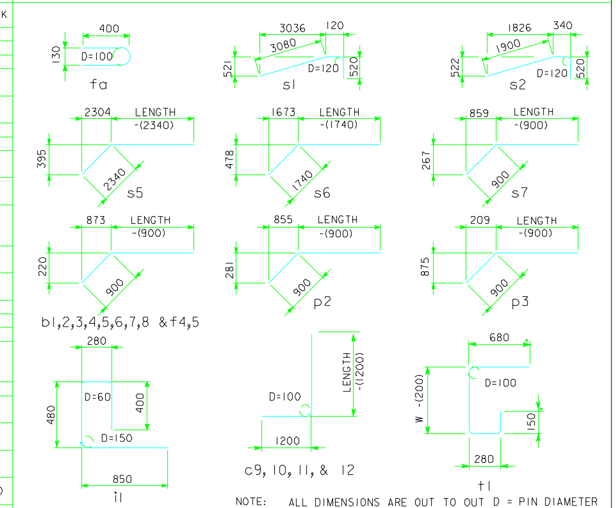
# BILL OF REINFORCING FOR ONE HEADWALL 45° SKEW CULVERT SPAN X CULVERT HEIGHT

| 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 | 22 430 | 35 | 1 | 18 930 | 30 | 1 | 15 430 | 24 | 1 | 11 930 | 19 | 1 | 22 430 | 35 | 1 | 18 930 | 30 | 1 | 15 430 | 24 | b1 |
| b2 | 15 | WINGWALL, B.F.H. SHORT | | 1 | 13 800 | 22 | 1 | 11 700 | 18 | 1 | 9600 | 15 | 1 | 7500 | 12 | 1 | 13 800 | 22 | 1 | 11 700 | 18 | 1 | 9600 | 15 | b2 |
| b3 | 15 | WINGWALL, B.F.H. LONG | | 10 VAR | 5700 / 21 450 | 213 | 8 VAR | 5700 / 17 950 | 149 | 6 VAR | 5700 / 14 450 | 95 | 4 VAR | 5700 / 10 950 | 52 | 10 VAR | 5700 / 21 450 | 213 | 8 VAR | 5700 / 17 950 | 149 | 6 VAR | 5700 / 14 450 | 95 | b3 |
| b4 | 15 | WINGWALL, B.F.H. SHORT | | 10 VAR | 3780 / 13 220 | 133 | 8 VAR | 3780 / 11 120 | 94 | 6 VAR | 3780 / 9020 | 60 | 4 VAR | 3780 / 6920 | 34 | 10 VAR | 3780 / 13 220 | 133 | 8 VAR | 3780 / 11 120 | 94 | 6 VAR | 3780 / 9020 | 60 | b4 |
| b5 | 15 | WINGWALL, F.F.H. LONG | | 1 | 22 430 | 35 | 1 | 18 930 | 30 | 1 | 15 430 | 24 | 1 | 11 930 | 19 | 1 | 22 430 | 35 | 1 | 18 930 | 30 | 1 | 15 430 | 25 | b5 |
| b6 | 15 | WINGWALL, F.F.H. SHORT | | 1 | 13 800 | 22 | 1 | 11 700 | 18 | 1 | 9600 | 15 | 1 | 7500 | 12 | 1 | 13 800 | 22 | 1 | 11 700 | 18 | 1 | 9600 | 15 | b6 |
| b7 | 15 | WINGWALL, F.F.H. LONG | | 11 VAR | 3960 / 21 450 | 219 | 9 VAR | 3960 / 17 950 | 155 | 7 VAR | 3960 / 14 450 | 101 | 5 VAR | 3960 / 10 950 | 59 | 11 VAR | 3960 / 21 450 | 219 | 9 VAR | 3960 / 17 950 | 155 | 7 VAR | 3960 / 14 450 | 101 | b7 |
| b8 | 15 | WINGWALL, F.F.H. SHORT | | 11 VAR | 2730 / 13 220 | 138 | 9 VAR | 2730 / 11 120 | 98 | 7 VAR | 2730 / 9020 | 65 | 5 VAR | 2730 / 6920 | 38 | 11 VAR | 2730 / 13 220 | 138 | 9 VAR | 2730 / 11 120 | 98 | 7 VAR | 2730 / 9020 | 65 | b8 |
| b9 | 15 | CENTER WALLS, BOTH F.H. | | 42 VAR | 2 EACH 1730 / 10 970 | 419 | 34 VAR | 2 EACH 1730 / 9290 | 294 | 26 VAR | 2 EACH 1750 / 7590 | 191 | 18 VAR | 2 EACH 1780 / 5890 | 108 | 42 VAR | 2 EACH 1730 / 10 970 | 419 | 34 VAR | 2 EACH 1730 / 9290 | 294 | 26 VAR | 2 EACH 1750 / 7590 | 191 | b9 |
| c1 | 15 | WINGWALL, F.F.V. LONG | | 72 VAR | 830 / 4480 | 300 | 60 VAR | 830 / 3860 | 221 | 49 VAR | 830 / 3290 | 158 | 37 VAR | 830 / 2680 | 102 | 72 VAR | 810 / 4460 | 298 | 60 VAR | 810 / 3840 | 219 | 49 VAR | 810 / 3270 | 157 | c1 |
| c2 | 15 | WINGWALL, F.F.V. SHORT | | 43 VAR | 840 / 4440 | 178 | 36 VAR | 840 / 3840 | 132 | 29 VAR | 840 / 3240 | 93 | 22 VAR | 840 / 2640 | 60 | 43 VAR | 820 / 4420 | 177 | 36 VAR | 820 / 3820 | 131 | 29 VAR | 820 / 3220 | 92 | 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 | | 2 | 4370 | 14 | 2 | 3770 | 12 | 2 | 3170 | 10 | 2 | 2570 | 8 | 2 | 4350 | 14 | 2 | 3750 | 12 | 2 | 3150 | 10 | c3 |
| c4 | 15 | CENTER WALLS, BOTH F.V. | | 4 | 500 | 3 | 4 | 490 | 3 | 4 | 490 | 3 | 4 | 490 | 3 | 4 | 480 | 3 | 4 | 470 | 3 | 4 | 470 | 3 | c4 |
| c5 | 15 | CENTER WALLS, BOTH F.V. | | 134 VAR | 2 EACH 540 / 3760 | 452 | 112 VAR | 2 EACH 540 / 3160 | 326 | 90 VAR | 2 EACH 540 / 2570 | 220 | 68 VAR | 2 EACH 530 / 1980 | 134 | 134 VAR | 2 EACH 520 / 3740 | 448 | 112 VAR | 2 EACH 520 / 3140 | 322 | 90 VAR | 2 EACH 520 / 2550 | 216 | c5 |
| c6 | 15 | CENTER WALLS, BOTH F.V. | | 6 | 3830 | 36 | 6 | 3230 | 30 | 6 | 2630 | 24 | 6 | 2030 | 20 | 6 | 3810 | 36 | 6 | 3210 | 30 | 6 | 2610 | 24 | c6 |
| c7 | 15 | WINGWALL, B.F.V. LONG | | 15 VAR | 830 / 1550 | 28 | 15 VAR | 830 / 1550 | 28 | 15 VAR | 830 / 1550 | 28 | 15 VAR | 830 / 1550 | 28 | 15 VAR | 810 / 1530 | 28 | 15 VAR | 810 / 1530 | 28 | 15 VAR | 810 / 1530 | 28 | c7 |
| c8 | 15 | WINGWALL, B.F.V. SHORT | | 4 VAR | 840 / 1100 | 6 | 4 VAR | 840 / 1100 | 6 | 4 VAR | 840 / 1100 | 6 | 4 VAR | 840 / 1100 | 6 | 4 VAR | 820 / 1080 | 6 | 4 VAR | 820 / 1080 | 6 | 4 VAR | 820 / 1080 | 6 | c8 |
| c9 | 15 | WINGWALL, B.F.V. LONG | | 57 VAR | 2800 / 5680 | 379 | 45 VAR | 2800 / 5060 | 278 | 33 VAR | 2800 / 4490 | 195 | 22 VAR | 2800 / 3880 | 115 | 56 VAR | 2780 / 5660 | 378 | 45 VAR | 2780 / 5040 | 276 | 33 VAR | 2780 / 4470 | 194 | c9 |
| c10 | 15 | WINGWALL, B.F.V. SHORT | | 39 VAR | 2380 / 5640 | 246 | 32 VAR | 2380 / 5040 | 186 | 25 VAR | 2380 / 4440 | 134 | 18 VAR | 2380 / 3840 | 88 | 39 VAR | 2360 / 5620 | 244 | 32 VAR | 2360 / 5020 | 185 | 25 VAR | 2360 / 4420 | 133 | c10 |
| c11 | 15 | WINGWALL, B.F.V. LONG | | 41 | 3150 | 203 | 30 | 3150 | 148 | 18 | 3150 | 89 | — | — | — | 41 | 3150 | 203 | 30 | 3150 | 148 | 18 | 3150 | 89 | c11 |
| c11 | 15 | WINGWALL, B.F.V. SHORT | | 26 | 3150 | 129 | 19 | 3150 | 94 | 12 | 3150 | 59 | — | — | — | 26 | 3150 | 129 | 19 | 3150 | 94 | 12 | 3150 | 59 | c11 |
| c12 | 15 | WINGWALL, B.F.V. LONG | | 1 | 5570 | 9 | 1 | 4970 | 8 | 1 | 4370 | 7 | 1 | 3770 | 6 | 1 | 5550 | 9 | 1 | 4950 | 8 | 1 | 4350 | 7 | c12 |
| c12 | 15 | WINGWALL, B.F.V. SHORT | | 2 | 5570 | 17 | 2 | 4970 | 16 | 2 | 4370 | 14 | 2 | 3770 | 12 | 2 | 5550 | 17 | 2 | 4950 | 16 | 2 | 4350 | 14 | c12 |
| d1 | 15 | APRON, LONGIT., BOTTOM | | 25 | 11 670 | 458 | 25 | 9970 | 391 | 25 | 8270 | 324 | 25 | 6580 | 258 | 21 | 11 670 | 385 | 21 | 9970 | 329 | 21 | 8270 | 273 | d1 |
| d2 | 15 | APRON, LONGIT., BOTTOM LONG | | 3 | 21 170 | 100 | 3 | 17 680 | 83 | 3 | 14 200 | 67 | 3 | 10 730 | 51 | 3 | 21 170 | 100 | 3 | 17 680 | 83 | 3 | 14 200 | 67 | d2 |
| d3 | 15 | APRON, LONGIT. BOT. SHORT | | 3 | 12 790 | 60 | 3 | 10 700 | 50 | 3 | 8610 | 41 | 3 | 6540 | 31 | 3 | 12 790 | 60 | 3 | 10 700 | 50 | 3 | 8610 | 41 | d3 |
| f1 | 20 | APRON, LONGIT., TOP | | 37 | 11 670 | 1017 | 37 | 9970 | 869 | 37 | 8270 | 721 | 37 | 6580 | 573 | 31 | 11 670 | 852 | 31 | 9970 | 728 | 31 | 8270 | 604 | f1 |
| f2 | 20 | APRON, LONGIT., TOP, LONG | | 17 VAR | 760 / 10 450 | 224 | 14 VAR | 870 / 8760 | 159 | 11 VAR | 980 / 7060 | 104 | 8 VAR | 1090 / 5360 | 61 | 17 VAR | 760 / 10 450 | 224 | 14 VAR | 870 / 8760 | 159 | 11 VAR | 980 / 7060 | 104 | f2 |
| f3 | 20 | APRON, LONGIT., TOP SHORT | | 10 VAR | 1430 / 10 570 | 141 | 9 VAR | 720 / 8870 | 102 | 7 VAR | 1040 / 7170 | 68 | 5 VAR | 1360 / 5470 | 40 | 10 VAR | 1430 / 10 570 | 141 | 9 VAR | 720 / 8870 | 102 | 7 VAR | 1040 / 7170 | 68 | f3 |
| f4 | 20 | APRON, LONGIT., TOP, LONG | | 1 | 22 430 | 53 | 1 | 18 930 | 45 | 1 | 15 430 | 36 | 1 | 11 930 | 28 | 1 | 22 430 | 53 | 1 | 18 930 | 45 | 1 | 15 430 | 36 | f4 |
| f5 | 20 | APRON, LONGIT., TOP SHORT | | 1 | 13 800 | 32 | 1 | 11 700 | 28 | 1 | 9600 | 23 | 1 | 7500 | 18 | 1 | 13 800 | 32 | 1 | 11 700 | 28 | 1 | 9600 | 23 | f5 |
| i1 | 15 | PARAPET, VERTICAL | | 77 | 2010 | 243 | 76 | 2010 | 240 | 76 | 2010 | 240 | 76 | 2010 | 240 | 65 | 2010 | 205 | 64 | 2010 | 202 | 64 | 2010 | 202 | i1 |
| j1 | 25 | PARAPET, HORIZONTAL | | 4 | 16 280 | 256 | 4 | 16 090 | 253 | 4 | 16 070 | 252 | 4 | 16 070 | 252 | 4 | 13 740 | 216 | 4 | 13 600 | 214 | 4 | 13 470 | 212 | j1 |
| m1 | 20 | APRON, TRANS., TOP | | 23 VAR | 13 420 / 14 660 | 760 | 16 VAR | 13 210 / 14 050 | 544 | 8 VAR | 13 100 / 13 490 | 266 | 1 | 13 100 | 31 | 20 VAR | 11 390 / 12 470 | 579 | 20 VAR | 11 180 / 12 260 | 561 | 12 VAR | 11 070 / 11 690 | 322 | m1 |
| m2 | 20 | APRON, TRANS., TOP | | 7 VAR | 11 590 / 10 390 | 181 | 14 VAR | 8440 / 11 360 | 326 | 21 VAR | 6910 / 11 410 | 453 | 28 VAR | 5220 / 11 290 | 544 | 7 VAR | 12 550 / 13 050 | 224 | 6 VAR | 8600 / 9590 | 129 | 14 VAR | 6690 / 9610 | 269 | m2 |
| m3 | 20 | APRON, TRANS., TOP | | 27 VAR | 5800 / 10 200 | 509 | 19 VAR | 5370 / 8410 | 308 | 12 VAR | 4830 / 6700 | 69 | 5 VAR | 4460 / 5140 | 57 | 27 VAR | 5470 / 10 030 | 493 | 22 VAR | 4870 / 8410 | 344 | 14 VAR | 4470 / 6670 | 184 | m3 |
| m4 | 20 | APRON, TRANS., TOP | | 12 | 5660 | 160 | 12 | 5130 | 145 | 12 | 4720 | 134 | 12 | 4240 | 120 | 10 | 5160 | 122 | 10 | 4700 | 110 | 10 | 4270 | 101 | m4 |
| m5 | 20 | APRON, TRANS., BOTTOM | | 25 VAR | 13 900 / 21 580 | 1044 | 20 VAR | 14 080 / 20 150 | 806 | 16 VAR | 14 000 / 18 800 | 618 | 12 VAR | 14 000 / 17 520 | 445 | 24 VAR | 11 670 / 19 030 | 868 | 20 VAR | 11 530 / 17 610 | 686 | 16 VAR | 11 460 / 16 260 | 522 | m5 |
| p1 | 20 | CURTAIN, HORIZONTAL | | 4 | 16 200 | 153 | 4 | 16 070 | 151 | 4 | 16 000 | 151 | 4 | 15 990 | 151 | 4 | 13 670 | 129 | 4 | 13 530 | 127 | 4 | 13 470 | 127 | p1 |
| p2 | 20 | CURTAIN, HORIZ. LONG | | 4 | 12 740 | 120 | 4 | 10 840 | 102 | 4 | 8940 | 84 | 4 | 7040 | 66 | 4 | 12 740 | 120 | 4 | 10 840 | 102 | 4 | 8940 | 84 | p2 |
| p3 | 20 | CURTAIN, HORIZ. SHORT | | 4 | 4700 | 44 | 4 | 4090 | 39 | 4 | 3480 | 33 | 4 | 2870 | 27 | 4 | 4700 | 44 | 4 | 4090 | 39 | 4 | 3480 | 33 | p3 |
| s1 | 20 | WING SLOPE, BOTH F. LONG | | 2 | 3720 | 18 | 2 | 3720 | 18 | 2 | 3720 | 18 | 2 | 3720 | 18 | 2 | 3720 | 18 | 2 | 3720 | 18 | 2 | 3720 | 18 | s1 |
| s2 | 20 | WING SLOPE, BOTH F. SHORT | | 2 | 2760 | 13 | 2 | 2760 | 13 | 2 | 2760 | 13 | 2 | 2760 | 13 | 2 | 2760 | 13 | 2 | 2760 | 13 | 2 | 2760 | 13 | s2 |
| s3 | 20 | WING SLOPE, BOTH F. LONG | | 2 | 19 670 | 93 | 2 | 16 120 | 76 | 2 | 12 570 | 59 | 2 | 9020 | 42 | 2 | 19 670 | 93 | 2 | 16 120 | 76 | 2 | 12 570 | 59 | s3 |
| s4 | 20 | WING SLOPE, BOTH F. SHORT | | 2 | 12 450 | 59 | 2 | 10 270 | 48 | 2 | 8080 | 38 | 2 | 5900 | 28 | 2 | 12 450 | 59 | 2 | 10 270 | 48 | 2 | 8080 | 38 | s4 |
| s5 | 20 | WING SLOPE, F.F. LONG | | 1 | 22 720 | 54 | 1 | 19 180 | 45 | 1 | 15 620 | 37 | 1 | 12 070 | 28 | 1 | 22 720 | 54 | 1 | 19 180 | 45 | 1 | 15 620 | 37 | s5 |
| s6 | 20 | WING SLOPE, F.F. SHORT | | 1 | 14 260 | 34 | 1 | 12 080 | 28 | 1 | 9910 | 23 | 1 | 7710 | 18 | 1 | 14 260 | 34 | 1 | 12 080 | 28 | 1 | 9910 | 23 | s6 |
| s7 | 20 | CENTER WALL, BOTH F.HOR. | | 4 | 11 690 | 110 | 4 | 9910 | 93 | 4 | 8110 | 76 | 4 | 6320 | 60 | 4 | 11 690 | 110 | 4 | 9910 | 93 | 4 | 8110 | 76 | s7 |
| t1 | 15 | CURTAIN, VERTICAL | | 74 | 2410 | 280 | 68 | 2260 | 242 | 61 | 2110 | 202 | 55 | 1960 | 170 | 69 | 2410 | 261 | 62 | 2260 | 220 | 55 | 2110 | 182 | 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 | | 9469 kg | | 7593 kg | | 5793 kg | | 4316 kg | | 8734 kg | | 6958 kg | | 5353 kg | |
| CONCRETE | PARAPET Δ | 3.8 | 126.9 m³ | 3.7 | 94.0 m³ | 3.7 | 71.4 m³ | 3.6 | 50.1 m³ | 3.4 | 114.6 m³ | 3.2 | 83.8 m³ | 3.2 | 63.1 m³ |
| CONCRETE | WINGWALLS | 37.0 | | 22.2 | | 14.9 | | 8.1 | | 36.9 | | 22.3 | | 15.0 | |
| CONCRETE | FOOTING ΔΔ | 86.1 | | 68.1 | | 52.8 | | 38.4 | | 74.3 | | 58.3 | | 44.9 | |

# 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-G1-94 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 45-6-94

REVISED 1-98 - BEND DIMENSIONS OF i1 BAR CHANGED.
REVISED 04-02 - CHANGED BAR LENGTHS AND WEIGHT TOTALS. CONCRETE QUANTITIES ADJUSTED.
TRH456M.S01

XXXXXXXXXXSYSTEMTIME XXXXXXXUSERNAME XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXDGNSPEC