

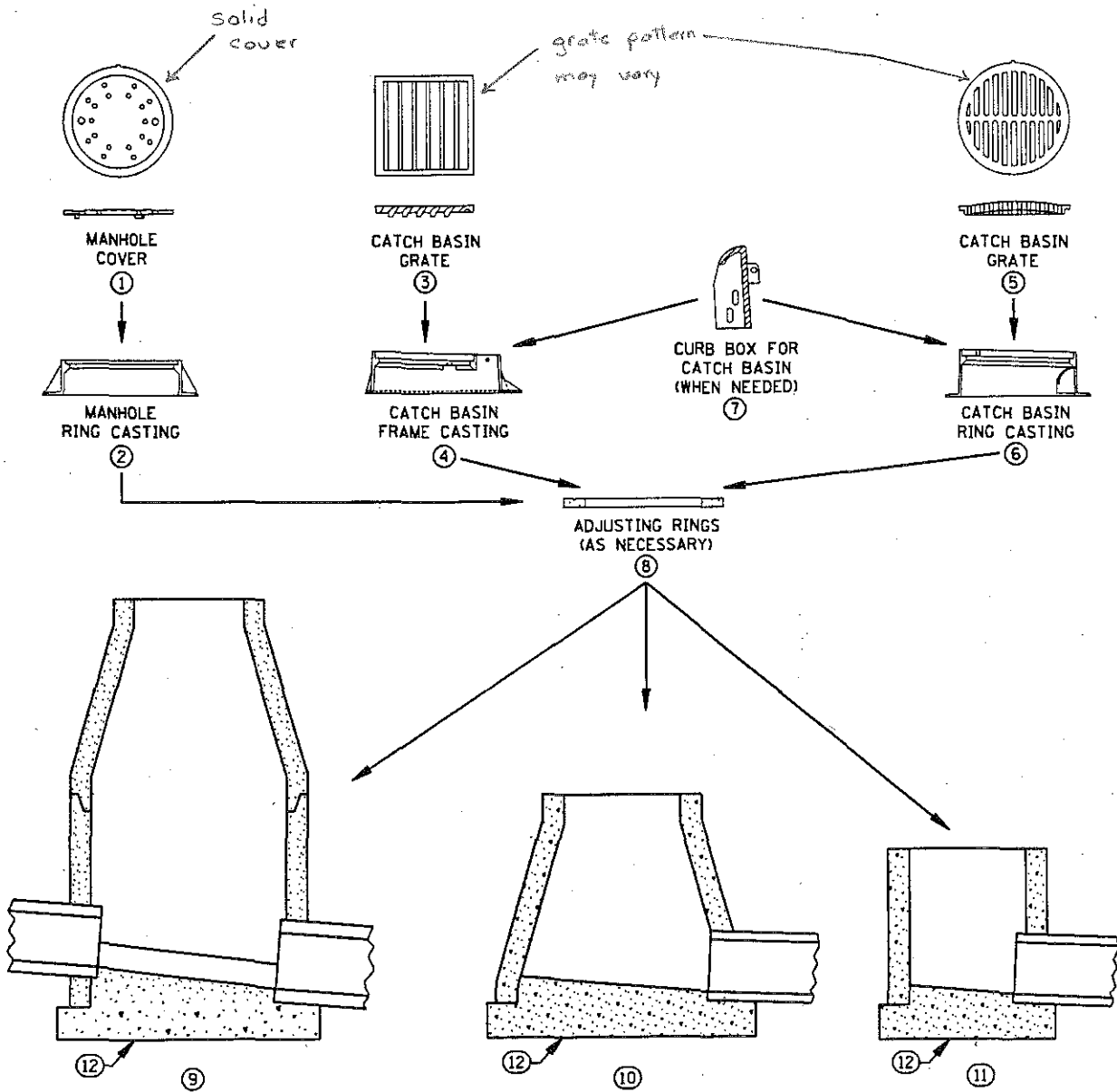


## Index to Standard Plates for HydInfra Features

### Page

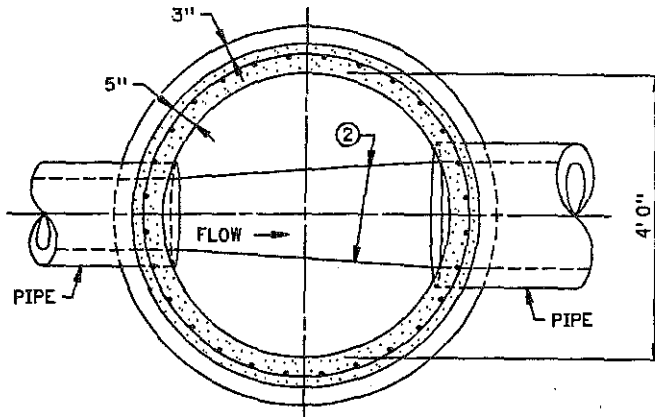
- 1 Index
- 2 Typical Casting Combinations for Manholes and Catch Basins
- 3 Structure – Manhole or Catch Basin Type A or B Cone, Precast
- 4 Structure – Manhole or Catch Basin, Masonry (block or brick)
- 5 Manhole Cover Casting
- 6 Catch Basin Grate Casting (round)
- 7 Design PM and PC
- 8 Concrete Pipe “3000”
- 9 Cattle Pass Precast Concrete
- 10 Arch Pipe Concrete
- 11 Arch Pipe Concrete pg 2
- 12 Concrete Safety Apron
- 13 Concrete Flared Apron
- 14 Concrete Arch Flared Apron
- 15 Concrete Sectional Apron for Arch Pipe
- 16 CMP Pipe Round or Arch Dimensions
- 17 Structural Plate Arch Pipe Dimensions (18” corner radius)
- 18 Structural Plate Arch Pipe Dimensions (31” corner radius)
- 19 Metal Flared Apron for Arch Pipe
- 20 Metal Safety Apron (3128 F sh 2)
- 21 Metal Safety Apron (3128 F sh 1)
- 22 Metal Safety Apron and Safety Grate (3128 H sh 1)
- 23 Metal Safety Apron (3128 H sh 2)
- 24 Cattle and Horse Pass Deformed Metal Culvert (Steel Plate)
- 25 Extension – CMP on Concrete Box

TYPICAL CONCRETE MANHOLE OR CATCH BASIN AND CASTING COMBINATIONS

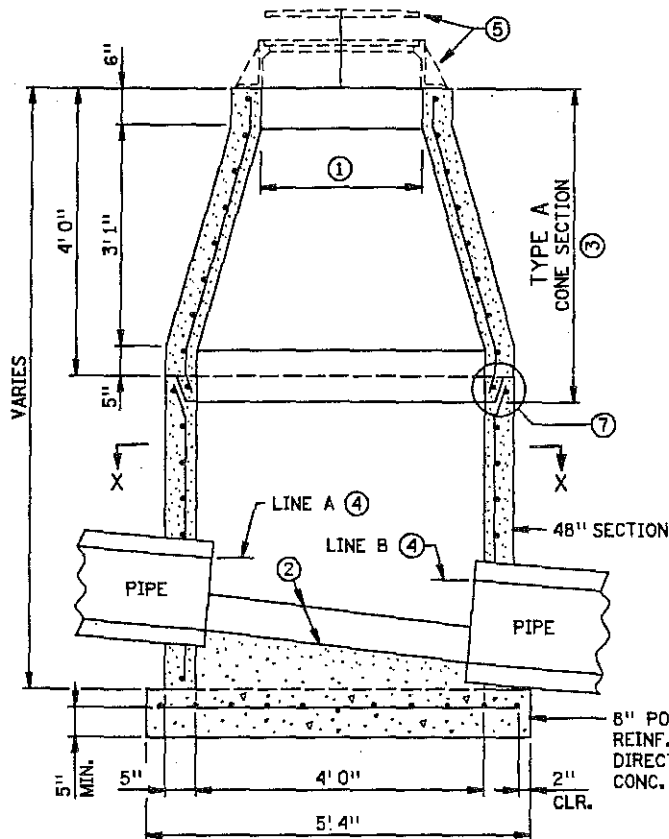


**STRUCTURES**

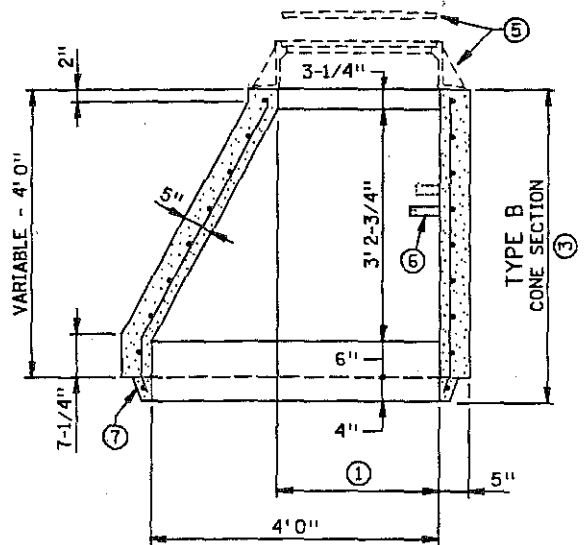
- |  |   |   |  |
|--|---|---|--|
| <p>① CASTING NO. 715<br/>PLATE NO. 4110<br/>CASTING NO. 716<br/>PLATE NO. 4110</p> <p>② CASTING NO. 700-4<br/>THRU NO. 700-10<br/>PLATE NO. 4101</p> <p>③ CASTING NO. 811<br/>PLATE NO. 4151<br/>CASTING NO. 814A<br/>PLATE NO. 4152<br/>CASTING NO. 815<br/>PLATE NO. 4153<br/>CASTING NO. 816<br/>PLATE NO. 4154</p> | <p>④ CASTING NO. 802A<br/>PLATE NO. 4129<br/>CASTING NO. 805<br/>PLATE NO. 4132<br/>CASTING NO. 806<br/>PLATE NO. 4125<br/>ONLY WITH CURB BOX</p> <p>⑤ CASTING NO. 720<br/>PLATE NO. 4140<br/>CASTING NO. 721<br/>PLATE NO. 4140<br/>CASTING NO. 810<br/>PLATE NO. 4149</p> | <p>⑥ CASTING NO. 801<br/>PLATE NO. 4126<br/>CASTING NO. 700-4<br/>THRU NO. 700-10<br/>PLATE NO. 4101<br/>CASTING NO. 731<br/>PLATE NO. 4143</p> <p>⑦ CASTING NO. 821B<br/>PLATE NO. 4161<br/>CASTING NO. 822<br/>PLATE NO. 4161<br/>CASTING NO. 823A<br/>PLATE NO. 4160<br/>CASTING NO. 824<br/>PLATE NO. 4133<br/>CASTING NO. 825<br/>PLATE NO. 4134</p> | <p>CASTING NO. 831A<br/>PLATE NO. 4161<br/>CASTING NO. 833A<br/>PLATE NO. 4160</p> <p>⑧ PLATE NO. 4010</p> <p>⑨ DESIGN A<br/>PLATE NO. 4000<br/>DESIGN F<br/>PLATE NO. 4005</p> <p>⑩ DESIGN C<br/>PLATE NO. 4002<br/>DESIGN G<br/>PLATE NO. 4006</p> <p>⑪ DESIGN H<br/>PLATE NO. 4006</p> <p>⑫ PRECAST BASE<br/>PLATE NO. 4011</p> |
|--|---|---|--|



SECTION X-X



SECTIONAL VIEW  
TYPE A CONE



SECTIONAL VIEW  
TYPE B CONE

SEE TYPE A CONE FOR ADDITIONAL INFORMATION

8" POURED CONCRETE BASE. BASE REINF. IS 0.12 SQ. IN. PER FT. IN EACH DIRECTION. FOR ALTERNATE PRECAST CONC. BASE, SEE STANDARD PLATE 4011.

**NOTES:**

REINFORCING: SINGLE LINE STEEL WIRE FABRIC HAVING AN AREA OF NOT LESS THAN 0.12 SQ. IN. PER FOOT OF HEIGHT.

- ① 2' 3" NOMINAL OPENING.
- ② PROVIDE MORTAR FILLETS TO FIT THE BOTTOM PORTION OF PIPE TO DIRECT FLOW TO OUTLET.
- ③ TYPE A CONE SECTION SHALL BE USED UNLESS OTHERWISE INDICATED IN THE PLANS. FOR SHORT CONE SECTION USE TYPE C. SEE STANDARD PLATE 4010.

- ④ THE ELEV. OF LINE A SHALL BE EQUAL TO OR ABOVE LINE B.
- ⑤ REFER TO PLAN FOR CASTINGS REQUIRED. USE ADJUSTING RINGS WHERE NECESSARY. SEE STANDARD PLATES INDEX. CASTING AND PRECAST CONC. ADJUSTING RINGS, SHALL BE SET ON FULL MORTAR BEDS.
- ⑥ REFER TO PLANS FOR ANY STEP REQUIREMENTS.
- ⑦ SEE STANDARD PLATES INDEX FOR OTHER APPROVED JOINTS.

DESIGN F

APPROVED JULY 31, 1995

*Donald J. Rodbrech*

STATE DESIGN ENGINEER

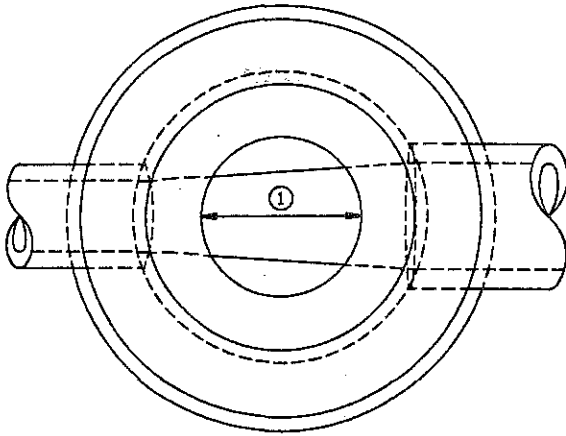
STATE OF MINNESOTA  
DEPARTMENT OF TRANSPORTATION  
**MANHOLE OR CATCH BASIN**  
TYPE A & B CONE SECTIONS  
PRECAST

SPECIFICATION  
REFERENCE  
2506

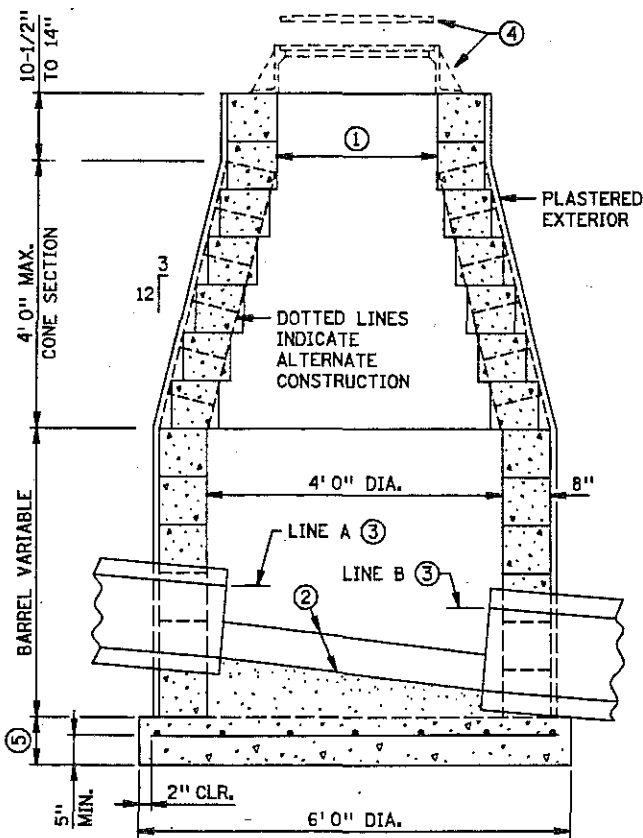
REVISED  
8-22-96

STANDARD  
PLATE  
NO.

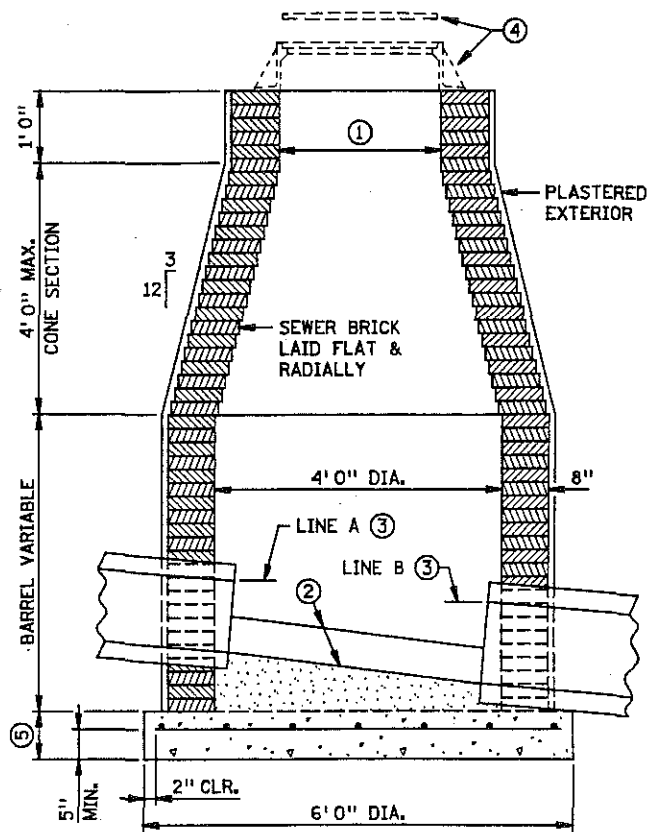
4005L



TOP VIEW  
MASONRY & BRICK



SECTION  
MASONRY UNITS



SECTION  
SEWER BRICK

**NOTES:**

REFER TO PLANS FOR ANY STEP REQUIREMENTS.

- ① 2' 3" NORMAL OPENING. WHEN GRATE FRAME CASTING NO. 806 (SEE STANDARD PLATES CASTING LIST) IS USED, THE OPENING SHALL BE 2' 6".
- ② PROVIDE MORTAR FILLETS TO FIT THE BOTTOM PORTION OF THE STRUCTURE AS SHOWN, TO DIRECT THE FLOW TO THE OUTLET.

- ③ THE ELEV. OF LINE A SHALL BE EQUAL TO OR ABOVE LINE B.
- ④ REFER TO PLAN FOR CASTINGS REQUIRED. USE ADJUSTING RINGS WHERE NECESSARY. SEE STANDARD PLATES INDEX. CASTING AND PRECAST CONC. ADJUSTING RINGS, SHALL BE SET ON FULL MORTAR BEDS.
- ⑤ 8" POURED CONCRETE BASE. FOR ALTERNATE PRECAST CONCRETE BASE, SEE STANDARD PLATES CASTING LIST. BASE REINFORCEMENT: 0.12 SQUARE INCHES PER FOOT IN EACH DIRECTION.

DESIGN A

APPROVED OCTOBER 17, 1994

*Gerald J. Robinson*

STATE DESIGN ENGINEER

STATE OF MINNESOTA  
DEPARTMENT OF TRANSPORTATION  
**MANHOLE OR CATCH BASIN**  
MASONRY  
FIELD CONSTRUCTED

SPECIFICATION  
REFERENCE  
2506

REVISED  
8-22-96

STANDARD  
PLATE  
NO.

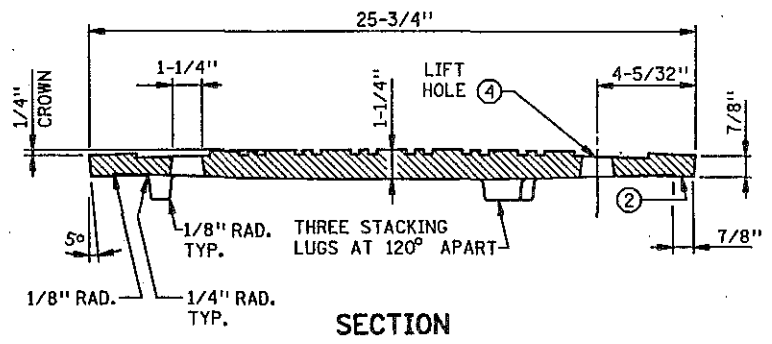
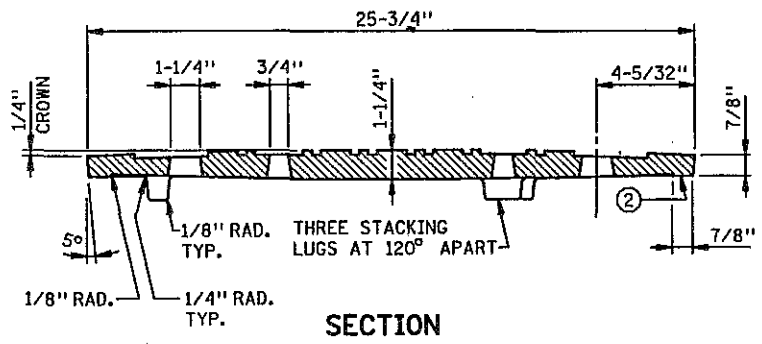
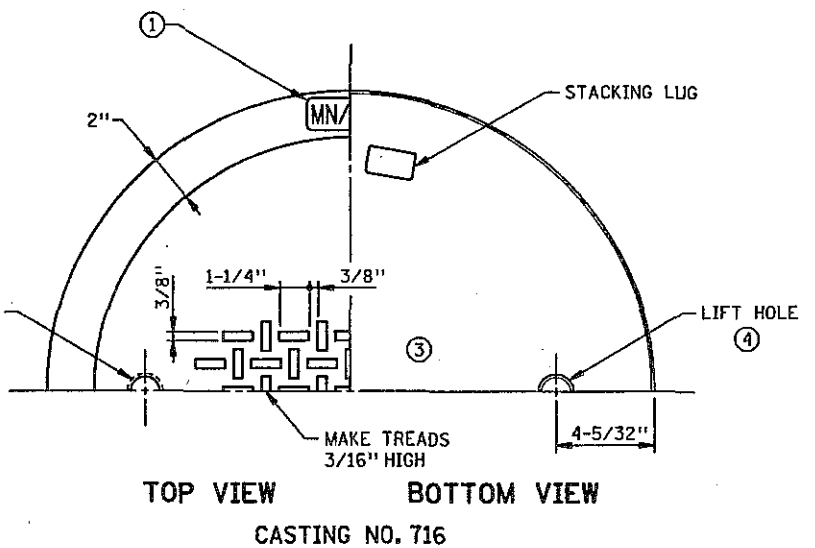
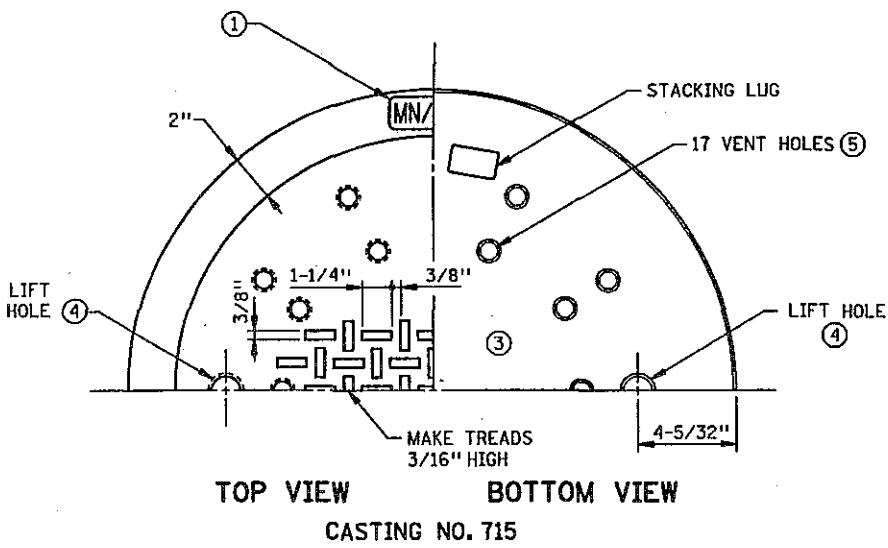
4000J

APPROVED OCTOBER 25, 1996  
*Stacy J. Rishard*  
 STATE DESIGN ENGINEER

STATE OF MINNESOTA  
 DEPARTMENT OF TRANSPORTATION  
**COVER CASTING FOR MANHOLE**  
 (FOR USE IN ALL TRAFFIC AREAS)

SPECIFICATION  
 REFERENCE  
 2506

STANDARD  
 PLATE  
 NO.  
**4110F**



CASTING NO. 715 - 115 LBS.  
 CASTING NO. 716 - 118 LBS.

**NOTES:**

THESE COVERS TO BE USED WITH RING CASTING NO. 700-7 TO 700-10 OR FRAME CASTING NO. 770.

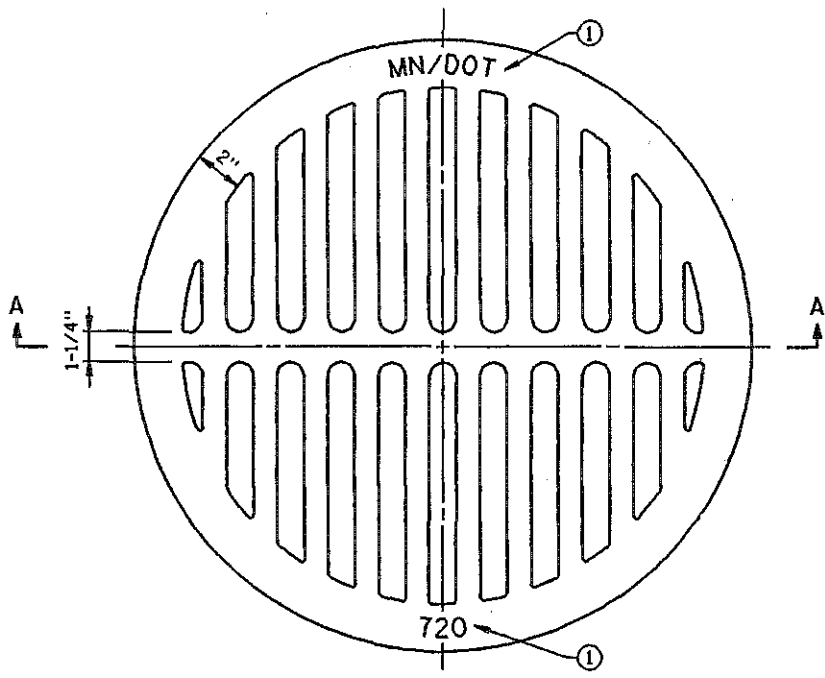
- ① ON OPPOSITE SIDE OF TOP SURFACE PLACE CASTING NUMBER, LETTERS (MN/DOT) AND NUMERALS TO BE 3/4" IN HEIGHT AND DEPRESSED 1/8".
- ② MACHINE FINISHED THICKNESS TO BE 13/16".
- ③ COVER SHALL BE MADE OF GRAY IRON. CLASS 35B.
- ④ LIFT HOLE 1-1/4" DIA. AT THE TOP, 1-1/2" AT THE BOTTOM.
- ⑤ EIGHT (8) VENT HOLES IN OUTER CIRCLE, NINE (9) VENT HOLES IN INNER CIRCLE. HOLES ARE 3/4" DIA. AT THE TOP AND 1" DIA. AT THE BOTTOM. INNER CIRCLE IS 2" FROM THE OUTER CIRCLE.

APPROVED Oct. 1, 1966  
*W. A. Eburn*  
 ASSISTANT COMMISSIONER  
 ENGINEERING STANDARDS

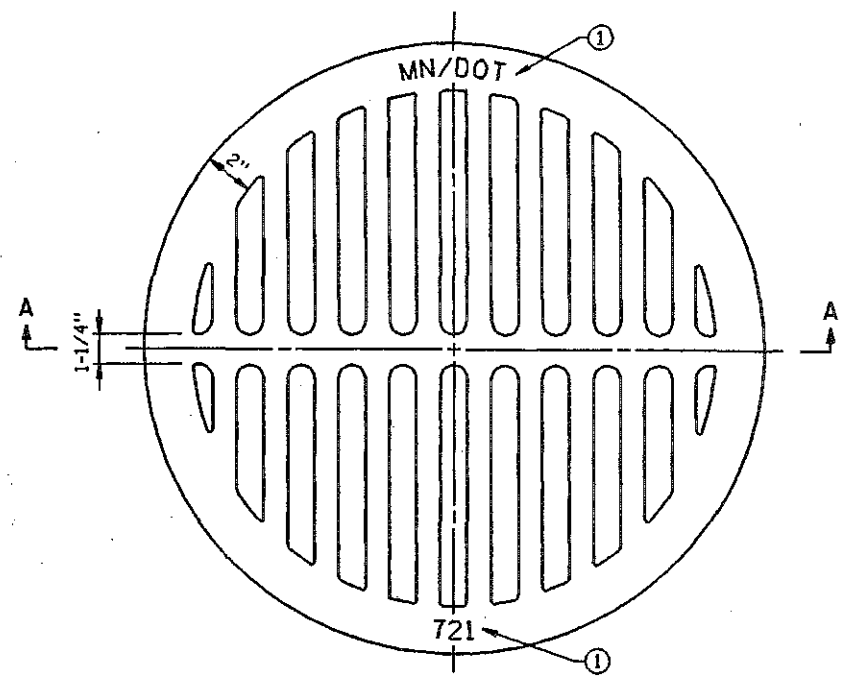
STATE OF MINNESOTA  
 DEPARTMENT OF TRANSPORTATION  
**SPECIAL GRATE CASTINGS**  
**FOR CATCH BASIN**  
 CONVEX AND CONCAVE

SPECIFICATION  
 REFERENCE  
 NO. 2506  
 REVISED  
 5-5-99 A.K.J.

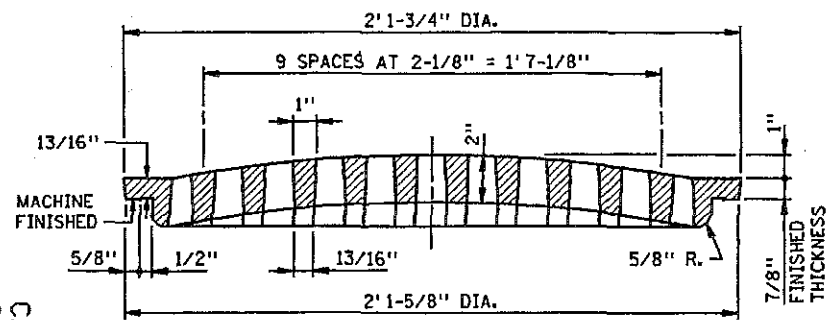
STANDARD  
 PLATE  
 NO. 4140D



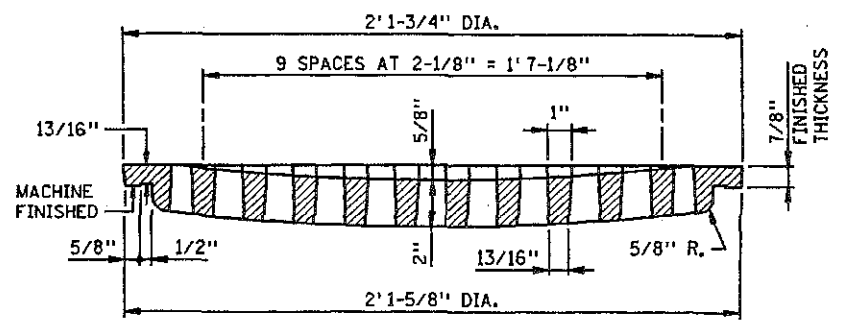
TOP VIEW  
 CASTING NO. 720



TOP VIEW  
 CASTING NO. 721



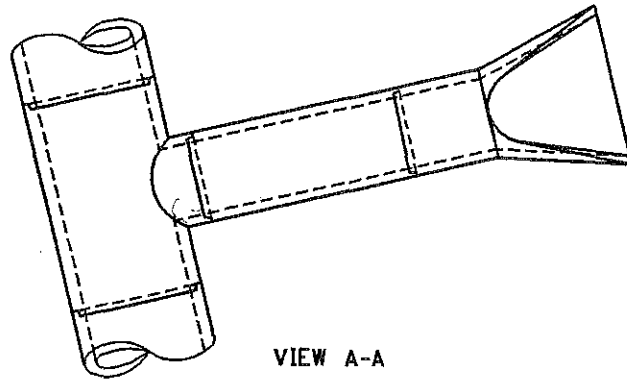
SECTION A-A  
 CONVEX



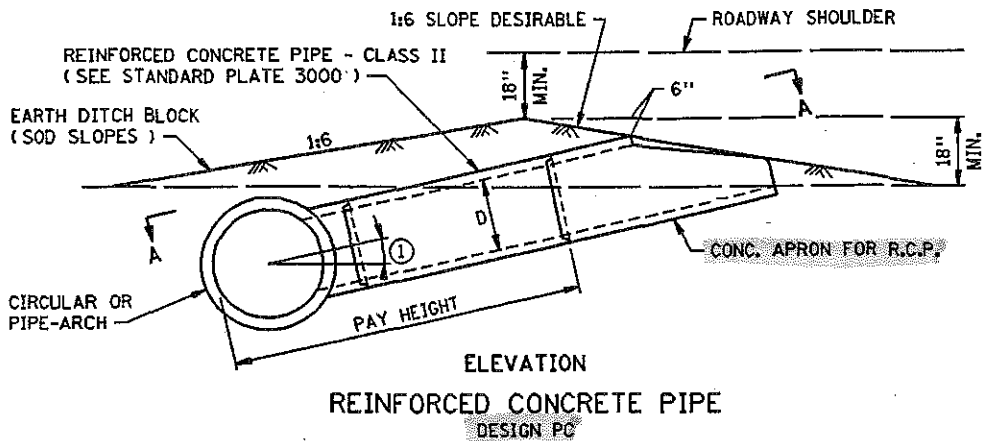
SECTION A-A  
 CONCAVE

NOTES:  
 THESE GRATES SHALL BE USED WITH RING CASTING NO. 700-7 TO 700-10.

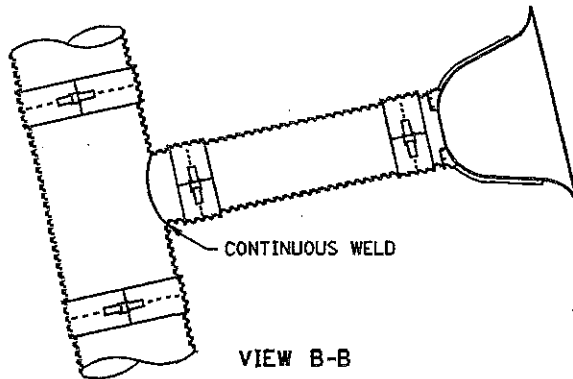
① LETTERS (MN/DOT) AND NUMERALS (720 & 721) SHALL BE 3/4 INCHES IN HEIGHT AND DEPRESSED 1/8 INCHES.



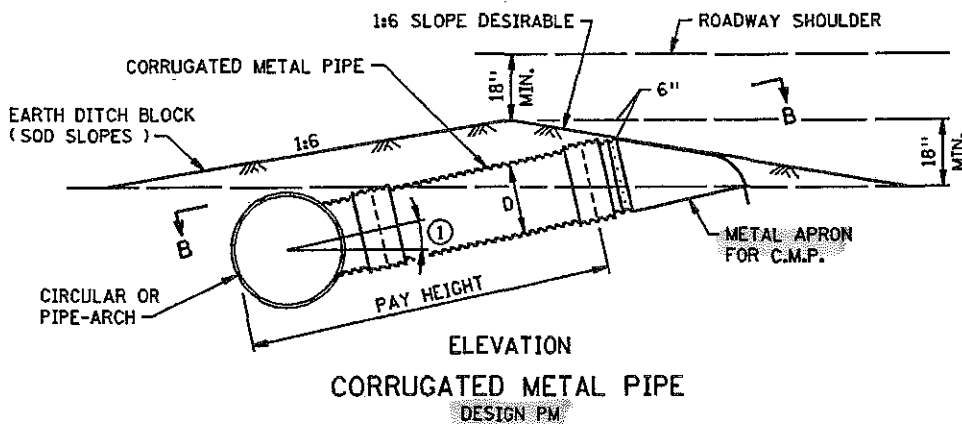
VIEW A-A



ELEVATION  
REINFORCED CONCRETE PIPE  
DESIGN PC



VIEW B-B



ELEVATION  
CORRUGATED METAL PIPE  
DESIGN PM

NOTES:  
INSIDE DIAMETER OF CATCH BASIN WILL BE INDICATED IN THE PAY ITEM.  
FOR USE PRINCIPALLY FOR MEDIAN DRAINAGE.  
ANGLE WILL BE SHOWN IN PLAN FOR ARCH PIPE.

DESIGN PC  
DESIGN PM

APPROVED Oct. 1, 1967  
*W. J. Ekern*  
ASSISTANT COMMISSIONER  
ENGINEERING STANDARDS

STATE OF MINNESOTA  
DEPARTMENT OF TRANSPORTATION  
**CATCH BASIN**  
CONCRETE PIPE AND METAL PIPE

SPECIFICATION  
REFERENCE  
2506  
REVISED  
4-19-01

STANDARD  
PLATE  
NO.  
**4017C**

INTERNAL DIAMETER OF PIPE IN INCHES	CROSS SECTION WATER AREA	LENGTH OF JOINT	NOMINAL - A	D1	D2	D3	D4
D	SQ. FT.	INCHES					
12	0.79	1-3/4	3/16	13-1/4	13-5/8	13-7/8	14-1/4
15	1.23	2	3/16	16-1/2	16-7/8	17-1/4	17-5/8
18	1.77	2-1/4	3/16	19-5/8	20	20-3/8	20-3/4
21	2.40	2-1/2	3/16	22-7/8	23-1/4	23-3/4	24-1/8
24	3.14	2-3/4	3/16	26	26-3/8	27	27-3/8
27	3.98	3	3/16	29-1/4	29-5/8	30-1/4	30-5/8
30	4.91	3-1/4	3/16	32-3/8	32-3/4	33-1/2	33-7/8
33	5.94	3-1/2	1/4	35-1/2	36	36-3/4	37-1/4
36	7.07	3-3/4	1/4	38-3/4	39-1/4	40	40-1/2
42	9.62	4	1/4	45-1/8	45-5/8	46-1/2	47
48	12.57	4-1/4	1/4	51-1/2	52	53	53-1/2
54	15.90	4-1/2	1/4	57-7/8	58-3/8	59-3/8	59-7/8
60	19.63	5	1/4	64-1/4	64-3/4	66	66-1/2
66	23.76	5-1/2	1/4	70-5/8	71-1/8	72-1/2	73
72	28.27	6	1/4	77	77-1/2	79	79-1/2
78	33.18	6-1/2	1/4	83-3/8	83-7/8	85-5/8	86-1/8
84	38.48	7	1/4	89-3/4	90-1/4	92-1/8	92-5/8
90	44.18	7	1/4	95-3/4	96-1/4	98-1/8	98-5/8
96	50.27	7	1/4	102-1/8	102-5/8	104-1/2	105
102	56.75	7-1/2	1/4	109	109-1/2	111-1/2	112
108	63.62	7-1/2	1/4	115-1/2	116	118	118-1/2

TOLERANCES IN DIMENSIONS:

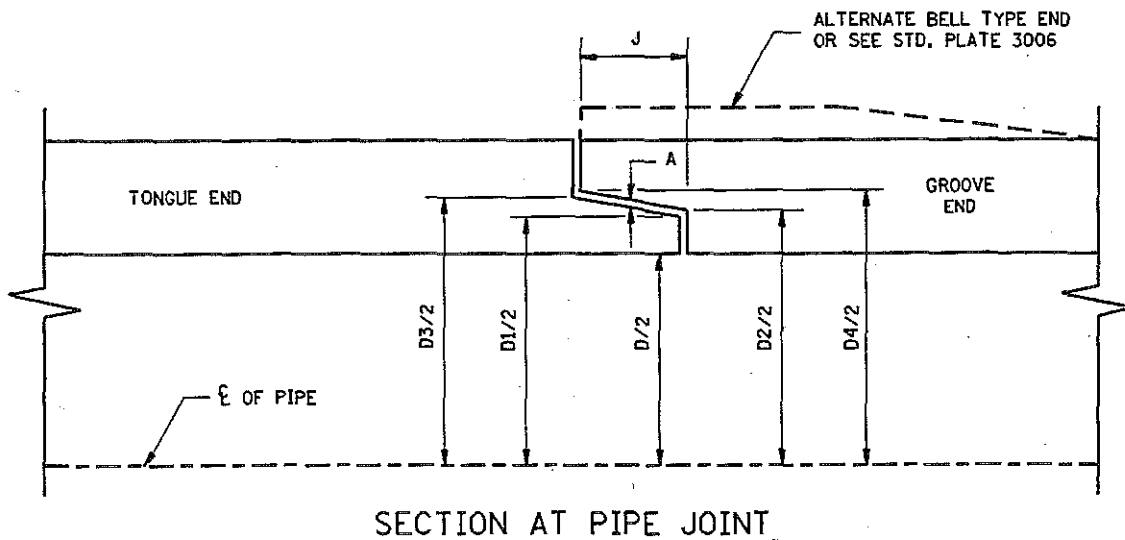
D: ± 1.5% FOR 12" TO 24" D, ± 1% OR 3/8" WHICHEVER IS GREATER FOR 27" TO 108" D.

D1, D2, D3, AND D4: ± 3/16" FOR 12" TO 30" D, ± 1/4" FOR 33" TO 108" D.

T: NOT LESS THAN THE DESIGN T BY MORE THAN 5% OR 3/16" WHICHEVER IS GREATER.

J: ALL SIZES ± 1/4".

LAYING LENGTH: SHALL NOT UNDERRUN BY MORE THAN 1/2".



APPROVED Aug. 31, 1989

*R.H. Sullivan*  
 Director  
 Materials, Research and Standards

STATE OF MINNESOTA  
 DEPARTMENT OF TRANSPORTATION

REINFORCED CONCRETE PIPE  
 JOINT DIMENSIONS FOR B-WALL AND C-WALL

SPECIFICATION  
 REFERENCE

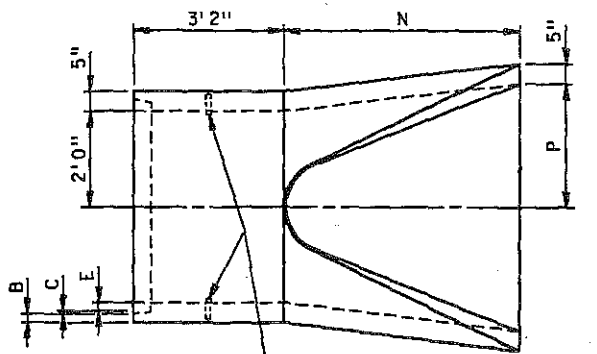
2501  
 2502  
 2503

STANDARD  
 PLATE  
 NO.

3000L

3 OF 5





1-1/4" CAST HOLES PLACED AT 75° FROM VERTICAL TO ACCOMMODATE CULVERT TIES (SEE OTHER STANDARD PLATES)

TOP VIEW

**CONSTRUCTION NOTES:**

IF THE SPLICES ARE NOT ELECTRICALLY WELDED, THE REINFORCEMENT SHALL BE LAPPED NOT LESS THAN 40 DIA.

IF SPLICES ARE ELECTRICALLY WELDED, MEMBERS AT EITHER A WELDED SPLICE OR INTERSECTION SHALL DEVELOP A TENSILE STRENGTH ACROSS THE WELD NOT LESS THAN THE MIN. REQUIRED STRENGTH OF THE FABRIC.

FOUR FT. LENGTHS SHALL BE USED ONLY TO SECURE REQUIRED LENGTH OF CATTLE PASS. SHORT LENGTH OF PIPE SHALL BE INSTALLED NEAR ENDS OF CATTLE PASS.

NOT MORE THAN TWO 4 FT. SECTIONS PERMITTED IN ANY CATTLE PASS.

FILL OVER TOP OF CATTLE PASS; 1 FT. MINIMUM, 15 FT. MAXIMUM.

DESIGN OF FLARED END SECTION SHALL CONFORM TO INTERMEDIATE SECTION.

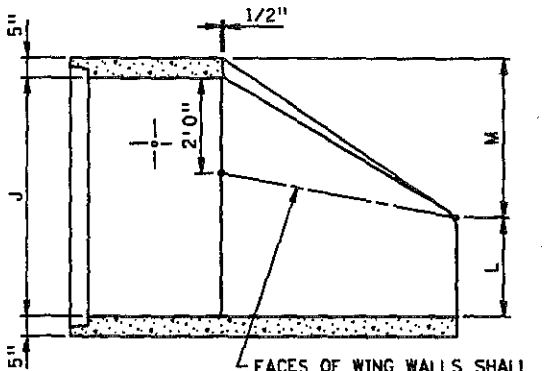
ROUNDED EDGE PERMITTED ON SLOPED END.

PLACE GROOVED END UP GRADE AND TONGUE END DOWNGRADE.

ONE LIFT HOLE SHALL BE CAST IN EACH SECTION OF PIPE.

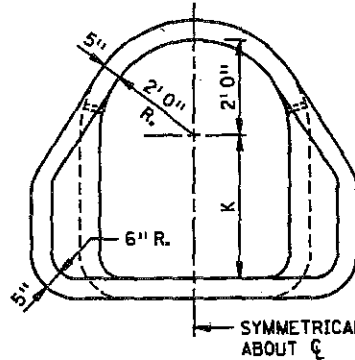
TAPERED CONCRETE PLUGS SHALL BE FURNISHED FOR CLOSING LIFT HOLES.

TIE BOLTS SHALL BE EITHER THE ADJUSTABLE TIE OR THE U-BOLT TIE SHOWN IN STANDARD PLATE 3145. THESE SHALL BE INSERTED FROM THE INSIDE WITH THE NUTS ON THE OUTSIDE.



FACES OF WING WALLS SHALL BE VERTICAL BELOW THIS LINE

SECTION ON C-C



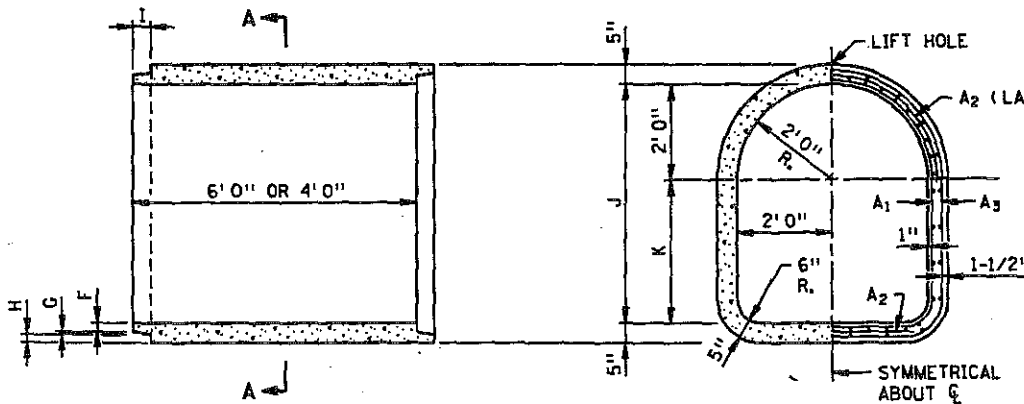
END VIEW

**DETAILS OF FLARED END SECTION**  
(REINFORCEMENT NOT SHOWN)

**DIMENSIONS**

CATTLE PASS SIZE	CATTLE PASS SIZE	
	60"	72"
B	2-1/8"	2"
C	5/8"	3/4"
E	2-1/4"	2-1/4"
F	2-1/16"	2"
G	5/8"	3/4"
H	2-5/16"	2-1/4"
I	4-1/2"	5"
J	5' 0"	6' 0"
K	3' 0"	4' 0"
L	2' 6"	2' 11"
M	2' 11"	3' 6"
N	5' 0"	7' 0"
P	3' 0"	3' 6"

ESTIMATED WEIGHT:  
7,320 LBS. (60")  
10,650 LBS. (72")



SECTION ON C-C

SECTION A-A

**DETAILS OF INTERMEDIATE SECTION**

CLASS III PIPE  
CONCRETE 4000 PSI

STEEL AREA SQ. IN. PER LIN. FT.		
A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>
0.26	0.15	0.20

APPROX. WT. OF SECTION  
(60") 1110 LBS. PER FT.  
(72") 1240 LBS. PER FT.

APPROVED Feb. 16, 1978

*[Signature]*  
Director  
Materials, Research and Standards

STATE OF MINNESOTA  
DEPARTMENT OF TRANSPORTATION

**REINFORCED PRECAST CONCRETE  
CATTLE PASS (60 IN. & 72 IN.)**

SPECIFICATION  
REFERENCE

2501

STANDARD  
PLATE  
NO.

3020F

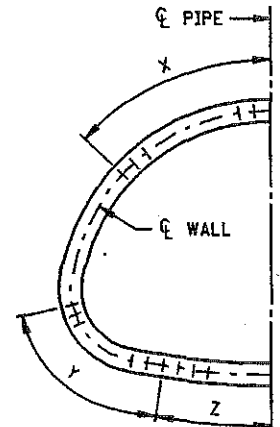
TABLE OF DIMENSIONS

NOMINAL SPAN	EQUIVALENT DIAMETER(A)	WATER AREA	RISE	SPAN	DIMENSION REQUIREMENTS IN INCHES													APPROX. WT./FT.
					t	a	b	c	j	e	f	g	R1	R2	R3	LB.		
22	18	1.7	13-1/2	22	2-1/2	1-3/8	3/8	3/4	2	1-1/8	3/8	1	27-1/2	13-3/4	5-1/4	175		
28	24	2.8	18	28-1/2	3-1/2	1-5/8	1/2	1-3/8	3	1-3/8	1/2	1-5/8	40-11/16	14-3/4	4-5/8	320		
36	30	4.4	22-1/2	36-1/4	4	1-13/16	5/8	1-9/16	3-1/2	1-9/16	5/8	1-13/16	51	18-3/4	6-1/8	455		
44	36	6.4	26-5/8	43-3/4	4-1/2	2	3/4	1-3/4	4	1-3/4	3/4	2	62	22-1/2	6-1/2	610		
51	42	8.8	31-5/16	51-1/8	4-1/2	2	3/4	1-3/4	4	1-3/4	3/4	2	73	26-1/4	7-3/4	740		
58	48	11.4	36	58-1/2	5	2-1/4	3/4	2	5	2	3/4	2-1/4	84	30	8-7/8	895		
65	54	14.0	40	65	5-1/2	2-1/2	3/4	2-1/4	5	2-1/4	3/4	2-1/2	92-1/2	33-3/8	10	1095		
73	60	17.7	45	73	6	3-5/16	3/4	1-15/16	5	2-3/4	3/4	2-1/2	105	37-1/2	11	1345		
88	72	25.6	54	88	7	3-13/16	1	2-3/16	6	3-1/4	1	2-3/4	126	45	13-5/16	1885		
102	84	34.6	62	102	8	4-1/8	1	2-7/8	6	3-1/2	1	3-1/2	162-1/2	52	14-1/2	2490		
115	90	44.5	72	115-1/2	8-1/2	4-1/4	1	3-1/4	7	3-3/4	1	3-3/4	183	59	18	2900		
122	96	51.7	77-1/2	122-3/8	9	4-1/2	1	3-1/2	7	4	1	4	218	62	20	3510		
138	108	66.0	87-1/8	138-1/2	10	5	1	4	7	4-1/2	1	4-1/2	269	70	22	4400		
154	120	81.8	96-7/8	154	11	5-1/2	1	4-1/2	7	5	1	5	301-3/8	78	24	5400		
169	132	99.1	106-1/2	168-3/4	10	5	1	4	7	4-1/2	1	4-1/2	329	85-5/8	26-7/8	5390		

(A) EQUIVALENT DIAMETER EQUALS DIAMETER OF CIRCULAR PIPE WITH APPROXIMATELY EQUIVALENT CROSS-SECTION AREA.

STIRRUP REQUIREMENTS (B)

NOMINAL SPAN	EQUIVALENT DIAMETER(A)	TOP										BOTTOM											
		S		X		As1						S		SIDES						CENTER			
		IN.	IN.	IN.	IN.	IIIA		IVA		IN.	IN.	Y		As1		IN.	IN.	Z		As1			
						IIIA	IVA	IIA	IIIA			IVA	IIA	IIIA	IVA			IIA	IIIA	IVA	IIIA	IVA	
73	60	5	2'8"		.20	4		1'8"	2'0"	.37	.66	5		1'8"	1'4"	.20	.20						
88	72	5	3'2"		.20	4		2'0"	2'5"	.39	.65	5		2'0"	1'7"	.20	.20						
102	84	6	3'8"		.20	4		2'3"	2'9"	.37	.64	6		2'3"	1'10"	.20	.20						
115	90	6	4'2"		.20	4		2'6"	3'1"	.36	.69	6		2'6"	2'0"	.20	.20						
122	96	7	4'5"		.20	4		2'9"	3'3"	.33	.67	7		2'9"	2'2"	.20	.20						
138	108	7	5'0"		.20	4-1/2		3'1"	3'8"	.33	.68	7		3'1"	2'6"	.20	.20						
154	120	8	5'6"		.20	5		3'5"	4'2"	.30	.62	8		3'5"	2'9"	.20	.20						
169	132	7	5'11"	.20		4-1/2	3'9"	3'9"	.20	.42	7	3'9"	3'9"	.20									



STIRRUP DETAILS

(B) SEE STANDARD PLATE 3007 FOR STIRRUP OPTIONS.

S = MAXIMUM STIRRUP SPACING IN INCHES MEASURED AT CENTERLINE OF WALL.

As1 = MINIMUM RADIAL REINFORCEMENT IN SQUARE INCHES PER SQUARE FOOT OF WALL MEASURED AT CENTERLINE OF WALL.

X, Y, & Z ARE MEASURED AT CENTERLINE OF WALL.

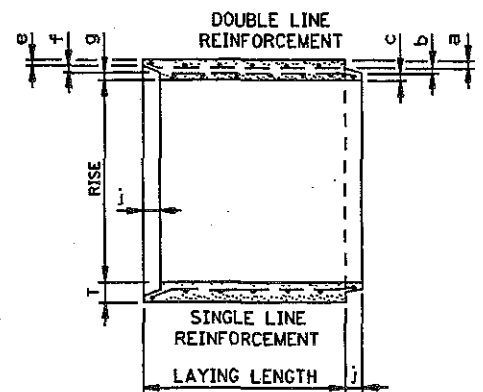
GENERAL NOTES:

- LAYING LENGTHS: 22" TO 122" DIA. (6' & 8'), 138" DIA. (4' & 6'), 154" & 169" DIA. (4' & 5').
- THREE-EDGE-BEARING-TEST REQUIREMENTS OF SPECIFICATION 3236 ARE NOT APPLICABLE.
- BEDDING: CLASS "B" BEDDING, SPEC. 2451, REQUIRED.

BASIS OF DESIGN:

- ULTIMATE STRENGTH ACCORDING TO 1977 AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES, USING  $U = 1.5D + 2.5(L+1)$ .
- LIVE LOAD BASED ON HS 20 LOADING WITH IMPACT AND DISTRIBUTION IN ACCORDANCE WITH 1977 AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES.
- FILL LOADS ON PIPE ARCH DETERMINED BY ACPA DESIGN DATA 17 PROCEDURE FOR POSITIVE PROJECTING CONDUIT, USING  $r_{sd} = 0.5$ ,  $p = 0.7$ ,  $w = 120$  LBS./C.F., AND BEARING ASSUMED TO ACT ON 80% OF THE CULVERT WIDTH.
- MAXIMUM DEPTH OF COVER, "EMBANKMENT CONDITION." \*  
 CLASS IIA 8 FT.  
 CLASS IIIA 16 FT.  
 CLASS IVA 23 FT.

\*MAXIMUM DEPTH OF COVER MAY BE INCREASED 25% OVER THE DEPTH LISTED FOR THE "EMBANKMENT CONDITION" WHEN INSTALLATION IN A "ZERO PROJECTION TRENCH CONDITION."



LONGITUDINAL SECTION

APPROVED Oct. 29, 1981

*R.H. Sullivan*  
 Assistant Division Director  
 Technical Services

STATE OF MINNESOTA  
 DEPARTMENT OF TRANSPORTATION  
**REINFORCED CONCRETE  
 PIPE ARCH**

GENERAL NOTES, DIMENSIONS & STIRRUP REQUIREMENTS

SPECIFICATION  
 REFERENCE  
 2501  
 2503

REVISED  
 5-3-99 A.K.J.

STANDARD  
 PLATE  
 NO.

**3014J**

1 OF 2

NOMINAL SPAN		EQUIVALENT DIAMETER (A)		TABLE OF REINFORCEMENT REQUIREMENTS																					
				f'c (Ksl)		As, CONTINUOUS BASIC REINFORCEMENT									As, ADDITIONAL REINFORCEMENT										
						INNER CAGE			OUTER CAGE			U - INNER CAGE						V - OUTER CAGE							
				CLASS			IIA	IIIA	IVA	IIA	IIIA	IVA	DIMEN - SION	TOP			BOTTOM			DIMEN - SION	IIA	IIIA	IVA		
IIA	IIIA	IVA	IIA	IIIA	IVA	IIA								IIIA	IVA	IIA	IIIA	IVA							
IN.	IN.																								
22	18	4				.42																			
28	24	4				.42																			
36	30	4				.22				.17		1'2"	.22			.06			2'9"	.17					
44	36	4				.21				.17		1'5"	.21			.08			3'3"	.17					
51	42	4				.26				.19		1'7"	.26			.08			3'6"	.19					
58	48	4				.24				.19		1'10"	.24			.09			4'0"	.19					
65	54	4				.24				.19		2'0"	.24			.09			4'6"	.19					
73	60	5	5	5		.24	.35	.54	.18	.35	.53	2'4"	.24	.11	.15	.11	.35	.54	5'0"	.18	.35	.53			
88	72	5	5	5		.23	.43	.63	.21	.42	.61	2'9"	.23	.12	.17	.19	.43	.63	6'0"	.21	.42	.61			
102	84	5	5	5		.23	.50	.73	.23	.49	.71	3'3"	.23	.13	.19	.23	.49	.73	7'0"	.23	.48	.71			
115	90	5	5	5		.28	.54	.88	.28	.54	.85	3'7"	.19	.16	.21	.28	.54	.88	8'0"	.28	.54	.85			
122	96	5	5	5		.30	.54	.90	.30	.54	.89	3'10"	.18	.16	.22	.30	.54	.90	8'6"	.30	.54	.89			
138	108	5	5	5		.35	.63	1.03	.36	.62	1.00	4'4"	.12	.18	.28	.35	.62	1.03	9'6"	.36	.61	1.00			
154	120	5	5	5		.39	.66	1.06	.38	.66	1.02	4'10"	.08	.18	.27	.39	.66	1.06	10'6"	.38	.65	1.02			
169	132	5	5	5		.50	.90		.49	.90		5'2"	.07	.23		.50	.90		11'0"	.49	.87				

(A) EQUIVALENT DIAMETER = DIAMETER OF CIRCULAR PIPE WITH APPROXIMATELY EQUIVALENT CROSS-SECTION AREA.

f'c (Ksl) = MINIMUM COMPRESSIVE STRENGTH OF CONCRETE IN THOUSANDS OF POUNDS PER SQUARE INCH.

As = CIRCUMFERENTIAL STEEL AREA IN SQUARE INCHES PER LINEAL FOOT OF PIPE BARREL IN EACH CONTINUOUS BASIC CAGE AND SUPPLEMENTAL REINFORCEMENT DESIGNATED "U" AND "V".

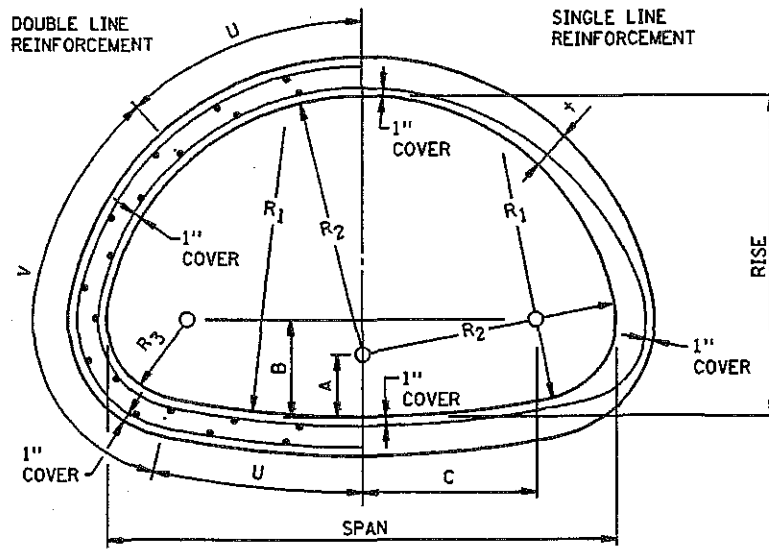
U = HALF BAR OR FABRIC LENGTH MEASURED ALONG CENTERLINE OF PIPE WALL FROM VERTICAL CENTERLINE OF PIPE.

V = FULL BAR OR FABRIC LENGTH MEASURED ALONG CENTERLINE OF PIPE WALL AND POSITIONED EQUIDISTANT WITH RESPECT TO ENDS OF "U" REINFORCEMENT.

$$A = \text{RISE} - R_2$$

$$B = A + \sqrt{(R_2 - R_3)^2 - C^2}$$

$$C = \frac{\text{SPAN}}{2} - R_3$$



REINFORCEMENT DETAILS

1. STEEL FABRIC SHALL CONFORM TO REQUIREMENTS OF ASTM A 185, fy = 65 ksi.
2. IF REINFORCEMENT BARS ARE USED, INCREASE TABLE VALUES FOR REINFORCEMENT AREAS BY 8%. REINFORCEMENT BARS SHALL CONFORM TO REQUIREMENTS OF ASTM A 615, GRADE 60, fy = 60 ksi.
3. MINIMUM COVER OF REINFORCEMENT SHALL BE 3/4", MAXIMUM SHALL BE 1" + 10% OF t OR 1-1/2" WHICHEVER IS GREATER.
4. WHERE DOUBLE LINE REINFORCEMENT IS INDICATED, ALTERNATE METHODS OF STEEL PLACEMENT WHICH SUPPLY EQUIVALENT REINFORCING STRENGTH AT ALL CRITICAL LOCATIONS MAY BE USED SUBJECT TO WRITTEN APPROVAL OF THE ENGINEER.
5. LONGITUDINAL REINFORCING PARALLEL TO THE AXIS OF THE PIPE SHALL BE A MINIMUM OF 0.06 SQUARE INCHES PER CIRCUMFERENTIAL FOOT ON ALL SIZE SECTIONS. THIS LONGITUDINAL REINFORCING SHALL BE UNIFORMLY SPACED AROUND THE REQUIRED AREAS OF THE CIRCUMFERENCE OF THE PIPE.
6. THE SPACING CENTER TO CENTER OF ADJACENT RINGS OF CIRCUMFERENTIAL REINFORCEMENT IN A CAGE SHALL NOT EXCEED 4 IN. FOR PIPE UP TO AND INCLUDING PIPE HAVING A 4 IN. WALL THICKNESS NOR EXCEEDING THE WALL THICKNESS FOR LARGER PIPE AND SHALL IN NO CASE EXCEED 6 IN.. THE CONTINUITY OF THE CIRCUMFERENTIAL REINFORCING STEEL SHALL NOT BE DESTROYED DURING THE MANUFACTURE OF THE PIPE.

APPROVED Oct. 29, 1981

*R.H. Sullivan*  
Assistant Division Director  
Technical Services

STATE OF MINNESOTA  
DEPARTMENT OF TRANSPORTATION  
**REINFORCED CONCRETE  
PIPE ARCH  
REINFORCEMENT**

SPECIFICATION  
REFERENCE

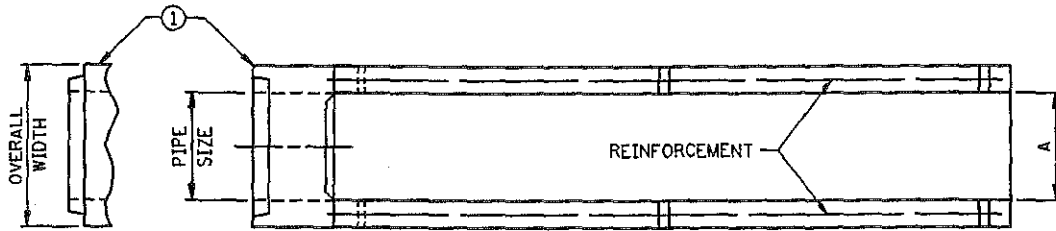
2501  
2503

REVISED  
10-12-2000 A.K.J.

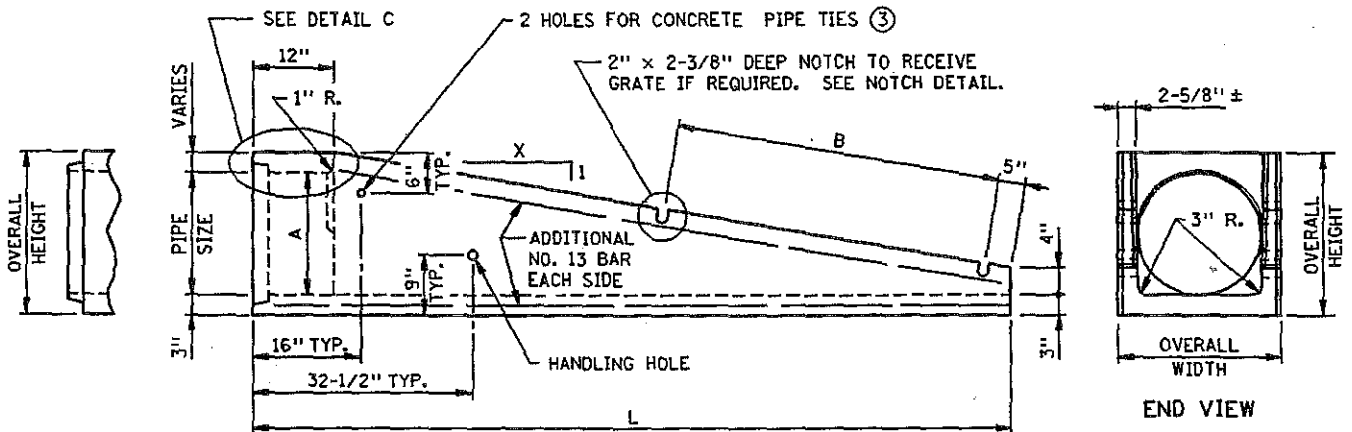
STANDARD  
PLATE  
NO.

3014J

2 OF 2



TOP VIEW



SIDE VIEW

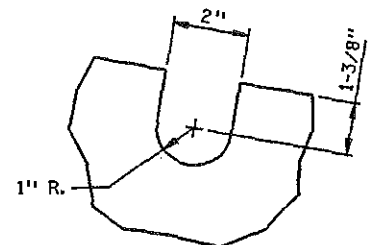
DESIGN OPTION NO. 1

1:6 SLOPES

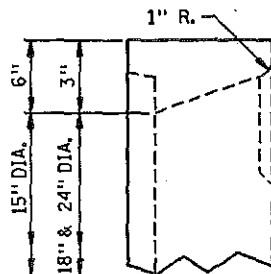
PIPE SIZE	A INSIDE	B $\phi$ - $\phi$	L	OVERALL HEIGHT	OVERALL WIDTH	WEIGHT (LBS.)
15"	15"	4' 0"	9' 4-1/2"	24"	24"	1800
18"	18"	4' 0"	9' 4-1/2"	24"	24"	1700
24"	24"	6' 0"	12' 4" (2)	30"	30"	2800

1:4 SLOPES

PIPE SIZE	A INSIDE	B $\phi$ - $\phi$	L	OVERALL HEIGHT	OVERALL WIDTH	WEIGHT (LBS.)
24"	24"	4' 0"	8' 5"	30"	30"	1900



NOTCH DETAIL



DETAIL C

NOTES:

ALL REBARS ARE IN METRIC DESIGNATIONS

THE DESIGN USED IS THE CONTRACTOR'S OPTION.  
 REINFORCING STEEL AND CONCRETE PER AASHTO M170.  
 REINFORCEMENT SHALL CONFORM TO STANDARD REINFORCED CONCRETE PIPE CLASS II, LOCATED AT CENTER OF WALL PLUS ONE (1) NO. 13 BAR, TOP, BOTTOM AND EACH SIDE.  
 JOINT IN END SECTION PER STANDARD PLATE 3000.  
 TOP EXPOSED CONCRETE CORNERS SHALL HAVE 3/4" CHAMFER.  
 TIE BOLTS AS REQUIRED.

- ① SEE PLANS FOR TYPE OF END REQUIRED.
- ② TWO PIECE CONSTRUCTION PERMISSIBLE.
- ③ SEE STANDARD PLATE 3145 FOR DETAILS.

APPROVED SEPT. 19, 2000

*Delbert W. Gendes*  
 STATE DESIGN ENGINEER

STATE OF MINNESOTA  
 DEPARTMENT OF TRANSPORTATION

**PRECAST CONCRETE SAFETY APRON**  
 (DESIGN OPTION NO. 1)

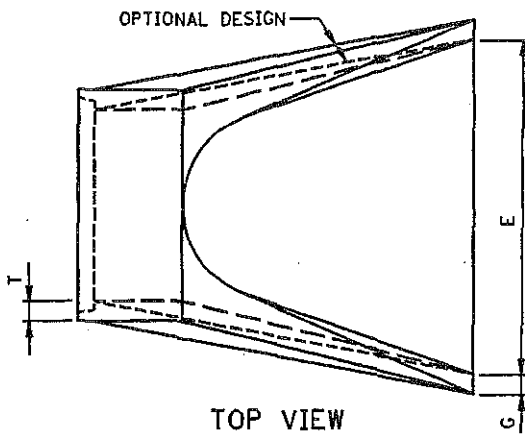
SPECIFICATION  
 REFERENCE

2501

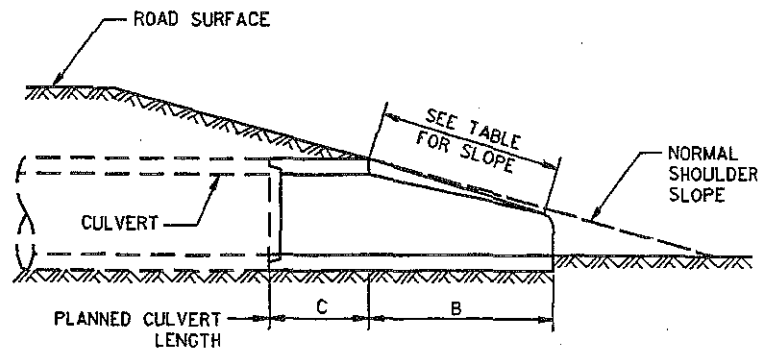
STANDARD  
 PLATE  
 NO.

**3022C**

1 OF 3



TOP VIEW

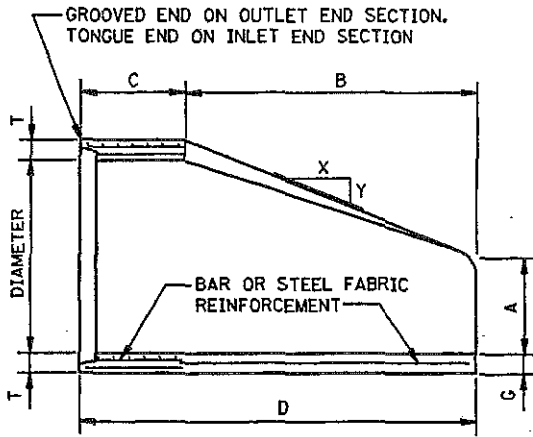


SLOPE DETAIL

NOTE: REINFORCEMENT AND DESIGN OF END SECTION "C" SHALL CONFORM TO STANDARD REINFORCED CONCRETE PIPE CLASS II, "B" WALL.

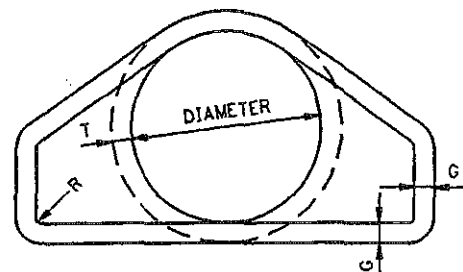
ROUNDED EDGE PERMITTED ON SLOPED END "B".

HANDLING HOLES SHALL BE PROVIDED AS NECESSARY FOR HANDLING OF APRONS.



LONGITUDINAL SECTION

SLOPE = Y TO X



END VIEW

SEE STD PLATE 3000 FOR ADDITIONAL REQUIREMENTS

DIAM.	WEIGHT PER SECTION (LBS.)	APPROX. SLOPE Y TO X	T	A	B	C	D	E	G	R	Ⓢ
12"	530	1 TO 2.4	2"	4"	24"	48-7/8"	72-7/8"	24"	2"	1-1/2"	0.07
15"	740	1 TO 2.4	2-1/4"	6"	27"	46"	73"	30"	2-1/4"	1-1/2"	0.07
18"	990	1 TO 2.3	2-1/2"	9"	27"	46"	73"	36"	2-1/2"	1-1/2"	0.07
21"	1280	1 TO 2.4	2-3/4"	9"	36"	37-1/2"	73-1/2"	42"	2-3/4"	1-1/2"	0.07
24"	1520	1 TO 2.5	3"	9-1/2"	43-1/2"	30"	73-1/2"	48"	3"	1-1/2"	0.07
27"	1930	1 TO 2.5	3-1/4"	10-1/2"	49-1/2"	24"	73-1/2"	54"	3-1/4"	1-1/2"	0.13
30"	2190	1 TO 2.5	3-1/2"	12"	54"	19-3/4"	73-3/4"	60"	3-1/2"	1-1/2"	0.14
36"	4100	1 TO 2.5	4"	15"	63"	34-3/4"	97-3/4"	72"	4"	1-1/2"	0.12
42"	5380	1 TO 2.5	4-1/2"	21"	63"	35"	98"	78"	4-1/2"	1-1/2"	0.15
48"	6550	1 TO 2.5	5"	24"	72"	26"	98"	84"	5"	1-1/2"	0.18
54"	8240	1 TO 2.0	5-1/2"	27"	65"	33-1/4"	98-1/4"	90"	5-1/2"	1-1/2"	0.22
60"	8730	1 TO 1.9	6"	35"	60"	39"	99"	96"	5"	1-1/2"	0.25
66"	10710	1 TO 1.7	6-1/2"	30"	72"	27"	99"	102"	5-1/2"	1-1/2"	0.31
72"	12520	1 TO 1.8	7"	36"	78"	21"	99"	108"	6"	1-1/2"	0.35
78"	14770	1 TO 1.8	7-1/2"	36"	90"	21"	111"	114"	6-1/2"	1-1/2"	0.40
84"	18160	1 TO 1.6	8"	36"	90-1/2"	21"	111-1/2"	120"	6-1/2"	1-1/2"	0.46
90"	20900	1 TO 1.5	8-1/2"	41"	87-1/2"	24"	111-1/2"	132"	6-1/2"	6"	0.51

Ⓢ CONTINUOUS BASIC REINFORCEMENT IN SQ. IN. PER LINEAL FT. FOR SLOPED END "B" (LARGER OF INNER OR OUTER CAGE ON STD. PLATE 3000). FOR WALL THICKNESSES LESS THAN 4", LOCATE REINFORCEMENT AT THE CENTER OF WALL. FOR WALL THICKNESSES 4" AND GREATER, LOCATE REINFORCEMENT WITH A MIN. OF 2" OF COVER MEASURED FROM THE OUTSIDE OF THE WALL.

NOTE: UNLESS SPECIFIED OTHERWISE IN THE PLANS, WHEN AN APRON IS REQUIRED FOR A RUN OF GASKET PIPE (STD. PLATE 3006), THE PRODUCER MAY FURNISH EITHER:

1. AN APRON WITH A STD. PLATE 3006 JOINT, OR
2. AN APRON WITH A STD. PLATE 3000 JOINT AND THE END OF THE STD. PLATE 3006 PIPE CONNECTING TO THE APRON PROVIDED WITH A STD. PLATE 3000 JOINT. THIS JOINT IS TO BE SEALED WITH A PREFORMED MASTIC SEALER.

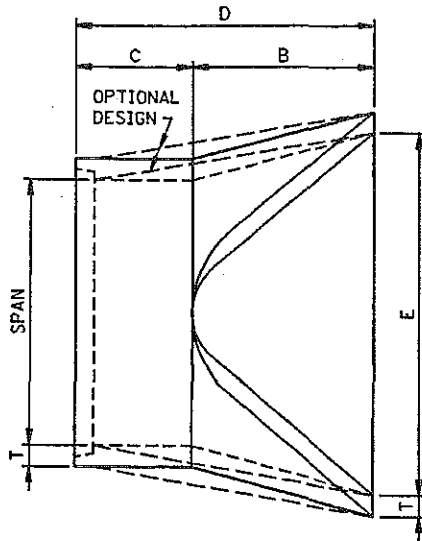
APPROVED May 8, 1985  
*R.H. Sullivan*  
 Assistant Division Director  
 Technical Services

STATE OF MINNESOTA  
 DEPARTMENT OF TRANSPORTATION  
**CONCRETE APRON FOR  
 REINFORCED CONCRETE PIPE**

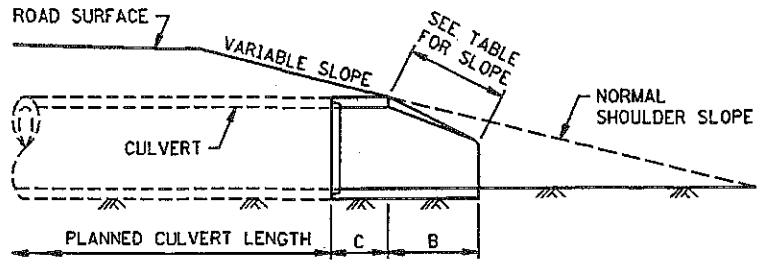
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SPECIFICATION  
 REFERENCE  
 2501, 2503  
 REVISED  
 10-16-2000 A.K.J.

STANDARD  
 PLATE  
 NO.  
**3100G**

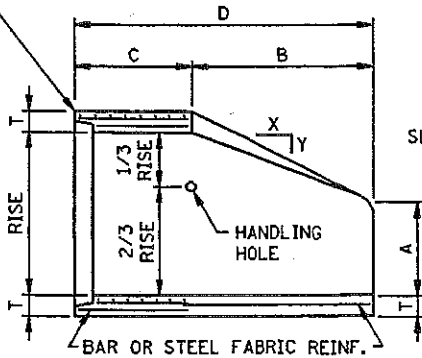


TOP VIEW



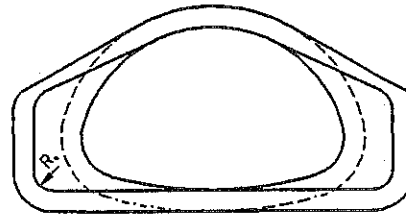
SLOPE DETAIL

GROOVE END ON OUTLET END SECTION  
TONGUE END ON INLET END SECTION



LONGITUDINAL SECTION

SLOPE = Y TO X



END VIEW

SIZE ①	WEIGHT PER SECTION (APPROX.) (LBS.)	RISE	SPAN	APPROX. SLOPE Y TO X	T	A	B	C	D	E	R	②
18"	1100	13-1/2"	22"	1 TO 3	2-1/2"	7"	27"	45"	72"	36"	2"	0.15
24"	1750	18"	28-1/2"	1 TO 3	3-1/2"	8-1/2"	39"	33"	72"	48"	3"	0.18
30"	3300	22-1/2"	36-1/4"	1 TO 3	4"	9-1/2"	50"	46"	96"	60"	3"	0.22
36"	4350	26-5/8"	43-3/4"	1 TO 3	4-1/2"	11-1/8"	60"	36"	96"	72"	6"	0.21
42"	5250	31-5/16"	51-1/8"	1 TO 3	4-1/2"	15-13/16"	60"	36"	96"	78"	6"	0.26
48"	6400	36"	58-1/2"	1 TO 3	5"	21"	60"	36"	96"	84"	6"	0.24
54"	7850	40"	65"	1 TO 3	5-1/2"	25-1/2"	60"	36"	96"	90"	6"	0.24
60"	9500	45"	73"	1 TO 3	6"	31"	60"	36"	96"	96"	6"	0.24
72"	13550	54"	88"	1 TO 2	7"	31"	60"	39"	99"	120"	6"	0.23
84"	17950	62"	102"	1 TO 2	8"	28-1/2"	83"	19"	102"	144"	6"	0.23

NOTES:

REINFORCEMENT AND DESIGN OF END SECTION "C" SHALL CONFORM TO STANDARD REINFORCED CONCRETE PIPE-ARCH CLASS II-A.

ROUNDED EDGE PERMITTED ON SLOPED END "B".

① SIZE = DIAMETER OF ROUND PIPE WITH SAME PERIPHERY. SEE STANDARD PLATE NO. 3014 FOR PIPE-ARCH SHAPE DIMENSIONS AND APPLICABLE REQUIREMENTS.

② CONTINUOUS BASIC REINFORCEMENT IN SQ. IN. PER LINEAL FT. FOR SLOPED END "B". FOR WALL THICKNESSES LESS THAN 4", LOCATE REINFORCEMENT AT THE CENTER OF WALL. FOR WALL THICKNESSES 4" AND GREATER, LOCATE REINFORCEMENT WITH A MINIMUM OF 2" OF COVER MEASURED FROM THE OUTSIDE OF THE WALL.

APPROVED May 8, 1985

*R.H. Sullivan*  
Assistant Division Director  
Technical Services

STATE OF MINNESOTA  
DEPARTMENT OF TRANSPORTATION  
**CONCRETE APRON FOR  
REINFORCED CONCRETE PIPE-ARCH**

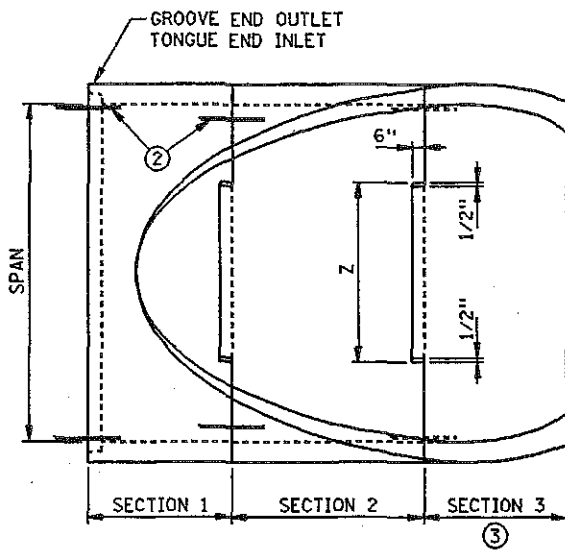
FLARED

SPECIFICATION  
REFERENCE  
2501  
2503

REVISED  
10-16-2000 A.K.J.

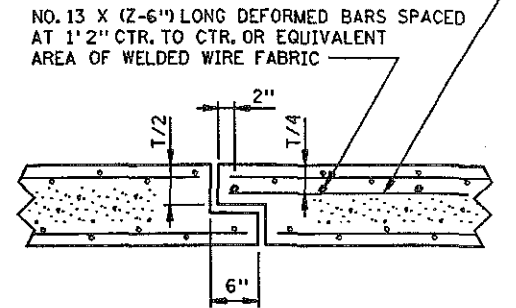
STANDARD  
PLATE  
NO.

3110G

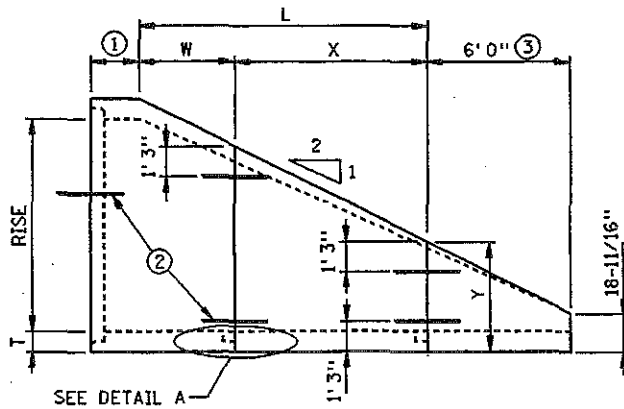


TOP VIEW

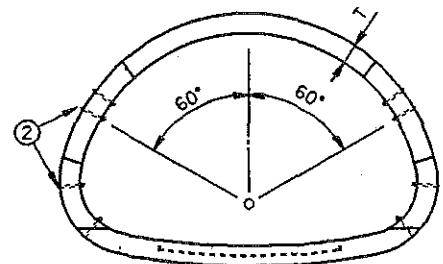
NO. 13 X 2' 6" LONG DEFORMED BARS SPACED AT 1' 0" CTR. TO CTR. OR EQUIVALENT AREA OF WELDED WIRE FABRIC



DETAIL A



SIDE VIEW



END VIEW

NOTES:

ALL REBARS ARE IN METRIC DESIGNATIONS

- ① 2' 0" FOR GROOVE END AND 2' 7" FOR TONGUE END.
- ② CULVERT TIES AS SHOWN ON STANDARD PLATE 3145.
- ③ 132" SIZE IS A 3 PIECE END SECTION.

SEE STANDARD PLATE 3014 FOR THE FOLLOWING:

- a. SHAPE, JOINT DIMENSIONS, TOLERANCES AND OTHER APPLICABLE REQUIREMENTS.
- b. REINFORCEMENT REQUIREMENTS IN SECTION 1 SHALL CONFORM TO CLASS II-A REINFORCEMENT EXCEPT STIRRUPS NOT REQUIRED. REINFORCEMENT REQUIREMENTS IN SECTION 2 AND 3 SHALL CONFORM TO CLASS II-A CONTINUOUS BASIC REINFORCEMENT ONLY, WITH ADDITIONAL REINFORCEMENT AS SHOWN IN DETAIL A.

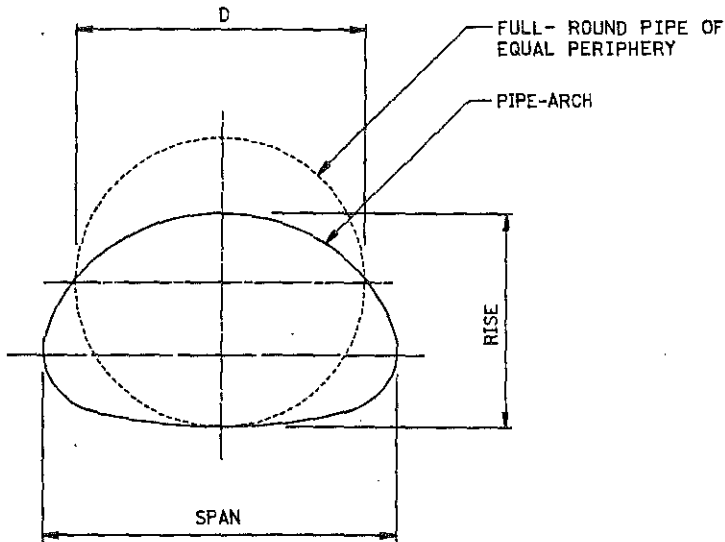
TABLE OF REQUIREMENTS											
SIZE	RISE	SPAN	T	L	W	X	Y	Z	SECTION	SECTION	SECTION
									1	2	3
INCHES									WEIGHT IN POUNDS (APPROX)		
90	72	115-1/2	8-1/2	102-1/4	72	30-1/4	37-7/8	48	19100	3950	
96	78	122-3/8	9	112-1/2	72	40-1/2	39	54	22000	6050	
108	88	138-1/2	10	129-1/2	48	81-1/2	42-3/8	66	23000	15800	
120	96-7/8	154	11	144	48	96	46-7/8	78	27000	24600	
132	106-1/2	168-3/4	10	144	48	96	54-5/8	90	27950	25260	13640

APPROVED Nov. 13, 1986  
*R.H. Sullivan*  
 Director  
 Materials, Research and Standards

STATE OF MINNESOTA  
 DEPARTMENT OF TRANSPORTATION  
**SECTIONAL CONCRETE APRON FOR  
 REINFORCED CONCRETE PIPE-ARCH**

SPECIFICATION  
 REFERENCE  
 2501  
 REVISED  
 1-28-2000 A.K.J.

STANDARD  
 PLATE  
 NO.  
**3114H**



SHEET THICKNESS - GAGE RELATIONSHIP		
GAGE	THICKNESS - EQUIVALENT	
	GALV. STEEL (IN.)	ALUM. ALLOY (IN.)
18	.0516	.048
16	.0635	.060
14	.0785	.075
12	.1084	.105
10	.1382	.135
8	.1681	.164

ROUND PIPE			PIPE-ARCH			
PIPE DIA. (IN.)	END AREA SQ. FT.	GAGE (MIN.)	SPAN ① (IN.)	RISE ① (IN.)	END AREA SQ. FT.	GAGE (MIN.)
6	0.2	18				
8	0.4	16				
10	0.6	16				
12	0.8	16				
15	1.2	16	17	13	1.1	16
18	1.8	16	21	15	1.5	16
21	2.4	16	24	18	2.2	16
24	3.1	16	28	20	2.8	16
30	4.9	14	35	24	4.4	14
36	7.1	14	42	29	6.4	14
42	9.6	12	49	33	8.7	12
48	12.6	12	57	38	11.4	12
54	15.9	12	64	43	14.3	12
60	19.6	10	71	47	17.6	10
66	23.8	10	77	52	21.3	8
72	28.3	10	83	57	25.3	8
78	33.2	8				
84	38.5	8				

ROUND PIPE SHALL HAVE THE VERTICAL AXIS ELONGATED 5% MORE THAN THE NORMAL DIAMETER WHEN CALLED FOR IN THE PLANS.

THE AVERAGE INSIDE DIAMETER OF CIRCULAR PIPE AND PIPE TO BE REFORMED INTO PIPE ARCHES SHALL NOT VARY MORE THAN ONE PERCENT OR ONE-HALF INCH, WHICHEVER IS GREATER, FROM THE NOMINAL DIAMETER WHEN MEASURED ON THE INSIDE CREST OF THE CORRUGATIONS.

FOR PIPE-ARCH A TOLERANCE OF PLUS OR MINUS ONE INCH OR TWO PERCENT OF THE EQUIVALENT CIRCULAR DIAMETER, WHICHEVER IS GREATER, WILL BE PERMISSIBLE IN SPAN AND RISE. ALL DIMENSIONS ARE MEASURED FROM THE INSIDE CRESTS OF THE CORRUGATIONS.

① SEE AASHTO M196M FOR ALUMINUM PIPE-ARCH VALUES.

APPROVED Jan. 29, 1979

*[Signature]*  
 Director  
 Construction and  
 Engineering Development

STATE OF MINNESOTA  
 DEPARTMENT OF TRANSPORTATION

**CORRUGATED METAL PIPE CULVERT**  
 STANDARD 2-2/3" x 1/2" CORRUGATION

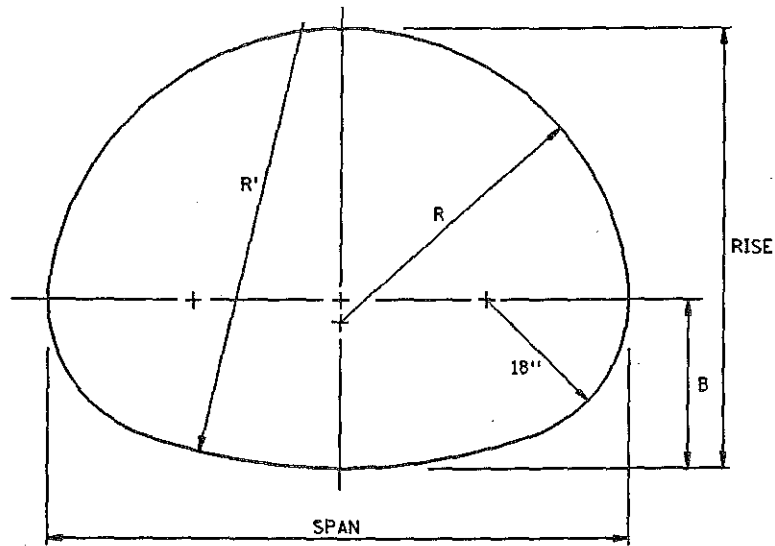
SPECIFICATION  
 REFERENCE  
 2501, 2502  
 2503

REVISED  
 8-22-96

STANDARD  
 PLATE  
 NO.

3040F





NOMINAL DIMENSIONS				LAYOUT DIMENSIONS				
SPAN	RISE	AREA SQ. FT.	TOTAL PERIPHERY PI INCHES	B INCHES	RISE INCHES	1/2 SPAN INCHES	R INCHES	R' INCHES
6'1"	4'7"	22	66	21.0	55.0	36.5	36.8	76.3
6'4"	4'9"	24	69	20.5	57.1	38.0	38.1	98.6
6'9"	4'11"	26	72	22.0	58.9	40.6	41.0	83.5
7'0"	5'1"	28	75	21.4	61.1	42.1	42.3	104.2
7'3"	5'3"	31	78	20.8	63.2	43.5	43.5	136.2
7'8"	5'5"	33	81	22.4	65.0	46.2	46.5	109.8
7'11"	5'7"	35	84	21.7	67.2	47.6	47.7	137.9
8'2"	5'9"	38	87	20.9	69.4	48.9	48.9	182.9
8'7"	5'11"	40	90	22.7	71.1	51.7	51.9	141.0
8'10"	6'1"	43	93	21.9	73.3	53.0	53.0	178.7
9'4"	6'3"	46	96	23.8	75.1	55.9	56.2	144.6
9'6"	6'5"	49	99	22.9	77.3	57.1	57.3	177.5
9'9"	6'7"	52	102	21.9	79.5	58.3	58.3	227.7
10'3"	6'9"	55	105	24.0	81.2	61.3	61.5	178.3
10'8"	6'11"	58	108	26.1	82.9	64.2	64.9	153.2
10'11"	7'1"	61	111	25.1	85.1	65.5	65.9	180.4
11'5"	7'3"	64	114	27.4	86.9	68.4	69.4	157.9
11'7"	7'5"	67	117	26.3	89.1	69.7	70.2	183.2
11'10"	7'7"	71	120	25.2	91.3	70.9	71.1	216.4
12'4"	7'9"	74	123	27.5	93.0	73.9	74.7	186.5
12'6"	7'11"	78	126	26.4	95.2	75.1	75.5	216.8
12'8"	8'1"	81	129	25.2	97.4	76.2	76.4	257.4
12'10"	8'4"	85	132	24.0	99.7	77.2	77.3	314.7
13'5"	8'5"	89	135	26.4	101.3	80.4	80.7	254.8
13'11"	8'7"	93	138	28.9	103.0	83.6	84.4	220.7
14'1"	8'9"	97	141	27.6	105.2	84.7	85.1	254.1
14'3"	8'11"	101	144	26.3	107.5	85.7	85.9	297.6
14'10"	9'1"	105	147	28.9	109.2	88.9	89.6	254.3
15'4"	9'3"	109	150	31.6	110.8	92.0	93.4	226.8
15'6"	9'5"	113	153	30.2	113.1	93.2	94.0	255.7
15'8"	9'7"	118	156	28.8	115.3	94.2	94.7	291.5
15'10"	9'10"	122	159	27.5	117.6	95.2	95.5	338.1
16'5"	9'11"	126	162	30.1	119.2	98.5	99.2	290.9
16'7"	10'1"	131	165	28.7	121.5	99.5	99.9	332.7

DIMENSIONS ARE TO INSIDE CRESTS AND ARE SUBJECT TO REASONABLE MANUFACTURING TOLERANCES.

① THESE STRUCTURES ARE PREFERRED BECAUSE THEY GIVE GREATEST AREA FOR GIVEN NUMBER OF PLATES AND BOLTS PER RING. EACH STRUCTURE OF LESS SPAN THAN THOSE MARKED PROVIDE CORRESPONDINGLY LESS AREA FOR THE SAME NUMBER OF PLATES AND BOLTS.

APPROVED Oct. 1, 1966

*W. A. Ebern*

ASSISTANT COMMISSIONER  
ENGINEERING STANDARDS

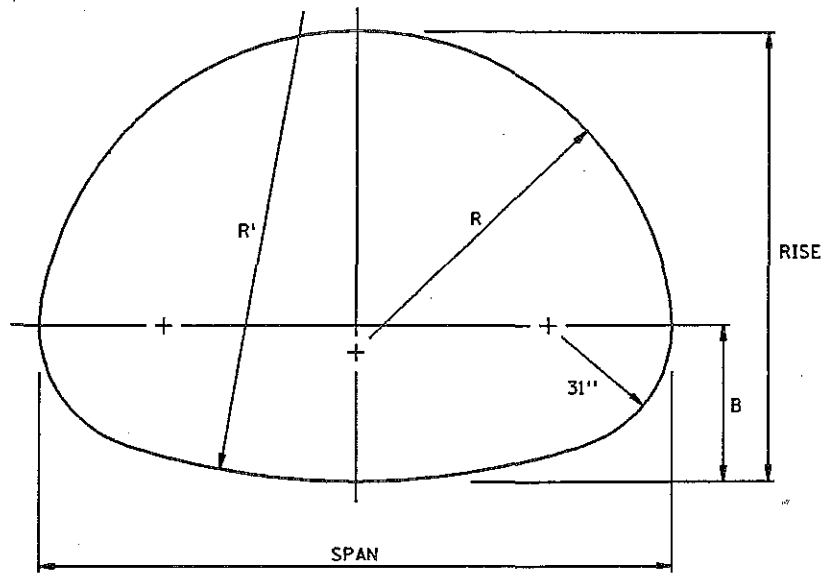
STATE OF MINNESOTA  
DEPARTMENT OF TRANSPORTATION  
DESIGN DATA  
STRUCTURAL PLATE STRUCTURES  
(18" CORNER RADIUS)

SPECIFICATION  
REFERENCE

2415

STANDARD  
PLATE  
NO.

3050B



NOMINAL DIMENSIONS				LAYOUT DIMENSIONS				
SPAN	RISE	AREA SQ. FT.	TOTAL PERIPHERY PI INCHES	B INCHES	RISE INCHES	1/2 SPAN INCHES	R INCHES	R' INCHES
13' 3"	9' 4"	98	138	38.6	112.3	79.7	80.1	192.6
13' 6"	9' 6"	102	141	37.8	114.4	81.1	81.3	220.0
14' 0"	9' 8"	106	144	39.6	116.2	83.8	84.4	197.9
14' 2"	9' 10"	110	147	38.9	118.4	85.3	85.6	222.6
14' 5"	10' 0"	115	150	38.0	120.5	86.4	86.6	256.6
14' 11"	10' 2"	119	153	39.9	122.3	89.3	89.8	227.7
15' 4"	10' 4"	124	156	41.9	124.1	92.1	93.1	208.5
15' 7"	10' 6"	129	159	41.0	126.3	93.5	94.1	232.1
15' 10"	10' 8"	133	162	40.1	128.5	94.8	95.2	260.6
16' 3"	10' 10"	138	165	42.2	130.2	97.7	98.5	236.0
16' 6"	11' 0"	143	168	41.2	132.4	99.0	99.5	263.2
17' 0"	11' 2"	148	171	43.4	134.2	101.8	102.9	241.0
17' 2"	11' 4"	153	174	42.4	136.3	103.1	103.8	266.8
17' 5"	11' 6"	158	177	41.4	138.5	104.4	104.8	297.9
17' 11"	11' 8"	163	180	43.6	140.3	107.3	108.2	270.6
18' 1"	11' 10"	168	183	42.5	142.4	108.6	109.1	299.7
18' 7"	12' 0"	174	186	44.8	144.2	111.5	112.6	274.5
18' 9"	12' 2"	179	189	43.7	146.4	112.7	113.5	302.3
19' 3"	12' 4"	185	192	46.0	148.1	115.7	117.0	278.6
19' 6"	12' 6"	190	195	44.9	150.3	117.0	117.9	305.1
19' 8"	12' 8"	196	198	43.8	152.5	118.2	118.8	336.5
19' 11"	12' 10"	202	201	42.6	154.7	119.3	119.7	374.3
20' 5"	13' 0"	208	204	45.0	156.4	122.4	123.2	338.1
20' 7"	13' 2"	214	207	43.8	158.6	123.5	124.0	373.5

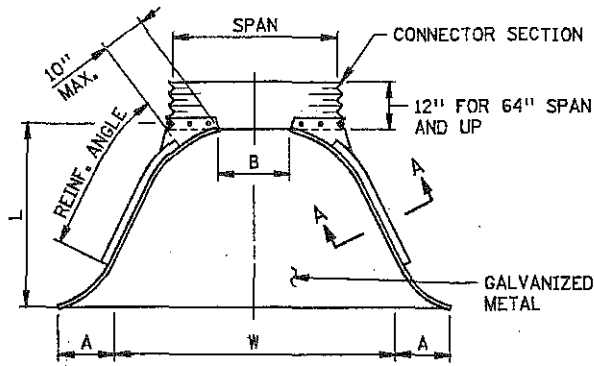
DIMENSIONS ARE TO INSIDE CRESTS AND ARE SUBJECT TO REASONABLE MANUFACTURING TOLERANCES.

APPROVED Oct. 1, 1966  
*W. A. Ebern*  
 ASSISTANT COMMISSIONER  
 ENGINEERING STANDARDS

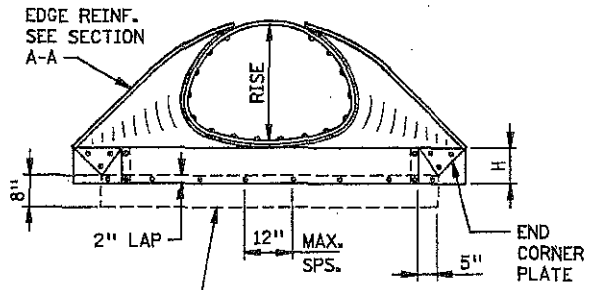
STATE OF MINNESOTA  
 DEPARTMENT OF TRANSPORTATION  
 DESIGN DATA  
 STRUCTURAL PLATE STRUCTURES  
 ( 31" CORNER RADIUS )

SPECIFICATION  
 REFERENCE  
 2415

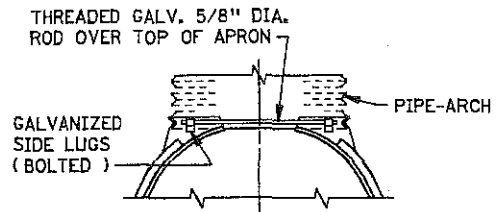
STANDARD  
 PLATE  
 NO.  
 3051B



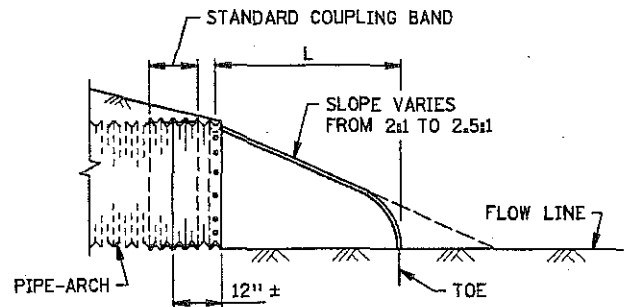
TOP VIEW



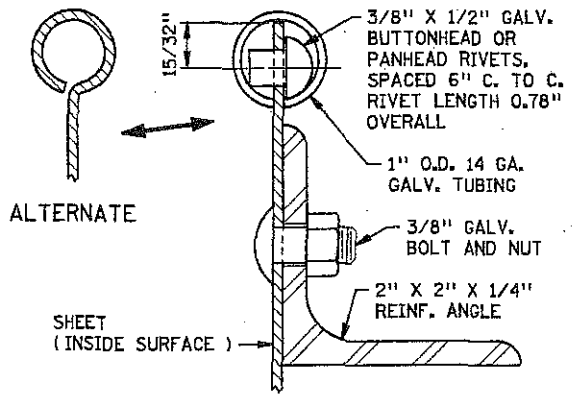
ELEVATION



FOR 17" X 13" THRU 57" X 38" ONLY  
ROD CONNECTION ①



CROSS SECTION



SECTION A-A

EQUIVALENT DIA. (IN.)	PIPE-ARCH SIZE (IN.)		GAUGE	DIMENSIONS					REMARKS
	④			A	B	H	L	W	
	SPAN	RISE		1" ± (IN.)	MAX. (IN.)	1" ± (IN.)	1-1/2" ± (IN.)	2" ± (IN.)	
15	17	13	16	7	9	6	19	30	1 PIECE
18	21	15	16	7	10	6	23	36	"
21	24	18	16	8	12	6	28	42	"
24	28	20	16	9	14	6	32	48	"
30	35	24	14	10	16	6	39	60	"
36	42	29	14	12	18	8	46	75	"
42	49	33	12	13	21	9	53	85	2 PIECES, C SPLICE
48	57	38	12	18	26	12	63	90	" "
54	64	43	12	18	30	12	70	102	" "
60	71	47	12	18	33	12	77	114	3 PIECES, 2 SPLICES
66	77	52	12	18	36	12	77	126	" "
72	83	57	12	18	39	12	77	138	" "

NOTES:

FOR OTHER APPROVED CONNECTIONS, SEE STANDARD PLATE 3124.

THE TOP EDGE OF ALL APRONS SHALL HAVE TUBING REINFORCING (SEE SECTION A-A). THE TUBING SHALL BE SUPPLEMENTED WITH GALVANIZED ANGLE FOR 77" X 52" AND 83" X 57" SIZES. ALTERNATE ROLLED TOP EDGE DESIGNS APPROVED BY THE MN/DOT MATERIALS SECTION MAY BE USED.

- ① FOR 18" THRU 29" SPAN PIPE-ARCHES, A FLAT STRAP CONNECTOR MAY BE USED IN PLACE OF THE ROD CONNECTION. STRAP CONNECTOR SHALL BE 1" WIDE, 12 GA. STRAP WITH STANDARD 6" LONG X 1/2" DIA. BAND BOLT AND NUT.
- ② A 3 PIECE APRON WITH 2 SPLICES MAY BE USED IN LIEU OF A 2 PIECE APRON. THE 3 PIECE BODIES SHALL BE MADE OF 3 EQUAL SECTIONS OF 12 GA. MATERIAL.

③ 3 PIECE BODIES SHALL HAVE 12 GA. SIDES AND 10 GA. CENTER PANELS. WIDTH OF CENTER PANEL SHALL EXCEED 20% OF PIPES PERIPHERY. MULTIPLE PANEL BODIES SHALL HAVE 2" MIN. LAP SEAMS WHICH ARE TO BE JOINED BY 3/8" DIA. RIVETS OR BOLTS (GALVANIZED) SPACED AT 6" MAX. C. TO C. NUTS TO BE TIGHTENED TO 25 LB. ± TORQUE. ANGLE REINFORCEMENT SHALL BE PLACED UNDER THE CENTER PANEL SEAMS ON 77" X 52" AND 83" X 57" SIZES.

④ PIPE-ARCH DIMENSIONS ARE FOR 2-2/3" X 1/2" CORRUGATIONS.

APPROVED Nov. 13, 1986

*R.H. Sullivan*  
Director  
Materials, Research and Standards

STATE OF MINNESOTA  
DEPARTMENT OF TRANSPORTATION  
METAL APRON FOR  
C.M. PIPE-ARCH CULVERT

SPECIFICATION REFERENCE  
2501

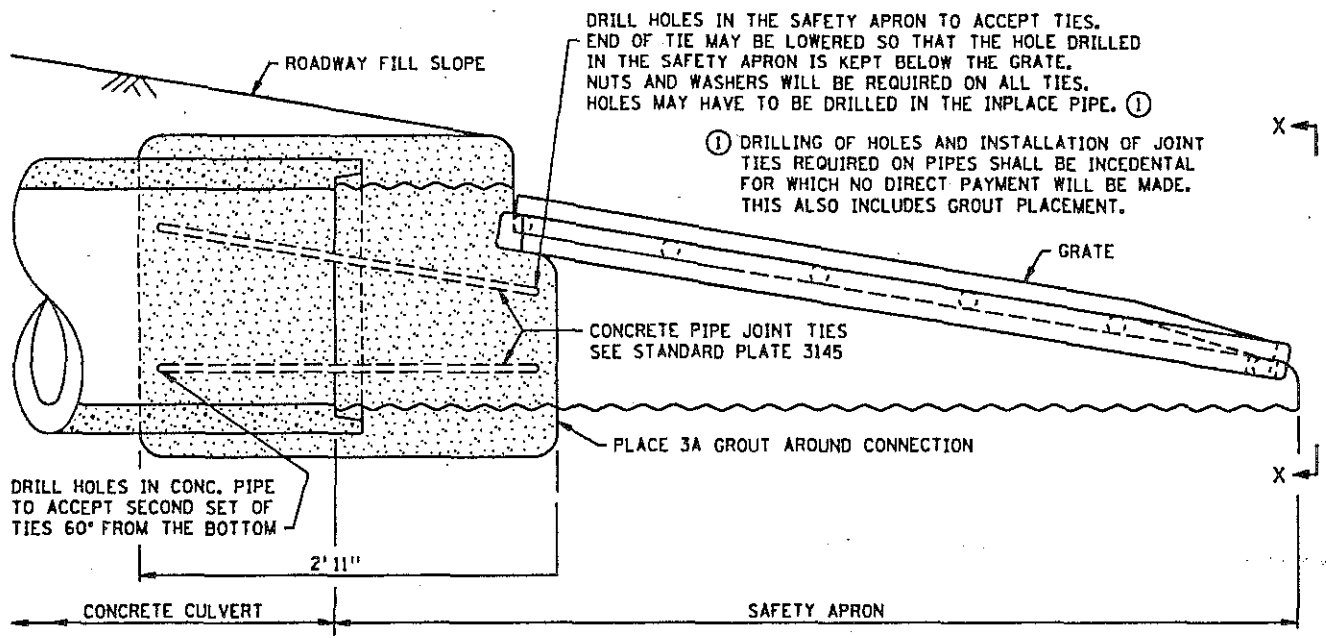
STANDARD PLATE NO.  
3122K

APPROVED *[Signature]*  
 STATE DESIGN ENGINEER

March 31, 1983

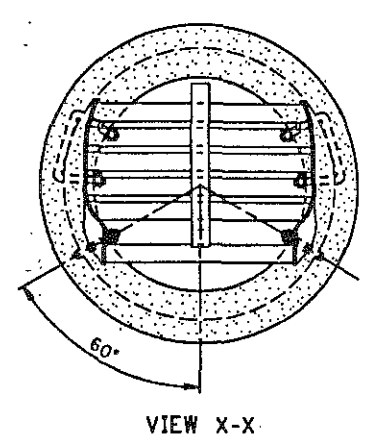
STATE OF MINNESOTA  
 DEPARTMENT OF TRANSPORTATION

SAFETY APRON

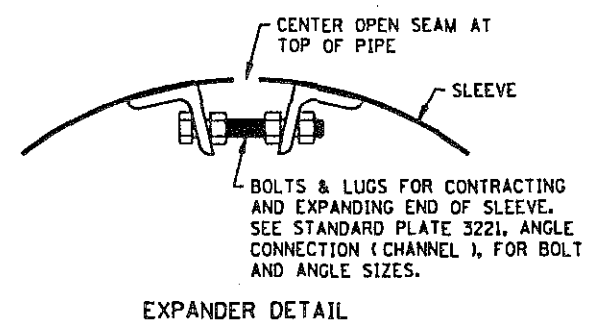
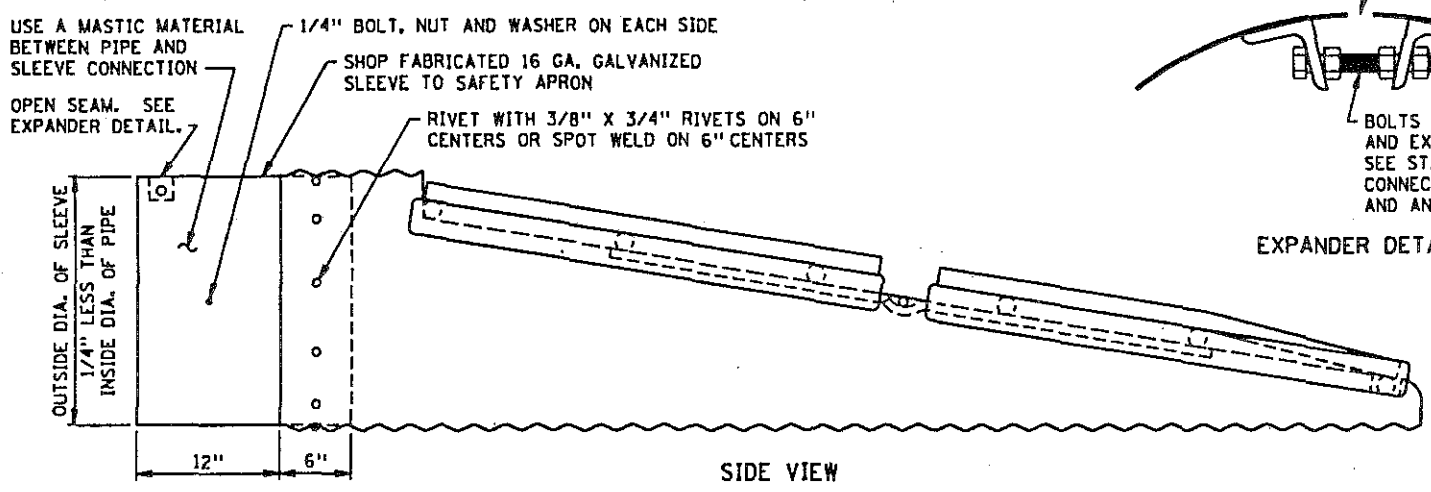


DRILL HOLES IN THE SAFETY APRON TO ACCEPT TIES. END OF TIE MAY BE LOWERED SO THAT THE HOLE DRILLED IN THE SAFETY APRON IS KEPT BELOW THE GRATE. NUTS AND WASHERS WILL BE REQUIRED ON ALL TIES. HOLES MAY HAVE TO BE DRILLED IN THE INPLACE PIPE. ①

① DRILLING OF HOLES AND INSTALLATION OF JOINT TIES REQUIRED ON PIPES SHALL BE INCIDENTAL FOR WHICH NO DIRECT PAYMENT WILL BE MADE. THIS ALSO INCLUDES GROUT PLACEMENT.



SIDE VIEW  
 PIPE JOINT TIE CONNECTION TO CONCRETE PIPE



SIDE VIEW  
 METAL SLEEVE CONNECTION TO POLYETHYLENE PIPE

SPECIFICATION REFERENCE  
 2501

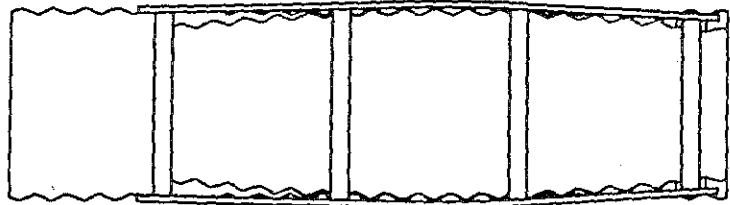
STANDARD PLATE NO.  
 3128F  
 2 OF 2

APPROVED *B.M. Mc...*  
 March 31, 1993  
 STATE DESIGN ENGINEER

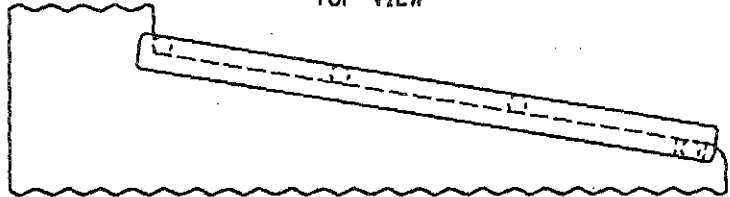
STATE OF MINNESOTA  
 DEPARTMENT OF TRANSPORTATION  
**SAFETY APRON**  
 FOR USE ON APPROPRIATE CULVERT ENDS  
 WITHIN REQUIRED CLEAR ZONE

SPECIFICATION  
 REFERENCE  
 2501

STANDARD  
 PLATE  
 NO.  
**3128F**  
 1 OF 2

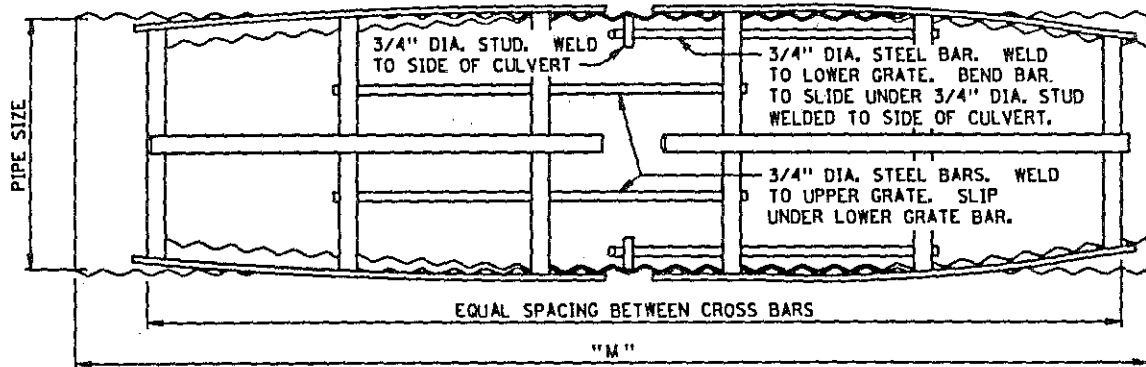


TOP VIEW

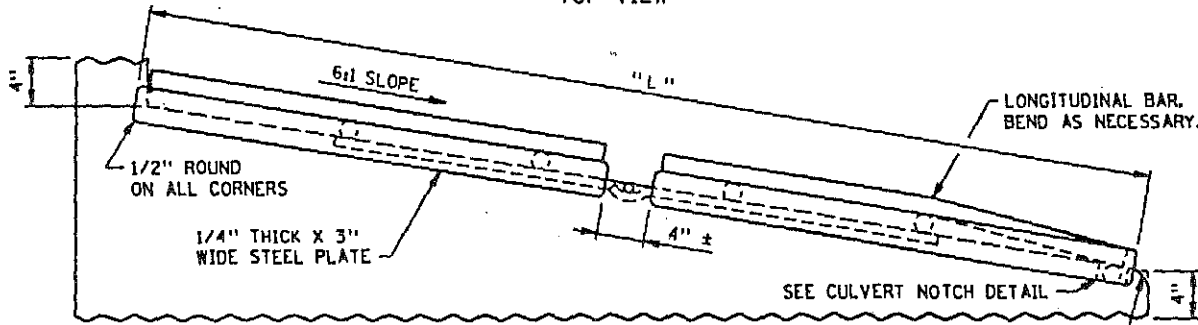


SIDE VIEW

TYPICAL SINGLE PIECE GRATE



TOP VIEW

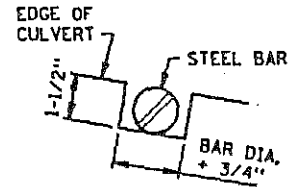


SIDE VIEW

TYPICAL SPLIT GRATE

PIPE SIZE AND TYPE	GAGE	NUMBER OF LONGITUDINAL BARS	NUMBER OF CROSS BARS	"L" LENGTH OF GRATE	NO. OF PIECES TO GRATE (1)	TOTAL WEIGHT OF PIECES (APPROX.)	"M" LENGTH OF PIPE
15" ROUND	12	0	4	4' 1"	1	55 LBS.	5' 0"
18" ROUND	12	0	5	5' 7"	1	75 LBS.	6' 9"
21" ROUND	12	1	6	7' 1"	2	145 LBS.	7' 6"
24" ROUND	12	1	6	8' 7"	2	165 LBS.	9' 3"
27" ROUND	10	1	7	10' 2"	3	205 LBS.	11' 0"
30" ROUND	10	1	8	11' 8"	4	245 LBS.	12' 9"
36" ROUND	10	1	10	14' 8"	5	325 LBS.	15' 3"
21" CMP-A	12	1	4	4' 1"	1	85 LBS.	5' 0"
24" CMP-A	12	1	5	5' 7"	2	120 LBS.	6' 9"
28" CMP-A	12	1	6	6' 7"	2	155 LBS.	7' 3"
35" CMP-A	10	1	6	8' 7"	3	195 LBS.	9' 3"

(1) EACH SECTION SHOULD BE OF EQUAL LENGTH FOR SPLIT GRATE WHEN POSSIBLE



CULVERT NOTCH DETAIL

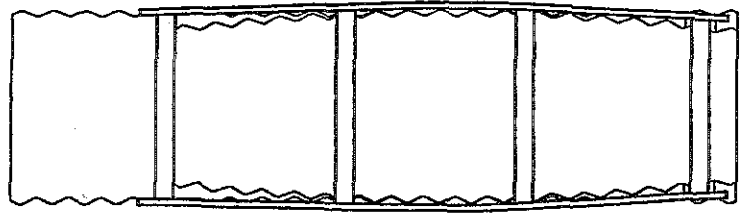
**NOTES:**  
 GALVANIZE PER SPEC. 3394 AFTER FABRICATION.  
 SAFETY APRON SHALL BE CONSTRUCTED OF STRUCTURAL STEEL PER SPEC. 3306.  
 ALL CROSS BARS SHALL BE WELDED ALL AROUND TO STEEL PLATE FRAME.  
 THE APRON SHALL BE FASTENED TO THE CULVERT WITH A STANDARD COUPLING BAND. SEE STANDARD PLATE 3221. SEE SHEET 2 OF 2 FOR CONNECTION TO CONCRETE CULVERTS.  
 ALL CROSS BARS AND CENTER LONGITUDINAL BARS SHALL BE 1-1/2" DIA. BARS AT HINGES SHALL BE 3/4" DIA. AS INDICATED.

APPROVED NOVEMBER 1, 2000  
*Debbie W. Gaudin*  
 STATE DESIGN ENGINEER

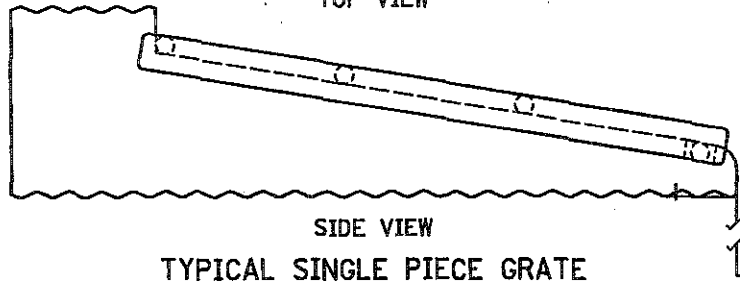
STATE OF MINNESOTA  
 DEPARTMENT OF TRANSPORTATION  
**METAL SAFETY APRON & GRATE**  
 FOR USE ON APPROPRIATE CULVERT ENDS  
 WITHIN REQUIRED CLEAR ZONE

SPECIFICATION  
 REFERENCE  
 2501  
 REVISED  
 3-12-2003

STANDARD  
 PLATE  
 NO.  
**3128H**  
 1 OF 2



TOP VIEW

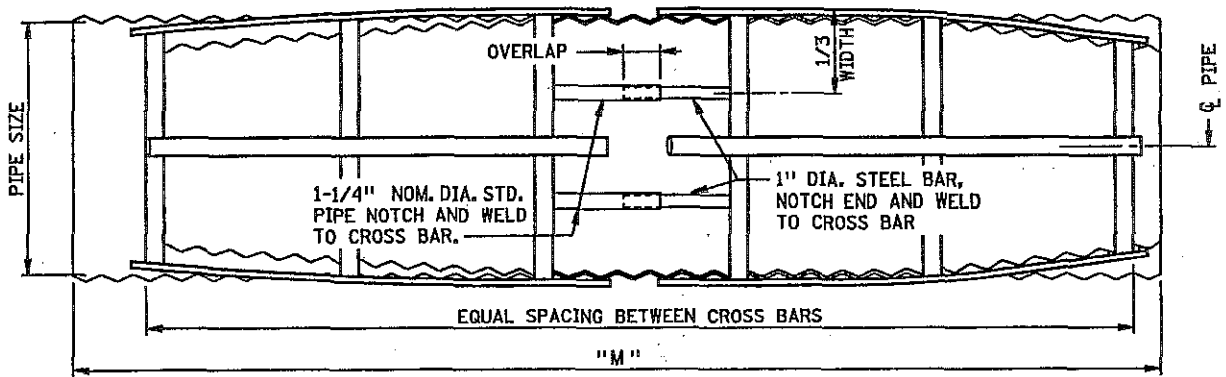


SIDE VIEW  
 TYPICAL SINGLE PIECE GRATE

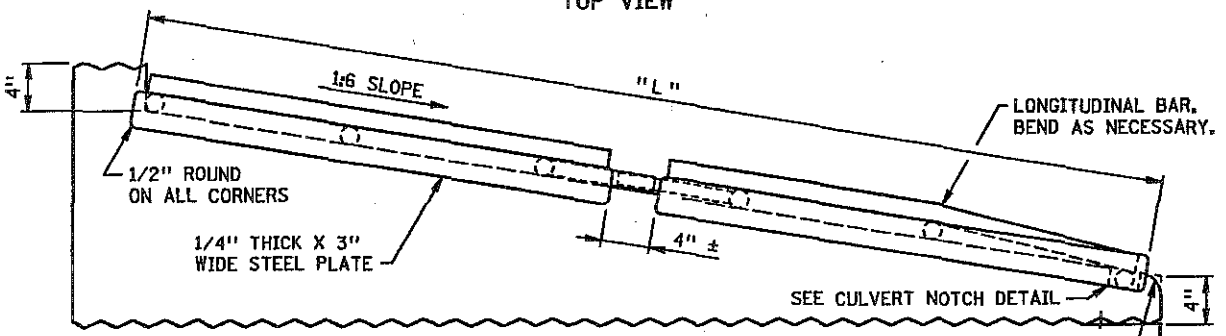
PIPE SIZE AND TYPE	GAGE	NUMBER OF LONGITUDINAL BARS	NUMBER OF CROSS BARS	"L" LENGTH OF GRATE	NO. OF PIECES TO GRATE ①	TOTAL WEIGHT OF PIECES (APPROX.)	"M" LENGTH OF PIPE
18" ROUND	12	0	5	5' 7"	1	75 LBS.	6' 9"
21" ROUND	12	1	6	7' 1"	2	145 LBS.	7' 6"
24" ROUND	12	1	6	8' 7"	2	165 LBS.	9' 3"
30" ROUND	10	1	8	11' 8"	4	245 LBS.	12' 9"
36" ROUND	10	1	10	14' 8"	5	325 LBS.	15' 3"
② 21" CMP-A	12	1	4	4' 1"	1	85 LBS.	5' 0"
② 24" CMP-A	12	1	5	5' 7"	2	120 LBS.	6' 9"
② 28" CMP-A	12	1	6	6' 7"	2	155 LBS.	7' 3"
② 35" CMP-A	10	1	6	8' 7"	3	195 LBS.	9' 3"

- ① EACH SECTION SHOULD BE OF EQUAL LENGTH FOR SPLIT GRATE WHEN POSSIBLE.
- ② SPAN DIMENSIONS.

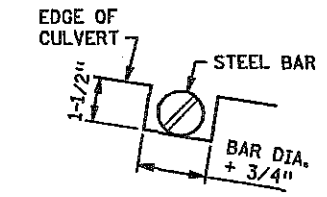
ANCHOR, (SEE DETAIL)



TOP VIEW



SIDE VIEW  
 TYPICAL SPLIT GRATE  
 (MITERED PIPE SHOWN)



CULVERT NOTCH DETAIL

**NOTES:**

- GALVANIZE PER SPEC. 3394 AFTER FABRICATION.
- SAFETY APRON SHALL BE CONSTRUCTED OF STRUCTURAL STEEL PER SPEC. 3306.
- ALL CROSS BARS SHALL BE WELDED ALL AROUND TO STEEL PLATE FRAME.
- THE APRON SHALL BE FASTENED TO THE CULVERT WITH A STANDARD COUPLING BAND. SEE STANDARD PLATE 3221. SEE SHEET 2 OF 2 FOR CONNECTION TO CONCRETE CULVERTS.
- ALL CROSS BARS AND CENTER LONGITUDINAL BARS SHALL BE 1-1/2" DIAMETER.
- NO GRATE OF ANY KIND IS ALLOWED ON AN OUTLET WITHOUT A GRATE BEING PLACED ON THE INLET ALSO.

APPROVED NOVEMBER 1, 2000  
*Robert W. Jucker*  
 STATE DESIGN ENGINEER

STATE OF MINNESOTA  
 DEPARTMENT OF TRANSPORTATION  
**METAL SAFETY APRON & GRATE**  
 (METAL APRON CONNECTIONS)

SPECIFICATION  
 REFERENCE  
 2501

STANDARD  
 PLATE  
 NO.  
**3128H**  
 2 OF 2

USE AN APPROVED MASTIC MATERIAL BETWEEN PIPE AND SLEEVE CONNECTION

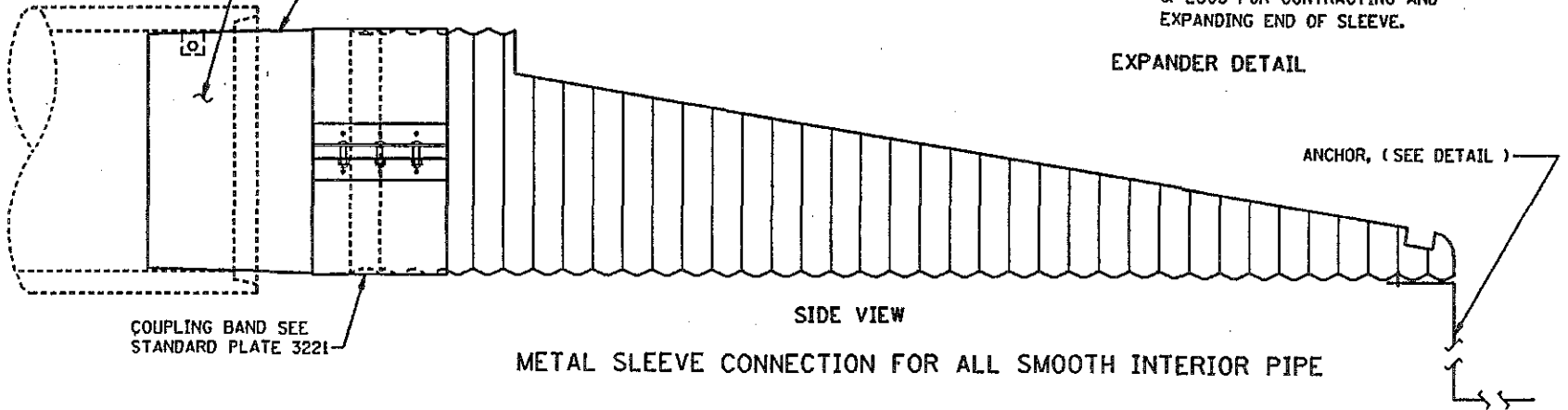
OPEN SEAM. SEE EXPANDER DETAIL.

BEND ANGLE AS REQUIRED

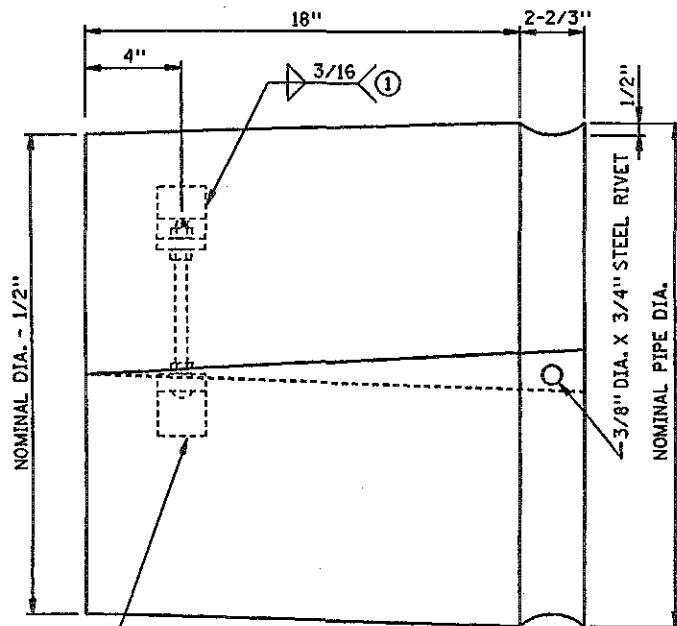
SLEEVE

1/2" DIA CARRIAGE BOLT, NUTS & LUGS FOR CONTRACTING AND EXPANDING END OF SLEEVE.

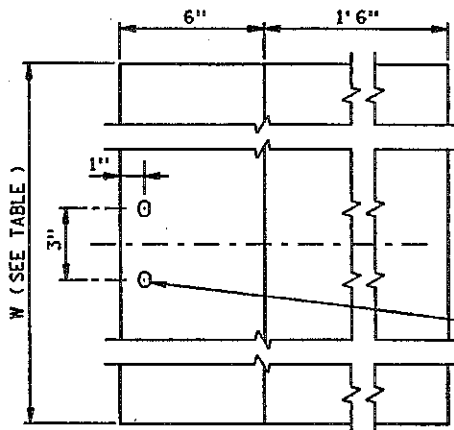
EXPANDER DETAIL



METAL SLEEVE CONNECTION FOR ALL SMOOTH INTERIOR PIPE

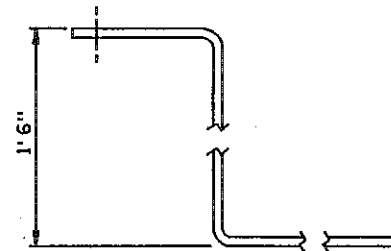


PLAN VIEW  
 SLEEVE ②



PLAN

PIPE DIA.	ANCHOR WIDTH - W
15" - 24"	30"
30" - 36"	42"



SIDE VIEW  
 ANCHOR DETAIL

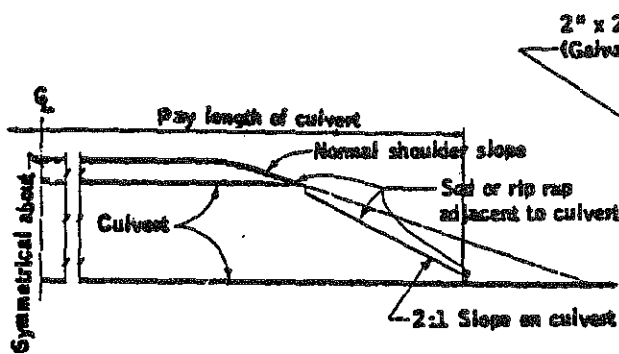
**NOTES:**

ANCHORS SHALL BE CONSIDERED INCIDENTAL, FOR WHICH NO DIRECT PAYMENT WILL BE MADE. ANCHOR SHALL BE MINIMUM 14 GAGE GALVANIZED STEEL PER SPEC. 3392.

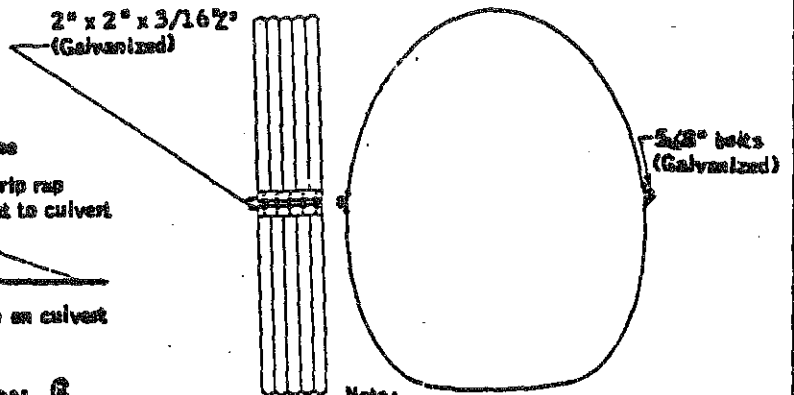
ALL HARDWARE SHALL BE GALVANIZED AS PER SPEC. 3392.

① AN APPROVED PROTECTIVE COATING SPEC. 2471.3L1 SHALL BE APPLIED TO ALL WELDED AREAS.

② OTHER METAL SLEEVE CONNECTION OPTIONS MAY BE USED, AS APPROVED BY THE HYDRAULICS SECTION.

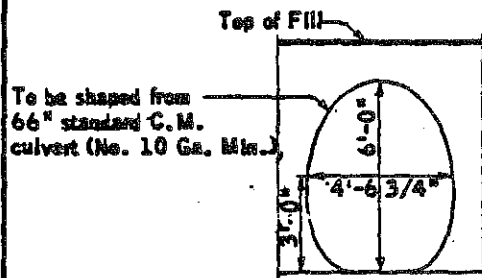


**PART LONGITUDINAL SECTION ON Q**

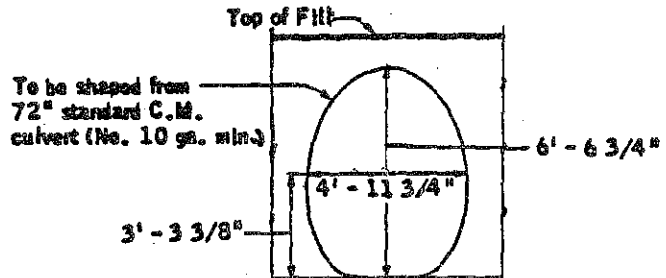


Note:  
Rivet lower half of coupling to one end of culvert and upper half of coupling to the other end.

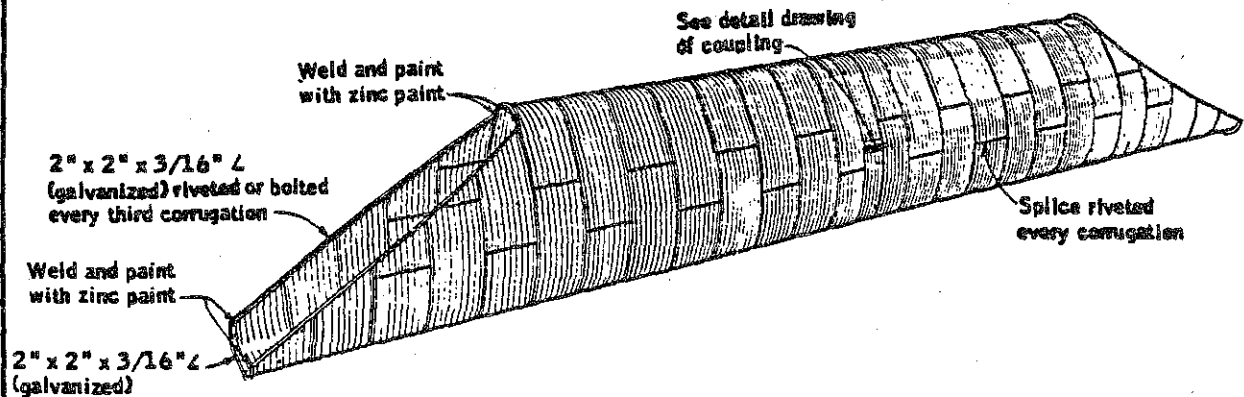
**DETAIL OF COUPLING**



**CROSS SECTION OF CATTLE PASS**



**CROSS SECTION OF HORSE PASS**



**PERSPECTIVE VIEW**

Spec. Ref. : 2501 and 3226

APPROVED Oct. 1, 1966

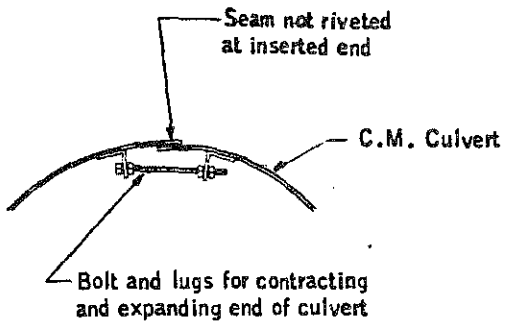
*W. D. Ekern*  
ASSISTANT COMMISSIONER  
ENGINEERING STANDARDS

STATE OF MINNESOTA  
DEPARTMENT OF HIGHWAYS  
**DEFORMED METAL CULVERT  
CATTLE AND HORSE PASS**

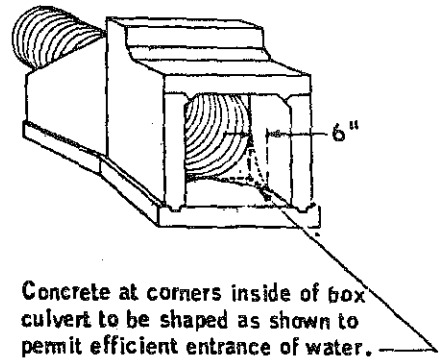
STANDARD  
PLATE  
NO.

**3045B**

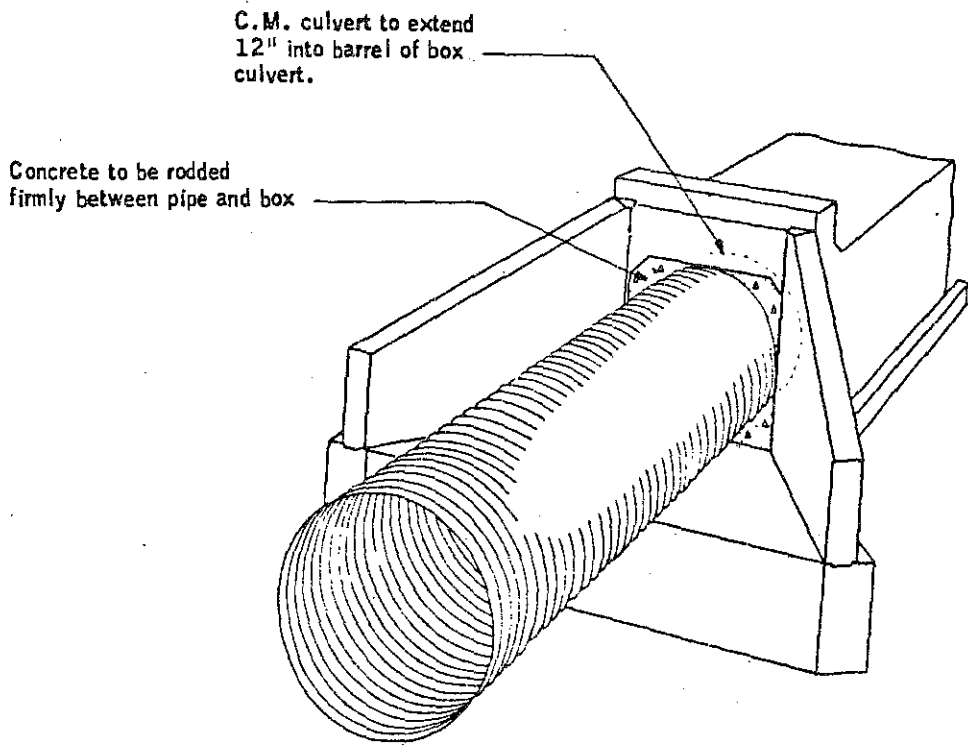




**EXPANDER DETAIL**



**INSIDE VIEW**



**PERSPECTIVE**

Spec. Ref. 2501

APPROVED Oct. 1, 1966  
*W. A. Ekern*  
 ASSISTANT COMMISSIONER  
 ENGINEERING STANDARDS

STATE OF MINNESOTA  
 DEPARTMENT OF HIGHWAYS  
**C.M. EXTENSION FOR BOX CULVERT**

STANDARD  
 PLATE  
 NO.  
**3066A**