

DESIGN CRITERIA FOR STEEL AND ALUMINUM PIPE

SPECIFICATIONS: A.A.S.H.T.O. 1989 Standard Specifications for Highway Bridges with 1990 and 1991 interims.

DEAD LOAD: 120 pounds/per square foot per foot [19 kPa per meter] of height of cover.

LIVE LOAD: HS 20-44 [MS 18]

SAFETY FACTORS: 3.0 for longitudinal seam strength.
2.0 for pipe wall buckling.
2.0 for pipe wall area.

BACKFILL: Material compaction to 95% proctor density.
K=0.22 soil stiffness factor.

BEARING PRESSURE: 2.0 tons per square foot [200 kPa] allowable corner pressure for arch pipe unless otherwise shown. [See general notes]

GENERAL NOTES FOR STEEL AND ALUMINUM PIPE

Construct with no less than the minimum cover and not to exceed the maximum fill height.

Minimum cover is measured from the top of the pipe to:
The bottom of flexible pavements (e.g. asphalt)
The top of rigid pavements (e.g. concrete)

For minor approaches only, provide 1 ft [305] minimum cover for 15 in [375] through 24 in [600] diameter pipe.

Measure fill height from top of pipe to top of surfacing.

Ensure the metal thickness for helical pipe is the same as required for annular pipe.

Consider continuous lap seam and continuous welded seam equivalent in strength to two fastenings per corrugation seam.

When 3 tons per ft² [300 kPa] corner pressure is required, the corner pressure will be shown in the plans. Use this corner pressure only if available foundation materials approved. Geology will provide written approval.

Spot welded longitudinal seams will not be allowed on corrugated aluminum pipe.

ROUND CORRUGATED STEEL PIPE								
2 2/3 IN X 1/2 IN CORRUGATIONS								
RIVETED, WELDED, OR HELICAL FABRICATION								
PIPE DIAMETER	WATERWAY AREA	MIN. COVER	RIVET PATTERN *	PLATE THICKNESS				
				0.064 IN 16 GA.	0.079 IN 14 GA.	0.109 IN 12 GA.	0.138 IN 10 GA.	0.168 IN 8 GA.
IN	FT ²	IN	RIVETS PER FT.	MAX. FILL HEIGHT ABOVE TOP OF PIPE (FT)				
15	1.2	21	4.5	74	81	100	100	100
18	1.8	21	4.5	62	67	87	91	95
24	3.1	21	4.5	46	51	65	68	71
30	4.9	21	4.5	37	40	52	54	57
36	7.1	21	4.5	31	34	43	45	47
42	9.6	21	9	34	47	74	78	81
48	12.6	21	9	30	41	65	68	71
54	15.9	21	9	-	37	58	60	63
60	19.6	21	9	-	-	52	54	57
66	23.8	21	9	-	-	-	49	52
72	28.3	21	9	-	-	-	45	48
78	33.2	21	9	-	-	-	-	44
84	38.5	21	9	-	-	-	-	41

* FOR 14 AND 16 GAGE THICKNESS; USE 5/16 IN RIVETS.
FOR 8, 10 AND 12 GAGE THICKNESS; USE 3/8 IN RIVETS.
FOR 15 IN THRU 36 IN DIA.; USE SINGLE RIVETS.
FOR 42 IN THRU 84 IN DIA.; USE DOUBLE RIVETS. (TABLE VALUE INCLUDES BOTH ROWS)

METRIC TABLE

ROUND CORRUGATED STEEL PIPE								
[68 x 13] CORRUGATIONS								
RIVETED, WELDED, OR HELICAL FABRICATION								
PIPE DIAMETER	WATERWAY AREA	MIN. COVER	RIVET PATTERN *	PLATE THICKNESS				
				[1.63]	[2.00]	[2.77]	[3.51]	[4.27]
mm	m ²	mm	RIVETS PER m	MAX. FILL HEIGHT ABOVE TOP OF PIPE (m)				
375	0.11	535	15	22.6	24.7	30.5	30.5	30.5
450	0.17	535	15	18.9	20.4	26.5	27.7	28.9
600	0.29	535	15	14.0	15.5	19.8	20.7	21.6
750	0.46	535	15	11.3	12.2	15.8	16.4	17.4
900	0.66	535	15	9.4	10.3	13.1	13.7	14.3
1050	0.89	535	29.5	10.3	14.3	22.6	23.8	24.7
1200	1.17	535	29.5	9.1	12.5	19.8	20.7	21.6
1350	1.48	535	29.5	-	11.3	17.7	18.3	19.2
1500	1.82	535	29.5	-	-	15.8	16.4	17.4
1650	2.21	535	29.5	-	-	-	14.9	15.8
1800	2.63	535	29.5	-	-	-	13.7	14.6
1950	3.08	535	29.5	-	-	-	-	13.4
2100	3.58	535	29.5	-	-	-	-	12.5

* FOR [2.00] AND [1.63] THICKNESS; USE [8] DIA. RIVETS.
FOR [4.27], [3.51] AND [2.77] THICKNESS; USE [10] DIA. RIVETS.
FOR [375] THROUGH [900] DIA.; USE SINGLE RIVETS.
FOR [1050] THROUGH [2100] DIA.; USE DOUBLE RIVETS. (TABLE VALUE INCLUDES BOTH ROWS)

ROUND CORRUGATED STEEL PIPE								
3 IN X 1 IN AND 5 IN X 1 IN CORRUGATIONS								
RIVETED, WELDED, OR HELICAL FABRICATION								
PIPE DIAMETER	WATERWAY AREA	MIN. COVER	RIVET PATTERN *	PLATE THICKNESS				
				0.064 IN 16 GA.	0.079 IN 14 GA.	0.109 IN 12 GA.	0.138 IN 10 GA.	0.168 IN 8 GA.
IN	FT ²	IN	RIVETS PER FT.	MAX. FILL HEIGHT ABOVE TOP OF PIPE (FT)				
36	7.1	21	8	53	66	98	100	100
42	9.6	21	8	46	57	84	100	100
48	12.6	21	8	40	50	74	88	98
54	15.9	21	8	35	44	65	79	87
60	19.6	21	8	32	40	59	71	79
66	23.8	21	8	29	36	54	64	71
72	28.3	21	8	27	33	49	59	65
78	33.2	21	8	25	31	45	54	60
84	38.5	21	8	23	28	42	51	56
90	44.2	21	8	21	26	39	47	52
96	50.3	33	8	-	25	37	44	49
102	56.7	33	8	-	23	35	42	46
108	63.6	33	8	-	-	33	39	44
114	70.9	33	8	-	-	31	37	41
120	78.5	33	8	-	-	29	35	39

* FOR 14 AND 16 GAGE THICKNESS; USE 3/8 IN RIVETS.
FOR 8, 10 AND 12 GAGE THICKNESS; USE 7/16 IN RIVETS.

METRIC TABLE

ROUND CORRUGATED STEEL PIPE								
[76 x 25] AND [125 x 25] CORRUGATIONS								
RIVETED, WELDED, OR HELICAL FABRICATION								
PIPE DIAMETER	WATERWAY AREA	MIN. COVER	RIVET PATTERN *	PLATE THICKNESS				
				[1.63]	[2.00]	[2.77]	[3.51]	[4.27]
mm	m ²	mm	RIVETS PER m	MAX. FILL HEIGHT ABOVE TOP OF PIPE (m)				
900	0.66	535	26	16.2	20.1	29.9	30.5	30.5
1050	0.89	535	26	14.0	17.4	25.6	30.5	30.5
1200	1.17	535	26	12.2	15.2	22.5	26.8	29.9
1350	1.48	535	26	10.7	13.4	19.8	24.1	26.5
1500	1.82	535	26	9.8	12.2	18.0	21.6	24.1
1650	2.21	535	26	8.8	11.0	16.5	19.5	21.6
1800	2.63	535	26	8.2	10.1	14.9	18.0	19.8
1950	3.08	535	26	7.6	9.4	13.7	16.5	18.3
2100	3.58	535	26	7.0	8.5	12.8	15.5	17.0
2250	4.11	535	26	6.4	7.9	11.9	14.3	15.8
2400	4.67	840	26	-	7.6	11.3	13.4	14.9
2550	5.27	840	26	-	7.0	10.7	12.8	14.0
2700	5.91	840	26	-	-	10.1	11.9	13.4
2850	6.59	840	26	-	-	9.4	11.3	12.5
3000	7.29	840	26	-	-	8.8	10.7	11.9

* FOR [2.00] AND [1.63] THICKNESS; USE [10] DIA. RIVETS.
FOR [4.27], [3.51] AND [2.77] THICKNESS; USE [11] DIA. RIVETS.

Designed by: WBW
Drawn by: TWIS
Checked by: WBW
Previous Dwg. No. 603-1A

GENERAL CMP REQUIREMENTS AND ROUND STEEL PIPE FILL HEIGHTS

Note: Units shown in brackets [] are metric and are in millimeters (mm) unless other units are shown.



PIPE FILL HEIGHT CHART AND INSTALLATION DETAILS

STANDARD PLAN

STANDARD PLAN NUMBER

603-1B

SHEET 1 of 6

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Date Issued: OCTOBER 2020

CORRUGATED STEEL PIPE-ARCH									
2 2/3 IN X 1/2 IN CORRUGATIONS									
RIVETED, WELDED, OR HELICAL FABRICATION									
PIPE DIMENSIONS SPAN x RISE		WATERWAY AREA	MIN. COVER	RIVET PATTERN **	CORNER RADIUS	CORNER PRESSURE			
						2 TONS PER SQ. FT.		*3 TONS PER SQ. FT.	
						MIN. THICKNESS	MAX. FILL HEIGHT	MIN. THICKNESS	MAX. FILL HEIGHT
FT - IN X FT - IN	IN	FT ²	IN	RIVETS PER FT	IN	GAGE (IN)	FT	GAGE (IN)	FT
1 - 5 x 1 - 1	17 x 13	1.1	27	4.5	3.5	16 (0.064)	14	16 (0.064)	21
1 - 9 x 1 - 3	21 x 15	1.6	27	4.5	4.1	16 (0.064)	13	16 (0.064)	20
2 - 0 x 1 - 6	24 x 18	2.2	27	4.5	4.9	16 (0.064)	14	16 (0.064)	20
2 - 4 x 1 - 8	28 x 20	2.9	27	4.5	5.5	16 (0.064)	13	16 (0.064)	20
2 - 11 x 2 - 0	35 x 24	4.5	27	4.5	6.9	16 (0.064)	13	16 (0.064)	20
3 - 6 x 2 - 5	42 x 29	6.5	27	4.5	8.3	16 (0.064)	13	16 (0.064)	20
4 - 1 x 2 - 9	49 x 33	8.9	27	9	9.6	14 (0.079)	13	14 (0.079)	20
4 - 9 x 3 - 2	57 x 38	11.6	27	9	11.0	12 (0.109)	13	12 (0.109)	19
5 - 4 x 3 - 7	64 x 43	14.7	27	9	12.4	12 (0.109)	13	12 (0.109)	19
5 - 11 x 3 - 11	71 x 47	18.1	27	9	13.8	10 (0.138)	13	10 (0.138)	19

* SEE GENERAL NOTES.

** FOR 14 AND 16 GAGE THICKNESS; USE 5/16 IN RIVETS.
 FOR 10 AND 12 GAGE THICKNESS; USE 3/8 IN RIVETS.
 FOR 17 IN THRU 42 IN SPAN; USE SINGLE RIVETS.
 FOR 49 IN THRU 71 IN SPAN; USE DOUBLE RIVETS. (TABLE VALUE INCLUDES BOTH ROWS)

METRIC TABLE

CORRUGATED STEEL PIPE-ARCH									
[68 x 13] CORRUGATIONS									
RIVETED, WELDED, OR HELICAL FABRICATION									
PIPE DIMENSIONS SPAN x RISE		WATERWAY AREA	MIN. COVER	RIVET PATTERN **	CORNER RADIUS	CORNER PRESSURE			
						200 kPa		*300 kPa	
						MIN. THICKNESS	MAX. FILL HEIGHT	MIN. THICKNESS	MAX. FILL HEIGHT
mm	m ²	mm	RIVETS PER m	mm	mm	m	mm	m	
425 x 325	0.10	685	15	90	1.63	4.3	1.63	6.4	
525 x 375	0.15	685	15	105	1.63	4.0	1.63	6.1	
600 x 450	0.20	685	15	125	1.63	4.3	1.63	6.1	
700 x 500	0.27	685	15	140	1.63	4.0	1.63	6.1	
875 x 600	0.42	685	15	175	1.63	4.0	1.63	6.1	
1050 x 725	0.60	685	15	210	1.63	4.0	1.63	6.1	
1225 x 825	0.83	685	29.5	245	2.00	4.0	2.00	6.1	
1425 x 950	1.08	685	29.5	280	2.77	4.0	2.77	5.8	
1600 x 1075	1.37	685	29.5	315	2.77	4.0	2.77	5.8	
1775 x 1175	1.68	685	29.5	350	3.51	4.0	3.51	5.8	

* SEE GENERAL NOTES.

** FOR [2.00] AND [1.63] THICKNESS; USE [8] DIA. RIVETS.
 FOR [3.51] AND [2.77] THICKNESS; USE [10] DIA. RIVETS.
 FOR [425] THROUGH [1050] SPAN; USE SINGLE RIVETS.
 FOR [1225] THROUGH [1775] SPAN; USE DOUBLE RIVETS. (TABLE VALUE INCLUDES BOTH ROWS)

CORRUGATED STEEL PIPE-ARCH									
3 IN x 1 IN AND 5 IN x 1 IN CORRUGATIONS									
RIVETED, WELDED, OR HELICAL FABRICATION									
PIPE DIMENSIONS SPAN x RISE		WATERWAY AREA	MIN. COVER	RIVET PATTERN **	CORNER RADIUS	CORNER PRESSURE			
						2 TONS PER SQ. FT.		*3 TONS PER SQ. FT.	
						MIN. THICKNESS	MAX. FILL HEIGHT	MIN. THICKNESS	MAX. FILL HEIGHT
FT - IN X FT - IN	IN	FT ²	IN	RIVETS PER FT	IN	GAGE (IN)	FT	GAGE (IN)	FT
5 - 0 x 3 - 10	60 x 46	15.6	27	8	18.8	14 (0.079)	21	14 (0.079)	31
5 - 6 x 4 - 3	66 x 51	19.3	27	8	20.8	14 (0.079)	21	14 (0.079)	32
6 - 1 x 4 - 7	73 x 55	23.2	27	8	22.9	14 (0.079)	21	14 (0.079)	31
6 - 9 x 4 - 11	81 x 59	27.4	27	8	20.9	14 (0.079)	17	14 (0.079)	26
7 - 3 x 5 - 3	87 x 63	32.1	27	8	22.6	14 (0.079)	17	14 (0.079)	26
7 - 11 x 5 - 7	95 x 67	37.0	27	8	24.4	14 (0.079)	17	14 (0.079)	25
8 - 7 x 5 - 11	103 x 71	42.4	33	8	26.1	12 (0.109)	17	12 (0.109)	25
9 - 4 x 6 - 3	112 x 75	48.0	33	8	27.8	12 (0.109)	17	12 (0.109)	25
9 - 9 x 6 - 7	117 x 79	54.2	33	8	29.5	12 (0.109)	17	12 (0.109)	25
10 - 8 x 6 - 11	128 x 83	60.5	33	8	31.3	10 (0.138)	16	10 (0.138)	24
11 - 5 x 7 - 3	137 x 87	67.4	33	8	33.0	10 (0.138)	16	10 (0.138)	24
11 - 10 x 7 - 7	142 x 91	74.5	33	8	34.8	8 (0.168)	16	8 (0.168)	25

* SEE GENERAL NOTES.

** FOR 14 AND 16 GAGE THICKNESS; USE 3/8 IN RIVETS.
 FOR 8, 10 AND 12 GAGE THICKNESS; USE 7/16 IN RIVETS.

METRIC TABLE

CORRUGATED STEEL PIPE-ARCH									
[76 x 25] AND [125 x 25] CORRUGATIONS									
RIVETED, WELDED, OR HELICAL FABRICATION									
PIPE DIMENSIONS SPAN x RISE		WATERWAY AREA	MIN. COVER	RIVET PATTERN **	CORNER RADIUS	CORNER PRESSURE			
						200 kPa		* 300 kPa	
						MIN. THICKNESS	MAX. FILL HEIGHT	MIN. THICKNESS	MAX. FILL HEIGHT
mm	m ²	mm	RIVETS PER m	mm	mm	m	mm	m	
1500 x 1150	1.45	685	26	480	2.00	6.3	2.00	9.4	
1650 x 1275	1.79	685	26	530	2.00	6.3	2.00	9.8	
1825 x 1375	2.16	685	26	580	2.00	6.3	2.00	9.4	
2025 x 1475	2.55	685	26	530	2.00	5.1	2.00	7.9	
2175 x 1575	2.98	685	26	570	2.00	5.1	2.00	7.9	
2375 x 1675	3.44	685	26	620	2.00	5.1	2.00	7.6	
2575 x 1775	3.94	840	26	660	2.77	5.1	2.77	7.6	
2800 x 1875	4.46	840	26	710	2.77	5.1	2.77	7.6	
2925 x 1975	5.04	840	26	750	2.77	5.1	2.77	7.6	
3200 x 2075	5.62	840	26	800	3.51	4.8	3.51	7.3	
3425 x 2175	6.26	840	26	840	3.51	4.8	3.51	7.3	
3550 x 2275	6.92	840	26	880	4.27	4.8	4.27	7.6	

* SEE GENERAL NOTES.

** FOR [2.00] AND [1.63] THICKNESS; USE [10] DIA. RIVETS.
 FOR [4.27], [3.51] AND [2.77] THICKNESS; USE [11] DIA. RIVETS.

Designed by: WBW
 Drawn by: TWS
 Checked by: WBW
 Previous Dwg. No. 603-1A

ARCH STEEL PIPE FILL HEIGHTS

Note: Units shown in brackets [] are metric and are in millimeters (mm) unless other units are shown.



PIPE FILL HEIGHT CHART AND INSTALLATION DETAILS

STANDARD PLAN

STANDARD PLAN NUMBER

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SHEET 2 of 6

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ROUND CORRUGATED ALUMINUM PIPE								
2 2/3 IN x 1/2 IN CORRUGATIONS								
RIVETED OR HELICAL FABRICATION								
PIPE DIAMETER	WATERWAY AREA	MIN. COVER	RIVET PATTERN *	PLATE THICKNESS				
				0.060"	0.075"	0.105"	0.135"	0.164"
IN	FT ²	IN	RIVETS PER FT	16 GA.	14 GA.	12 GA.	10 GA.	8 GA.
				MAX. FILL HEIGHT ABOVE TOP OF PIPE (FT)				
15	1.2	24	4.5	40	40	69	72	75
18	1.8	24	4.5	33	33	58	60	62
24	3.1	24	4.5	25	25	43	45	47
30	4.9	27	4.5	20	20	35	36	37
36	7.1	27	4.5	17	17	29	30	31
42	9.6	27	9	22	29	50	52	54
48	12.6	27	9	-	-	44	46	47
54	15.9	33	9	-	-	39	41	42
60	19.6	33	9	-	-	-	37	38
66	23.8	33	9	-	-	-	-	34
72	28.3	33	9	-	-	-	-	31

* FOR 14 AND 16 GAGE THICKNESS; USE 5/16 IN RIVETS.
 FOR 8, 10 AND 12 GAGE THICKNESS; USE 3/8 IN RIVETS.
 FOR 15 IN THRU 36 IN DIA., USE SINGLE RIVETS.
 FOR 42 IN THRU 72 IN DIA., USE DOUBLE RIVETS. (TABLE VALUE INCLUDES BOTH ROWS)

METRIC TABLE

ROUND CORRUGATED ALUMINUM PIPE								
[68 x 13] CORRUGATIONS								
RIVETED OR HELICAL FABRICATION								
PIPE DIAMETER	WATERWAY AREA	MIN. COVER	RIVET PATTERN *	PLATE THICKNESS				
				[1.52]	[1.91]	[2.67]	[3.43]	[4.17]
mm	m ²	mm	RIVETS PER m	MAX. FILL HEIGHT ABOVE TOP OF PIPE (m)				
375	0.11	610	15	12.2	12.2	21.0	21.9	22.9
450	0.17	610	15	10.1	10.1	17.7	18.3	18.9
600	0.29	610	15	7.6	7.6	13.1	13.7	14.3
750	0.46	685	15	6.1	6.1	10.7	11.0	11.3
900	0.66	685	15	5.2	5.2	8.8	9.1	9.4
1050	0.89	685	29.5	6.7	8.8	15.2	15.8	16.5
1200	1.17	685	29.5	-	-	13.4	14.0	14.3
1350	1.48	840	29.5	-	-	11.9	12.5	12.8
1500	1.82	840	29.5	-	-	-	11.3	11.6
1650	2.21	840	29.5	-	-	-	-	10.4
1800	2.63	840	29.5	-	-	-	-	9.4

* FOR [1.91] AND [1.52] THICKNESS; USE [8] DIA. RIVETS.
 FOR [4.17], [3.43] AND [2.67] THICKNESS; USE [10] DIA. RIVETS.
 FOR [375] THROUGH [900] DIA.; USE SINGLE RIVETS.
 FOR [1050] THROUGH [1800] DIA.; USE DOUBLE RIVETS. (TABLE VALUE INCLUDES BOTH ROWS)

ROUND CORRUGATED ALUMINUM PIPE								
3 IN x 1 IN CORRUGATIONS								
RIVETED OR HELICAL FABRICATION								
PIPE DIAMETER	WATERWAY AREA	MIN. COVER	RIVET PATTERN *	PLATE THICKNESS				
				0.060"	0.075"	0.105"	0.135"	0.164"
IN	FT ²	IN	RIVETS PER FT	16 GA.	14 GA.	12 GA.	10 GA.	8 GA.
				MAX. FILL HEIGHT ABOVE TOP OF PIPE (FT)				
30	4.9	27	8	37	46	62	93	100+
36	7.1	27	8	31	38	52	78	100+
42	9.6	27	8	26	33	44	67	87
48	12.6	27	8	23	28	39	58	76
54	15.9	33	8	20	25	35	52	67
60	19.6	33	8	18	23	31	47	61
66	23.8	33	8	17	21	28	42	55
72	28.3	33	8	15	19	26	39	50
78	33.2	33	8	-	18	24	36	47
84	38.5	33	8	-	-	22	33	43
90	44.2	33	8	-	-	21	31	40
96	50.3	33	8	-	-	19	29	38

* FOR 14 AND 16 GAGE THICKNESS; USE 3/8 IN RIVETS.
 FOR 8, 10 AND 12 GAGE THICKNESS; USE 1/2 IN RIVETS.

METRIC TABLE

ROUND CORRUGATED ALUMINUM PIPE								
[76 x 25] CORRUGATIONS								
RIVETED OR HELICAL FABRICATION								
PIPE DIAMETER	WATERWAY AREA	MIN. COVER	RIVET PATTERN *	PLATE THICKNESS				
				[1.52]	[1.91]	[2.67]	[3.43]	[4.17]
mm	m ²	mm	RIVETS PER m	MAX. FILL HEIGHT ABOVE TOP OF PIPE [m]				
750	0.46	685	26	11.3	14.0	18.9	28.3	30.5
900	0.66	685	26	9.4	11.6	15.8	23.8	30.5
1050	0.89	685	26	7.9	10.1	13.4	20.4	26.5
1200	1.17	685	26	7.0	8.5	11.9	17.7	23.2
1350	1.48	840	26	6.1	7.6	10.7	15.8	20.4
1500	1.82	840	26	5.5	7.0	9.4	14.3	18.6
1650	2.21	840	26	5.2	6.4	8.5	12.8	16.8
1800	2.63	840	26	4.6	5.8	7.9	11.9	15.2
1950	3.08	840	26	-	5.5	7.3	11.0	14.3
2100	3.58	840	26	-	-	6.7	10.1	13.1
2250	4.11	840	26	-	-	6.4	9.4	12.2
2400	4.67	840	26	-	-	5.8	8.8	11.6

* FOR [1.91] AND [1.52] THICKNESS; USE [10] DIA. RIVETS.
 FOR [4.17], [3.43] AND [2.67] THICKNESS; USE [13] DIA. RIVETS.

Designed by: WBW
 Drawn by: TWS
 Checked by: WBW
 Previous Dwg. No. 603-1A

ROUND ALUMINUM PIPE FILL HEIGHTS

Note: Units shown in brackets [] are metric and are in millimeters (mm) unless other units are shown.



PIPE FILL HEIGHT CHART AND INSTALLATION DETAILS

STANDARD PLAN

STANDARD PLAN NUMBER
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 SHEET 3 of 6
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 Date Issued: OCTOBER 2020

CORRUGATED ALUMINUM PIPE-ARCH									
2 2/3 IN x 1/2 IN CORRUGATIONS RIVETED OR HELICAL FABRICATION									
PIPE DIMENSIONS SPAN x RISE		WATERWAY AREA	MIN. COVER	RIVET PATTERN **	CORNER RADIUS	CORNER PRESSURE			
						2 TONS PER SQ. FT.		*3 TONS PER SQ. FT.	
FT - IN X FT - IN	IN x IN	FT ²	IN	RIVETS PER FT	IN	MIN. THICKNESS GAGE (IN)	MAX. FILL HEIGHT FT	MIN. THICKNESS GAGE (IN)	MAX. FILL HEIGHT FT
1 - 5 x 1 - 1	17 x 13	1.1	30	4.5	3.5	16 (0.060)	14	16 (0.060)	21
1 - 9 x 1 - 3	21 x 15	1.6	30	4.5	4.1	16 (0.060)	13	16 (0.060)	20
2 - 0 x 1 - 6	24 x 18	2.2	30	4.5	4.9	16 (0.060)	14	16 (0.060)	20
2 - 4 x 1 - 8	28 x 20	2.9	30	4.5	5.5	14 (0.075)	13	14 (0.075)	20
2 - 11 x 2 - 0	35 x 24	4.5	30	4.5	6.9	14 (0.075)	13	14 (0.075)	17
3 - 6 x 2 - 5	42 x 29	6.5	30	4.5	8.3	12 (0.105)	13	12 (0.105)	20
4 - 1 x 2 - 9	49 x 33	8.9	33	9	9.6	12 (0.105)	13	12 (0.105)	20
4 - 9 x 3 - 2	57 x 38	11.6	33	9	11.0	10 (0.135)	13	10 (0.135)	19
5 - 4 x 3 - 7	64 x 43	14.7	33	9	12.4	10 (0.135)	13	10 (0.135)	19
5 - 11 x 3 - 11	71 x 47	18.1	33	9	13.8	8 (0.164)	13	8 (0.164)	19

* SEE GENERAL NOTES.

** FOR 14 AND 16 GAGE THICKNESS; USE 5/16 IN RIVETS.
 FOR 8, 10 AND 12 GAGE THICKNESS; USE 3/8 IN RIVETS.
 FOR 17 IN THRU 42 IN SPAN; USE SINGLE RIVETS.
 FOR 49 IN THRU 71 IN SPAN; USE DOUBLE RIVETS. (TABLE VALUE INCLUDES BOTH ROWS)

METRIC TABLE

CORRUGATED ALUMINUM PIPE-ARCH									
[68 x 13] CORRUGATIONS RIVETED OR HELICAL FABRICATION									
PIPE DIMENSIONS SPAN x RISE		WATERWAY AREA	MIN. COVER	RIVET PATTERN **	CORNER RADIUS	CORNER PRESSURE			
						200 kPa		*300 kPa	
mm x mm	m ²	mm	RIVETS PER m	mm	mm	m	mm	m	
425 x 325	0.10	760	15	90	1.52	4.3	1.52	6.4	
525 x 375	0.15	760	15	105	1.52	4.0	1.52	6.1	
600 x 450	0.20	760	15	125	1.52	4.3	1.52	6.1	
700 x 500	0.27	760	15	140	1.91	4.0	1.91	6.1	
875 x 600	0.42	760	15	175	1.91	4.0	1.91	5.2	
1050 x 725	0.60	760	15	210	2.67	4.0	2.67	6.1	
1225 x 825	0.83	840	29.5	245	2.67	4.0	2.67	6.1	
1425 x 950	1.08	840	29.5	280	3.43	4.0	3.43	5.8	
1600 x 1075	1.37	840	29.5	315	3.43	4.0	3.43	5.8	
1775 x 1175	1.68	840	29.5	350	4.17	4.0	4.17	5.8	

* SEE GENERAL NOTES.

** FOR [1.91] AND [1.52] THICKNESS; USE [8] DIA. RIVETS.
 FOR [4.17], [3.43] AND [2.67] THICKNESS; USE [10] DIA. RIVETS.
 FOR [425] THROUGH [1050] SPAN; USE SINGLE RIVETS.
 FOR [1225] THROUGH [1775] SPAN; USE DOUBLE RIVETS. (TABLE VALUE INCLUDES BOTH ROWS)

EQUIVALENT SIZE CMP-ARCH	
2 2/3 IN x 1/2 IN CORR.	3 IN x 1 IN, 5 IN x 1 IN CORR.
IN	IN
42 x 29	40 x 31
49 x 33	46 x 36
57 x 38	53 x 41
64 x 43	60 x 46
71 x 47	66 x 51

METRIC TABLE

EQUIVALENT SIZE CMP-ARCH	
[68 x 13] CORR.	[76 x 25], [125 x 25] CORR.
mm x mm	mm x mm
1050 x 725	1000 x 775
1225 x 825	1150 x 900
1425 x 950	1325 x 1025
1600 x 1075	1500 x 1150
1775 x 1175	1650 x 1275

Designed by: WBW
 Drawn by: TWS
 Checked by: WBW
 Previous Dwg. No. 603-1A

**ARCH ALUMINUM PIPE FILL HEIGHTS
AND EQUIVALENT CMP ARCH SIZE TABLES**

Note: Units shown in brackets [] are metric and are in millimeters (mm) unless other units are shown.



**PIPE FILL HEIGHT CHART
AND INSTALLATION DETAILS**

STANDARD PLAN

STANDARD PLAN NUMBER

603-1B

SHEET 4 of 6

Issued by: ENGINEERING SERVICES
 Date Issued: OCTOBER 2020

DESIGN CRITERIA FOR RCP

Design criteria for concrete pipe positive projection

- $r_{sd} = 0.5$
- $P' = 0.7$ (Class B installation)
- $P' = 0.9$ (Class C installation)
- D-Load = 0.01 in [0.25] crack
- Factor of safety = 1 with D-Load

NOTES FOR RCP

- Use only one class of RCP per installation.
- Ensure the outside span of arch and elliptical pipe is the same as the B_c of circular conduit.
- Provide a minimum class II or greater pipe.

PIPE CLASS	RCP PIPE			
	MIN. COVER		MAX. FILL HEIGHT	
	IN	mm	FT	m
II	24	610	12	3.7
III	18	460	16	4.9
IV (2)	12 (1)	300	23	7.0
V (2)	6 (1)	150	34	10.4

- (1) WHERE POSSIBLE, PROVIDE 18" [460] MINIMUM FILL HEIGHT FOR CLASS IV AND CLASS V PIPE.
- (2) DO NOT USE CLASS IV PIPE GREATER THAN 84 IN [2100] DIA. AND CLASS V PIPE GREATER THAN 72 IN [1800] DIA.

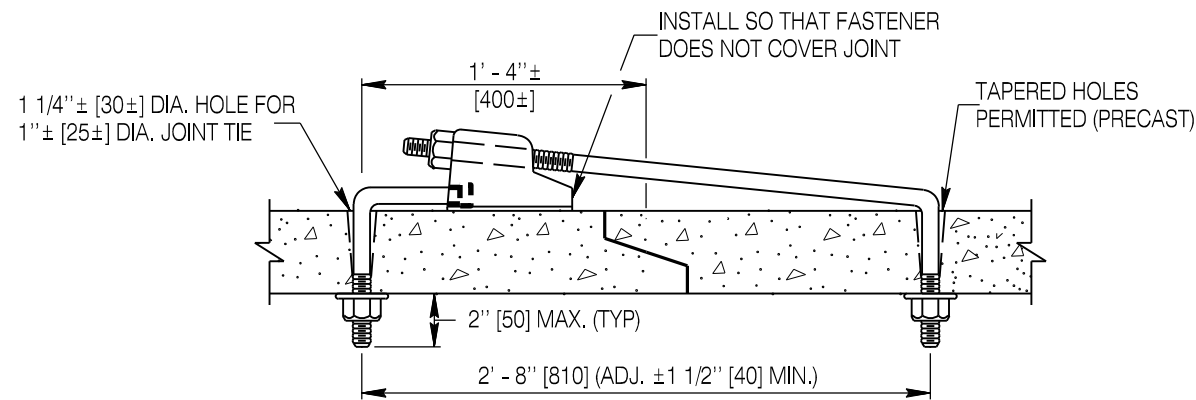
DIA.	HDPE PIPE AASHTO M294, TYPE S			
	MIN. COVER		MAX. FILL HEIGHT	
	IN	mm	FT	m
18	24	[610]	10	3.0
24	24	[610]	10	3.0
30	24	[610]	10	3.0
36	24	[610]	10	3.0

FILL HEIGHT CHART FOR HDPE

DIA.	PVC PIPE ASTM D1784 SMOOTH OR PROFILE WALL			
	MIN. COVER		MAX. FILL HEIGHT	
	IN	mm	FT	m
18	24	[610]	10	3.0
24	24	[610]	10	3.0
30	24	[610]	10	3.0
36	24	[610]	10	3.0

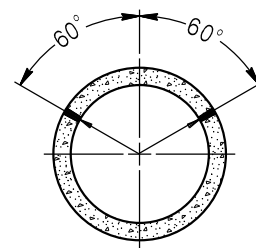
FILL HEIGHT CHART FOR PVC

FILL HEIGHT CHART FOR RCP



CONCRETE PIPE JOINT TIE

NOTE: ALTERNATE JOINT TIES ARE SHOWN ON THE STANDARD PLAN FOR RCP FLARED END SECTIONS.



LOCATIONS OF HOLES FOR JOINT TIES

RCP PIPE

PLASTIC PIPE

Designed by: WBW
 Drawn by: TWS
 Checked by: WBW
 Previous Dwg. No. 603-1A

RCP & PLASTIC PIPE FILL HEIGHTS AND GENERAL REQUIREMENTS

Note: Units shown in brackets [] are metric and are in millimeters (mm) unless other units are shown.



PIPE FILL HEIGHT CHART AND INSTALLATION DETAILS

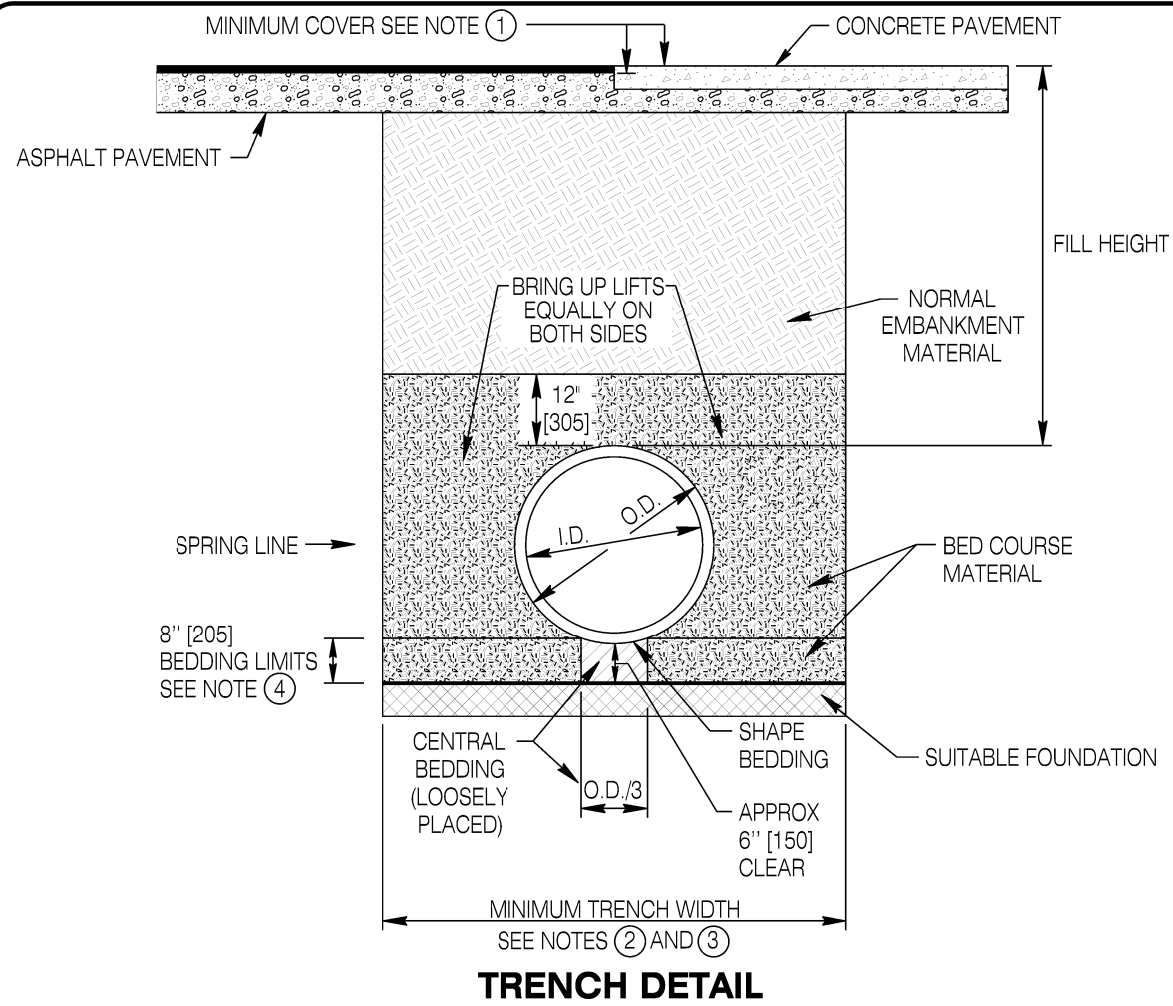
STANDARD PLAN

STANDARD PLAN NUMBER

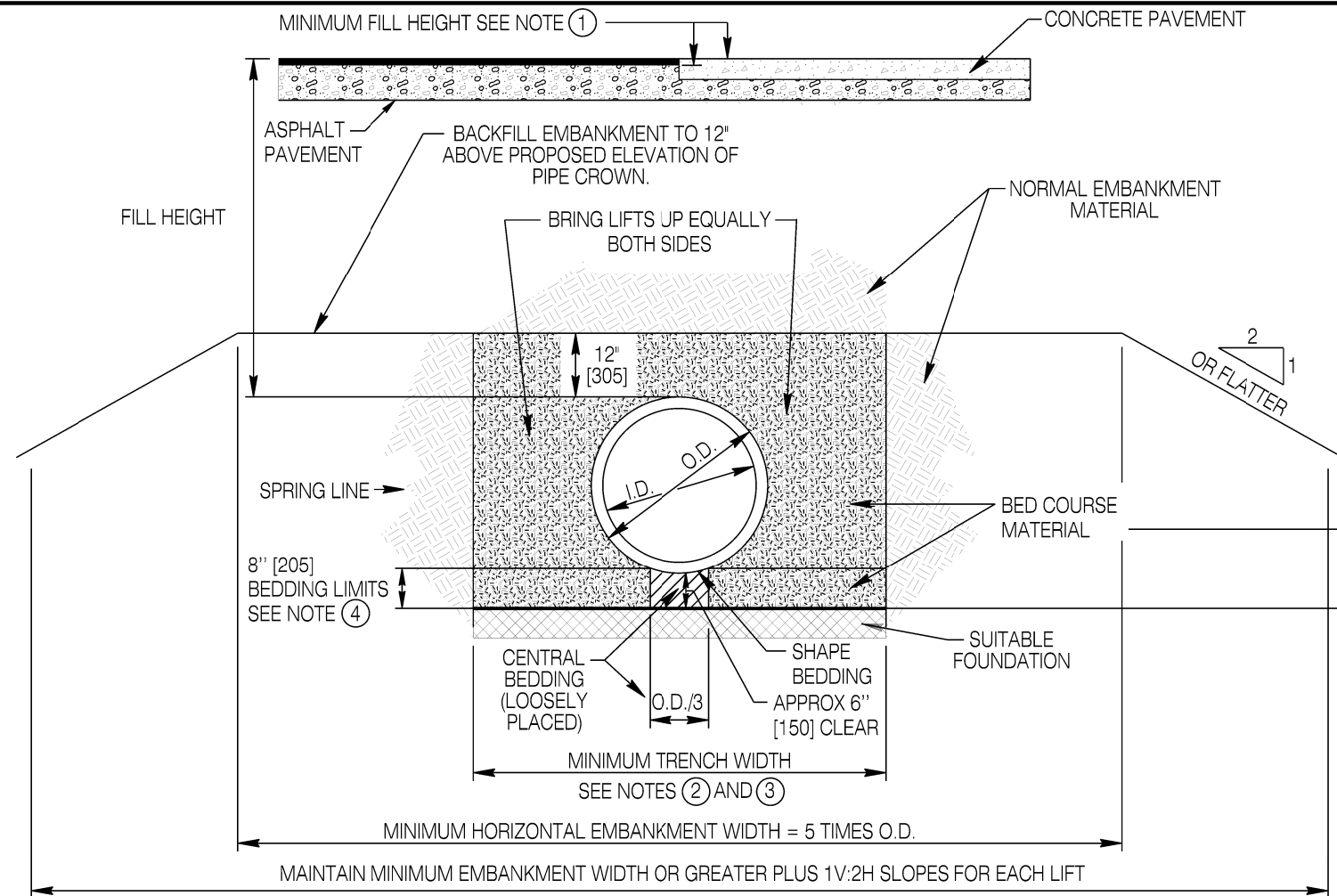
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SHEET 5 of 6

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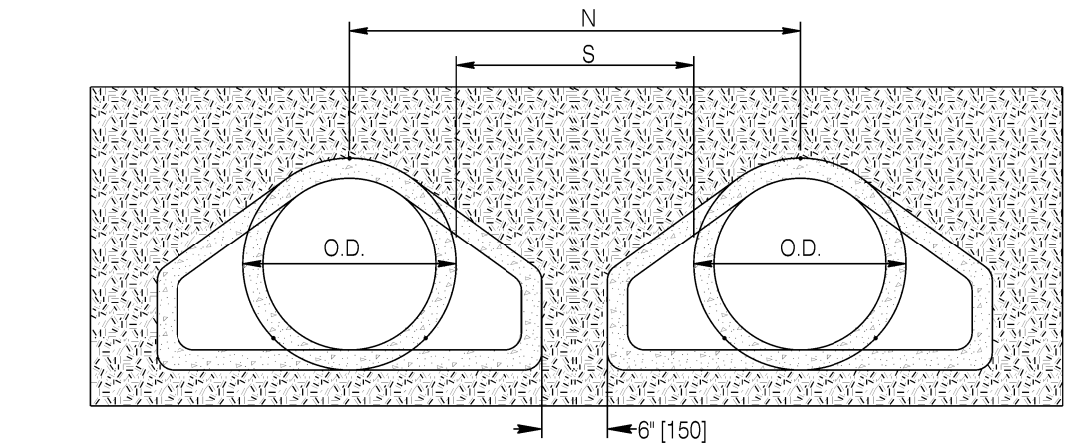
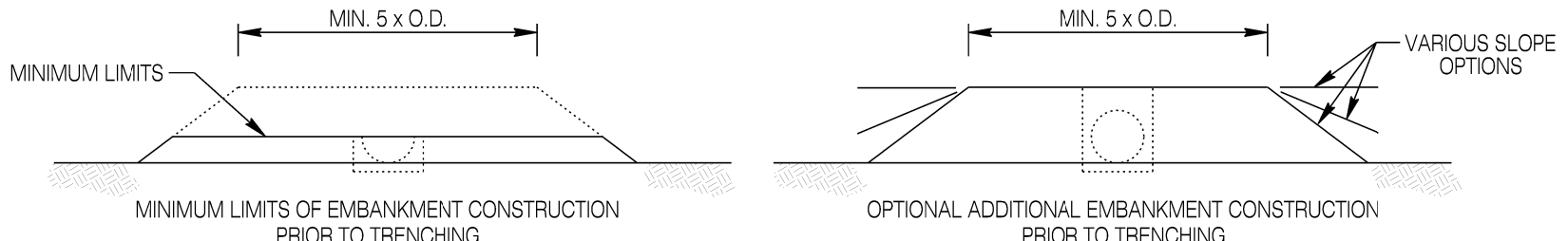


TRENCH DETAIL



EMBANKMENT DETAILS

Construct embankment to the minimum dimensions shown (or greater) up to at least spring line. Then excavate trench to bottom of bedding.



MULTIPLE PIPE INSTALLATION SPACING

- With flared ends -** spacing required for flared ends to be placed 6" [150] apart
- Cut-off and headwalls -** spacing as indicated in Standard Plan 617-1 "Bevel End Finish, Cut-Off Walls and Head walls" (See dimension "N")
- Other -** S = 2 feet [610] min.

NOTES

- ① See General Notes **PAGE 1**
- ② Minimum trench width:
Concrete pipe = O.D. + 36"
Flexible pipe = I.D. + 48"
Center pipe in trench.
- ③ Reduce the minimum trench width by 12" if flowable fill is used.
- ④ Increase bedding depth to 12" [305] when foundation material is rock.

- ⑤ **Springline** - The elevation at which the pipe reaches its maximum horizontal dimension (i.e. span). For round pipes springline is the elevation at one half of the diameter.

