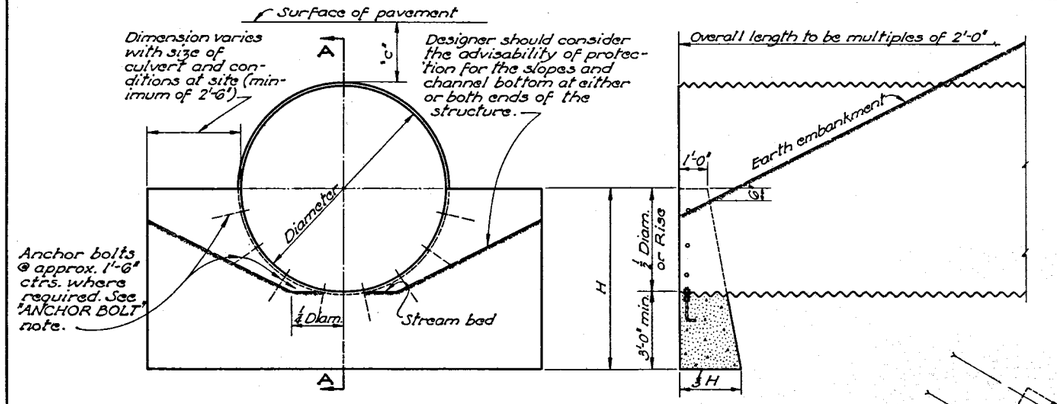
TABLE I PIPE CULVERTS — REQUIRED GAGE OF PLATES

Diam.	Area	Height of Cover in Feet (c)																					Max. 'c' in feet No. 1 Ga.
Ft.	Sq. ft.	2	3-5	6-10	11-15	16-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65	66-70	71-75	76-80	81-85	86-90	91-95	96-100	
5'-0"	20	10-10	10-10	10-10	10-10	10-10	10-10	10-10	10-10	10-8	10-8	10-8	10-8	8-7	8-7	8-5	7-5	7-5	5-3	5-3	5-3	3-1	127
5'-6"	24	10-10	10-10	10-10	10-10	10-10	10-10	10-10	10-8	10-8	10-8	8-7	8-7	8-5	7-5	7-5	5-3	5-3	5-3	3-1	3-1	3-1	115
6'-0"	28	10-10	10-10	10-10	10-10	10-10	10-10	10-8	10-8	10-8	8-7	8-7	8-5	7-5	7-5	5-3	5-3	3-1	3-1	3-1	1-1	1-1	104
6'-6"	33	10-10	10-10	10-10	10-10	10-10	10-8	10-8	10-8	8-7	8-7	8-5	7-5	5-3	5-3	5-3	3-1	3-1	1-1	1-1	1-1		96
7'-0"	38	10-10	10-10	10-10	10-10	10-8	10-8	10-8	8-7	8-7	8-5	7-5	5-3	5-3	5-3	3-1	3-1	1-1	1-1				88
7'-6"	44	10-8	10-10	10-10	10-8	10-8	10-8	8-7	8-7	8-5	7-5	5-3	5-3	5-3	3-1	3-1	1-1	1-1					82
8'-0"	50	10-8	10-8	10-8	10-8	10-8	10-8	8-7	8-5	7-5	7-5	5-3	5-3	3-1	3-1	1-1	1-1						76
8'-6"	57	10-8	10-8	10-8	10-8	10-8	8-7	8-7	7-5	7-5	5-3	5-3	3-1	3-1	1-1	1-1							70
9'-0"	64	10-8	10-8	10-8	10-8	8-7	8-7	7-5	7-5	5-3	5-3	3-1	3-1	1-1	1-1								66
9'-6"	71	8-7	10-8	10-8	8-7	8-7	8-5	7-5	5-3	5-3	3-1	3-1	1-1	1-1									62
10'-0"	79	8-7	8-7	8-7	8-7	8-7	7-5	7-5	5-3	5-3	3-1	1-1	1-1										57
10'-6"	87	8-5	8-7	8-7	8-7	8-5	7-5	5-3	5-3	3-1	3-1	1-1											54
11'-0"	95	8-5	8-5	8-7	8-5	7-5	7-5	5-3	3-1	3-1	1-1	1-1											51
11'-6"	104	7-5	8-5	8-5	7-5	7-5	5-3	5-3	3-1	3-1	1-1												48
12'-0"	113	7-5	7-5	7-5	7-5	7-5	5-3	3-1	3-1	1-1	1-1												45
12'-6"	123	7-5	7-5	7-5	7-5	5-3	5-3	3-1	3-1	1-1													42
13'-0"	133	5-3	7-5	7-5	5-3	5-3	3-1	3-1	1-1	1-1													40
13'-6"	143	5-3	5-3	5-3	5-3	5-3	3-1	3-1	1-1														38
14'-0"	154	5-3	5-3	5-3	5-3	5-3	3-1	1-1	1-1														35
14'-6"	165	5-3	5-3	5-3	5-3	3-1	3-1	1-1															33
15'-0"	177	3-1	5-3	5-3	3-1	3-1	1-1	1-1															31

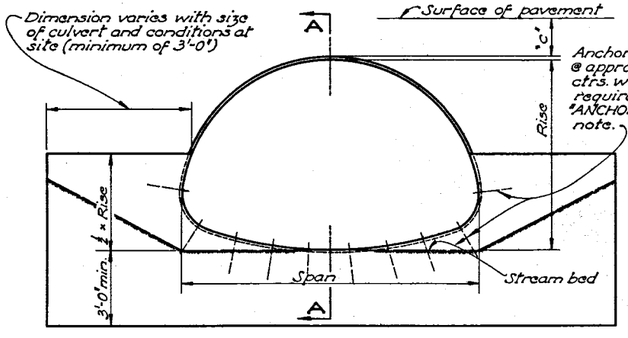
First number indicates gage of plates, except bottom row. Second number indicates gage of bottom row of plates.

Max. 'c' for No. 1 gage may be increased 50% if pipe is elongated and additional bolts provided (See Note).

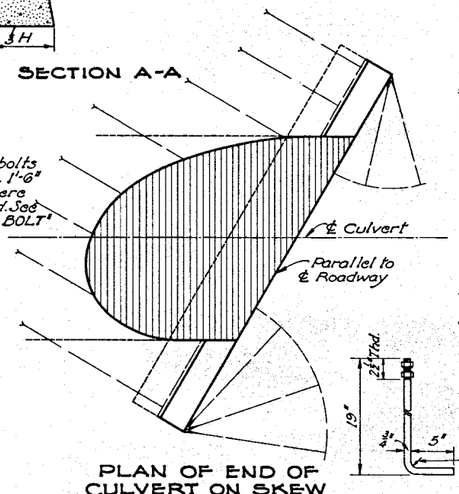


SECTIONAL PLATE PIPE CULVERT END WALL DETAILS

SECTION A-A



SECTIONAL PLATE PIPE-ARCH CULVERT END WALL DETAILS



PLAN OF END OF CULVERT ON SKEW
(Slopes shown for round pipe)

ANCHOR BOLT

TABLE II PIPE-ARCH CULVERTS — REQUIRED GAGE OF PLATES

Span	Rise	Area	Height of Cover in Feet (c)												Max. 'c' in feet No. 1 Ga.
		Sq. ft	2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	17-18	19-20	21-22	23-24	
6'-1"	4'-7"	22	10-10	10-10	10-10	10-10	10-10	10-10	10-8	8-7	8-5	5-3	3-1	1-1	24
7'-3"	5'-3"	31	10-10	10-10	10-10	10-10	10-10	10-8	8-7	8-5	5-3	3-1	1-1		22
8'-7"	5'-11"	40	10-8	10-10	10-10	10-10	10-8	8-7	8-5	5-3	3-1	1-1			20
9'-6"	6'-5"	49	8-7	10-8	10-8	10-8	10-8	8-7	7-5	5-3	1-1				18
10'-8"	6'-11"	58	8-7	10-8	10-8	10-8	8-7	7-5	5-3	3-1					17
11'-7"	7'-5"	67	7-5	8-7	10-8	8-7	8-5	7-5	3-1	1-1					16
12'-6"	7'-11"	78	7-5	8-7	8-7	8-7	7-5	5-3	3-1						15
13'-5"	8'-5"	89	5-3	8-5	8-5	8-5	7-5	5-3	1-1						14
14'-3"	8'-11"	101	5-3	7-5	7-5	7-5	5-3	3-1	1-1						14
15'-6"	9'-5"	113	3-1	5-3	7-5	5-3	5-3	1-1							13
15'-10"	9'-10"	122	3-1	5-3	7-5	5-3	5-3	1-1							13
16'-7"	10'-1"	131	3-1	5-3	5-3	5-3	3-1	1-1							12

First number indicates gage of plates, except bottom and corner plates.

Second number indicates gage of bottom and corner plates.

Max. 'c' for No. 1 Gage shall in no case be exceeded

TABLE III

Gage No.	't' in inches
1	.274
3	.244
5	.213
7	.183
8	.164
10	.134

Table III applies to design only and shall not be used as a material specification.

NOTES

GENERAL: This drawing provides design and general construction details for sectional corrugated plate pipe and pipe-arch culverts. The project plans should show the size, length, gage of plates, skew, gradient of flow line, and wall details and estimated quantities for each culvert. Unless otherwise shown on the project plans, all construction and materials shall conform to the requirements of this drawing and the Construction and Material Specifications.

The overall length of culverts should be in multiples of 2'-0" unless otherwise shown on project plans to meet special conditions.

For rigid type pavements the height of cover (c) from top of culvert to surface of pavement should be not less than 1'-6" for diameters or spans of 3'-0" or less, and not less than 2'-0" for larger diameters or spans. For flexible type pavements, the above dimensions should be increased 6".

A tolerance of 1" plus or minus will be permitted in the diameter of pipe and in the span and rise of pipe-arches.

Where multiple lines of pipes or pipe-arches are used, they should be spaced so that the adjacent sides are at least ⅓ the diameter or span apart to permit thorough tamping of the filling material, except that the clear distance between adjacent sides need not be greater than 4 feet. The spacing should be shown on the project plans.

The gages of plates provided for in Tables I and II are considered adequate for all live load frequency ratings.

The gages of the plates should be determined for the maximum height of cover and such gages shall be used for the full length of the structure unless otherwise shown on the project plans.

The corrugations of the plates shall have a pitch of 6", plus or minus ¼", and a depth of 2", plus or minus ⅛". The radius on the inside of the corrugations shall be at least 1⅛". Plates shall be assembled with ¾" high-strength bolts meeting the requirements of ASTM A-325. Longitudinal seams shall be bolted with 4 bolts per foot of seam except as otherwise provided hereon. All plates and bolts shall be galvanized.

PIPE CULVERTS: Table I is a listing of the sizes of sectional plate pipe which are available. The diameter listed is the clear inside diameter.

The gages are determined from the following formula:

$$t = 0.00042\,dc + \frac{0.25d}{c+16}$$

in which, t = minimum thickness of metal in inches, except bottom row of plates.
d = diameter of pipe in feet.
c = max. height of cover, in feet, measured from top of pipe to surface of pavement.

The bottom row of plates should have a minimum thickness of t + 0.03 inches, but not thicker than No. 1 gage.

The height of embankment (c), above the top of a pipe culvert may be 50 % greater than the Max. 'c' indicated in Table I for No. 1 gage, provided that the vertical axis of the pipe is elongated 3 % by field strutting and jacking or is elongated 3 % in shop fabrication, and further provided that the bolts are increased from 4 to 6 per foot of longitudinal seam. If field strutting is used, the size and number of struts, and method of procedure shall conform to the manufacturers recommendations.

PIPE-ARCH CULVERTS: Table II is a listing of the sizes of sectional plate pipe-arches which shall generally be used. Other sizes, conforming to manufacturer's standards, may be used for special conditions. The sizes are designated by the clear inside span and rise in feet and inches.

For pipe-arch sizes not shown in Table II, the gages shall be selected from Table III to provide the required minimum thickness of metal as determined by the following formula:

$$t = 0.00007\,sc^2 + \frac{0.10s}{c+3}$$

in which, t = minimum thickness of metal in inches, except bottom and corner plates.
s = inside clear span in feet (use nearest ½ foot).
c = max. height of cover in feet, measured from top of culvert to surface of pavement (use nearest foot).

The bottom and corner plates should have a minimum thickness of t + 0.03 inches, but not thicker than No. 1 gage.

Sectional plate pipe-arches shall not be used for heights of cover in excess of that allowed by the above formula for No. 1 gage.

END WALLS: Pipe or pipe-arch culverts shall be assembled and the embankment over the top of the culvert placed to finished height, and struts, if any, shall be removed before any work is done on the end walls. Excavation shall then be made and the end walls constructed and backfilled. Estimated quantity of excavation should include fill material removed for constructing end walls. Concrete in end walls should be Class "E".

PROVISION FOR SETTLEMENT: Where subsoil conditions are poor and appreciable settlement is anticipated, consideration should be given to the use of a cambered grade for the flow line of the culvert to offset the settlement. Where such provision is made, the amount of camber at center of roadway will be indicated on the project plans.

ANCHOR BOLTS @ approximately 1'-6" ctrs. shall be provided to anchor inlet end of culvert where the rate of slope of invert exceeds that shown in table. Bolts and nuts to be hot dipped galvanized with threads chased to give Class 2 fit. Included with corrugated plate culvert for payment.

WHEN TO PROVIDE ANCHOR BOLTS

Diameter or span	Slope rate greater than
5'-0" to 7'-0"	.0100
7'-6" to 12'-0"	.0075
over 12'-0"	.0050

REVISIONS
11-25-58

STATE OF OHIO
DEPARTMENT OF HIGHWAYS
BUREAU OF BRIDGES

SECTIONAL CORRUGATED PLATE PIPE AND PIPE-ARCH CULVERTS

APPROVED: Richard D. Orr
CHIEF ENGINEER OF BRIDGES
DATE: 7-31-58

DESIGNED	DRAWN	TRACED	CHECKED	REVIEWED
[illegible]	NEY	[illegible]	DFG	[illegible]

DRAWING NUMBER
SP-53