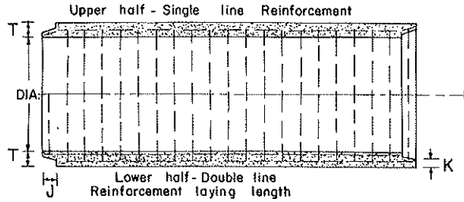
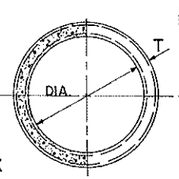
REINFORCED CONCRETE PIPE CULVERT AND END SECTIONS

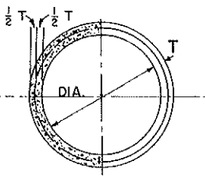
D-630-1



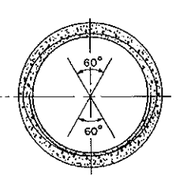
REINFORCED CONCRETE PIPE
TYPICAL LONGITUDINAL SECTION



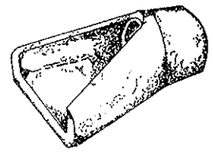
END VIEW
Double line Reinforcement



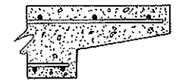
END VIEW
Single line Reinforcement



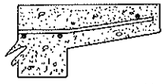
END VIEW
Top half showing Elliptical Reinforcement.
Bottom half showing Elliptical & Inner Cage Reinforcement.



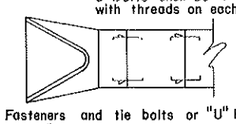
PERSPECTIVE



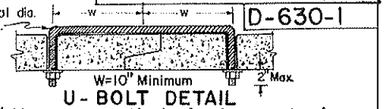
ARRANGEMENT FOR REINFORCEMENT
At end of 36" to 108" pipe.



REINFORCEMENT
At end of 12" to 33" pipe.

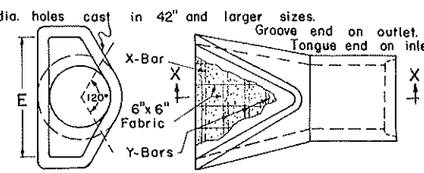


U-Bolts shall be 1" nomial dia. with threads on each end.



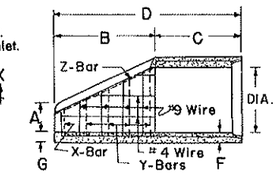
U - BOLT DETAIL
(Alternate method of tying sections)

Fasteners and tie bolts or "U" Bolts are required on end sections (4ea) for 42" thru 108" RCP Culverts. On culverts without flared-end sections the 3-end sections of the above culvert sizes shall be tied together in the same manner for each end. Galvanizing of fasteners, tie bolts or "U" Bolts is not req'd.

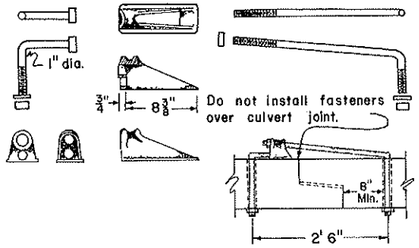


END VIEW

PLAN



SECTION X-X
END SECTION
Equivalent to Class III Pipe



ASSEMBLY

FASTENERS AND TIE BOLTS

END SECTION															
	TERMINAL DIMENSIONS							REINFORCING STEEL							
DIA.	A	B	C	D	E	F	G	X	Y	Z					
12	0'-4"	2'-0"	4'-0 7/8"	6'-0 3/8"	2'-0"	2"	2"	2 1/4" x 2'	6-1/4" x 2' @ 6" c.c.	2-1/4" x 4'					
15	0'-6"	2'-3"	3'-10"	6'-1"	2'-6"	2 1/4"	2 1/4"	2 1/4" x 2 1/2	6-1/4" x 2 1/2' @ 6" c.c.	2-3/8" x 4'					
18	0'-9"	2'-3"	3'-10"	6'-1"	3'-0"	2 1/2"	2 1/2"	2 3/8" x 3'	6-1/4" x 3' @ 6" c.c.	2-3/8" x 4'					
21	0'-9"	3'-0"	3'-1 1/2"	6'-1 1/2"	3'-6"	2 3/4"	2 3/4"	2 3/8" x 3 1/2	6 1/4" x 3 1/2' @ 6" c.c.	2-3/8" x 5'					
24	0'-9 1/2"	3'-7 1/2"	2'-6"	6'-1 1/2"	4'-0"	3"	3"	2 1/2" x 4'	8-3/8" x 4' @ 8" c.c.	2-3/8" x 6'					
27	0'-10 1/2"	4'-1 1/2"	2'-0"	6'-1 1/2"	4'-6"	3 1/4"	3 1/4"	2 1/2" x 5'	8-3/8" x 5' @ 9" c.c.	2-3/8" x 6'					
30	1'-0"	4'-6"	3'-7 3/4"	8'-1 3/4"	5'-0"	3 1/2"	3 1/2"	2 1/2" x 5'	12-3/8" x 5' @ 8" c.c.	2-1/2" x 6'					
36	1'-3"	5'-3"	2'-10 3/8"	8'-1 3/4"	6'-0"	4"	4"	2 1/2" x 6'	18-3/8" x 6' @ 6" c.c.	2-1/2" x 8'					
42	1'-9"	5'-3"	2'-11"	8'-2"	6'-6"	4 1/2"	4 1/2"	2 1/2" x 7'	12-1/2" x 7' @ 9" c.c.	2-1/2" x 8'					
48	2'-0"	6'-0"	2'-2"	8'-2"	7'-0"	5"	5"	2 1/2" x 8'	16-1/2" x 8' @ 8" c.c.	2-1/2" x 8'					
54	2'-3"	6'-5"	2'-9 1/4"	8'-2 1/4"	7'-6"	5 1/2"	5 1/2"	2 1/2" x 8'	16-1/2" x 8' @ 7" c.c.	2-1/2" x 8'					
60	2'-11"	5'-0"	3'-3"	8'-3"	8'-0"	6"	5"	2 1/2" x 9'	16-1/2" x 9' @ 6" c.c.	2-1/2" x 9'					
66	2'-6"	6'-0"	2'-3"	8'-3"	8'-6"	6 1/2"	5 1/2"	2 1/2" x 9'	22-1/2" x 9' @ 6" c.c.	2-1/2" x 9'					
72	3'-0"	6'-6"	1'-9"	8'-3"	9'-0"	7"	6"	2 1/2" x 10'	24-1/2" x 10' @ 6" c.c.	2-1/2" x 9'					
78	3'-0"	7'-6"	1'-9"	9'-3"	9'-6"	7 1/2"	6 1/2"	2 1/2" x 10'	28-1/2" x 10' @ 6" c.c.	2-1/2" x 10'					
84	3'-0"	7'-6 1/2"	1'-9"	9'-3 1/2"	10'-0"	8"	6 1/2"	4 1/2" x 10'	28-1/2" x 10' @ 6" c.c.	4-1/2" x 10'					
90	3'-5"	7'-3 1/2"	2'-0"	9'-3 1/2"	11'-0"	8 1/2"	6 1/2"	4 1/2" x 11'	28-1/2" x 11' @ 6" c.c.	4-1/2" x 10'					

Permissable Fill Heights
RCP-Sewer-Trench Conditions
Other than Class I

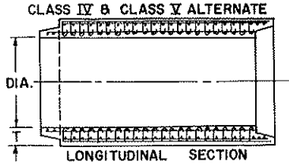
PIPE SIZE	Class II	Class III	Class IV	Class V
	FT.	FT.	FT.	FT.
2" thru 54"	3-9	1-3 9-13	13-23	23+
60" thru 108"	1-9	9-13	13-23	23+

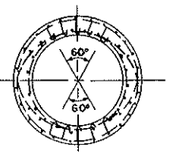
REINFORCED CONCRETE PIPE

CLASS I	CLASS II	CLASS III	CLASS IV	CLASS IV ALTERNATE	CLASS V	CLASS V ALTERNATE
D-LOAD TO PRODUCE A 0.01 INCH CRACK						
800	1000	1350	2000		3000	
D-LOAD TO PRODUCE ULTIMATE LOAD						
1200	1500	2000	3000		3750	

Internal Dia. of Pipe in inches	Cross-Sectional Water Area	Weight per lin. foot of pipe Std. Wall	Joint Groove Min./Max. End	Joint Tongue Min. K	1200 4000 P.S.I. Minimum Wall Thickness	Circular reinforcement in circular pipe: Inner cage Sq.in.	Circular reinforcement in circular pipe: Outer cage Sq.in.	Ellip. reinforcement in Cir. pipe & Cir. reinforcement in Ellip. pipe Sq.in.	Height of Fill Trench Conditions Ft.	1500 4000 P.S.I. Minimum Wall Thickness	Circular reinforcement in circular pipe: Inner cage Sq.in.	Circular reinforcement in circular pipe: Outer cage Sq.in.	Ellip. reinforcement in Cir. pipe & Cir. reinforcement in Ellip. pipe Sq.in.	Height of Fill Normal Backfill Ft.	Height of Fill Imperfect Trench Ft.	2000 4000 P.S.I. Minimum Wall Thickness	Circular reinforcement in circular pipe: Inner cage Sq.in.	Circular reinforcement in circular pipe: Outer cage Sq.in.	Ellip. reinforcement in Cir. pipe & Cir. reinforcement in Ellip. pipe Sq.in.	Height of Fill Normal Backfill Ft.	Height of Fill Imperfect Trench Ft.	3000 4000 P.S.I. Minimum Wall Thickness	Circular reinforcement in circular pipe: Inner cage Sq.in.	Circular reinforcement in circular pipe: Outer cage Sq.in.	Ellip. reinforcement in Cir. pipe & Cir. reinforcement in Ellip. pipe Sq.in.	3000 5000 P.S.I. Minimum Wall Thickness	Shear Steel: Inner cage Ai Sq.in.	Shear Steel: Ellip. cage Ae Sq.in.	Shear Steel: Outer cage Ao Sq.in.	Shear Steel: N No.	Shear Steel: S In.	Shear Steel: Ar Sq.in.	Height of Fill Normal Backfill Ft.	Height of Fill Imperfect Trench Ft.
Dia.	Sq.ft.	Lbs.	In.	In.	In.	Sq.in	Sq.in	Sq.in	Ft.	In.	Sq.in.	Sq.in.	Sq.in.	Ft.	Ft.	In.	Sq.in.	Sq.in.	Sq.in.	Ft.	Ft.	In.	Sq.in.	Sq.in.	Sq.in.	In.	Sq.in	Sq.in	Sq.in	No.	In.	Sq.in	Ft.	Ft.
12	0.79	92	1 5/8-2 3/8	3/4						2	.07			3-11	11-18	2	.07			1-3 11-16	16-31	2	.07											16-24	24-43	24-35	35-69
15	1.23	127	1 3/4-2 3/8	7/8		TO BE USED FOR				2 1/4	.07			3-11	11-18	2 1/4	.07			1-3 11-16	16-31	2 1/4	.10											16-24	24-43	24-35	35-69
18	1.77	168	1 7/8-2 5/8	1		R.C.P. SEWER ONLY				2 1/2	.07		.07	3-11	11-18	2 1/2	.07		.07	1-3 11-16	16-31	2 1/2	.14		.11										16-24	24-43	24-35	35-69
21	2.40	214	1 7/8-3 5/8	1 1/8						2 3/4	.07		.07	3-11	11-18	2 3/4	.07		.07	1-3 11-16	16-31	2 3/4	.20		.17										16-24	24-43	24-35	35-69
24	3.14	265	2 1/4-3 3/4	1 1/8						3	.07		.07	3-11	11-18	3	.07		.07	1-3 11-16	16-31	3	.27		.23	3 3/4	.07	.07	.08						16-24	24-43	24-35	35-69
27	3.98	322	2 3/4-4	1 1/3		☆ Special conditions only				3 1/4	.13		.11	3-11	11-18	3 1/4	.16		.14	1-3 11-16	16-31	3 1/4	.31		.25	4	.08	.07	.09						16-24	24-43	24-35	35-69
30	4.91	384	3 1/8-4 1/4	1 1/4						3 1/2	.14		.12	3-11	11-18	3 1/2	.18		.15	1-3 11-16	16-31	3 1/2	.35		.28	4 1/2	.09	.07	.10						16-24	24-43	24-35	35-69
33	5.94	452	3 1/2-4 1/2	1 1/2						3 3/4	.15		.13	3-11	11-18	3 3/4	.15	.11	.17	1-3 11-16	16-31	3 3/4	.27	.20	.30	4 1/2	.11	.08	.12						16-24	24-43	24-35	35-69
36	7.07	524	3 3/4-4 3/4	1 1/2						4	.12	.09	.13	3-11	11-18	4	.17	.13	.19	1-3 11-16	16-31	4	.30	.22	.33	4 3/4	.14	.10	.15						16-24	24-43	24-35	35-69
42	9.62	685	3 3/4-4 3/4	1 1/4						4 1/2	.15	.12	.17	3-11	11-18	4 1/2	.21	.16	.23	1-3 11-16	16-31	4 1/2	.35	.26	.39	5 1/4	.20	.15	.22						16-24	24-43	24-35	35-69
48	12.57	867	3 3/4-4 3/4	1 1/4						5	.18	.14	.20	3-11	11-18	5	.24	.18	.27	1-3 11-16	16-31	5	.42	.32	.47	5 3/4	.26	.20	.29						16-24	24-43	24-35	35-69
54	15.90	1070	4 1/8-5 1/2	2					☆	5 1/2	.22	.16	.24	3-11	11-18	5 1/2	.29	.22	.32	1-3 11-16	16-31	5 1/2	.50	.37	.55	6 1/4	.34	.26	.38						16-24	24-43		
																	5000 P.S.I.																	
60	19.63	1296	4 1/2-5 1/2	2 1/4	6	.21	.16	.23	6-9	6	.25	.19	.28	3-11	11-18	6	.34	.26	.38	1-3 11-16	16-31	6	.59	.45	.66	6 3/4	.41	.31	.46	6	.27	.27	.22	7	6	.22	16-24	24-43		
66	23.76	1542	5 -6	2 3/8	6 1/2	.25	.19	.28	6-9	6 1/2	.31	.23	.34	3-11	11-18	6 1/2	.41	.31	.46	1-3 11-16	16-31	6 1/2	.69	.52	.77	7 1/4	.51	.39	.57	6 1/2	.30	.30	.24	8	6	.22	16-24	24-43		
																											5000 P.S.I.										
72	28.27	1810	5 3/8-6 3/4	2 1/8	7	.29	.22	.32	6-9	7	.35	.26	.39	3-11	11-18	7	.49	.37	.54	7 3/4	.36	.27	.40	1-3 11-16	16-31	7	.79	.60	.88	7 3/4	.61	.46	.68	7	.32	.32	.26	8	6	.23	16-24	24-43		
78	33.18	2098	6 1/4-7 1/4	2 5/8	7 1/2	.32	.24	.36	6-9	7 1/2	.40	.30	.44	3-11	11-18	7 1/2	.57	.43	.63	8 1/4	.42	.32	.47	1-3 11-16	16-31					8 1/4	.71	.53	.79	7 1/2	.35	.35	.28	9	6	.25	16-24	24-43		
84	38.48	2410	5 7/8-7 3/8	3 3/8	8	.37	.28	.41	6-9	8	.46	.34	.51	3-11	11-18	8	.64	.48	.71	8 3/4	.50	.38	.56	1-3 11-16	16-31					8 3/4	.85	.63	.94	8	.38	.38	.30	10	6	.28	16-24	24-43		
																	5000 P.S.I.																	
90	44.18	2565	6 3/4-8 1/4	3 1/8	8 1/2	.41	.31	.46	6-9	8 1/2	.51	.38	.57	3-11	11-18	8 1/2	.69	.52	.77	9 1/4	.59	.45	.66	1-3 11-16	16-31									8	.43	.43	.34	11	6	.31	16-24	24-43		
96	50.27	2910	7 -8 1/4	3 1/2	9	.46	.35	.51	6-9	9	.57	.43	.63	3-11	11-18	9	.76	.57	.84					1-3 11-16	16-31									8 1/2	.46	.46	.36	11	6	.34	16-24	24-43		
					5000 P.S.I.					5000 P.S.I.																											
102	56.75	3075	7-8 1/4	3 1/2	9 1/2	.54 .20	.41	.41	6-9	9 1/2	.68 .24	.51	.51	3-11	11-18	9 1/2	.90 .32	.68	.68	1-3 11-16	16-31									9	.52	.52	.41	12	6	.37	16-24	24-43		
108	63.62	3690	7 1/8-8 3/4	3 3/4	10	.61 .22	.46	.46	6-9	10	.76 .27	.57	.57	3-11	11-18	10	1.08 .39	.81	.81	1-3 11-16	16-31									9	.57	.57	.46	12	6	.40	16-24	24-43		

NOTES:
All reinforcement shall be electrically welded cold drawn steel wire fabric.
Circular reinforcement shall lap in accordance to A.A.S.H.O. M170.
All circular, longitudinal and elliptical reinforcement shall be assembled and securely fastened in cage fashion so as to maintain reinforcement in exact shape and correct positions within the forms.
Laying length of pipe: 12" to 66" (incl.) = Not less than 4 feet.
66" to 108" (incl.) = Not less than 6 feet.
Furnishing and installing fasteners and tie bolts shall be included in price bid for R.C.P. Culverts.





Ai, Ae, Ao = Minimum circumferential reinforcement required in square inches per lineal foot of pipe.
Ar = Minimum radial reinforcement required in square inches per square foot of pipe.
N = Minimum number of rows of radial reinforcing at top and bottom of pipe.
S = Maximum circumferential spacing of rows of radial reinforcing.

REVISIONS	
DATE	CHANGE
1-1-75	

NORTH DAKOTA
STATE HIGHWAY DEPARTMENT
Submitted: _____ Design Engineer
Recommended: _____ Asst. Chief Engineer Pre-Construction
Approved: _____ Chief Engineer

4.11