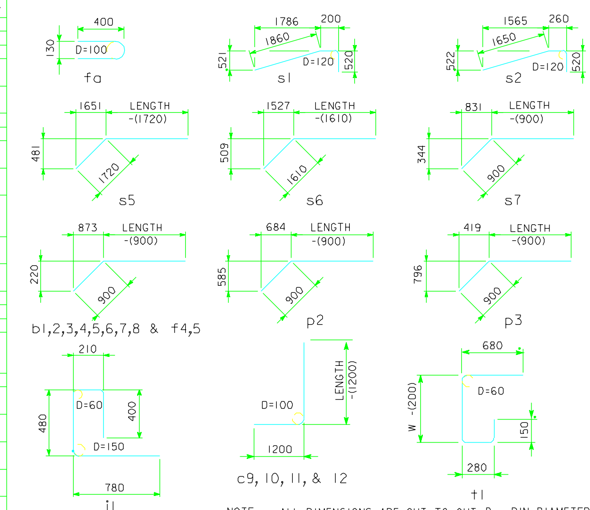
BILL OF REINFORCING FOR ONE HEADWALL 15° SKEW CULVERT SPAN X CULVERT HEIGHT

MARK	SIZE	LOCATION	SHAPE	3600 x 3600 NO.	LENGTH	MASS	3600 x 3000 NO.	LENGTH	MASS	3600 x 2400 NO.	LENGTH	MASS	3600 x 1800 NO.	LENGTH	MASS	3000 x 3600 NO.	LENGTH	MASS	3000 x 3000 NO.	LENGTH	MASS	3000 x 2400 NO.	LENGTH	MASS	MARK
fa	15	FENCE ANCHOR (GALV.)		2	930	3	2	930	3	2	930	3	2	930	3	2	930	3	2	930	3	2	930	3	fa
b1	15	WINGWALL, B.F.H. LONG		1	13 550	21	1	11 490	18	1	9430	15	1	7370	12	1	13 550	21	1	11 490	18	1	9430	15	b1
b2	15	WINGWALL, B.F.H. SHORT		1	11 950	19	1	10 150	16	1	8350	13	1	6550	10	1	11 950	19	1	10 150	16	1	8350	13	b2
b3	15	WINGWALL, B.F.H. LONG		10 VAR	3720/12 990	132	8 VAR	3720/10 930	92	6 VAR	3720/8870	59	4 VAR	3720/6810	33	10 VAR	3720/12 990	132	8 VAR	3720/10 930	92	6 VAR	3720/8870	59	b3
b4	15	WINGWALL, B.F.H. SHORT		10 VAR	3360/11 470	116	8 VAR	3360/9670	82	6 VAR	3360/7870	53	4 VAR	3360/6070	30	10 VAR	3360/11 470	116	8 VAR	3360/9670	82	6 VAR	3360/7870	53	b4
b5	15	WINGWALL, F.F.H. LONG		1	13 550	21	1	11 490	18	1	9430	15	1	7370	12	1	13 550	21	1	11 490	18	1	9430	15	b5
b6	15	WINGWALL, F.F.H. SHORT		1	11 950	19	1	10 150	16	1	8350	13	1	6550	10	1	11 950	19	1	10 150	16	1	8350	13	b6
b7	15	WINGWALL, F.F.H. LONG		11 VAR	2690/12 990	136	9 VAR	2690/10 930	96	7 VAR	2690/8870	64	5 VAR	2690/6810	37	11 VAR	2690/12 990	136	9 VAR	2690/10 930	96	7 VAR	2690/8870	64	b7
b8	15	WINGWALL, F.F.H. SHORT		11 VAR	2460/11 470	120	9 VAR	2460/9670	86	7 VAR	2460/7870	57	5 VAR	2460/6070	33	11 VAR	2460/11 470	120	9 VAR	2460/9670	86	7 VAR	2460/7870	57	b8
b9	15	CENTER WALLS, BOTH F.H.		42 VAR	2 EACH 1440/8330	322	34 VAR	2 EACH 1450/7090	228	26 VAR	2 EACH 1470/5850	150	18 VAR	2 EACH 1500/4600	86	42 VAR	2 EACH 1440/8330	322	34 VAR	2 EACH 1450/7090	228	26 VAR	2 EACH 1470/5850	150	b9
c1	15	WINGWALL, F.F.V. LONG		42 VAR	840/4430	174	35 VAR	840/3810	128	29 VAR	840/3290	94	22 VAR	840/2680	61	42 VAR	820/4410	172	35 VAR	820/3790	127	29 VAR	820/3270	93	c1
c2	15	WINGWALL, F.F.V. SHORT		37 VAR	850/4450	154	31 VAR	850/3850	114	25 VAR	850/3250	80	19 VAR	850/2650	52	37 VAR	830/4430	153	31 VAR	830/3830	113	25 VAR	830/3230	80	c2
c3	15	WINGWALL, F.F.V. LONG		2	4370	14	2	3770	12	2	3170	10	2	2570	8	2	4350	14	2	3750	12	2	3150	10	c3
c3	15	WINGWALL, F.F.V. SHORT		1	4370	7	1	3770	6	1	3170	5	1	2570	4	1	4350	7	1	3750	6	1	3150	5	c3
c4	15	CENTER WALLS, BOTH F.V.		4	510	3	4	510	3	4	510	3	4	500	3	4	490	3	4	490	3	4	490	3	c4
c5	15	CENTER WALLS, BOTH F.V.		98 VAR	2 EACH 570/3710	330	82 VAR	2 EACH 570/3120	238	66 VAR	2 EACH 570/2540	162	50 VAR	2 EACH 560/1960	98	98 VAR	2 EACH 550/3690	326	82 VAR	2 EACH 550/3100	234	66 VAR	2 EACH 550/2520	160	c5
c6	15	CENTER WALLS, BOTH F.V.		4	3830	24	4	3230	20	4	2630	16	4	2030	12	4	3810	24	4	3210	20	4	2610	16	c6
c7	15	WINGWALL, B.F.V. LONG		9 VAR	840/1540	17	9 VAR	840/1540	17	9 VAR	840/1540	17	9 VAR	840/1540	17	9 VAR	820/1520	17	9 VAR	820/1520	17	9 VAR	820/1520	17	c7
c8	15	WINGWALL, B.F.V. SHORT		6 VAR	850/1350	10	6 VAR	850/1350	10	6 VAR	850/1350	10	6 VAR	850/1350	10	6 VAR	830/1330	10	6 VAR	830/1330	10	6 VAR	830/1330	10	c8
c9	15	WINGWALL, B.F.V. LONG		33 VAR	2830/5630	219	26 VAR	2830/5010	160	20 VAR	2830/4490	115	13 VAR	2830/3880	68	33 VAR	2810/5610	218	26 VAR	2810/4990	159	20 VAR	2810/4470	114	c9
c10	15	WINGWALL, B.F.V. SHORT		31 VAR	2650/5650	202	25 VAR	2650/5050	151	19 VAR	2650/4450	106	13 VAR	2650/3850	66	31 VAR	2630/5630	201	25 VAR	2630/5030	150	19 VAR	2630/4430	105	c10
c11	15	WINGWALL, B.F.V. LONG		24	3220	119	17	3220	84	10	3220	49	—	—	—	24	3200	119	17	3200	84	10	3200	49	c11
c11	15	WINGWALL, B.F.V. SHORT		19	3220	94	13	3220	64	7	3220	35	—	—	—	19	3200	94	13	3200	64	7	3200	35	c11
c12	15	WINGWALL, B.F.V. LONG		2	5570	17	2	4970	16	2	4370	14	2	3770	12	2	5550	17	2	4950	16	2	4350	14	c12
c12	15	WINGWALL, B.F.V. SHORT		1	5570	9	1	4970	8	1	4370	7	1	3770	6	1	5550	9	1	4950	8	1	4350	7	c12
d1	15	APRON, LONGIT., BOTTOM		25	8540	335	25	7300	287	25	6060	238	25	4810	189	21	8540	282	21	7300	241	21	6060	200	d1
d2	15	APRON, LONGIT., BOTTOM LONG		3	12 060	57	3	10 020	47	3	7980	38	3	5950	28	3	12 060	57	3	10 020	47	3	7980	38	d2
d3	15	APRON, LONGIT. BOT. SHORT		3	10 580	50	3	8790	41	3	7010	33	3	5240	25	3	10 580	50	3	8790	41	3	7010	33	d3
f1	20	APRON, LONGIT., TOP		37	8540	746	37	7300	637	37	6060	529	37	4810	420	31	8540	625	31	7300	534	31	6060	443	f1
f2	20	APRON, LONGIT., TOP, LONG		10 VAR	870/7690	101	9 VAR	350/6450	72	7 VAR	630/5210	48	5 VAR	890/3960	29	10 VAR	870/7690	101	9 VAR	350/6450	72	7 VAR	630/5210	48	f2
f3	20	APRON, LONGIT., TOP SHORT		9 VAR	770/7720	90	8 VAR	380/6480	65	6 VAR	860/5240	43	5 VAR	460/3990	26	9 VAR	770/7720	90	8 VAR	380/6480	65	6 VAR	860/5240	43	f3
f4	20	APRON, LONGIT., TOP, LONG		1	13 550	32	1	11 490	27	1	9430	22	1	7370	17	1	13 550	32	1	11 490	27	1	9430	22	f4
f5	20	APRON, LONGIT., TOP SHORT		1	11 950	28	1	10 150	24	1	8350	20	1	6550	15	1	11 950	28	1	10 150	24	1	8350	20	f5
i1	15	PARAPET, VERTICAL		77	1870	226	76	1870	223	76	1870	223	76	1870	223	65	1870	191	64	1870	188	64	1870	188	i1
j1	25	PARAPET, HORIZONTAL		4	12 020	189	4	11 860	186	4	11 790	185	4	11 790	185	4	10 160	160	4	10 000	157	4	9920	156	j1
m1	20	APRON, TRANS., TOP		9 VAR	12 400/12 850	268	8 VAR	12 200/12 590	234	8 VAR	12 100/12 490	232	8 VAR	12 100/12 490	232	8 VAR	10 540/10 930	202	7 VAR	10 340/10 670	173	7 VAR	10 240/10 570	172	m1
m2	20	APRON, TRANS., TOP		20 VAR	12 990/15 120	662	15 VAR	12 670/14 240	475	10 VAR	12 570/13 580	308	4 VAR	12 570/12 900	120	22 VAR	11 080/13 440	635	17 VAR	10 760/12 560	467	12 VAR	10 660/11 890	319	m2
m3	20	APRON, TRANS., TOP		9 VAR	5820/12 090	190	9 VAR	5780/12 050	189	9 VAR	5010/11 280	173	9 VAR	5080/11 350	174	8 VAR	4970/10 460	145	8 VAR	4940/10 430	145	8 VAR	4170/9660	130	m3
m4	20	APRON, TRANS., TOP		3	4770	34	3	4730	33	3	3960	28	3	4030	28	2	3920	18	2	3890	18	2	3120	15	m4
m5	20	APRON, TRANS., BOTTOM		24 VAR	10 490/14 210	698	20 VAR	10 390/13 460	562	16 VAR	10 330/12 760	435	12 VAR	10 340/12 120	317	24 VAR	8630/12 350	593	20 VAR	8530/11 600	474	16 VAR	8470/10 900	365	m5
p1	20	CURTAIN, HORIZONTAL		4	11 970	113	4	11 870	112	4	11 820	111	4	11 810	111	4	10 110	95	4	10 010	94	4	9950	94	p1
p2	20	CURTAIN, HORIZ. LONG		4	6560	62	4	5650	53	4	4750	45	4	3840	36	4	6560	62	4	5650	53	4	4750	45	p2
p3	20	CURTAIN, HORIZ. SHORT		4	5060	48	4	4390	41	4	3730	35	4	3060	29	4	5060	48	4	4390	41	4	3730	35	p3
s1	20	WING SLOPE, BOTH F. LONG		2	2580	12	2	2580	12	2	2580	12	2	2580	12	2	2580	12	2	2580	12	2	2580	12	s1
s2	20	WING SLOPE, BOTH F. SHORT		2	2430	11	2	2430	11	2	2430	11	2	2430	11	2	2430	11	2	2430	11	2	2430	11	s2
s3	20	WING SLOPE, BOTH F. LONG		2	12 240	58	2	10 090	48	2	7950	37	2	5800	27	2	12 240	58	2	10 090	48	2	7950	37	s3
s4	20	WING SLOPE, BOTH F. SHORT		2	10 930	51	2	9030	43	2	7130	34	2	5210	25	2	10 930	51	2	9030	43	2	7130	34	s4
s5	20	WING SLOPE, F.F. LONG		1	14 050	33	1	11 930	28	1	9780	23	1	7640	18	1	14 050	33	1	11 930	28	1	9780	23	s5
s6	20	WING SLOPE, F.F. SHORT		1	12 540	31	1	10 640	25	1	8750	21	1	6850	16	1	12 540	31	1	10 640	25	1	8750	21	s6
s7	20	CENTER WALL, BOTH F.HOR.		4	9160	86	4	7780	74	4	6410	60	4	5030	48	4	9160	86	4	7780	74	4	6410	60	s7
t1	15	CURTAIN, VERTICAL		52	2410	197	48	2260	171	45	2110	149	40	1960	123	47	2410	178	43	2260	153	40	2110	133	t1

ESTIMATED QUANTITIES ONE HEADWALL		3600 x 3600		3600 x 3000		3600 x 2400		3600 x 1800		3000 x 3600		3000 x 3000		3000 x 2400	
REINFORCING STEEL		6710 kg		5406 kg		4258 Kg		3167 kg		6167 kg		4933 kg		3857 kg	
CONCRETE	PARAPET Δ	2.8	86.6 m³	2.7	64.4 m³	2.7	49.4 m³	2.6	35.0 m³	2.4	77.8 m³	2.3	57.1 m³	2.3	43.4 m³
	WINGWALLS	26.2		15.7		10.6		5.8		26.2		15.8		10.6	
	FOOTING ΔΔ	57.6		46.0		36.1		26.6		49.2		39.0		30.5	

BENT BAR DETAILS



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

"SHORT" DENOTES SHORT WINGWALL
"LONG" DENOTES LONG WINGWALL
VARIABLE LENGTH REBAR DENOTED BY X/Y

MASS OF BARS OVER 12 000 mm LONG INCLUDES AN ALLOWANCE FOR LAP (800 mm FOR TOP APRON "m" BARS AND 650 mm ALL OTHER BARS).
LENGTHS SHOWN FOR BARS OVER 12 000 mm LONG DO NOT INCLUDE LAP (800 mm FOR TOP APRON "m" BARS AND 650 mm ALL OTHER).
Δ NOTE: INCLUDES TOP OF WINGWALL QUANTITIES.
ΔΔ ASSUMES APRON AND FLOOR ARE EQUAL THICKNESS, ADJUST CONCRETE QUANTITIES FOR TRANSITION WHERE APRON AND FLOOR THICKNESS ARE NOT EQUAL.

HEADWALL NOTES:

ALL DIMENSIONS ARE IN MILLIMETERS (mm) UNLESS OTHERWISE NOTED OR SHOWN.
SEE SHEET MTRRCB-GI-94 FOR GENERAL INFORMATION, SPECIFICATIONS, AND DESIGN STRESSES.
THIS HEADWALL IS BASED ON A 3:1 SLOPE NORMAL TO CENTERLINE OF ROADWAY. THE SIDES OF THE FOOTING ARE TO BE FORMED TO INSURE CORRECT LINE AND GRADE.
ALL EXPOSED CORNERS OF 90° OR SHARPER ARE TO BE FILLETED WITH A 20 mm DRESSED AND BEVELED STRIP.
ALL REINFORCING IS TO BE SECURELY WIRED IN PLACE BEFORE THE CONCRETE IS POURED. ALL SLAB AND FLOOR REINFORCING STEEL IS TO BE SUPPORTED BY BAR CHAIRS AT INTERVALS OF NOT MORE THAN 900 mm IN EITHER DIRECTION AS OUTLINED IN THE STANDARD SPECIFICATIONS.
CLEAR DISTANCE FROM FACE OF CONCRETE TO NEAR REINFORCING BAR IS TO BE 50 mm UNLESS OTHERWISE NOTED OR SHOWN.
CONCRETE QUANTITIES ARE ESTIMATED FROM BACK OF PARAPET.
HORIZONTAL TAILS OF BARS "b" & "s" ESTIMATED TO EXTEND 600 mm BEYOND BACK OF PARAPET (INTO END OF BARREL). LONGITUDINAL BARS "d", "f1", "f4", AND "f5" ESTIMATED TO PROJECT INTO END SECTION OF BARREL A MINIMUM OF 600 mm BEYOND BACK OF PARAPET.
THE "LENGTH" COLUMN REFLECTS TOTAL NUMBER OF MILLIMETER (mm) NECESSARY TO MEET THESE REQUIREMENTS.

LATEST REVISION DATE: 04-02
APPROVED BY: [signature]

STANDARD DESIGN
FLARED WING HEADWALLS
FOR
TRIPLE REINFORCED CONCRETE BOX CULVERTS

PROJECT DEVELOPMENT DIVISION
IOWA DEPARTMENT OF TRANSPORTATION

DECEMBER, 1994

MTRH 15-5-94

REVISED 1-98 - BEND DIMENSIONS OF i1 BAR CHANGED.
REVISED 04-02 - CHANGED BAR LENGTHS AND WEIGHT TOTALS. CONCRETE QUANTITIES ADJUSTED.
TRH155M.SOI

XXXXXXXXXXSYSTEMTIME XXXXXXXUSERNAME XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXDGNSPEC