

DESIGN CRITERIA FOR CONCRETE PIPE

The height of cover tables have been prepared from data in the "Concrete Pipe Design Manual" published by the American Concrete Pipe Association using the values listed below.

FOR EMBANKMENT CONDITIONS

Fill Material Density = $w = 120$ lbs. per cu. ft.
 Settlement Ratio = $rsd = +0.5$
 * = $ku = 0.13$
 Projection Ratio = $p = 0.9$ (Class "C" bedding)
 = $p = 0.7$ (Class "B" bedding)
 Factor of Safety = $F.S. = 1.33$ on Ultimate Strength

* Using a ratio of lateral to vertical earth pressure (k) of 0.37 (saturated yellow clay) and a coefficient of internal friction (u) of 0.34.

The values shown for concrete pipe were calculated for concrete pipe placed under embankment conditions. These values do not apply to design and installation of sanitary sewer except where sanitary sewer would be placed under embankment conditions.

CONCRETE CULVERT PIPE CLASS "B" BEDDING				
DIAMETER OF PIPE 'D' Inches	(H) MAXIMUM ALLOWABLE COVER IN FEET			
	1500D (Class II)	2000D (Class III)	3000D (Class IV)	3750D (Class V)
18	11	13	20	25
24	12	14	21	26
36	13	16	23	28
48	14	16	24	29
60	14	17	24	29
72	14	17	24	30
84	15	17	25	30
96	15	18	25	31
108	15	18	26	32

CONCRETE CULVERT PIPE CLASS "C" BEDDING				
DIAMETER OF PIPE 'D' Inches	(H) MAXIMUM ALLOWABLE COVER IN FEET			
	1500D (Class II)	2000D (Class III)	3000D (Class IV)	3750D (Class V)
18	9	12	18	22
24	10	13	19	23
36	11	14	20	24
48	11	15	21	25
60	12	15	21	26
72	12	16	22	26
84	13	16	22	27
96	13	16	23	27
108	13	17	23	28

When unclassified pipe is specified, furnish and install a class of pipe meeting the requirements on the chart.

For Steel Round Pipe, the Contractor may choose the type of corrugated pipe and installation to furnish as long as the selection conforms to the limits indicated for the type specified.

When furnishing Steel Arch Pipe, furnish pipe with corrugations as specified in plans.

Minimum allowable cover for concrete and metal pipe is 2 feet for roadway culverts and 1 foot for entrance culverts.

Maximum cover for all sizes and installations of concrete arch pipe is 12 feet.

For all sizes and installations of polyethylene pipe:
 minimum cover = 2 feet
 maximum cover = 24 feet for 12 to 24 inch pipes
 20 feet for 30 to 48 inch pipes



Where a pipe size not listed in the table is required, the 'H' indicated for the next smaller size will apply.

Special installations may be designed to exceed indicated maximum allowable cover by specific modification of one or more of the following conditions:

1. Bedding Class
2. Pipe Strength (including special design pipe)
3. Type of backfill or cover material
4. Compaction requirements for backfill or cover material
5. Controlled trench width

Where site conditions favor such modifications, significant economy may result from special design installations and these should be considered. Special designs will specify particular modification of construction requirements or design criteria as applicable. Necessary modifications of normal requirements will not ordinarily be paid for separately but will be included in the price bid for culvert pipe.

CONCRETE CULVERT PIPE

 STANDARD ROAD PLAN	REVISION	
	1	04-19-16
DR-104		
SHEET 1 of 3		
REVISIONS: Added general note regarding maximum cover on concrete arch pipes.		
 APPROVED BY DESIGN METHODS ENGINEER		
DEPTH OF COVER TABLES FOR CONCRETE AND CORRUGATED PIPE		

STEEL ROUND PIPE 2 2/3" x 1/2" CORRUGATIONS											
DIAMETER OF PIPE 'D' Inches	MINIMUM COVER ABOVE PIPE Inches	(H) MAXIMUM ALLOWABLE COVER IN FEET									
		16 GAGE (0.064")		14 GAGE (0.079")		12 GAGE (0.109")		10 GAGE (0.138")		8 GAGE (0.168")	
		*	**	*	**	*	**	*	**	*	**
12	12	70	-	76	-	-	-	-	-	-	-
15	12	56	-	61	-	-	-	-	-	-	-
18	12	40	-	48	-	64	-	-	-	-	-
24	12	23	-	26	-	33	-	-	-	-	-
30	12	-	-	18	30	22	43	25	51	-	-
36	12	-	-	15	25	17	33	19	38	-	-
42	12	-	-	-	-	14	28	16	31	17	34
48	12	-	-	-	-	13	25	14	27	15	29
54	18	-	-	-	-	12	24	13	25	13	26
60	18	-	-	-	-	-	-	12	23	12	25
66	18	-	-	-	-	-	-	11	22	12	23
72	18	-	-	-	-	-	-	11	17	11	21
78	24	-	-	-	-	-	-	-	-	11	17
84	24	-	-	-	-	-	-	-	-	11	13

* Round ** Elongated



STEEL ROUND PIPE 3" X 1" and 5" X 1" CORRUGATIONS											
DIAMETER OF PIPE 'D' Inches	MINIMUM COVER ABOVE PIPE Inches	(H) MAXIMUM ALLOWABLE COVER IN FEET									
		16 GAGE (0.064")		14 GAGE (0.079")		12 GAGE (0.109")		10 GAGE (0.138")		8 GAGE (0.168")	
		*	**	*	**	*	**	*	**	*	**
36	12	27	40	31	50	40	74	-	-	-	-
42	12	21	34	23	42	29	58	-	-	-	-
48	12	17	30	19	37	23	46	-	-	-	-
54	12	15	27	16	32	19	38	-	-	-	-
60	12	13	24	15	29	16	33	-	-	-	-
66	12	13	22	13	27	15	30	-	-	-	-
72	12	12	20	12	25	14	27	-	-	-	-
78	12	12	18	12	23	13	26	-	-	-	-
84	12	-	-	12	21	12	24	13	26	-	-
90	12	-	-	-	-	12	24	12	35	13	26
96	12	-	-	-	-	11	23	12	24	12	25
102	24	-	-	-	-	-	-	12	23	12	24
108	24	-	-	-	-	-	-	-	-	12	23
114	24	-	-	-	-	-	-	-	-	11	23
120	24	-	-	-	-	-	-	-	-	11	20

* Round ** Elongated

STRUCTURAL STEEL ROUND PIPE 6" X 2" CORRUGATIONS															
DIAMETER OF PIPE 'D' Inches	MINIMUM COVER ABOVE PIPE Inches	(H) MAXIMUM ALLOWABLE COVER IN FEET													
		12 GAGE (0.109")		10 GAGE (0.138")		8 GAGE (0.168")		7 GAGE (0.187")		5 GAGE (0.218")		3 GAGE (0.250")		1 GAGE (0.281")	
		*	**	*	**	*	**	*	**	*	**	*	**	*	**
60	12	35	35	43	52	51	67	-	-	-	-	-	-	-	-
66	12	29	32	35	45	41	61	-	-	-	-	-	-	-	-
72	12	25	29	29	43	34	56	-	-	-	-	-	-	-	-
78	12	22	27	25	40	29	52	31	60	-	-	-	-	-	-
84	12	19	25	22	37	25	48	27	53	-	-	-	-	-	-
90	12	18	23	20	34	22	44	23	47	-	-	-	-	-	-
96	12	16	22	18	32	20	40	21	42	-	-	-	-	-	-
102	24	15	21	17	30	18	36	19	38	-	-	-	-	-	-
108	24	14	19	16	29	17	34	18	36	-	-	-	-	-	-
114	24	14	18	15	27	16	32	17	33	18	36	-	-	-	-
120	24	13	18	14	26	15	30	16	31	17	33	-	-	-	-
126	24	13	-	13	25	14	29	15	30	16	31	-	-	-	-
132	24	12	-	13	24	14	27	14	28	15	30	-	-	-	-
138	24	12	-	13	23	13	26	14	27	14	29	-	-	-	-
144	24	12	-	12	22	13	26	13	26	14	27	-	-	-	-
150	24	12	-	12	21	12	25	13	26	13	27	14	28	-	-
156	24	11	-	12	20	12	24	12	25	13	26	13	27	-	-
162	24	11	-	12	19	12	24	12	24	13	25	13	26	13	27
168	24	11	-	11	19	12	23	12	24	12	25	13	25	13	26
174	24	11	-	11	18	12	23	12	23	12	24	12	25	13	25
180	24	11	-	11	17	11	23	11	23	12	24	12	24	12	25

* Round ** Elongated

STRUCTURAL STEEL ROUND PIPE

 STANDARD ROAD PLAN	REVISION	
	1	04-19-16
	DR-104	
SHEET 2 of 3		
REVISIONS: Added general note regarding maximum cover on concrete arch pipes.		
 APPROVED BY DESIGN METHODS ENGINEER		
DEPTH OF COVER TABLES FOR CONCRETE AND CORRUGATED PIPE		



STEEL ARCH PIPE 2 2/3" X 1/2" CORRUGATIONS								
SPAN Inches	RISE Inches	R _c ^① Inches	MINIMUM COVER ABOVE PIPE Inches	(H) MAXIMUM ALLOWABLE COVER IN FEET				
				16 GA. (0.064")	14 GA. (0.079")	12 GA. (0.109")	10 GA. (0.138")	8 GA. (0.168")
17	13	3.5	18	6	6	-	-	-
21	15	4.125	18	6	6	-	-	-
24	18	4.875	18	5	5	-	-	-
28	20	5.5	18	5	5	-	-	-
35	24	6.875	18	5	5	-	-	-
42	29	8.25	18	4	4	-	-	-
49	33	9.625	18	-	-	4	4	4
57	38	11.0	18	-	-	4	4	4
64	43	12.375	18	-	-	4	4	4
71	47	13.75	18	-	-	-	4	4
77	52	15.125	18	-	-	-	-	4
83	57	16.5	18	-	-	-	-	4

STEEL ARCH PIPE 3" X 1" and 5" X 1" CORRUGATIONS							
SPAN Inches	RISE Inches	R _c ^① Inches	MINIMUM COVER ABOVE PIPE Inches	(H) MAX. ALLOWABLE COVER IN FT.			
				16 GA. (0.064")	14 GA. (0.079")	12 GA. (0.109")	10 GA. (0.138")
60	46	18.75	18	6	6	-	-
66	51	20.75	18	6	6	-	-
73	55	22.875	18	8	8	-	-
81	59	20.875	18	-	7	7	-
87	63	22.625	18	-	7	7	-
95	67	24.375	18	-	6	6	-
103	71	26.125	24	-	-	6	-
112	75	27.75	24	-	-	5	-
117	79	29.5	24	-	-	5	-
128	83	31.25	24	-	-	-	5

① Corner Radius, R_c, changes from 18 inches to 31 inches for the 6 in. x 2 in. corrugation.

STRUCTURAL STEEL ARCH PIPE 6" X 2" CORRUGATIONS							
SPAN Inches	RISE Inches	R _c ^① Inches	MINIMUM COVER ABOVE PIPE Inches	(H) MAXIMUM ALLOWABLE COVER IN FEET			
				12 GA. (0.109")	10 GA. (0.138")	8 GA. (0.168")	7 GA. (0.187")
73	55	18	18	8	-	-	-
84	61	18	18	7	-	-	-
95	67	18	18	6	-	-	-
106	73	18	24	6	-	-	-
117	79	18	24	5	-	-	-
131	85	18	24	5	-	-	-
142	91	18	24	4	-	-	-
154	100	18	24	4	-	-	-
159	112	31	24	6	-	-	-
170	118	31	24	6	-	-	-
184	124	31	24	-	6	-	-
195	130	31	36	-	5	-	-
206	136	31	36	-	5	-	-
217	142	31	36	-	-	5	-
231	148	31	36	-	-	4	-
239	154	31	36	-	-	4	-
247	158	31	36	-	-	-	4

STEEL ARCH PIPE

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SHEET 3 of 3		
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**DEPTH OF COVER TABLES
FOR CONCRETE AND CORRUGATED PIPE**