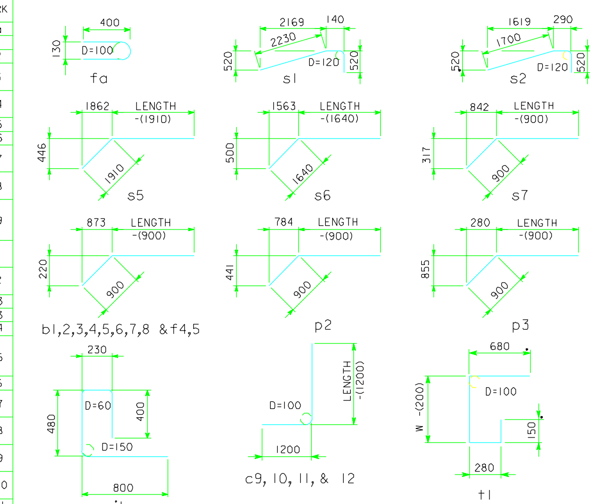
BILL OF REINFORCING FOR ONE HEADWALL 30° SKEW CULVERT SPAN X CULVERT HEIGHT

MARK	SIZE	LOCATION	SHAPE	3600 x 3600			3600 x 3000			3600 x 2400			3600 x 1800			3000 x 3600			3000 x 3000			3000 x 2400			MARK
				NO.	LENGTH	MASS	NO.	LENGTH	MASS	NO.	LENGTH	MASS	NO.	LENGTH	MASS	NO.	LENGTH	MASS	NO.	LENGTH	MASS	NO.	LENGTH	MASS	
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	16 290	26	1	13 790	22	1	11 280	18	1	8780	14	1	16 290	26	1	13 790	22	1	11 280	18	b1
b2	15	WINGWALL, B.F.H. SHORT		1	12 400	19	1	10 520	17	1	8650	14	1	6780	11	1	12 400	19	1	10 520	17	1	8650	14	b2
b3	15	WINGWALL, B.F.H. LONG		10 VAR	4330 / 15 600	160	8 VAR	4330 / 13 100	110	6 VAR	4330 / 10 590	70	4 VAR	4330 / 8090	39	10 VAR	4330 / 15 600	160	8 VAR	4330 / 13 100	110	6 VAR	4330 / 10 590	70	b3
b4	15	WINGWALL, B.F.H. SHORT		10 VAR	3460 / 11 890	120	8 VAR	3460 / 10 020	85	6 VAR	3460 / 8140	55	4 VAR	3460 / 6270	31	10 VAR	3460 / 11 890	120	8 VAR	3460 / 10 020	85	6 VAR	3460 / 8140	55	b4
b5	15	WINGWALL, F.F.H. LONG		1	16 290	26	1	13 790	22	1	11 280	18	1	8780	14	1	16 290	26	1	13 790	22	1	11 280	18	b5
b6	15	WINGWALL, F.F.H. SHORT		1	12 400	19	1	10 520	17	1	8650	14	1	6780	11	1	12 400	19	1	10 520	17	1	8650	14	b6
b7	15	WINGWALL, F.F.H. LONG		11 VAR	3080 / 15 600	161	9 VAR	3080 / 13 100	114	7 VAR	3080 / 10 590	75	5 VAR	3080 / 8090	44	11 VAR	3080 / 15 600	161	9 VAR	3080 / 13 100	114	7 VAR	3080 / 10 590	75	b7
b8	15	WINGWALL, F.F.H. SHORT		11 VAR	2530 / 11 890	125	9 VAR	2530 / 10 020	89	7 VAR	2530 / 8140	59	5 VAR	2530 / 6270	35	11 VAR	2530 / 11 890	125	9 VAR	2530 / 10 020	89	7 VAR	2530 / 8140	59	b8
b9	15	CENTER WALLS, BOTH F.H.		42 VAR	2 EACH 1550 / 9150	353	34 VAR	2 EACH 1550 / 7780	249	26 VAR	2 EACH 1560 / 6390	162	18 VAR	2 EACH 1590 / 5000	93	42 VAR	2 EACH 1550 / 9150	353	34 VAR	2 EACH 1550 / 7780	249	26 VAR	2 EACH 1560 / 6390	162	b9
c1	15	WINGWALL, F.F.V. LONG		51 VAR	830 / 4430	211	43 VAR	830 / 3850	158	35 VAR	830 / 3280	113	26 VAR	830 / 2630	71	51 VAR	810 / 4410	209	43 VAR	810 / 3830	157	35 VAR	810 / 3260	112	c1
c2	15	WINGWALL, F.F.V. SHORT		38 VAR	840 / 4440	158	32 VAR	840 / 3830	117	26 VAR	840 / 3250	83	20 VAR	840 / 2670	55	38 VAR	820 / 4380	155	32 VAR	820 / 3810	116	26 VAR	820 / 3230	83	c2
c3	15	WINGWALL, F.F.V. LONG		2	4370	14	2	3770	12	1	3170	5	1	2570	4	2	4350	14	2	3750	12	1	3150	5	c3
c3	15	WINGWALL, F.F.V. SHORT		2	4370	14	2	3770	12	1	3170	5	2	2570	8	2	4350	14	2	3750	12	1	3150	5	c3
c4	15	CENTER WALLS, BOTH F.V.		4	500	4	4	500	4	4	500	4	4	500	4	4	480	3	4	480	4	4	480	3	c4
c5	15	CENTER WALLS, BOTH F.V.		110 VAR	2 EACH 560 / 3760	373	92 VAR	2 EACH 560 / 3160	269	74 VAR	2 EACH 560 / 2520	179	56 VAR	2 EACH 550 / 1930	109	110 VAR	2 EACH 540 / 3740	370	92 VAR	2 EACH 540 / 3140	266	72 VAR	2 EACH 540 / 2500	172	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		11 VAR	830 / 1550	21	11 VAR	830 / 1550	21	11 VAR	830 / 1550	21	11 VAR	830 / 1550	21	11 VAR	810 / 1530	20	11 VAR	810 / 1530	20	11 VAR	810 / 1530	20	c7
c8	15	WINGWALL, B.F.V. SHORT		6 VAR	840 / 1330	10	6 VAR	840 / 1330	10	6 VAR	840 / 1330	10	6 VAR	840 / 1330	10	6 VAR	820 / 1310	10	6 VAR	820 / 1310	10	6 VAR	820 / 1310	10	c8
c9	15	WINGWALL, B.F.V. LONG		40 VAR	2830 / 5630	266	32 VAR	2830 / 5050	198	24 VAR	2830 / 4480	138	15 VAR	2830 / 3830	78	40 VAR	2810 / 5610	264	32 VAR	2810 / 5030	197	24 VAR	2810 / 4460	137	c9
c10	15	WINGWALL, B.F.V. SHORT		32 VAR	2620 / 5600	206	26 VAR	2620 / 5030	156	20 VAR	2620 / 4450	115	14 VAR	2620 / 3870	71	32 VAR	2600 / 5580	205	26 VAR	2600 / 5010	155	20 VAR	2600 / 4430	110	c10
c11	15	WINGWALL, B.F.V. LONG		29	3150	143	21	3150	104	13	3150	64	—	—	—	29	3150	143	21	3150	104	13	3150	64	c11
c11	15	WINGWALL, B.F.V. SHORT		21	3150	104	14	3150	69	8	3150	40	—	—	—	21	3150	104	14	3150	69	8	3150	40	c11
c12	15	WINGWALL, B.F.V. LONG		2	5570	17	2	4970	16	1	4370	7	1	3770	6	2	5550	17	2	4950	16	1	4350	7	c12
c12	15	WINGWALL, B.F.V. SHORT		2	5570	17	2	4970	16	1	4370	7	2	3770	12	2	5550	17	2	4950	16	1	4350	7	c12
d1	15	APRON, LONGIT., BOTTOM		25	9530	374	25	8140	319	25	6760	265	25	5370	209	21	9530	315	21	8140	268	21	6760	222	d1
d2	15	APRON, LONGIT., BOTTOM LONG		3	14 850	70	3	12 360	58	3	9870	46	3	7400	35	3	14 850	70	3	12 360	58	3	9870	46	d2
d3	15	APRON, LONGIT. BOT. SHORT		3	11 160	53	3	9300	44	3	7450	35	3	5600	26	3	11 160	53	3	9300	44	3	7450	35	d3
f1	20	APRON, LONGIT., TOP		37	9530	831	37	8140	709	37	6760	587	37	5370	463	31	9530	696	31	8140	594	31	6760	492	f1
f2	20	APRON, LONGIT., TOP, LONG		12 VAR	930 / 8560	134	10 VAR	920 / 7170	95	8 VAR	900 / 5790	63	6 VAR	890 / 4400	37	12 VAR	930 / 8560	134	10 VAR	920 / 7170	95	8 VAR	900 / 5790	63	f2
f3	20	APRON, LONGIT., TOP SHORT		9 VAR	1180 / 8630	104	8 VAR	700 / 7240	75	6 VAR	1160 / 5850	50	5 VAR	680 / 4470	30	9 VAR	1180 / 8630	104	8 VAR	700 / 7240	75	6 VAR	1160 / 5850	50	f3
f4	20	APRON, LONGIT., TOP, LONG		1	16 290	38	1	13 790	32	1	11 280	27	1	8780	21	1	16 290	38	1	13 790	32	1	11 280	27	f4
f5	20	APRON, LONGIT., TOP SHORT		1	12 400	29	1	10 520	25	1	8650	20	1	6780	16	1	12 400	29	1	10 520	25	1	8650	20	f5
i1	15	PARAPET, VERTICAL		81	1910	243	79	1910	237	79	1910	237	79	1910	237	69	1910	207	67	1910	201	67	1910	201	i1
j1	25	PARAPET, HORIZONTAL		4	13 780	227	4	13 550	223	4	13 440	221	4	13 440	221	4	13 780	227	4	13 550	223	4	13 440	221	j1
m1	20	APRON, TRANS., TOP		16 VAR	12 840 / 13 700	500	16 VAR	12 600 / 13 470	491	13 VAR	12 510 / 13 150	393	7 VAR	12 510 / 12 800	209	14 VAR	10 890 / 11 670	372	14 VAR	10 690 / 11 460	365	14 VAR	10 580 / 11 350	362	m1
m2	20	APRON, TRANS., TOP		9 VAR	13 780 / 14 650	301	3 VAR	13 550 / 13 760	96	19 VAR	5010 / 11 130	361	18 VAR	4940 / 11 030	338	13 VAR	11 800 / 13 020	380	7 VAR	11 590 / 12 150	196	1	11 430	27	m2
m3	20	APRON, TRANS., TOP		19 VAR	5940 / 11 940	400	19 VAR	5450 / 11 450	378	—	—	—	—	—	—	16 VAR	5510 / 10 510	302	16 VAR	5010 / 10 010	283	16 VAR	4560 / 9610	267	m3
m4	20	APRON, TRANS., TOP		6	5540	78	6	5130	72	6	4800	68	6	4400	62	5	5030	59	5	4620	54	5	4240	50	m4
m5	20	APRON, TRANS., BOTTOM		24 VAR	11 680 / 16 380	793	20 VAR	11 690 / 15 440	638	16 VAR	11 710 / 14 570	495	12 VAR	11 490 / 13 740	356	24 VAR	9590 / 14 290	675	20 VAR	9870 / 13 360	547	16 VAR	9430 / 12 490	413	m5
p1	20	CURTAIN, HORIZONTAL		4	13 310	132	4	13 200	130	4	13 140	130	4	13 130	130	4	11 240	106	4	11 120	105	4	11 060	104	p1
p2	20	CURTAIN, HORIZ. LONG		4	8450	80	4	7240	68	4	6030	57	4	4820	45	4	8450	80	4	7240	68	4	6030	57	p2
p3	20	CURTAIN, HORIZ. SHORT		4	4790	45	4	4170	39	4	3540	33	4	2920	28	4	4790	45	4	4170	39	4	3540	33	p3
s1	20	WING SLOPE, BOTH F. LONG		2	2890	14	2	2890	14	2	2890	14	2	2890	14	2	2890	14	2	2890	14	2	2890	14	s1
s2	20	WING SLOPE, BOTH F. SHORT		2	2510	12	2	2510	12	2	2510	12	2	2510	12	2	2510	12	2	2510	12	2	2510	12	s2
s3	20	WING SLOPE, BOTH F. LONG		2	14 560	69	2	11 980	56	2	9410	44	2	6840	32	2	14 560	69	2	11 980	56	2	9410	44	s3
s4	20	WING SLOPE, BOTH F. SHORT		2	11 300	53	2	9350	44	2	7380	35	2	5410	25	2	11 300	53	2	9350	44	2	7380	35	s4
s5	20	WING SLOPE, F.F. LONG		1	16 700	39	1	14 120	33	1	11 550	27	1	8970	21	1	16 700	39	1	14 120	33	1	11 550	27	s5
s6	20	WING SLOPE, F.F. SHORT		1	12 910	30	1	10 940	26	1	8980	21	1	7010	17	1	12 910	30	1	10 940	26	1	8980	21	s6
s7	20	CENTER WALL, BOTH F.HOR.		4	9940	94	4	8440	80	4	6930	66	4	5430	52	4	9940	94	4	8440	80	4	6930	66	s7
t1	15	CURTAIN, VERTICAL		61	2410	231	55	2260	195	50	2110	166	46	1960	142	55	2410	208	49	2260	174	44	2110	146	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		7568 kg		6099 kg		4768 kg		3534 kg		6992 kg		5613 kg		4334 kg	
CONCRETE	PARAPET Δ	3.1	98.5 m^3	3.0	73.3 m^3	3.0	56.0 m^3	2.9	39.6 m^3	2.7	88.7 m^3	2.6	65.0 m^3	2.6	49.2 m^3
CONCRETE	WINGWALLS	29.4		17.7		11.9		6.5		29.4		17.7		11.9	
CONCRETE	FOOTING ΔΔ	66.0		52.6		41.1		30.2		56.6		44.7		34.7	

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 30-5-94

REVISED 1-98 - BEND DIMENSIONS OF i1 BAR CHANGED. BAR MASS CORRECTED FOR m2, m5 & s7.
REVISED 04-02 - CHANGED BAR LENGTHS AND WEIGHT TOTALS. CONCRETE QUANTITIES ADJUSTED.
TRH305M.S01 : THIS SHEET ISSUED 03/95

XXXXXXXXXXSYSTEMTIME XXXXXXXUSERNAME XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXDGNSPEC