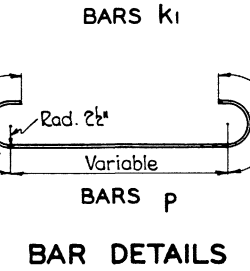
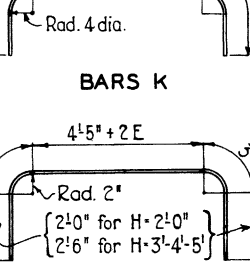
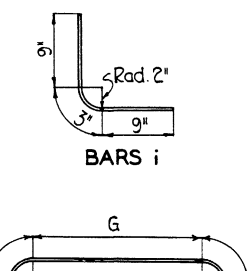
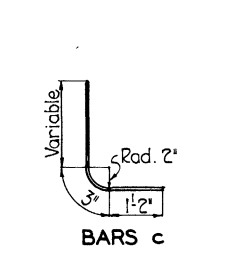
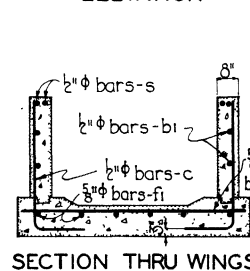
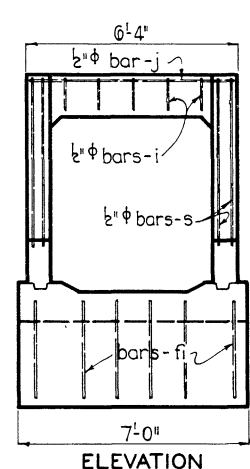


GENERAL NOTES

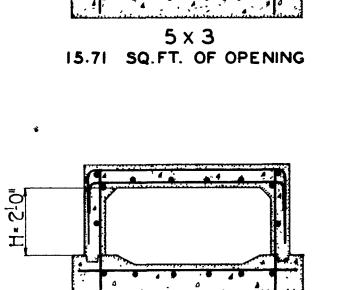
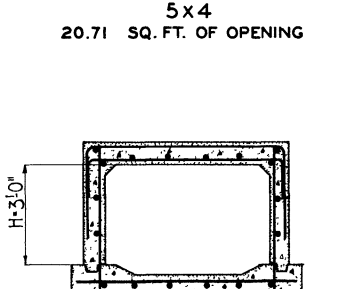
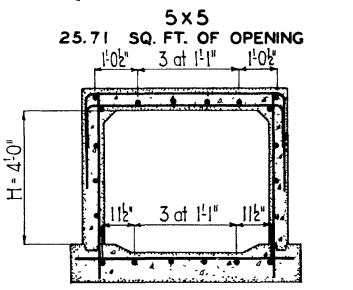
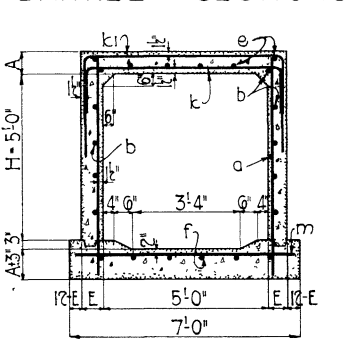
Construction joints formed by beveled 2"x4's to be placed in barrel as shown. Longitudinal reinforcing not to extend thru joints. Longitudinal bars between joints may be spliced by using a 1'8" lap. Number of b, e and f bars given in Bill of Reinforcing are for each intermediate section of length M. Bars k and m to be cut to fit skew at ends of culvert.

All exposed corners 90° or sharper to be filleted with a 3/4" dressed beveled strip. Sides of footings are to be formed to insure correct line and grade. Floor of barrel to be finished smooth. A section 10'0" long of barrel to be built monolithic with headwall at each end.

Standard Specifications, Series of 1937 of the Iowa State Highway Commission.



BARREL SECTIONS



All dimensions on above sections same as for 5'x5' except H.

QUANTITIES IN TWO HEADWALLS ONLY FOR SKEWS TO 45°

5 x 5	Concrete = $\frac{8.91}{\cos \phi}$ Cu. Yds.	Steel = $74 + \frac{586}{\cos \phi}$ pounds
5 x 4	Concrete = $\frac{6.99}{\cos \phi}$ Cu. Yds.	Steel = $79 + \frac{463}{\cos \phi}$ pounds
5 x 3	Concrete = $\frac{5.22}{\cos \phi}$ Cu. Yds.	Steel = $78 + \frac{343}{\cos \phi}$ pounds
5 x 2	Concrete = $\frac{3.61}{\cos \phi}$ Cu. Yds.	Steel = $50 + \frac{266}{\cos \phi}$ pounds

BILL OF REINFORCING

SKEW ANGLE		$\phi = 0^\circ$				$\phi = 15^\circ$				$\phi = 30^\circ$				$\phi = 45^\circ$			
Position of Bars	Mark	Number	Size	Spacing	Length	Number	Size	Spacing	Length	Number	Size	Spacing	Length	Number	Size	Spacing	Length
Walls: Vertical	a	2L+2	$\frac{1}{2}"$	1'0"	H+2A+3'	2L+2	$\frac{1}{2}"$	1'0"	H+2A+3'	2L+2	$\frac{1}{2}"$	1'0"	H+2A+3'	2L+2	$\frac{1}{2}"$	1'0"	H+2A+3'
" Horizontal	b	2H	"	"	M-4"	2H	"	"	M-4"	2H	"	"	M-4"	2H	"	"	M-4"
" " ends	bi	4H	"	"	Table 1	4H	"	"	Table 1	4H	"	"	Table 1	4H	"	"	Table 1
Wings: Vertical	c	Table 2	"	"	" 2	Table 2	"	"	" 2	Table 2	"	"	" 2	Table 2	"	"	" 2
Slab: Longitudinal	e	6	"	shown	M-4"	6	"	shown	M-4"	6	"	shown	M-4"	6	"	shown	M-4"
" " ends	ei	12	$\frac{1}{2}"$	"	10'10"	12	$\frac{1}{2}"$	"	Table 3	12	$\frac{1}{2}"$	"	Table 3	12	$\frac{1}{2}"$	"	Table 3
Floor: "	f	6	$\frac{5}{8}"$	"	M-4"	6	$\frac{5}{8}"$	"	M-4"	6	$\frac{5}{8}"$	"	M-4"	6	$\frac{5}{8}"$	"	M-4"
" " ends	fi	12	"	"	Table 4	12	"	"	Table 4	12	"	"	Table 4	12	"	"	Table 4
Parapets: Vertical	i	10	$\frac{1}{2}"$	1'0"	1'9"	10	$\frac{1}{2}"$	1'0"	1'9"	12	$\frac{1}{2}"$	1'0"	1'9"	16	$\frac{1}{2}"$	1'0"	1'9"
" Transverse	j	2	"	shown	6'10"	2	"	shown	6'10"	2	"	shown	6'11"	2	"	shown	8'6"
Slab: "	k	Table 5				Table 5				Table 5				Table 5			
" " top	ki	$\frac{1}{2}"$ Table 5 See Detail				$\frac{1}{2}"$ Table 5 See Detail				$\frac{1}{2}"$ Table 5 See Detail				$\frac{1}{2}"$ Table 5 See Detail			
Floor: "	m	Table 5 6'8"				Table 5 6'8"				Table 5 6'8"				Table 5 6'8"			
Parapet and Curtain	p	Skews only				8	$\frac{5}{8}"$	4"	7'5"	8	$\frac{5}{8}"$	4"	8'2"	8	$\frac{5}{8}"$	4"	9'9"
Slab: Dowels	r	12	$\frac{1}{2}"$	1'0"	4'0"	12	$\frac{1}{2}"$	1'0"	4'0"	12	$\frac{1}{2}"$	1'0"	4'0"	12	$\frac{1}{2}"$	1'0"	4'0"
Wing: Slope	s	8	"	4"	1.83H+10"	8	"	4"	1.87H+10"	8	"	4"	2.08H+10"	8	"	4"	2.54H+10"
Floor: Headwalls	m1	shown	$\frac{5}{8}"$	8"	6'8"	"	$\frac{5}{8}"$	8"	6'8"	"	$\frac{5}{8}"$	8"	6'8"	"	$\frac{5}{8}"$	8"	6'8"

TABLE - I				b1 BARS																TWO EACH LENGTH REQUIRED																				
SKEW	5 x 5																5 x 4								5 x 3								5 x 2							
$\phi = 0^\circ$	12'9"	12'9"	14'3"	14'3"	15'9"	15'9"	17'3"	17'3"	18'4"	18'4"	12'9"	12'9"	14'3"	14'3"	15'9"	15'9"	16'10"	16'10"	12'9"	12'9"	14'3"	14'3"	15'4"	15'4"	12'9"	12'9"	13'10"	13'10"												
$\phi = 15^\circ$	12'1"	13'9"	13'7"	15'3"	15'2"	16'10"	16'8"	18'4"	17'10"	19'6"	12'1"	13'9"	13'7"	15'3"	15'2"	16'10"	16'3"	17'14"	12'1"	13'9"	13'7"	15'3"	14'9"	16'5"	12'1"	13'9"	13'2"	14'10"												
$\phi = 30^\circ$	11'6"	14'1"	13'3"	16'8"	15'0"	18'5"	16'8"	20'1"	17'4"	21'4"	11'6"	14'1"	13'3"	16'8"	15'0"	18'5"	16'3"	19'8"	11'6"	14'1"	13'3"	16'8"	14'6"	17'11"	11'6"	14'1"	12'9"	16'2"												
$\phi = 45^\circ$	10'9"	16'9"	12'11"	18'11"	15'0"	21'0"	17'2"	23'2"	18'8"	24'8"	10'9"	16'9"	12'11"	18'11"	15'0"	21'0"	16'7"	22'7"	10'9"	16'9"	12'11"	18'11"	14'5"	20'5"	10'9"	16'9"	12'4"	18'4"												

TABLE - 2														TABLE - 3													
c BARS								FOUR EACH LENGTH REQUIRED								e BARS											
5 x 5				5 x 4				5 x 3				5 x 2				ALL HEIGHTS											
φ=0°	φ=15°	φ=30°	φ=45°	φ=0°	φ=15°	φ=30°	φ=45°	φ=0°	φ=15°	φ=30°	φ=45°	φ=0°	φ=15°	φ=30°	φ=45°	TWO EACH LENGTH REQUIRED											
7'10"	7'10"	7'10"	7'10"	6'10"	6'10"	6'10"	6'10"	5'10"	5'10"	5'10"	5'10"	4'10"	4'10"	4'10"	4'10"	φ=0°	φ=15°	φ=30°	φ=45°								
7'2"	7'2"	7'3"	7'4"	6'2"	6'2"	6'3"	6'4"	5'2"	5'2"	5'3"	5'4"	4'2"	4'2"	4'3"	4'4"	10'10"	10'15"	9'4"	8'4"								
6'6"	6'6"	6'8"	6'11"	5'6"	5'6"	5'8"	5'11"	4'6"	4'6"	4'8"	4'11"	3'6"	3'6"	3'8"	3'11"	"	10'5"	10'0"	9'4"								
5'10"	5'11"	6'1"	6'5"	4'10"	4'11"	5'1"	5'5"	3'10"	3'11"	4'1"	4'5"				3'5"	"	10'8"	10'7"	10'5"								
5'2"	5'3"	5'6"	6'0"	4'2"	4'3"	4'6"	5'0"	3'2"	3'3"	3'6"	4'0"					"	11'0"	11'3"	11'7"								
4'6"	4'7"	4'11"	5'6"	3'6"	3'7"	3'11"	4'6"				3'6"					"	11'3"	11'10"	12'8"								
3'10"	3'11"	4'4"	5'0"			3'4"	4'0"									"	11'7"	12'6"	13'8"								
3'2"	3'4"	3'9"	4'7"				3'7"																				
		3'2"	4'1"																								
			3'7"																								
			3'2"																								

TABLE — 4		f1 BARS																TWO EACH LENGTH REQUIRED															
SKEW		5 x 5								5 x 4								5 x 3								5 x 2							
		21'0"	21'0"	21'0"	21'0"	21'0"	21'0"	21'0"	21'0"	19'0"	19'0"	19'0"	19'0"	19'0"	19'0"	19'0"	19'0"	17'0"	17'0"	17'0"	17'0"	17'0"	17'0"	15'0"	15'0"	15'0"	15'0"	15'0"	15'0"				
φ = 0°		21'0"	21'0"	21'0"	21'0"	21'0"	21'0"	21'0"	21'0"	20'0"	19'8"	19'5"	19'1"	18'10"	18'6"	17'11"	17'7"	17'4"	17'0"	16'9"	16'5"	15'10"	15'6"	15'3"	14'11"	14'8"	14'4"	14'0"	13'5"				
φ = 15°		22'0"	21'8"	21'5"	21'1"	20'10"	20'6"	20'0"	19'8"	19'5"	19'1"	18'10"	18'6"	17'11"	17'7"	17'4"	17'0"	16'9"	16'5"	15'10"	15'6"	15'3"	14'11"	14'8"	14'4"	14'0"	13'5"	13'1"	12'6"				
φ = 30°		24'0"	23'2"	22'7"	21'11"	21'4"	20'6"	21'9"	20'11"	20'4"	19'8"	19'1"	18'3"	17'6"	16'8"	16'1"	17'5"	16'10"	16'0"	17'3"	16'5"	15'10"	15'2"	14'7"	13'9"	13'1"	12'4"	11'7"	11'0"				
φ = 45°		27'3"	25'11"	24'10"	23'8"	22'7"	21'3"	24'8"	23'4"	22'3"	21'1"	20'0"	18'8"	17'14"	16'0"	19'7"	18'10"	16'0"	16'0"	17'3"	16'5"	15'10"	15'10"	14'9"	13'5"	12'9"	11'4"	10'9"	10'2"				

TABLE - 5				DIMENSIONS AND QUANTITIES FOR BARREL SECTIONS												
DIMENSIONS				K & M BARS		KI BARS	LENGTH OF BARS		QUANTITIES PER FOOT OF BARREL							
FILL	A	E	G	Size	Spacing	Spacing	k	m	5 x 5		5 x 4		5 x 3		5 x 2	
									Concrete	Steel	Concrete	Steel	Concrete	Steel	Concrete	Steel
0'	9"	7"	5'5"	5 ³ / ₈ "	6" c/s	1'3"	7'11"	6'8"	.685 C.Y.	60.57*	.642 C.Y.	57.90*	.599 C.Y.	55.23*	.556 C.Y.	52.02*
1'-2'	7"	6"	5'3"	"	6 1/2" c/s	"	6'11"	"	.569 C.Y.	57.51*	.532 C.Y.	54.84*	.495 C.Y.	52.17*	.458 C.Y.	48.96*
3'-5'	7"	"	"	"	8 1/2" c/s	"	"	"	"	51.35*	"	48.68*	"	46.01*	"	42.80*
6'-7'	7"	"	"	"	7 1/2" c/s	"	"	"	"	54.02*	"	51.35*	"	48.68*	"	45.47*
8'-9'	7"	"	"	"	6 1/2" c/s	"	"	"	"	57.51*	"	54.84*	.495 C.Y.	52.17*	.458 C.Y.	48.96*
10'-11'	.8'	"	"	"	7" c/s	"	"	"	.610 C.Y.	55.87*	.573 C.Y.	53.20*	.536 C.Y.	50.52*	.498 C.Y.	47.32*
12'-13'	.8'	"	"	"	6" c/s	"	"	"	"	59.91*	"	57.24*	"	54.56*	"	51.36*
14'	.8'	"	"	"	5 1/2" c/s	"	"	"	"	62.49*	"	59.82*	"	57.14*	"	53.94*
15'-17'	.9'	7"	5'5"	"	5 1/2" c/s	"	7'1"	"	.685 C.Y.	63.19*	.642 C.Y.	60.52*	.599 C.Y.	57.85*	.556 C.Y.	54.64*
18'	.9'	"	"	5 ³ / ₈ "	5" c/s	"	"	"	.685 C.Y.	66.31*	"	63.64*	"	60.97*	"	57.76*
19'	.9'	"	5'4"	3 ¹ / ₂ "	6 1/2" c/s	1'0"	7'4"	"	"	72.20*	"	69.53*	"	66.85*	"	63.51*
20'	.9'	7"	5'4"	3 ¹ / ₂ "	6" c/s	1'0"	7'4"	6'8"	.685 C.Y.	75.43*	.642 C.Y.	72.76*	.599 C.Y.	70.08*	.556 C.Y.	66.74*

QUANTITIES IN TWO HEADWALLS									
SKEW ANGLE	5x5		5x4		5 x 3		5 x 2		
	Concrete	Steel	Concrete	Steel	Concrete	Steel	Concrete	Steel	
φ = 0°	8.91 CY	622 *	6.99 CY	501 *	5.22 CY	382 *	3.01 CY	277 *	
φ = 15°	9.22 CY	680 *	7.24 CY	556 *	5.40 CY	433 *	3.74 CY	325 *	
φ = 30°	10.29 CY	754 *	8.07 CY	618 *	6.03 CY	475 *	4.17 CY	357 *	
φ = 45°	12.60 CY	902 *	9.89 CY	733 *	7.38 CY	563 *	5.11 CY	426 *	

STANDARD DESIGN

CONCRETE BOX CULVERTS

5-LO SPAN

PARALLEL WING WALLS

QUANTITIES IN TWO HEADWALLS	5 x 5	5 x 4	5 x 3	5 x 2
SKEW ANGLE	Concrete	Steel	Concrete	Steel
$\phi = 0^\circ$	8.91 CY	622*	6.99 CY	501*
$\phi = 15^\circ$	9.22 CY	680*	7.24 CY	556*
$\phi = 30^\circ$	10.29 CY	754*	8.07 CY	618*
$\phi = 45^\circ$	12.60 CY	902*	9.89 CY	733*

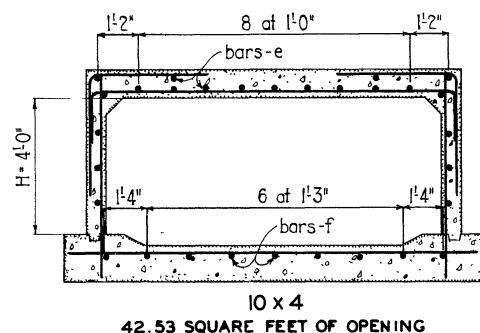
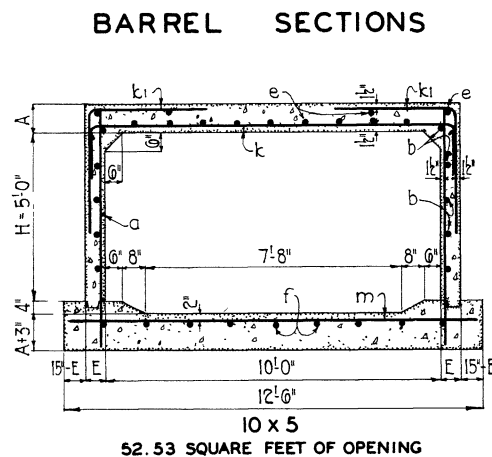
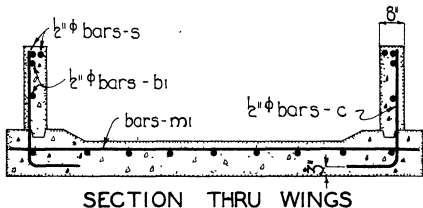
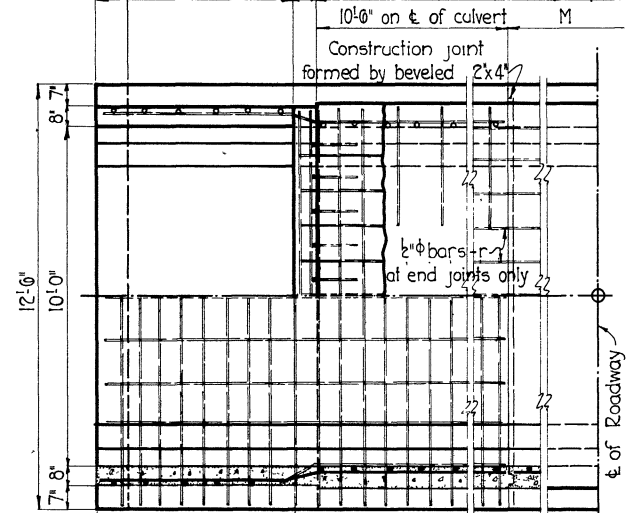
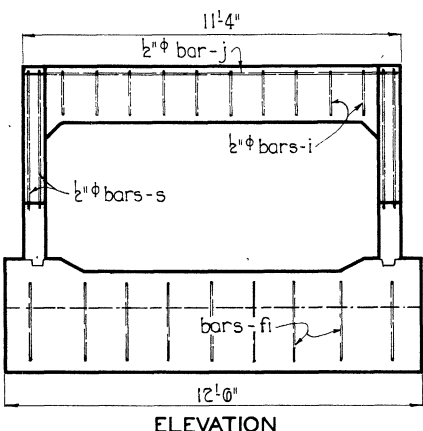
Headwalls constant for all fills. Bars r at end construction joints are included in headwall quantities. To obtain total quantities add quantities of barrel section to those given for two headwalls.

APPROVED BY *J.R. White* CHIEF ENGINEER
REVISED JUNE 1944

STANDARD DESIGN
CONCRETE BOX CULVERTS
5'0" SPAN
PARALLEL WING WALLS
IOWA STATE HIGHWAY COMMISSION
APRIL 1932

C5P

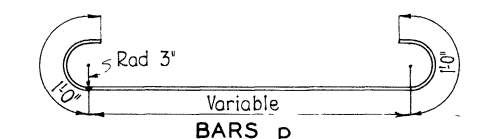
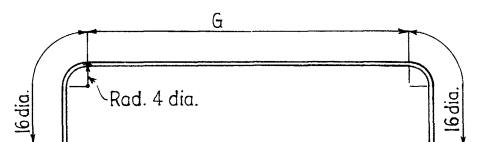
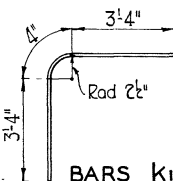
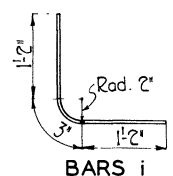
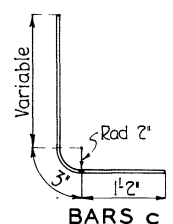
THIS PLAN SUPERSEDES ALL CONFLICTING STANDARDS OF PRIOR DATE



All dimensions on above sections
same as for 10x5 except H

QUANTITIES IN TWO HEADWALLS
ONLY FOR SKEWS TO 45°

10x 5	Concrete = $\frac{10.18}{\cos \theta}$	Cu. Yds.
	Steel = 137 + $\frac{1288}{\cos \theta}$	pounds
10x 4	Concrete = $\frac{12.97}{\cos \theta}$	Cu. Yds.
	Steel = 145 + $\frac{1059}{\cos \theta}$	pounds



BAR DETAILS

GENERAL NOTES

Construction joints formed by beveled 2"x6"s to be placed in floor as shown. Longitudinal reinforcing not to extend thru joints. Longitudinal bars between joints may be spliced by using a 1'-8" lap. Number of b, e and f bars given in Bill of Reinforcing are for each intermediate section of length M. Bars k and m to be cut to fit skew at end of culvert.

All exposed corners 90° or sharper to be filleted with a 3/4" dressed beveled strip. Sides of footings are to be formed to insure correct line and grade. Floor of barrel to be finished smooth. A section 10'-6" long of barrel to be built monolithic with headwall at each end.

Standard Specifications, Series of 1937 of the Iowa State Highway Commission.

B I L L O F R E I N F O R C I N G

SKEW ANGLE		$\phi = 0^\circ$				$\phi = 15^\circ$				$\phi = 30^\circ$				$\phi = 45^\circ$			
Position of bars	Mark	Number	Size	Spacing	Length	Number	Size	Spacing	Length	Number	Size	Spacing	Length	Number	Size	Spacing	Length
Walls: Vertical	a	2L+2	$\frac{5}{8}\phi$	1'-0"	H+2A+4"	2L+2	$\frac{5}{8}\phi$	1'-0"	H+2A+4"	2L+2	$\frac{5}{8}\phi$	1'-0"	H+2A+4"	2L+2	$\frac{5}{8}\phi$	1'-0"	H+2A+4"
" Horizontal	b	2H	"	"	M-4"	2H	"	"	M-4"	2H	"	"	M-4"	2H	"	"	M-4"
" " ends	br	4H	"	"	Table 1	4H	"	"	Table 1	4H	"	"	Table 1	4H	"	"	Table 1
Wings: Vertical	c	Table 2	"	"	" 2	Table 2	"	"	" 2	Table 2	"	"	" 2	Table 2	"	"	" 2
Slab: Longitudinal	e	13	$\frac{5}{8}\phi$	shown	M-4"	13	$\frac{5}{8}\phi$	shown	M-4"	13	$\frac{5}{8}\phi$	shown	M-4"	13	$\frac{5}{8}\phi$	shown	M-4"
" " ends	er	26	$\frac{5}{8}\phi$	"	10'-10"	26	$\frac{5}{8}\phi$	"	Table 3	26	$\frac{5}{8}\phi$	"	Table 3	26	$\frac{5}{8}\phi$	"	Table 3
Floor: "	f	9	$\frac{3}{4}\phi$	"	M-4"	9	$\frac{3}{4}\phi$	"	M-4"	9	$\frac{3}{4}\phi$	"	M-4"	9	$\frac{3}{4}\phi$	"	M-4"
" " ends	fr	18	$\frac{3}{4}\phi$	"	Table 4	18	$\frac{3}{4}\phi$	"	Table 4	18	$\frac{3}{4}\phi$	"	Table 4	18	$\frac{3}{4}\phi$	"	Table 4
Parapets: Vertical	i	20	$\frac{5}{8}\phi$	1'-0"	2'-1 7"	20	$\frac{5}{8}\phi$	1'-0"	2'-1 7"	22	$\frac{5}{8}\phi$	1'-0"	2'-7"	28	$\frac{5}{8}\phi$	1'-0"	2'-7"
" Transverse	j	2	"	shown	11'-0"	2	"	shown	11'-4"	2	"	shown	12'-9"	2	"	shown	15'-8"
Slab: "	k			Table 5				Table 5				Table 5				Table 5	
" " top	kl		$\frac{5}{8}\phi$	1'-3"	7'-0"		$\frac{5}{8}\phi$	1'-3"	7'-0"		$\frac{5}{8}\phi$	1'-3"	7'-0"		$\frac{5}{8}\phi$	1'-3"	7'-0"
Floor: "	m		Table 5		12'-2"		Table 5		12'-2"		Table 5		12'-2"		Table 5		12'-2"
Parapet and curtain	p		Skews only			8	$\frac{3}{4}\phi$	4"	12'-10"	8	$\frac{3}{4}\phi$	4"	14'-3"	8	$\frac{3}{4}\phi$	4"	17'-2"
Slab: Dowels	r	22	$\frac{5}{8}\phi$	1'-0"	4'-0"	22	$\frac{5}{8}\phi$	1'-0"	4'-0"	22	$\frac{5}{8}\phi$	1'-0"	4'-0"	22	$\frac{5}{8}\phi$	1'-0"	4'-0"
Wing: Slope	s	8	"	4"	183 H+10"	8	"	4"	187 H+10"	8	"	4"	208 H+10"	8	"	4"	254 H+10"
Floor: Headwalls	on	shown	$\frac{5}{8}\phi$	8"	12'-2"		$\frac{5}{8}\phi$	8"	12'-2"		$\frac{5}{8}\phi$	8"	12'-2"		$\frac{5}{8}\phi$	8"	12'-2"

TABLE -	b ₁ BARS	TWO EACH LENGTH REQUIRED
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SKEW	10 x 5										10 x 4							
φ = 0°	13'3"	13'3"	14'9"	14'9"	16'3"	16'3"	17'9"	17'9"	18'4"	18'4"	13'3"	13'3"	14'9"	14'9"	16'3"	16'3"	16'10"	16'10"
φ = 15°	11'11"	14'11"	13'6"	16'6"	15'0"	18'0"	16'7"	19'7"	17'2"	20'2"	11'11"	14'11"	13'6"	16'6"	15'0"	18'0"	15'8"	18'7"
φ = 30°	10'7"	17'0"	12'4"	18'9"	14'1"	20'6"	15'10"	22'3"	16'5"	22'10"	10'7"	17'0"	12'4"	18'9"	14'1"	20'6"	14'9"	21'2"
φ = 45°	9'0"	20'0"	11'11"	22'11"	13'3"	24'3"	15'4"	26'4"	16'2"	27'2"	9'0"	20'0"	11'11"	22'11"	13'3"	24'3"	14'1"	25'11"

TABLE - 2 c BARS FOUR EACH LENGTH REQUIRED

10 x 5				10 x 4				ALL HEIGHTS			
ø = 0°	ø = 15°	ø = 30°	ø = 45°	ø = 0°	ø = 15°	ø = 30°	ø = 45°	ø = 0°	ø = 15°	ø = 30°	ø = 45°
8 ¹ 6"	8 ¹ 6"	8 ¹ 6"	8 ¹ 6"	7 ¹ 6"	7 ¹ 6"	7 ¹ 6"	7 ¹ 6"	10 ¹ 10"	9 ¹ 5"	7 ¹ 11"	5 ¹ 10"
7 ¹ 10"	7 ¹ 10"	7 ¹ 11"	8 ¹ 0"	6 ¹ 10"	6 ¹ 10"	6 ¹ 11"	7 ¹ 0"	"	9 ¹ 9"	8 ¹ 7"	7 ¹ 0"
7 ¹ 2"	7 ¹ 3"	7 ¹ 4"	7 ¹ 7"	6 ¹ 2"	6 ¹ 3"	6 ¹ 4"	6 ¹ 7"	2 at 10 ¹ 10"	2 at 10 ¹ 0"	2 at 9 ¹ 2"	2 at 8 ¹ 0"
6 ¹ 2"	6 ¹ 7"	6 ¹ 9"	7 ¹ 1"	5 ¹ 6"	5 ¹ 7"	5 ¹ 9"	6 ¹ 1"	10 ¹ 10"	10 ¹ 4"	9 ¹ 9"	9 ¹ 0"
5 ¹ 10"	5 ¹ 11"	6 ¹ 2"	6 ¹ 7"	4 ¹ 10"	4 ¹ 11"	5 ¹ 2"	5 ¹ 7"	"	10 ¹ 7"	10 ¹ 4"	10 ¹ 0"
5 ¹ 2"	5 ¹ 3"	5 ¹ 7"	6 ¹ 2"	4 ¹ 2"	4 ¹ 3"	4 ¹ 7"	5 ¹ 2"	"	10 ¹ 10"	10 ¹ 11"	11 ¹ 0"
4 ¹ 6"	4 ¹ 7"	5 ¹ 0"	5 ¹ 8"			4 ¹ 0"	4 ¹ 8"	"	11 ¹ 1"	11 ¹ 6"	12 ¹ 0"
3 ¹ 10"	4 ¹ 0"	4 ¹ 5"	5 ¹ 3"				4 ¹ 3"	"	11 ¹ 4"	12 ¹ 1"	13 ¹ 0"
		3 ¹ 10"	4 ¹ 9"					2 at 10 ¹ 10"	2 at 11 ¹ 8"	2 at 12 ¹ 8"	2 at 14 ¹ 0"
			4 ¹ 3"					10 ¹ 10"	11 ¹ 11"	13 ¹ 3"	15 ¹ 0"
			3 ¹ 10"					10 ¹ 10"	12 ¹ 3"	13 ¹ 11"	16 ¹ 2"

TABLE - 4 f1 BARS TWO EACH LENGTH REQUIRED

SKEW	10 x 5									10 x 4								
$\phi = 0^\circ$	21 ¹ 0"	21 ¹ 0"	21 ¹ 0"	21 ¹ 0"	21 ¹ 0"	21 ¹ 0"	21 ¹ 0"	21 ¹ 0"	21 ¹ 0"	19 ¹ 0"	19 ¹ 0"	19 ¹ 0"	19 ¹ 0"	19 ¹ 0"	19 ¹ 0"	19 ¹ 0"	19 ¹ 0"	19 ¹ 0"
$\phi = 15^\circ$	22 ¹ 9"	22 ³ 3"	21 ¹ 11"	21 ¹ 7"	21 ¹ 3"	20 ¹ 11"	20 ¹ 7"	20 ¹ 3"	19 ¹ 9"	20 ¹ 9"	20 ¹ 3"	19 ¹ 11"	19 ¹ 7"	19 ¹ 3"	18 ¹ 11"	18 ¹ 7"	18 ¹ 3"	17 ¹ 9"
$\phi = 30^\circ$	25 ¹ 5"	24 ¹ 5"	23 ¹ 8"	23 ¹ 0"	22 ¹ 3"	21 ¹ 6"	20 ¹ 0"	20 ¹ 1"	19 ¹ 1"	23 ¹ 2"	22 ¹ 2"	21 ¹ 5"	20 ¹ 9"	20 ¹ 0"	19 ¹ 3"	18 ¹ 7"	17 ¹ 10"	16 ¹ 10"
$\phi = 45^\circ$	29 ¹ 9"	28 ¹ 0"	26 ¹ 9"	25 ¹ 6"	24 ¹ 3"	23 ¹ 0"	21 ¹ 9"	20 ¹ 6"	18 ¹ 9"	27 ¹ 2"	25 ¹ 5"	24 ¹ 2"	22 ¹ 11"	21 ¹ 8"	20 ¹ 5"	19 ¹ 2"	17 ¹ 11"	16 ¹ 2"

TABLE - 5

DIMENSIONS AND QUANTITIES FOR BARREL SECTIONS

DIMENSIONS				K AND M BARS		K ₁ BARS		LENGTH OF BARS			QUANTITIES PER FOOT OF BARREL			
FILL	A	E	G	Size	Spacing	Size	Spacing	k ₁	k	m	10 x 5		10 x 4	
											Concrete	Steel	Concrete	Steel
0'	11"	9"	10' 7"	3" φ	8" c/s	3" φ	1' 3" c/s	7' 0"	12' 11"	12' 2"	1.269 C.Y.	131.92 #	1.214 C.Y.	129.25 #
1' 2"	"	"	"	"	8 1/2" c/s	"	"	"	"	"	"	127.41 #	"	124.74 #
3' 4"	"	"	"	"	7 1/2" c/s	"	"	"	"	"	"	137.06 #	"	134.39 #
5' 6"	12"	10"	10' 8"	1" φ	9" c/s	3" φ	1' 3" c/s	7' 0"	13' 4"	12' 2"	1.380 C.Y.	146.00 #	1.318 C.Y.	143.32 #

QUANTITIES IN TWO HEADWALLS

SKEW ANGLE	10 x 5		10 x 4	
	Concrete	Steel	Concrete	Steel
$\phi = 0^\circ$	10.18 C.Y.	1333 #	12.97 C.Y.	1106 #
$\phi = 15^\circ$	10.75 C.Y.	1471 #	13.43 C.Y.	1239 #
$\phi = 30^\circ$	11.68 C.Y.	1632 #	14.98 C.Y.	1376 #
$\phi = 45^\circ$	22.88 C.Y.	1958 #	18.34 C.Y.	1643 #

Note:-

Metal bar chairs spaced not over 3' centers in either direction, are to be used to support the lower layer of the top slab bars.

Headwalls constant for all fills
Bars at end construction joints are included in headwall quantities
To obtain total quantities add quantities of barrel section to those given for two headwalls.

STANDARD DESIGN
CONCRETE BOX CULVERTS
10'0" SPAN
PARALLEL WING WALLS
IOWA STATE HIGHWAY COMMISSION
APRIL 1932

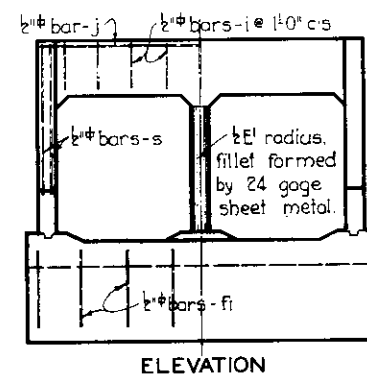
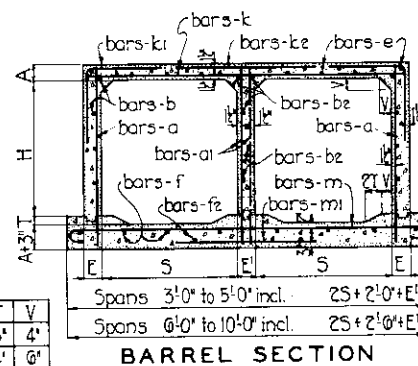
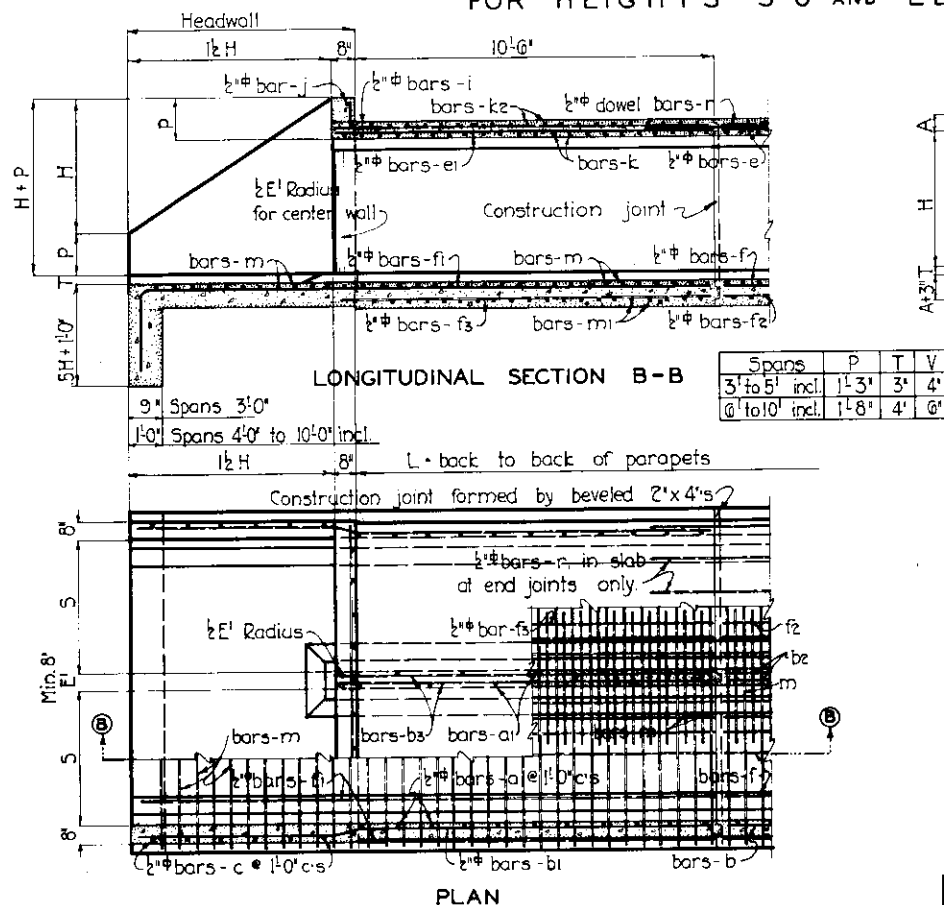
APPROVED BY: A. R. Whit
CHIEF ENGINEER

REVISÉD JUNE 1944

THIS PLAN SUPERSEDES ALL CONFLICTING STANDARDS OF PRIOR DATE



PARALLEL WING WALLS FOR HEIGHTS 5'0" AND LESS



BILL OF REINFORCING

PARALLEL WING WALLS					FLARING WING WALLS				
Position of bars	Mark	Number	Size	Spacing	Position of bars	Mark	Number	Size	Spacing
Wall-Exterior: Vertical	a	2L+2	1/2"	1'-0"	Wall-Exterior: Vertical	a	2L+2	1/2"	1'-0"
" Center: "	ai	L+1	1/2"	1'-0"	" Center: "	ai	L+1	1/2"	1'-0"
" Exterior: Horizontal	b	2H	1/2"	M-4"	" Exterior: Horizontal	b	2H	1/2"	M-4"
" " ends	bi	4H	"	Table 1	" " ends	bi	4H	"	Table 1
" Center: "	be	H+1	1/2"	M-4"	" Center: "	be	H+1	1/2"	M-4"
" " ends	bs	2H+2	"	10'-10"	" " ends	bs	2H+2	"	10'-10"
Wings: Vertical	c	Table 2	"	Table 2	Wings: Vertical	c	Table 1	1/2"	Table 1
Slab: Longitudinal	e	See Note	"	2	" Slab: Longitudinal	d	4	1/2"	shown
" " ends	ei	"	"	2	" " ends	ei	"	"	2
Floor: "	f	"	"	2	Floor: "	f	"	"	2
" " ends	fi	"	"	2	" " ends	fi	"	"	2
" " bottom	fe	2	"	shown	" " bottom	fe	2	"	shown
" " ends	fs	4	"	10'-10"	" " ends	fs	4	"	10'-10"
Parapet: Vertical	i	4S+2	1/2"	5	Parapet: Vertical	i	4S+2	1/2"	5
" Transverse	j	2	"	shown	" Transverse	j	2	"	shown
Slab: "	k	"	"	Table 5	Slab: "	k	"	"	Table 5
" " corners	ki	"	"	4	" " corners	ki	"	"	4
" " top	ke	"	"	Same as k	" " top	ke	"	"	Same as k
Floor: "	m	"	"	Table 5	Floor: "	m	"	"	Table 5
" " bottom	mi	"	"	Same as m	" " bottom	mi	"	"	Same as m
Parapet and Curtain	p	Skews only, See Standards	"	4	Parapet and Curtain	p	4	"	See Std.
Slab: Dowels	r	4S+4	1/2"	4'-0"	Slab: Dowels	r	4S+4	1/2"	4'-0"
Wing: Slope	s	8	"	4"	Wing: Slope	s	8	"	4"

GENERAL NOTES:

Bills of Reinforcing gives number, size and length of bars for straight culverts with twin openings for both wing types. Number of b, be, e, f and fe, fs bars given are for each intermediate section of length M.

Longitudinal reinforcing bars not to extend thru construction joints. If longitudinal bars are spliced use a 2'-0" lap.

On skew culverts the k and m bars are cut to fit skew at ends, and supported by bars p in parapet and floor in parallel wing type, and on bars p in parapet and by bars p in floor in flaring wing type.

Construction joints formed by beveled timber, size as noted on Standard Plan of Span S, to be placed in floor as shown.

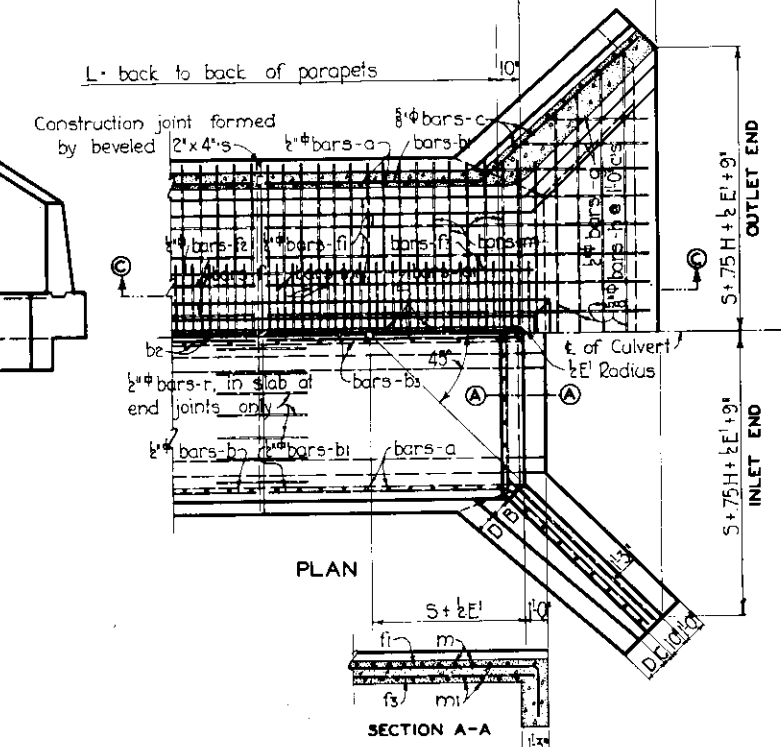
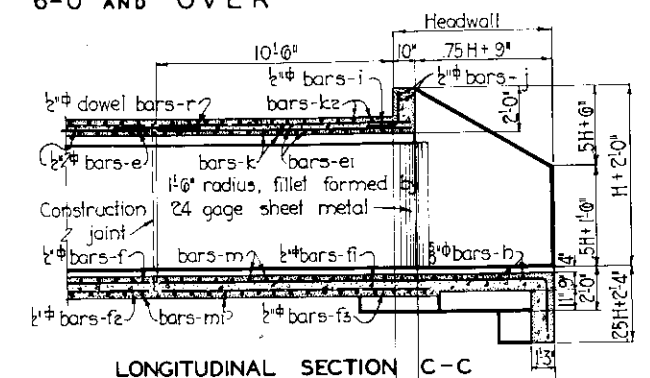
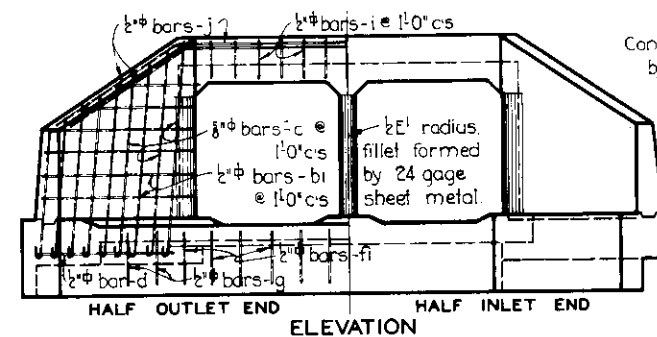
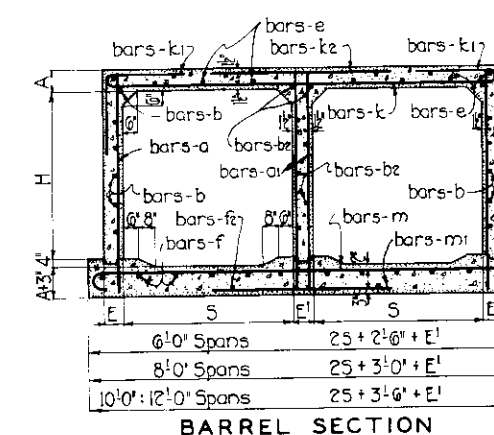
All exposed corners of 90° or sharper to be filleted with a 3/4" dressed beveled strip.

Floor of barrel to be finished smooth. Sides of footings are to be formed to insure correct line and grade. A section 10'-0" long to be built monolithic with headwall. Wing and barrel junction of flaring wing culverts to be filleted with an 18" radius and center wall ends to be rounded with 1/2 E' radius fillet as shown.

Center wall width E' to be equal to E for single opening of Span S, for same fill, but not less than 6'.

Standard Specification Series of 1937 of the Iowa State Highway Commission.

FLARING WING WALLS FOR HEIGHTS 6'0" AND OVER



REINFORCING NOTE:

Bars k2 and m1 to be same size and spacing as k and m bars, length of bars to be as follows:-
1/2" bar - 5'-0" long
3/4" bar - 6'-0" long
1" bar - 8'-0" long

The number of e and ei bars will vary slightly from number required for 2 spans. Space bottom row same as shown on Standard Plan for Span S.

Where bill of Reinforcing refers to Table 1, Table 2, etc. the reference is to Tables on Standard Plan of Spans S.

The number of f and fi bars required will be two bars less than twice the number required for one Span S.

DATA SHEET FOR STANDARD
CONCRETE BOX CULVERTS
WITH TWIN OPENINGS
FLARING AND PARALLEL WING WALLS
IOWA STATE HIGHWAY COMMISSION
APRIL 1932

APPROVED BY *J.R. White*
CHIEF ENGINEER

CTC

THIS PLAN SUPERSEDES ALL CONFLICTING STANDARDS OF PRIOR YEARS

TWIN
F & P