REINFORCED CONCRETE PIPE ARCH CULVERTS AND END SECTIONS

			MENSION I CULVE					DIMENSIONS OF END SECTIONS DIMENSIONS OF INTERMEDIATE SECTIONS													S	STIRRUP REQUIREMENTS									DOUBI	E LINE	REINFOR	13M3O	NT														
	KUP	ARCH	COLVE	K13																	CLASS III CLA		ASS I	ASS IV		SI) WT	- 1	As			A _e			SINGLE LINE															
SPAN	- EQUIN	/. т	RISE	SPAN	WATER	A	В	С	D	E	F	G	R	ш	WEIGI		l u			к		N	, ,			Q F	01 6	R2	R3		v		s.,)	χ Y	As	. As,		FOO	. IOON	TINUOUS BA	SIC F	REINFO	RCEMEN	AD!	DITION	AL REINFO	RCEME	.NT	REINFORCEMENT
RISE	SIZE				₿₩									o	LB	3S.	''	'	"		-	"	' '	` '			` '				١	' '	³ y /	` '	1	x / Asy	CLAS	s	l In	NNER CAGE	(OUTER	CAGE	"U" INI	NER C	AGE "V" (OUTER	CAGE	1
IN.	IN.	IN.	IN.	IN.	S.F.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	7 °	SEC. 1	SEC. 2	IN.	IN.	IN.	IN	. IN	. 11	۱. ا	N. II	۱. ا	N. I	N. I	IN.	IN.	IN.	IN.	IN.	II.	N. IN			11 111	IV LBS	S. CL.I	I CLIII CL.I	V CL	II CL	III CL.IV	CL.II	CLIII	CL.IV CL.II	CLIII	CL.IV	CL.II CLIII CL.IV
22x13	18	21/2	131/2	22	1.65	7	27	45	72	36			2	3:1			2	13%	3/8	3/4	1½	, 1	1 3	4 6	5 5	5¾ 2	7½ 1	3¾	51/4								4 4	4 170)									T 7	0.11 0.14 0.26
29x18	24	3	18	281/2	2.8	81/2	39	33	72	48			3	3:1			3	15/8	1/2	13/	á 13/	ś 15	/8 3	7/16 5 ²	/ ₃₂ 9 ²	²¹ / ₃₂ 40	1/16 14	49/16	119/32								4 4	4 31	5										0.16 0.22 0.32
36x23	30	31/2	221/2	361/4	4.4	91/2	50	46	96	60			3	3:1			3½	113/16	5/8	19/	16 19/	6 1 ¹³ /	₁₆ 3	3/4 7 ¹	/16 12	23/32 5	51 18	8¾	61/32	26	29						4 4	4 44	5 0.0	9 0.12 0.18	8 0.0	7 0.0	9 0.14	0.09	0.12	0.18 0.07	0.09	0.13	0.18 0.24 0.36
44x27	36	4	265/8	43¾	6.4	111/8	60	36	96	72			6	3:1			4	2	3/4	13	4 13/	á :	2 4	1/8 89	/ ₁₆ 1:	5½ 6	32 2	21/2	63/8	30	34						4 4	4 59	7 0.1	1 0.15 0.22	2 0.0	9 0.1	2 0.17	0.11	0.15	0.22 0.09	0.12	0.16	0.22 0.30 0.44
51x31	42	41/2	315/16	511/8	8.8	15 ¹³ / ₁₆	60	36	96	78			6	3:1			4	2	3/4	13	4 13/	á :	2 5	V ₁₆ 10	1/16	18	73 2	261/4	7%	34	39						4 4	4 739											0.26 0.36 0.54
58x36	48	5	36	581/2	11.4	21	60	36	96	84			6	3:1			5	21/4	3/4	2	2	2	4 6	3 11 ¹			34 30	0	8¾	42	43						4 4	4 882		5 0.22 0.40									0.30 0.44
65x40	54	51/2	40	65	14.3	251/2	60	36	96	90			6	3:1			5	3	3/4	13	4 21/	ź 2!	4 6	5⁄ ₈ 1	3 22	211/16 93	2½ 33	3% 9	113/16	48	49						4 4			8 0.24 0.44									0.36 0.48
73x45	60	6	45	73	17.7	31	60	36	96	96			6	3:1			5	35/16	3/4	115/	16 2 ³	4 2!	/2 7	1/2 14	11/16 25	5%2 1	05 3	71/2	11/32	52	55	48 0	55 3	6 48	0.4	4 0.98	4 4			1 0.28 0.52									0.42 0.56
88x54	72	7	54	88	25.6	31	60	39	99	120			6	2:1			6	313/16	1	23/	6 31	4 2 ³	1/4	9 1	7 3°	11/16 1	26 4	45	2%	60	67	60 0	66 4	8 60	0.5	5 1.18	4 5	5 184	0 0.2	6 0.36 0.60	0 0.2	0 0.2	8 0.38	0.26	0.36	0.44 0.20	0.28	0.38	0.52 0.72
102x6	2 84	8	62	102	34.6	281/2	84	18	102	144			6	2:1			6	41/8	1	27	s 31	/ ₂ 3	1/2 1	0 18 ²	1/32 37	71/32 16	21/2	52 1	331/32	68	77	72 0	77 6	50 72	0.6	6 1.37	4 5	5 241	2 0.3	2 0.44 0.70	0 0.2	4 0.3	4 0.48	0.32	0.44	0.49 0.24	0.34	0.44	
115x7	90	81/2	72	115		293/8			1331/4		301/4	48		2:1	19100	3950	7	41/4	1	31	_	_	3/4 1	3 23	13/16 38	87/32	183	59 1	9%32	40	87	84 0	88 7	2 84	0.7	7 1.57	4 5		_	0 0.53 0.75	_	_		_		0.75 0.28			
122x7	_	9	771/4	122	51.7	30			1431/4		401/2	54		_	22000	6050	_	41/2	1	31/		. 4	1 15	51/4 24	1/32 40	015/16 2	218 (62 2	201/16	41	96	84 0	88 7	2 84	0.7	7 1.57	4 5	_		2 0.54 0.77	_				_				
138x8	3 108	10	871/8	138	66.0	323/8			1601/2		811/2	66		2:1	23000	15800	7	5	1		41/	<u>′</u> 4	1/2 1	71/8 26		6% 2	269	70 3	223/8	48	105	96 0	99 8	4 96	0.8	8 1.77	5 5		_	0 0.64 0.9	_	_	_		_		0.45	0.63	
154x9	_	11	96%	154	81.8	351/8			175		96	78		2:1	27000	24600	7	5½	1	41/	² 5		-	8% 29	a	53 30	13%	78	24	70	125	108 1	10 9	6 10	3 0.9	9 1.96	5 5	5 504	8 0.5	9 0.76 1.07	7 0.4	11 0.5	3 0.76	0.59	0.76	1.07 0.41	0.53	0.76	

Equiv. Size = Dia. of Circular Pipe with approximately equivalent cross section area.

As = Minimum Circumferential Steel Area (in square inches) per lineal foot of pipe barrel in each continuous basic cage and additional cages in area denoted "U" and "V".

As_yand As_y= Minimum Stirrup Reinforcement Steel Area in square inches per lineal feet of Pipe Arch.

Maximum spacing of Stirrups = 12"

Tolerance in radial dimensions at Joints = + $\frac{1}{2}$ for 54" or smaller & + $\frac{1}{2}$ " for 60" or larger.

Tolerance in length of Joints (H) + 1/4".

Laying length underruns shall not be more than $\frac{1}{2}$ ".

f_c (KSI) = Minimum compressive strength of concrete in thousands of lbs. per

Laying length of pipe shall not be less than 6 feet for size 84" and larger.

3/4" Minimum Reinforcement cover.

Reinforced Concrete Pipe Arch & End Sections shall conform to Sec. 714 of the Std. Specs.

Design of End Sections shall conform to Class III Reinforced Concrete Pipe Arch. For Class IV and Class V reinforced concrete pipe arches and end sections, shop drawings and design calculations shall be sealed by a Professional Engineer and submitted for Engineer's review.

Tolerance in Rise and Span = + 2% of Tabular values.

Tolerance in Wall thickness (T) = Not less than Design T by more than 7% or $\frac{1}{4}$ ".

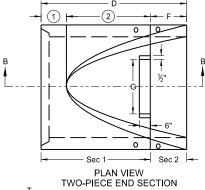
Dimension "U" and "V" is measured on the & of the Culvert wall.

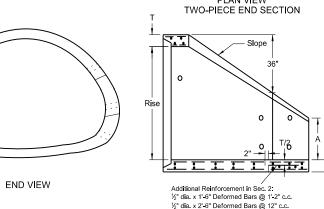
NOTE:

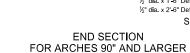
SEE STANDARD DRAWING D-714-22 FOR DETAILS OF CONCRETE PIPE TIES (TIE BOLTS).

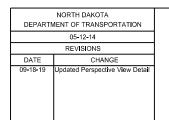
Joints shall be sealed with rubber gaskets or with sealer approved by the engineer whenever pipe are specified for storm drains or sanitary sewers.

- ① 2' 0" for groove end and 2' 7" for tongue end.
- ② 72" for 90" and 96". 48" for 108" and 120".





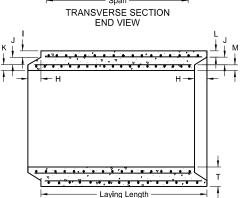




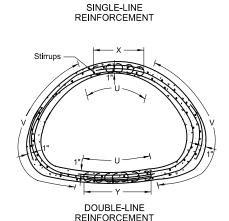
This document was originally issued and sealed by Jon Ketterling, Registration Number PE-4684, on 9/18/19 and the original document is stored at the North Dakota Department of Transportation

SECTION B-B

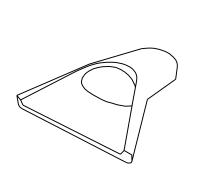




LONGITUDINAL SECTION



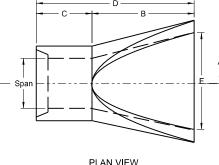
(½ Span, Min. Lap)



PERSPECTIVE VIEW

END VIEW

Holes for Tie Bolts



SECTION A-A

PLAN VIEW

END SECTION FOR ARCHES SMALLER THAN 90"

REINFORCED CONCRETE PIPE ARCH CULVERT