REINFORCED CONCRETE PIPE ARCH CULVERTS AND END SECTIONS

D-714-2

SPAN-RISE	SIZE	T	RISE	SPAN	WATER AREA	MINIMUM AND MAXIMUM COVER IN FEET: CLASS II NORMAL BACKFILL	CLASS II SEWER TRENCH	CLASS III NORMAL BACKFILL	CLASS III SEWER TRENCH	CLASS IV NORMAL BACKFILL	CLASS IV SEWER TRENCH	DIMENSIONS OF END SECTIONS: D	E	I	J	K	L	N	R	SLOPE	WEIGHT IN LBS. SEC. 1	WEIGHT IN LBS. SEC. 2
IN.	IN.	IN.	IN.	IN.	S.F.							IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.			
22x13	18	2 1/2	13 1/2	22	1.65	3-10		2-3/10-14	2-13	1-3/14-21	1-3/13-30	72	36	45	7			27	2	3:1		
29x18	24	3	18	28 1/2	2.8	3-10	4-6	2-3/10-14	2-12	1-3/14-22	1-3/12-26	72	48	33	8 1/2			39	3	3:1		
36x23	30	3 1/2	22 1/2	36 1/4	4.4	3-10	3-7	1-3/10-14	1-3/7-13	14-22	13-25	96	60	46	9 1/2			50	3	3:1		
44x27	36	4	26 5/8	43 3/4	6.4	2-10	2-8	1-2/10-14	1-2/8-13	14-22	13-25	96	72	36	11 1/8			60	6	3:1		
51x31	42	4 1/2	31 5/16	51 1/8	8.8	1-10	2-8	10-15	8-14	15-22	14-25	96	78	36	15 13/16			60	6	3:1		
58x36	48	5	36	58 1/2	11.4	1-10	1-8	10-15	8-14	15-22	14-25	96	84	36	21			60	6	3:1		
65x40	54	5 1/2	40	65	14.3	1-11	1-8	11-15	8-12	15-22	12-21	96	90	36	25 1/2			60	6	3:1		
73x45	60	6	45	73	17.7	1-11	1-8	11-15	8-12	15-22	12-21	96	96	36	31			60	6	3:1		
88x54	72	7	54	88	25.6	1-12	1-9	12-15	9-13	15-23	13-22	99	120	39	31			60	6	2:1		
102x62	84	8	62	102	34.6	1-12	1-9	12-16	9-14	16-23	14-22	102	144	19	28 1/2			83	6	2:1		
115x72	90	8 1/2	72	115 1/2	44.5	1-14	1-13	14-17	13-16	17-24	16-24	133 1/4			29 3/8	30 1/4	48			2:1	19100	3950
122x78	96	9	77 1/2	122 3/8	51.7	1-14	1-13	14-17	13-16	17-24	16-24	143 1/4			30	40 1/2	54			2:1	22000	6050
138x88	108	10	87 1/8	138 1/2	66.0	1-14	1-14	14-18	14-17	18-25	17-25	160 1/2			32 3/8	81 1/2	66			2:1	23000	15800
154x97	120	11	96 7/8	154	81.8	1-15	1-14	15-19	14-17	19-25	17-25	175			35 7/8	96	78			2:1	27000	24600

SPAN-RISE	DIMENSIONS OF INTERMEDIATE SECTIONS: A	B	C	F	G	H	M		R1	R2	R3		U	V
IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.		IN.	IN.	IN.		IN.	IN.
22x13	1 3/8	3/8	3/4	1 1/8	1	2	1/4		27 1/2	13 3/4	5 1/4			
29x18	1 5/8	1/2	1 3/8	1 3/8	1 5/8	3	3 7/16		40 11/16	14 9/16	4 19/32			
36x23	1 13/16	5/8	1 9/16	1 9/16	1 13/16	3 1/2	3 3/4		51	18 3/4	6 1/32		26	29
44x27	2	3/4	1 3/4	1 3/4	2	4	4 1/8		62	22 1/2	6 3/8		30	34
51x31	2	3/4	1 3/4	1 3/4	2	4	5 1/16		73	26 1/4	7 9/16		34	39
58x36	2 1/4	3/4	2	2	2 1/4	5	6		84	30	8 3/4		42	43
65x40	3	3/4	1 3/4	2 1/2	2 1/4	5	6 1/2		92 1/2	33 3/8	9 13/16		48	49
73x45	3 5/16	3/4	1 15/16	2 3/4	2 1/2	5	7 1/2		105	37 1/2	11 7/32		52	55
88x54	3 15/16	1	2 3/16	3 1/4	2 3/4	6	9		126	45	12 9/16		60	67
102x62	4 1/8	1	2 7/8	3 1/2	3 1/2	6	10		162 1/2	52	13 25/32		68	77
115x72	4 1/4	1	3 1/4	3 3/4	3 3/4	7	13		183	59	19 9/32		40	87
122x78	4 1/2	1	3 1/2	4	4	7	15 1/4		218	62	20 1/16		41	96
138x88	5	1	4	4 1/2	4 1/2	7	17 1/8		269	70	22 3/8		48	105
154x97	5 1/2	1	4 1/2	5	5	7	18 7/8		301 3/8	78	24		70	125

SPAN-RISE	STIRRUP REQUIREMENTS CLASS III: Y	As y	CLASS IV: X	Y	As x	As y	f_c (KSI) CLASS II	III	IV	WT. PER FOOT LBS.	DOUBLE LINE REINFORCEMENT As CONTINUOUS BASIC REINFORCEMENT INNER CAGE CL.II	CL.III	CL.IV	OUTER CAGE CL.II	CL.III	CL.IV	As ADDITIONAL REINFORCEMENT "U" INNER CAGE CL.II	CL.III	CL.IV	"V" OUTER CAGE CL.II	CL.III	CL.IV	SINGLE LINE REINFORCEMENT CL.II	CL.III	CL.IV
IN.	IN.		IN.	IN.						LBS.															
22x13							4	4	4	170													0.11	0.14	0.26
29x18							4	4	4	315													0.16	0.22	0.32
36x23							4	4	4	445	0.09	0.12	0.18	0.07	0.09	0.14	0.09	0.12	0.18	0.07	0.09	0.13	0.18	0.24	0.36
44x27							4	4	4	597	0.11	0.15	0.22	0.09	0.12	0.17	0.11	0.15	0.22	0.09	0.12	0.16	0.22	0.30	0.44
51x31							4	4	4	739	0.13	0.18	0.27	0.10	0.14	0.21	0.13	0.18	0.27	0.10	0.14	0.22	0.26	0.36	0.54
58x36							4	4	4	882	0.15	0.22	0.40	0.12	0.17	0.26	0.15	0.22	0.33	0.12	0.17	0.27	0.30	0.44	
65x40							4	4	4	1090	0.18	0.24	0.44	0.14	0.19	0.28	0.18	0.24	0.33	0.14	0.19	0.28	0.36	0.48	
73x45	48		0.55	36	48	0.44	4	4	5	1320	0.21	0.28	0.52	0.17	0.22	0.33	0.21	0.28	0.36	0.17	0.22	0.33	0.42	0.56	
88x54	60		0.66	48	60	0.55	4	5	5	1840	0.26	0.36	0.60	0.20	0.28	0.38	0.26	0.36	0.44	0.20	0.28	0.38	0.52	0.72	
102x62	72		0.77	60	72	0.66	4	5	5	2412	0.32	0.44	0.70	0.24	0.34	0.48	0.32	0.44	0.49	0.24	0.34	0.44	0.64	0.88	
115x72	84		0.88	72	84	0.77	4	5	5	2894	0.40	0.53	0.75	0.28	0.36	0.51	0.40	0.53	0.75	0.28	0.36	0.51			
122x78	84		0.88	72	84	0.77	4	5	5	3285	0.42	0.54	0.77	0.30	0.39	0.56	0.42	0.54	0.77	0.30	0.39	0.56			
138x88	96		0.99	84	96	0.88	5	5	5	4126	0.50	0.64	0.91	0.34	0.45	0.63	0.50	0.64	0.91	0.34	0.45	0.63			
154x97	108		1.10	96	108	0.99	5	5	5	5048	0.59	0.76	1.07	0.41	0.53	0.76	0.59	0.76	1.07	0.41	0.53	0.76			

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_y and As_x = 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 = + 1/8 for 54" or smaller & + 1/4" for 60" or larger.

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

Laying length underruns shall not be more than 1/2".

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

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 II Reinforced Concrete Pipe Arch.

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

Tolerance in Wall thickness (T) = Not less than Design T by more than 7% or 1/4".

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

All reinforcement shall be electrically welded cold drawn steel wire fabric.

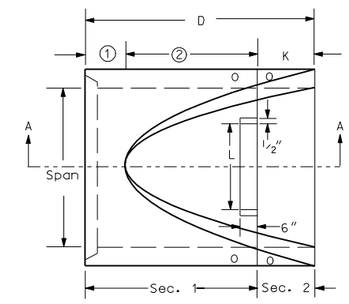
NOTE:

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

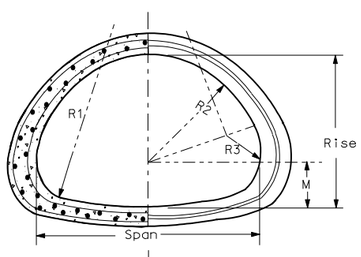
Joints shall be sealed with rubber gaskets or with sealer approved by the engineer whenever pipe are specified for storm drains or sanitary sewers.

① 2'0" for groove end and 2'7" for tongue end.

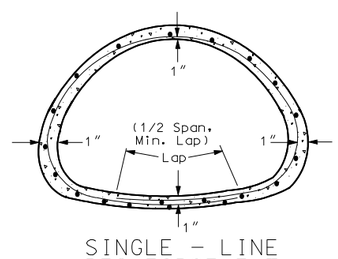
② 72" for 90" and 96". 48" for 108" and 120".



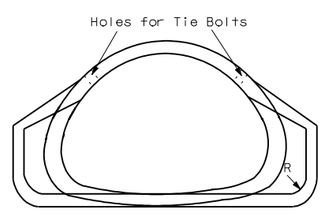
PLAN
TWO-PIECE END SECTION



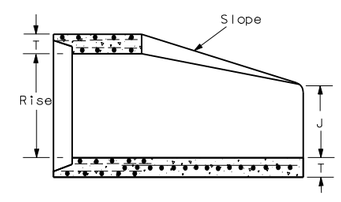
TRANSVERSE SEC. — END VIEW



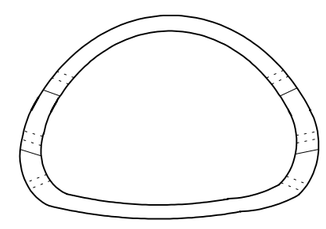
SINGLE - LINE REINFORCEMENT



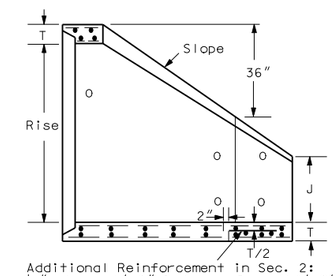
END VIEW



A-A



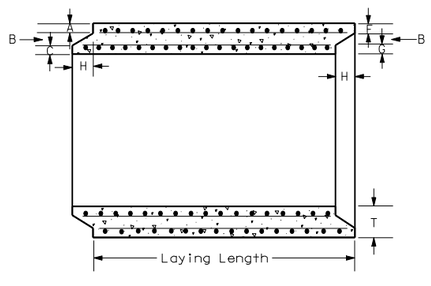
END VIEW



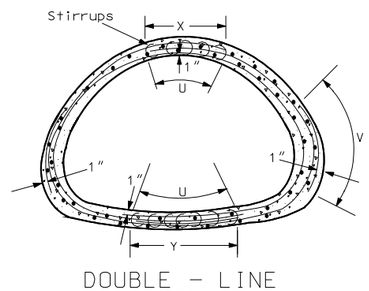
Additional Reinforcement in Sec. 2:
1/2" dia. x 1'-6" Deformed Bars @ 1'-2" c.c.
1/2" dia. x 2'-6" Deformed Bars @ 12" c.c.

A-A

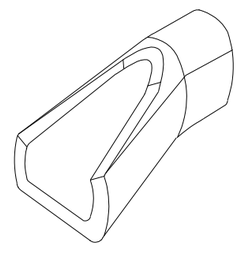
END SECTION
FOR ARCHES 90" AND LARGER



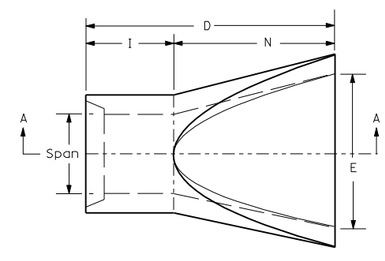
LONGITUDINAL SECTION



DOUBLE - LINE REINFORCEMENT



PERSPECTIVE



PLAN

REINFORCED CONCRETE PIPE ARCH CULVERT

END SECTION
FOR ARCHES SMALLER THAN 90"

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
10-1-86	
REVISIONS	
DATE	CHANGE
11-05-86	Note added
06-25-03	General revisons
12-01-04	PE Stamp added

This document was originally issued and sealed by MARK S GAYDOS, Registration Number PE-4518, on 12/01/04 and the original document is stored at the North Dakota Department of Transportation