 VAR.	20'-6 TO 22'-9	422	6m1
6m2	APRON, TRANS., TOP		1 VAR.	27'-6 TO 27'-6	41	4 VAR.	18'-8 TO 20'-11	119	7 VAR.	16'-7 TO 21'-1	198	11 VAR.	13'-0 TO 20'-6	277	17 VAR.	23'-0 TO 29'-0	664	13 VAR.	23'-0 TO 27'-6	493	9 VAR.	23'-0 TO 26'-0	331	6m2
6m3	APRON, TRANS., TOP		27 VAR.	6'-3 TO 20'-11	551	23 VAR.	5'-9 TO 18'-1	412	20 VAR.	5'-2 TO 15'-10	315	16 VAR.	4'-0 TO 12'-5	197	22 VAR.	8'-4 TO 20'-2	471	22 VAR.	7'-9 TO 19'-7	452	22 VAR.	7'-2 TO 19'-0	432	6m3
6m4	APRON, TRANS., BOTT.		14 VAR.	22'-11 TO 36'-9	627	12 VAR.	22'-11 TO 34'-8	519	10 VAR.	22'-11 TO 32'-6	416	8 VAR.	22'-11 TO 30'-4	320	20 VAR.	17'-4 TO 37'-8	826	18 VAR.	17'-4 TO 35'-6	714	16 VAR.	17'-4 TO 33'-4	609	6m4
6p1	CURTAIN, HORIZONTAL		4	29'-3	176	4	29'-3	176	4	29'-3	176	4	29'-3	176	4	23'-9	143	4	23'-9	143	4	23'-9	143	6p1
6p2	CURTAIN, HORIZONTAL LONG		4	26'-6	159	4	23'-4	140	4	20'-2	121	4	17'-0	102	4	36'-0	216	4	32'-10	197	4	29'-8	178	6p2
6p3	CURTAIN, HORIZONTAL SHORT		4	10'-7	64	4	9'-6	57	4	8'-6	51	4	7'-6	45	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	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	39'-5	118	2	33'-6	101	2	27'-7	83	2	21'-8	65	2	57'-2	178	2	51'-3	161	2	45'-4	143	6s3
6s4	WING SLOPE, BOTH F. SHORT		2	23'-11	72	2	20'-3	61	2	16'-8	50	2	13'-0	39	2	34'-10	105	2	31'-2	94	2	27'-7	83	6s4
6s5	WING SLOPE, F.F. LONG		1	44'-8	70	1	38'-9	58	1	32'-10	49	1	26'-11	40	1	62'-5	97	1	56'-6	88	1	50'-7	79	6s5
6s6	WING SLOPE, F.F. SHORT		1	28'-11	43	1	25'-3	38	1	21'-7	32	1	18'-0	27	1	39'-10	60	1	36'-2	54	1	32'-6	49	6s6
6s7	INTERIOR WALL, BOTH F.H.		2	23'-11	72	2	20'-11	63	2	17'-11	54	2	14'-11	45	2	32'-10	99	2	29'-10	90	2	26'-10	81	6s7
5t1	CURTAIN, VERTICAL		41	6'-8	285	37	6'-5	248	35	6'-5	234	31	6'-5	207	47	7'-5	364	44	7'-2	329	40	6'-11	289	5t1
ESTIMATED QUANTITIES ONE HEADWALL	REINF. STEEL			7142 LB			5957 LB			4721 LB			3860 LB			10,640 LB			9251 LB			7722 LB		
	CONCRETE	PARAPET Δ	3.3	55.4 CY		3.3	46.1 CY		3.3	38.2 CY		3.3	30.9 CY		3.0	82.2 CY		3.0	71.0 CY		3.0	60.6 CY		
		WINGWALLS	12.3			9.4			6.9			4.7			25.4			21.1			17.2			
		FOOTING ✱	39.8			33.4			28.0			22.9			53.8			46.9			40.4			

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 45-9-12

ENGLISHLRFDSIGNEDTWINCULVERTS.DGN - TWH 45-9-12 - THIS SHEET ISSUED 04-12.