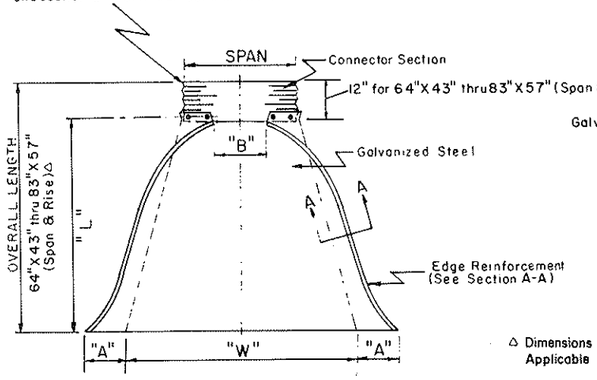
FHWA REGION	STATE	FED AID PROJ NO	SHEET NO
8	N.D.	F-1-094(03)	91

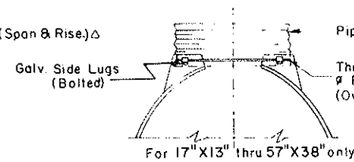
D-630-5

CORRUGATED STEEL PIPE ARCH CULVERTS AND END SECTIONS

This connection for 64"X43" thru 83"X57" pipe arch to be bolted or riveted to the end section with 3/8" Galv bolts or rivets.

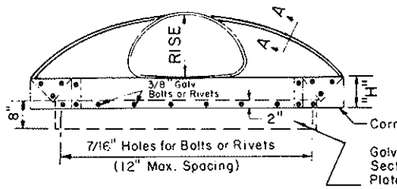


PLAN



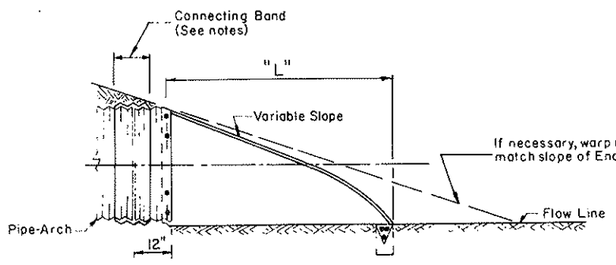
ROD CONNECTION DETAIL

△ Dimensions shown for 2⅔" x ½" corrugations. Applicable to equivalent sizes with 3"x1" corrugations.

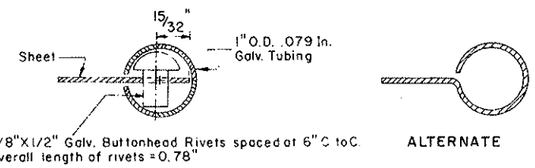


ELEVATION

Galvanized Toe Plate extension required on End Sections for Pipe-Arch of 27" rise or larger. Plate to be fastened to apron in field. Thickness of Toe Plate to be same as End Section. Where Toe Plate is needed, the Toe Plate, Bolts and Nuts are to be included in price bid for End Sections.



TYPICAL CROSS SECTION
(Showing Connector Section)

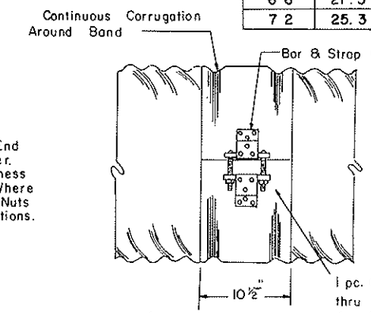


3/8"X1/2" Galv. Buttonhead Rivets spaced at 6" C to C. Overall length of rivets = 0.78"

NOTE: Tubing is slipped over the sheet and rivets prior to forming operations of the End Section.

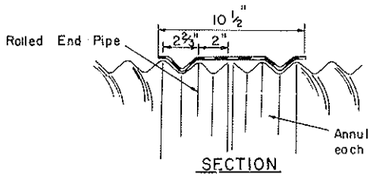
ALTERNATE

SECTION A-A



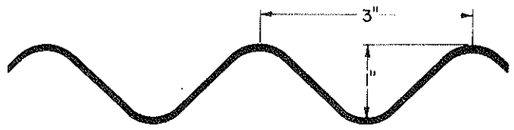
1 pc. Connector for 12" thru 48" Pipe & 2 pc. for 54" and above.

PLAN

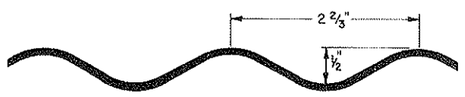


SECTION

CONNECTING BAND DETAILS FOR HELICAL, WELDED - SEAM CULVERT



3" x 1" CORRUGATIONS



2⅔" x ½" CORRUGATIONS

FILL HEIGHT TABLES

RIVETED, WELDED, OR HELICAL FABRICATION

2⅔" BY 1/2" CORRUGATIONS									
EQUIV. PIPE DIA.	WATERWAY AREA	SPAN	RISE	MIN. COVER	MAXIMUM FILL HEIGHT (FEET) FOR GALV. THICKNESS				
					.064	.079	.109	.138	.168
IN.	SQ. FT.	IN.	IN.	IN.					
15	1.1	17	13	18	13				
18	1.6	21	15	18	12				
21	2.2	24	18	18	10				
24	2.8	28	20	18	10				
30	4.4	35	24	18	9				
36	6.4	42	29	18	9				
42	8.7	49	33	18		8			
48	11.4	57	38	18			8		
54	14.3	64	43	18			8		
60	17.6	71	47	18				8	
66	21.3	77	52	18					8
72	25.3	83	57	18					9

3" BY 1" CORRUGATIONS								
EQUIV. PIPE DIA.	WATERWAY AREA	SPAN	RISE	MIN. COVER	MAXIMUM FILL HEIGHT (FEET) FOR GALV. THICKNESS			
					.064	.079	.109	.138
IN.	SQ. FT.	IN	IN	IN				
36	6.4	43	27	18	12			
42	8.7	50	31	18	12			
48	11.4	58	36	18	12			
54	14.3	65	40	18	12			
60	17.6	72	44	18	12			
66	22.0	73	55	18	15			
72	26	81	59	18		15		
78	31	87	63	18		14		
84	35	95	67	18			13	
90	40	103	71	24			12	
96	46	112	75	24			11	
102	52	117	79	24			10	
108	58	128	83	24				9
114	64	137	87	24				9
120	71	142	91	24				8

Fill Height Tables are based on the following criteria:
1. Embankment weight = 120 lb/ft³
2. Max. pipe deflection = 5 %
3. Bedding - Class C
4. Compaction = 95% Proctor Density
5. Modulus of passive soil resistance (E') = 1400 psi.
6. H-20 Live Load
7. Corner bearing pressure = 2 tons/ft.²

NOTES:

Pipe and Connecting Bands shall conform to applicable sections of NDSHD Standard Specifications and to AASHO M-36.

Top edge of all End Sections to have tubing reinforcement or rolled tube reinforcement (See Section A-A). This reinforcement is to be supplemented with 2"X2"X¼" Galv. Angle for 77"X52" and 83"X57" sizes. Angles to be attached by Galv. ⅜" dia. bolts and nuts. Angles are to extend from pipe to the corner wing bend.

Angle reinforcement shall also be placed under the center panel seams on 77" X 52" and 83" X 57" sizes.

PIPE ARCH DIMENSION		GALV. THICK.	END SECTION DIMENSIONS					APPROX. SLOPE	BODY
SPAN	RISE		A	B	H	L	W		
IN.	IN.		IN.	IN.	IN.	IN.	IN.	RATE	PIECE
17	13	.064	7	9	6	19	30	2 1/2 : 1	1
21	15	.064	7	10	6	23	36	2 1/2 : 1	1
24	18	.064	8	12	6	28	42	2 1/2 : 1	1
28	20	.064	9	14	6	32	48	2 1/2 : 1	1
35	24	.079	10	16	6	39	60	2 1/2 : 1	1
42	29	.079	12	18	8	47	75	2 1/2 : 1	1
49	33	.109	13	21	9	53	85	2 1/2 : 1	2
57	38	.109	18	26	12	63	90	2 1/2 : 1	2
64	43	.109	18	30	12	70	102	2 1/4 : 1	2
*71	47	.109	18	33	12	77	114	2 1/4 : 1	3
*77	52	.109	18	36	12	77	126	2 : 1	3
*83	57	.109	18	39	12	77	138	2 : 1	3

① Applicable to equivalent sizes of 3"x1" corrugations

* These Sizes have .138 in. center panels.

Manufacturers tolerances of above dimensions will be allowed.

Splices to be the lap riveted type.

Multiple panel bodies shall have lap seams which are to be tightly joined with ⅜" Ø galv. bolts or rivets. Nuts to be torqued to 25 lbs. ±.

REVISIONS	
DATE	CHANGE
1-15-75	Connecting Band

8-1-74

NORTH DAKOTA
STATE HIGHWAY DEPARTMENT

Submitted R P Thomas
Design Engineer

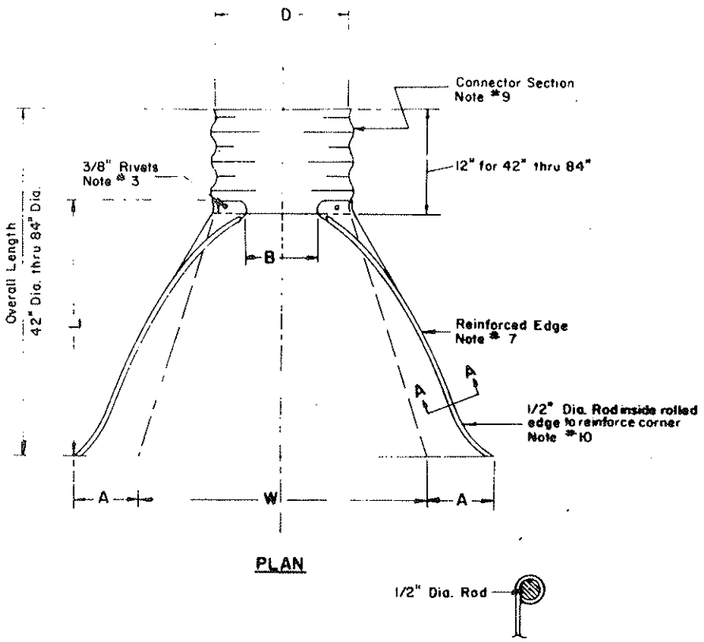
Recommended _____
Asst. Chief Engineer
Pre-Construction

Approved. _____
Chief Engineer

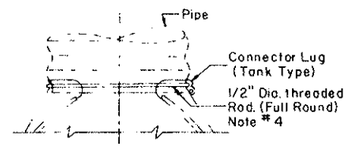
FHWA REGION	STATE	FED. AID PROJ. NO.	SHEET NO.
8	N.D.	F-1-094(03)	92

D-630-7

CORRUGATED ALUMINUM PIPE CULVERT AND END SECTIONS
(ROUND PIPE)



PLAN



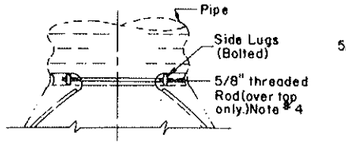
SIZES 18" & 24" ONLY

TABLE

1/2" Dia. threaded Rod

Pipe Size	Length In.
18"	65"
24"	83"

2 1/2" thread length both ends. 1/2"-13 UNC thread



SIZES 30" & 36" ONLY

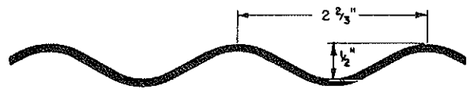
TABLE

5/8" Dia. threaded Rod

Pipe Size	Length In.
30"	22 1/4"
36"	25 3/8"

1 3/4" thread length both ends. 5/8"-11 UNC thread.

ROD CONNECTION DETAILS



2 2/3" x 1/2" CORRUGATIONS

END SECTIONS

WATERWAY AREA SQ. FT.	** PIPE DIA. (IN.)	THICK.	DIMENSIONS A	B	H	L	W	APPROX. SLOPE	BODY
			In.	In.	In.	In.	In.	Rate	Piece
1.8	18	.060	8	10	6	31	36	2 1/2 :1	1
3.1	24	.060	10	13	6	41	48	2 1/2 :1	1
4.9	30	.075	12	16	8	51	60	2 1/2 :1	1
7.1	36	.075	14	19	9	60	72	2 1/2 :1	2
9.6	42	.105	16	22	11	69	84	2 1/2 :1	2
12.6	48	.105	18	27	12	78	90	2 1/4 :1	2
16.0	54	.105	18	30	12	84	102	2 :1	2
19.6	*60	.105	18	33	12	87	114	1 3/4 :1	3
23.8	*66	.105	18	36	12	87	120	1 1/2 :1	3
28.3	*72	.105	18	39	12	87	126	1 1/3 :1	3
33.2	*78	.105	18	42	12	87	132	1 1/4 :1	3
38.5	*84	.105	18	45	12	87	138	1 1/6 :1	3

* These sizes shall have 0.135 In. thick center panels.

** Pipe diameter is equal to dimension "D" of End Section.

Manufactures tolerances of above dimensions will be allowed.

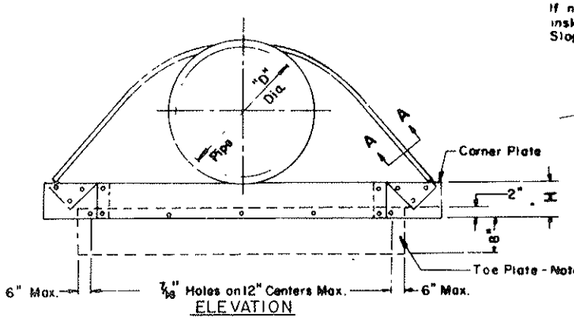
78" and 84" diameter Pipe shall be 5 % vertically elongated.

RIVETED OR HELICAL FABRICATION 2 2/3 x 1/2 INCH CORRUGATIONS

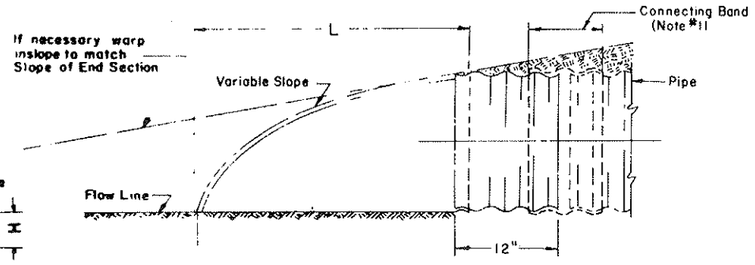
PIPE DIA. (IN.)	MIN. COVER (IN.)	MAX. FILL HEIGHT OVER TOP OF PIPE FOR METAL THICKNESS (IN.) .060	.075	.105	.135	.164
18	12	30	30	52	54	56
24	12	22	22	39	41	42
30	12	18	18	31	32	34
36	12	15	15	26	27	28
42	12		26	43	43	44
48	12			40	41	43
54	12			35	37	38
60	12				33	34
66	12				30	31
72	12					29
78	12					26
84	12					24

Fill Height Table is based on the following criteria:

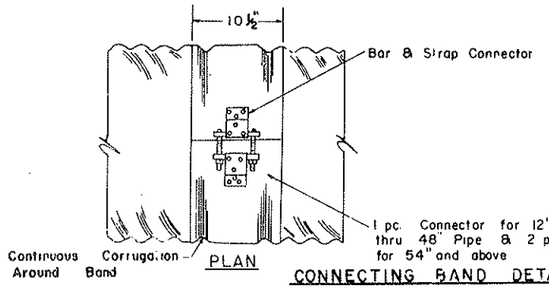
1. Embankment weight = 120 lb/ft^3
2. Max. pipe deflection = 5 %
3. Bedding - Class C
4. Compaction = 95% Proctor Density
5. Modulus of passive soil resistance (E') = 1400 psi
6. H-20 Live Load



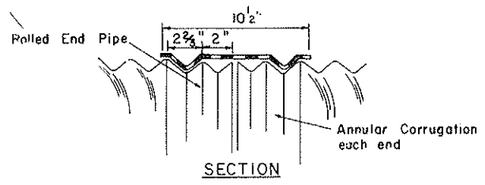
ELEVATION



TYPICAL CROSS SECTION
(Showing Connector Section)



PLAN



SECTION

SECTION A-A

CONNECTING BAND DETAILS FOR HELICAL, WELDED-SEAM CULVERT

NOTES:

1. End Sections shall be made from Aluminum Alloy 3004-0, clad 5% each side with Alloy 7072.
2. Corner Plate shall be the same material and thickness as End Section.
3. Rivets shall be Aluminum Alloy 6053-T4.
4. Threaded Rods shall be Aluminum Alloy 6061-T6.
5. Connector & Side Lugs, Bolts, and Nuts shall be Hot-Dipped Galvanized Steel.
6. Multiple panel bodies shall have 2" Lap Seams which are to be tightly joined with 3/8" diameter rivets spaced 6" C to C.
7. Top edge of all End Sections to have rolled edge reinforcement (See Section A-A). The rolled edge is to be supplemented with 2"X2"X1/4" Aluminum Alloy Angle for 60" thru 72" diameter and 2 1/2"X 2 1/2"X1/4" Angle for 78" and 84" diameter. Angles to be attached by 3/8" diameter bolts and nuts. Angles are to extend from pipe to the corner of the wing bend.
8. Aluminum Alloy Toe Plate required on End Sections for Pipe of 30" diameter or larger. Plate to be fastened to End Section in field. Thickness of Toe Plate to be same as End Section. Where Toe Plate is needed, the Toe Plate, Nuts, and Bolts are to be included in price bid for End Sections.
9. Connector Section, when specified, shall be Corrugated Aluminum Alloy Pipe Culvert.
10. Reinforcement for edge of End Section shall be Alloy 6063-F.
11. Pipe and Connecting Bands shall Conform to Applicable Sections of N.D.S.H.D. Standard Specifications and to A.A.S.H.O. M-196 and M-211.

8-1-74 REVISIONS	
DATE	CHANGE
1-15-75	Connecting Band

NORTH DAKOTA STATE HIGHWAY DEPARTMENT

Submitted: _____ Design Engineer

Recommended: _____ Asst. Chief Engineer Pre-Construction

Approved: _____ Chief Engineer

419A