CULVERT SIZE DIAMETER (mm)	1½ :1 Slope		2:1 Slope	
	Normal Depth	Increments For Each Add'l. 0.3 m Above Normal	Normal Depth	Increments For Each Add'l. 0.3 m Above Normal
	Cu. Meters	Cu. Meters	Cu. Meters	Cu. Meters
300	0.77	0.39	0.73	0.36
375	1.22	0.61	1.14	0.57
450	1.76	0.88	1.65	0.83
600	3.11	1.56	2.92	1.46
750	4.87	2.43	4.58	2.29
900	7.01	3.50	6.59	3.29
1050	9.41	4.70	8.83	4.42
1200	12.10	6.05	11.36	5.68
1350	15.21	7.61	14.27	7.13
1500	18.68	9.34	17.51	8.76

Table D-1M
STONE FOR EROSION CONTROL WITH ST'D. ES-1 END SECTIONS

CULVERT SIZE DIAMETER (mm)	1½ :1 Slope		2:1 Slope	
	Normal Depth	Increments For Each Add'l. 0.3 m Above Normal	Normal Depth	Increments For Each Add'l. 0.3 m Above Normal
	Cu. Meters	Cu. Meters	Cu. Meters	Cu. Meters
300	0.87	0.44	0.82	0.41
375	1.28	0.64	1.21	0.60
450	1.95	0.97	1.84	0.92
600	3.44	1.72	3.24	1.62
750	5.35	2.67	5.04	2.52
900	7.68	3.84	7.25	3.62
1050	10.44	5.22	9.84	4.92
1200	13.42	6.71	12.65	6.32
1350	16.92	8.46	15.94	7.97
1500	20.80	10.40	19.58	9.79

Table D-2M
STONE FOR EROSION CONTROL WITH ST'D. ES-2 END SECTIONS

PIPE ARCH Span Rise (mm)	1¹⁄₂ :1 Slope		2:1 Slope	
	Normal Depth	Increments For Each Add'l. 0.3 m Above Normal	Normal Depth	Increments For Each Add'l. 0.3 m Above Normal
	Cu. Meters	Cu. Meters	Cu. Meters	Cu. Meters
450 340	1.45	0.72	1.35	0.68
510 380	1.87	0.93	1.75	0.87
560 420	2.30	1.15	2.15	1.07
680 500	3.29	1.65	3.08	1.54
800 580	4.59	2.30	4.29	2.15
910 660	6.11	3.06	5.72	2.86
1030 740	7.75	3.87	7.25	3.63
1150 820	9.60	4.80	8.99	4.50
1390 970	13.70	6.85	12.81	6.40
1630 1120	18.52	9.26	17.31	8.65

Table D-3M
STONE FOR EROSION CONTROL WITH ST'D. ES-3 END SECTIONS

CULVERT SIZE DIAMETER (mm)	1¹⁄₂ :1 Slope		2:1 Slope		Increments For Each Add'l. Pipe (St'd. EW-6)	
	Normal Depth	Increments For Each Add'l. 0.3 m Above Normal	Normal Depth	Increments For Each Add'l. 0.3 m Above Normal	Conc.	C.M.
	Cu. Meters	Cu. Meters	Cu. Meters	Cu. Meters	Cu. Meters	Cu. Meters
300	0.53	0.26	0.50	0.25	0.26	0.22
375	0.83	0.41	0.79	0.39	0.40	0.35
450	1.20	0.60	1.14	0.57	0.58	0.51
600	2.13	1.07	2.02	1.01	1.01	0.90
750	3.34	1.67	3.17	1.59	1.60	1.41
900	4.84	2.42	4.60	2.30	2.34	2.07

Table D-4M
STONE FOR EROSION CONTROL WITH ST'D. EW-1
AND EW-6 ENDWALLS

ELLIPTICAL PIPE Span Rise (mm)	1½ :1 Slope		2:1 Slope	
	Normal Depth	Increments For Each Add'l. 0.3 m Above Normal	Normal Depth	Increments For Each Add'l. 0.3 m Above Normal
	Cu. Meters	Cu. Meters	Cu. Meters	Cu. Meters
575 365	1.23	0.62	1.17	0.59
770 490	2.24	1.12	2.13	1.06
865 550	2.82	1.41	2.68	1.34
960 610	3.47	1.73	3.29	1.65
1055 670	4.20	2.10	3.99	2.00
1150 730	4.99	2.49	4.73	2.37
1250 795	5.92	2.96	5.62	2.81
1345 855	6.84	3.42	6.50	3.25

Table D-5M
STONE FOR EROSION CONTROL WITH ST'D. EW-1A ENDWALLS

CULVERT SIZE DIAMETER (mm)	1½ :1 Slope		2:1 Slope		ST'D. EW-7
	Normal Depth	Increments For Each Add'l. 0.3 m Above Normal	Normal Depth	Increments For Each Add'l. 0.3 m Above Normal	Increments For Each Add'l. Pipe (Conc.)
	Cu. Meters	Cu. Meters	Cu. Meters	Cu. Meters	Cu. Meters
1050	8.02	4.01	7.48	3.74	3.49
1200	10.65	5.32	9.92	4.96	4.57
1350	13.44	6.72	12.52	6.26	5.75
1500	16.55	8.28	15.42	7.71	7.09
1650	19.99	9.99	18.62	9.31	8.57
1800	23.75	11.87	22.11	11.06	10.16
1950	28.13	14.07	26.19	13.10	11.94
2100	32.56	16.28	30.31	15.16	13.84

Table D-6M
STONE FOR EROSION CONTROL WITH ST'D. EW-2
AND EW-7 ENDWALLS

D-4
Metric

CULVERT SIZE DIAMETER (mm)	1½ :1 Slope		2:1 Slope		ST'D. EW-7S
	Normal Depth	Increments For Each Add'l. 0.3 m Above Normal	Normal Depth	Increments For Each Add'l. 0.3 m Above Normal	Increments For Each Add'l. Pipe (Conc.)
	Cu. Meters	Cu. Meters	Cu. Meters	Cu. Meters	Cu. Meters
1050	8.34	4.17	7.80	3.90	4.03
1200	11.04	5.52	10.31	5.16	5.27
1350	13.96	6.98	13.03	6.52	6.64
1500	17.21	8.60	16.07	8.04	8.18
1650	20.77	10.38	19.40	9.70	9.90
1800	24.70	12.35	23.06	11.53	11.74
1950	29.24	14.62	27.30	13.65	13.79
2100	33.83	16.91	31.58	15.79	15.97

Table D-7M
STONE FOR EROSION CONTROL WITH ST'D. EW-2S
AND EW-7S ENDWALLS (30° Skew)

CULVERT SIZE DIAMETER (mm)	1½ :1 Slope		2:1 Slope		ST'D. EW-7S
	Normal Depth	Increments For Each Add'l. 0.3 m Above Normal	Normal Depth	Increments For Each Add'l. 0.3 m Above Normal	Increments For Each Add'l. Pipe (Conc.)
	Cu. Meters	Cu. Meters	Cu. Meters	Cu. Meters	Cu. Meters
1050	9.68	4.84	9.34	4.67	4.94
1200	12.81	6.41	12.35	6.18	6.46
1350	16.18	8.09	15.60	7.80	8.13
1500	19.92	9.96	19.20	9.60	10.03
1650	24.07	12.03	23.20	11.60	12.12
1800	28.58	14.29	27.54	13.77	14.37
1950	33.81	16.90	32.57	16.28	16.89
2100	39.12	19.56	37.69	18.84	19.57

Table D-7A M
STONE FOR EROSION CONTROL WITH ST'D. EW-2S
AND EW-7S ENDWALLS (45° Skew)

ELLIPTICAL PIPE Span Rise (mm)	1½ :1 Slope		2:1 Slope	
	Normal Depth	Increments For Each Add'l. 0.3 m Above Normal	Normal Depth	Increments For Each Add'l. 0.3 m Above Normal
	Cu. Meters	Cu. Meters	Cu. Meters	Cu. Meters
1535 975	10.72	5.36	9.54	4.77
1730 1095	14.08	7.04	12.62	6.31
1920 1220	17.68	8.84	15.81	7.90
2110 1340	21.05	10.53	18.81	9.40
2305 1465	25.39	12.70	22.67	11.33
2495 1585	31.72	15.86	28.58	14.29
2690 1705	34.47	17.23	30.75	15.37

Table D-8M
STONE FOR EROSION CONTROL WITH ST'D. EW-2A ENDWALLS

PIPE ARCH Span Rise (mm)	1½ :1 Slope		2:1 Slope		ST'D.EW-10
	Normal Depth	Increments For Each Add'l. 0.3 m Above Normal	Normal Depth	Increments For Each Add'l. 0.3 m Above Normal	Increments For Each Add'l. Pipe
	Cu. Meters	Cu. Meters	Cu. Meters	Cu. Meters	Cu. Meters
425 325	0.82	0.41	0.77	0.39	0.39
525 375	1.17	0.58	1.11	0.55	0.52
600 450	1.60	0.80	1.52	0.76	0.68
700 500	2.08	1.04	1.98	0.99	0.84
875 600	3.11	1.55	2.95	1.47	1.16
1050 725	4.52	2.26	4.29	2.14	1.72
1225 825	6.02	3.01	5.72	2.86	2.29
1425 950	8.11	4.05	7.70	3.85	3.12

Table D-9M
STONE FOR EROSION CONTROL WITH ST'D. EW-9
AND EW-10 PIPE ARCHES

CULVERT SIZE (Meters) Span x Rise	1¹⁄₂ :1 Slope		2:1 Slope	
	Normal Depth	Increments For Each Add'l. 0.3 m Above Normal	Normal Depth	Increments For Each Add'l. 0.3 m Above Normal
	Cu. Meters	Cu. Meters	Cu. Meters	Cu. Meters
0.91 x 0.91	7.12	3.56	6.92	3.46
0.91 x 1.22	9.82	4.91	9.82	4.91
1.22 x 0.91	9.71	4.86	9.10	4.55
1.22 x 1.22	12.82	6.41	12.51	6.25
1.22 x 1.52	16.29	8.15	16.28	8.14
1.22 x 1.83	20.03	10.01	20.64	10.32
1.52 x 0.91	12.60	6.30	11.54	5.77
1.52 x 1.22	16.09	8.04	15.22	7.61
1.52 x 1.52	19.93	9.96	19.34	9.67
1.52 x 1.83	24.14	12.07	24.07	12.04
1.52 x 2.13	28.80	14.40	29.13	14.57
1.83 x 1.22	19.85	9.93	18.42	9.21
1.83 x 1.52	24.07	12.04	22.85	11.42
1.83 x 1.83	28.77	14.39	27.96	13.98
1.83 x 2.13	33.81	16.91	33.38	16.69
1.83 x 2.44	39.11	19.55	39.45	19.72
2.13 x 1.22	23.87	11.93	21.87	10.94
2.13 x 1.83	33.68	16.84	32.04	16.02
2.13 x 2.44	45.10	22.55	44.25	22.12
2.13 x 3.05	57.41	28.71	57.77	28.89
2.44 x 1.22	28.41	14.20	25.77	12.89
2.44 x 1.83	39.08	19.54	36.60	18.30
2.44 x 2.44	51.27	25.64	49.78	24.89
2.44 x 3.05	64.56	32.28	64.38	32.19
2.74 x 1.22	33.17	16.59	29.87	14.93
2.74 x 1.83	44.78	22.39	41.40	20.70
2.74 x 2.44	57.63	28.81	55.14	27.57
2.74 x 3.05	71.85	35.92	70.55	35.28
2.74 x 3.66	87.57	43.79	87.99	43.99
3.05 x 1.22	38.48	19.24	34.44	17.22
3.05 x 1.83	51.06	25.53	46.71	23.36
3.05 x 2.44	64.58	32.29	61.01	30.51
3.05 x 3.05	79.99	40.00	77.55	38.78
3.05 x 3.66	96.84	48.42	95.99	47.99
3.66 x 1.83	64.12	32.06	57.80	28.90
3.66 x 2.44	79.60	39.80	73.68	36.84
3.66 x 3.05	96.58	48.29	91.69	45.85
3.66 x 3.66	115.36	57.68	111.82	55.91

Table D-10M
STONE FOR EROSION CONTROL FOR BOX CULVERT
ST'D. BS00.6 THRU BS15.0 (No Skew)

CULVERT SIZE (Meters) Span x Rise	1¹⁄₂ :1 Slope		2:1 Slope	
	Normal Depth	Increments For Each Add'l. 0.3 m Above Normal	Normal Depth	Increments For Each Add'l. 0.3 m Above Normal
	Cu. Meters	Cu. Meters	Cu. Meters	Cu. Meters
0.91 x 0.91	7.17	3.58	6.97	3.48
0.91 x 1.22	9.89	4.95	9.89	4.94
1.22 x 0.91	9.78	4.89	9.17	4.58
1.22 x 1.22	12.91	6.46	12.60	6.30
1.22 x 1.52	16.41	8.21	16.39	8.20
1.22 x 1.83	20.17	10.09	20.78	10.39
1.52 x 0.91	12.69	6.34	11.62	5.81
1.52 x 1.22	16.20	8.10	15.34	7.67
1.52 x 1.52	20.08	10.04	19.49	9.75
1.52 x 1.83	24.31	12.16	24.25	12.13
1.52 x 2.13	29.01	14.51	29.34	14.67
1.83 x 1.22	19.99	10.00	18.56	9.28
1.83 x 1.52	24.25	12.12	23.02	11.51
1.83 x 1.83	28.98	14.49	28.17	14.08
1.83 x 2.13	34.06	17.03	33.63	16.81
1.83 x 2.44	39.39	19.69	39.73	19.86
2.13 x 1.22	24.03	12.02	22.04	11.02
2.13 x 1.83	33.92	16.96	32.29	16.14
2.13 x 2.44	45.43	22.71	44.58	22.29
2.13 x 3.05	57.83	28.91	58.18	29.09
2.44 x 1.22	28.60	14.30	25.96	12.98
2.44 x 1.83	39.37	19.68	36.88	18.44
2.44 x 2.44	51.65	25.83	50.16	25.08
2.44 x 3.05	65.03	32.52	64.86	32.43
2.74 x 1.22	33.38	16.69	30.08	15.04
2.74 x 1.83	45.10	22.55	41.72	20.86
2.74 x 2.44	58.05	29.03	55.56	27.78
2.74 x 3.05	72.38	36.19	71.08	35.54
2.74 x 3.66	88.21	44.10	88.62	44.31
3.05 x 1.22	38.72	19.36	34.68	17.34
3.05 x 1.83	51.41	25.71	47.07	23.53
3.05 x 2.44	65.05	32.53	61.49	30.74
3.05 x 3.05	80.58	40.29	78.14	39.07
3.05 x 3.66	97.55	48.77	96.70	48.35
3.66 x 1.83	64.54	32.27	58.23	29.11
3.66 x 2.44	80.16	40.08	74.24	37.12
3.66 x 3.05	97.29	48.64	92.40	46.20
3.66 x 3.66	116.21	58.11	112.67	56.33

Table D-11M
STONE FOR EROSION CONTROL FOR BOX CULVERT
ST'D. BS00.6 THRU BS15.0 (15° Skew)

CULVERT SIZE (Meters) Span x Rise	1¹/₂ :1 Slope		2:1 Slope	
	Normal Depth	Increments For Each Add'l. 0.3 m Above Normal	Normal Depth	Increments For Each Add'l. 0.3 m Above Normal
	Cu. Meters	Cu. Meters	Cu. Meters	Cu. Meters
0.91 x 0.91	7.40	3.70	7.24	3.62
0.91 x 1.22	10.28	5.14	10.39	5.20
1.22 x 0.91	10.00	5.00	9.41	4.70
1.22 x 1.22	13.35	6.68	13.10	6.55
1.22 x 1.52	17.08	8.54	17.27	8.63
1.22 x 1.83	21.31	10.66	22.15	11.08
1.52 x 0.91	12.89	6.45	11.83	5.92
1.52 x 1.22	16.60	8.30	15.79	7.89
1.52 x 1.52	20.72	10.36	20.29	10.14
1.52 x 1.83	25.39	12.69	25.52	12.76
1.52 x 2.13	30.41	15.21	31.10	15.55
1.83 x 1.22	20.40	10.20	18.97	9.49
1.83 x 1.52	24.87	12.44	23.74	11.87
1.83 x 1.83	29.99	14.99	29.34	14.67
1.83 x 2.13	35.42	17.71	35.28	17.64
1.83 x 2.44	41.30	20.65	42.04	21.02
2.13 x 1.22	24.45	12.23	22.41	11.21
2.13 x 1.83	34.83	17.42	33.36	16.68
2.13 x 2.44	47.11	23.56	46.77	23.38
2.13 x 3.05	60.92	30.46	62.13	31.06
2.44 x 1.22	29.02	14.51	26.31	13.15
2.44 x 1.83	40.24	20.12	37.85	18.92
2.44 x 2.44	53.40	26.70	52.28	26.14
2.44 x 3.05	68.22	34.11	68.72	34.36
2.74 x 1.22	33.82	16.91	30.40	15.20
2.74 x 1.83	45.93	22.96	42.61	21.31
2.74 x 2.44	59.72	29.86	57.54	28.77
2.74 x 3.05	75.41	37.71	74.73	37.37
2.74 x 3.66	92.78	46.39	94.24	47.12
3.05 x 1.22	39.16	19.58	34.96	17.48
3.05 x 1.83	52.19	26.10	47.88	23.94
3.05 x 2.44	66.65	33.32	63.36	31.68
3.05 x 3.05	83.47	41.73	81.65	40.83
3.05 x 3.66	101.95	50.98	102.18	51.09
3.66 x 1.83	65.13	32.56	58.80	29.40
3.66 x 2.44	81.60	40.80	75.80	37.90
3.66 x 3.05	99.86	49.93	95.46	47.73
3.66 x 3.66	120.29	60.15	117.72	58.86

Table D-12M

STONE FOR EROSION CONTROL FOR BOX CULVERT
ST'D. BS00.6 THRU BS15.0 (30° Skew)

CULVERT SIZE (Meters) Span x Rise	1½ :1 Slope		2:1 Slope	
	Normal Depth	Increments For Each Add'l. 0.3 m Above Normal	Normal Depth	Increments For Each Add'l. 0.3 m Above Normal
	Cu. Meters	Cu. Meters	Cu. Meters	Cu. Meters
0.91 x 0.91	7.79	3.89	7.62	3.81
0.91 x 1.22	10.80	5.40	10.91	5.46
1.22 x 0.91	10.52	5.26	9.93	4.96
1.22 x 1.22	14.05	7.02	13.80	6.90
1.22 x 1.52	17.73	8.87	18.13	9.07
1.22 x 1.83	22.36	11.18	23.19	11.60
1.52 x 0.91	13.54	6.77	12.48	6.24
1.52 x 1.22	17.47	8.74	16.66	8.33
1.52 x 1.52	21.80	10.90	21.37	10.68
1.52 x 1.83	26.69	13.34	26.82	13.41
1.52 x 2.13	31.93	15.96	32.61	16.30
1.83 x 1.22	21.44	10.72	20.01	10.01
1.83 x 1.52	26.17	13.09	25.04	12.52
1.83 x 1.83	31.55	15.78	30.90	15.45
1.83 x 2.13	37.24	18.62	37.10	18.55
1.83 x 2.44	43.38	21.69	44.13	22.07
2.13 x 1.22	25.66	12.83	23.63	11.81
2.13 x 1.83	36.65	18.33	35.18	17.59
2.13 x 2.44	49.54	24.77	49.20	24.60
2.13 x 3.05	63.95	31.98	65.16	32.58
2.44 x 1.22	30.41	15.21	27.70	13.85
2.44 x 1.83	42.33	21.16	39.94	19.97
2.44 x 2.44	56.18	28.09	55.06	27.53
2.44 x 3.05	71.70	35.85	72.20	36.10
2.74 x 1.22	35.38	17.69	31.96	15.98
2.74 x 1.83	48.27	24.14	44.96	22.48
2.74 x 2.44	62.85	31.42	60.66	30.33
2.74 x 3.05	79.32	39.66	78.64	39.32
2.74 x 3.66	97.46	48.73	98.92	49.46
3.05 x 1.22	40.90	20.45	36.70	18.35
3.05 x 1.83	54.80	27.40	50.49	25.24
3.05 x 2.44	70.12	35.06	66.84	33.42
3.05 x 3.05	87.81	43.91	86.00	43.00
3.05 x 3.66	107.17	53.58	107.40	53.70
3.66 x 1.83	68.26	34.13	61.93	30.96
3.66 x 2.44	85.77	42.89	79.97	39.99
3.66 x 3.05	105.07	52.54	100.67	50.34
3.66 x 3.66	126.55	63.27	123.98	61.99

Table D-13M

STONE FOR EROSION CONTROL FOR BOX CULVERT
ST'D. BS00.6 THRU BS15.0 (45° Skew)

CULVERT SIZE (Meters) Span x Rise	No Skew	15° Skew	30° Skew	45° Skew
	Cu. Meters	Cu. Meters	Cu. Meters	Cu. Meters
0.91 x 0.91	1.90	1.97	2.21	2.69
0.91 x 1.22	2.65	2.74	3.08	3.71
1.22 x 0.91	2.33	2.41	2.69	3.29
1.22 x 1.22	3.12	3.23	3.60	4.41
1.22 x 1.52	3.89	4.03	4.48	5.71
1.22 x 1.83	4.68	4.84	5.40	6.62
1.52 x 0.91	2.82	2.92	3.26	3.98
1.52 x 1.22	3.78	3.91	4.37	5.34
1.52 x 1.52	4.71	4.87	5.43	6.65
1.52 x 1.83	5.67	5.87	6.54	8.01
1.52 x 2.13	6.60	6.83	7.62	9.32
1.83 x 1.22	4.46	4.62	5.15	6.31
1.83 x 1.52	5.61	5.81	6.49	7.93
1.83 x 1.83	6.86	7.10	7.90	9.64
1.83 x 2.13	8.08	8.35	9.36	11.38
1.83 x 2.44	8.91	9.23	10.30	12.61
2.13 x 1.22	5.12	5.30	5.91	7.24
2.13 x 1.83	7.77	8.03	8.96	10.95
2.13 x 2.44	10.55	10.92	12.22	14.87
2.13 x 3.05	13.37	13.82	15.49	18.81
2.44 x 1.22	5.80	6.00	6.69	8.20
2.44 x 1.83	8.70	9.00	10.04	12.29
2.44 x 2.44	11.60	12.01	13.39	16.40
2.44 x 3.05	14.50	15.01	16.74	20.50
2.74 x 1.22	6.46	6.69	7.45	9.13
2.74 x 1.83	9.69	10.03	11.19	13.70
2.74 x 2.44	12.91	13.37	15.03	18.38
2.74 x 3.05	16.53	17.10	19.13	23.31
2.74 x 3.66	20.00	20.69	23.15	28.18
3.05 x 1.22	7.14	7.39	8.24	10.09
3.05 x 1.83	10.71	11.09	12.37	15.14
3.05 x 2.44	14.28	14.78	16.48	20.19
3.05 x 3.05	17.85	18.48	20.60	25.24
3.05 x 3.66	21.41	22.16	24.73	30.28
3.66 x 1.83	12.72	13.17	14.68	17.98
3.66 x 2.44	16.95	17.55	19.58	23.98
3.66 x 3.05	21.19	21.94	24.47	29.97
3.66 x 3.66	25.43	26.33	29.36	35.96

Table D-14M
STONE FOR EROSION CONTROL FOR MULTIPLE BOX CULVERTS
(Increments For Each Additional Barrel)

DISPLACEMENT QUANTITIES FOR PIPE OPENINGS
(To be used with standard JB-1 Junction Box)

PIPE SIZE	PIPE CLASS	CONCRETE				REINFORCING STEEL
		0° CU. METERS	15° CU. METERS	30° CU. METERS	45° CU. METERS	Kg
300 mm	III, IV, V	0.03	0.03	0.03	0.04	8.0
	C. M.	0.01	0.02	0.02	0.02	5.0
375 mm	III, IV, V	0.04	0.04	0.04	0.05	11.3
	C. M.	0.02	0.02	0.03	0.03	7.2
450 mm	III, IV, V	0.05	0.06	0.06	0.08	15.1
	C. M.	0.03	0.03	0.04	0.05	9.8
600 mm	III, IV, V	0.09	0.09	0.10	0.13	24.3
	C. M.	0.06	0.06	0.07	0.08	16.3
750 mm	III, IV, V	0.14	0.14	0.16	0.20	35.7
	C. M.	0.09	0.09	0.10	0.13	24.3
900 mm	III, IV, V	0.19	0.20	0.22	0.28	49.3
	C. M.	0.13	0.13	0.15	0.19	33.9
1050 mm	III, IV, V	0.26	0.27	0.30	0.37	65.0
	C. M.	0.18	0.18	0.20	0.25	45.2
1200 mm	III, IV, V	0.34	0.35	0.39	0.48	83.0
	C. M.	0.23	0.24	0.27	0.33	58.0
1350 mm	III & IV	0.42	0.44	0.49	0.60	103.1
	V	0.44	0.46	0.51	0.63	107.7
	C. M.	0.29	0.30	0.34	0.42	72.4
1500 mm	III & IV	0.52	0.54	0.60	0.74	125.4
	V	0.54	0.56	0.63	0.77	130.5
	C. M.	0.36	0.37	0.42	0.51	88.5
1650 mm	III & IV	0.63	0.65	0.72	0.89	149.9
	V	0.65	0.67	0.75	0.93	155.5
	C. M.	0.44	0.45	0.51	0.62	106.2
1800 mm	III & IV	0.74	0.77	0.86	1.06	176.6
	V	0.77	0.80	0.89	1.09	182.6
	C. M.	0.52	0.54	0.60	0.74	125.4

TABLE D-15M
ADJUSTMENT QUANTITIES FOR JUNCTION BOX

PROJECT _____   STATION _____

1. Grade Elevation _____
2. Minus Inv. Elev. _____
3. Vertical Difference _____
4. Minus Pipe Size (m) _____
5. Difference _____

If Line 5 is over 1.62 m, use Type A Tower
If Line 5 is 0.96 m to 1.62 m, use Type B Tower
If Line 5 is 0.71 m to 0.96 m, use Type C Tower

Increase above dimensions by 0.30 m for use with 1800 mm pipe.

CHAMBER

	CONCRETE CU. METERS	REINFORCING STEEL Kg

6. Type _____   Pipe Size _____   Turn Angle _____

Less: Pipe Openings

7. Size _____   Class _____   Defl. Angle _____
8. Size _____   Class _____   Defl. Angle _____
9. Size _____   Class _____   Defl. Angle _____
10. Size _____   Class _____   Defl. Angle _____

11. Total Deductions (Lines 7-10)

12. Quantities for Chamber
(Subtract Line 11 from Line 6 and Transfer to Line 17)

See Standard JB-1

See Table D-27

TOWER

13. Type _____   x Height _____
   x 1200 mm Pipe = Line 3 minus 1.93 m
   x 1350 mm Pipe = Line 3 minus 2.08 m
   x 1500 mm Pipe = Line 3 minus 2.23 m
   x 1650 mm Pipe = Line 3 minus 2.39 m
   x 1800 mm Pipe = Line 3 minus 2.84 m

Min. Height
Type A = 0.91 m
Type B = 0.25 m
Type C = 0.0 m

14. Minimum Height Quantities

15. (Line 13 less Min. Height) x increment per meter

16. Quantities for tower (Add Lines 14 & 15)

17. Quantities for Chamber (Line 12)

18. Total Concrete and Reinforcing Steel (Add Lines 16 & 17)

STRUCTURAL STEEL QUANTITY (Kg)

FIGURE D-1M
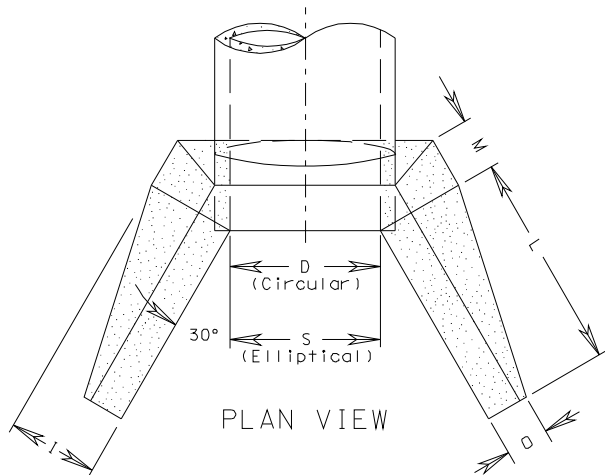### COMPUTATIONS FOR STANDARD JB-1 JUNCTION BOX
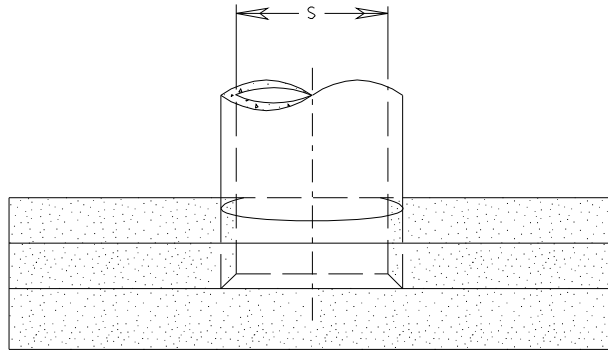
PLAN VIEW

Area for computing ratio

Standard	(S) Span of Culvert (mm)	Area (A) Conc. or C. M. Square Meters
EW-1A	1250	2.26
	1345	2.48

Area is given for one endwall.
Double area shown if two endwalls are used.

TO DETERMINE RATIO	$\dfrac{A}{S \text{ (meters) X Length of Culvert}}$

Table D-16M
COMPUTATIONS OF RATIOS FOR MINOR STRUCTURE EXCAVATION
STANDARD EW-1A

PLAN VIEW

Area for computing ratio

(D) Diameter* of Culvert (mm)	Area (A)	
	1 1/2 :1 Slope Sq.Meters	2:1 Slope Sq.Meters
1200	2.48	3.12
1350	3.06	3.83
1500	3.65	4.56
1650	4.35	5.42
1800	5.09	6.35
1950	5.86	7.39
2100	6.65	8.42

(S) Span* of Culvert (mm)	Area (A)	
	1 1/2 :1 Slope Sq.Meters	2:1 Slope Sq.Meters
1535	2.15	2.64
1730	2.15	2.64
1920	2.48	3.12
2110	3.06	3.83
2305	3.65	4.56
2495	4.35	5.42
2690	5.09	6.35

Area is given for one endwall.
Double area shown if two endwalls are used.
* Nominal sizes are shown. See standard
for actual "D" and "S" dimensions.

TO DETERMINE RATIO	$\dfrac{A}{D \text{ or } S \text{ (meters)} \times \text{Length of Culvert}}$

Table D-17M
COMPUTATIONS OF RATIOS FOR MINOR STRUCTURE EXCAVATION
STANDARDS EW-2, EW-2A
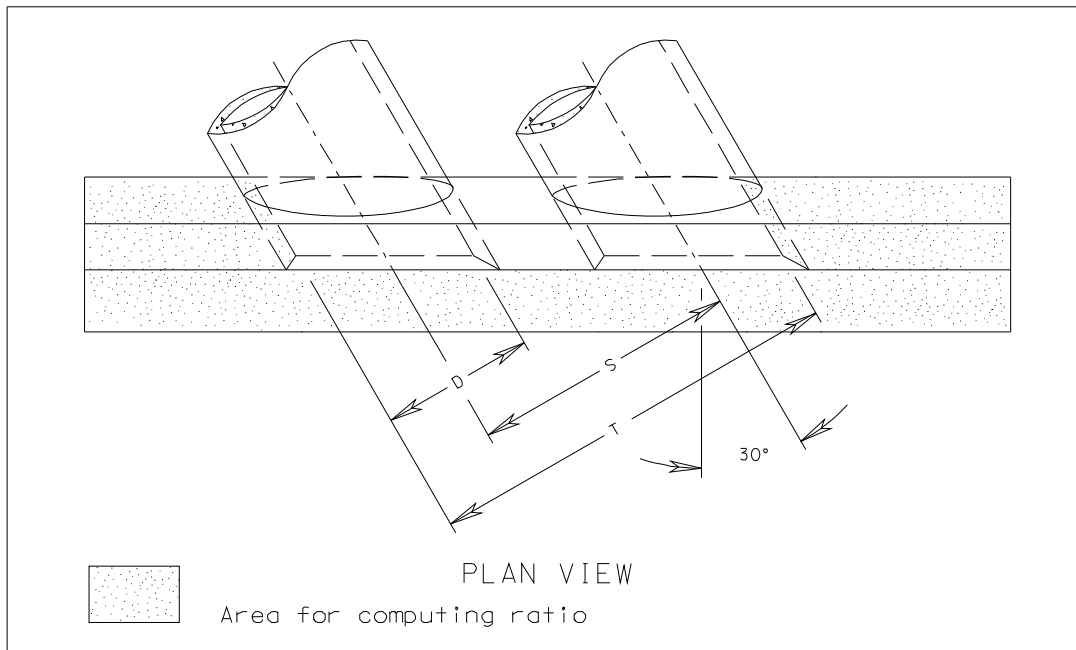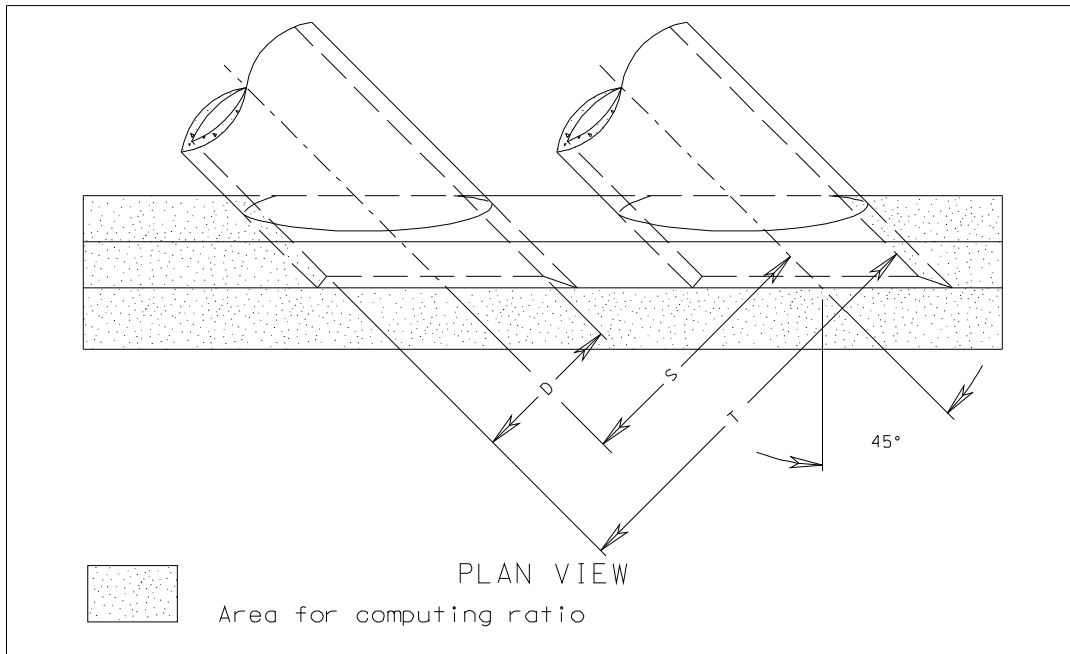
30°

30°   30°

PLAN VIEW

Area for computing ratio
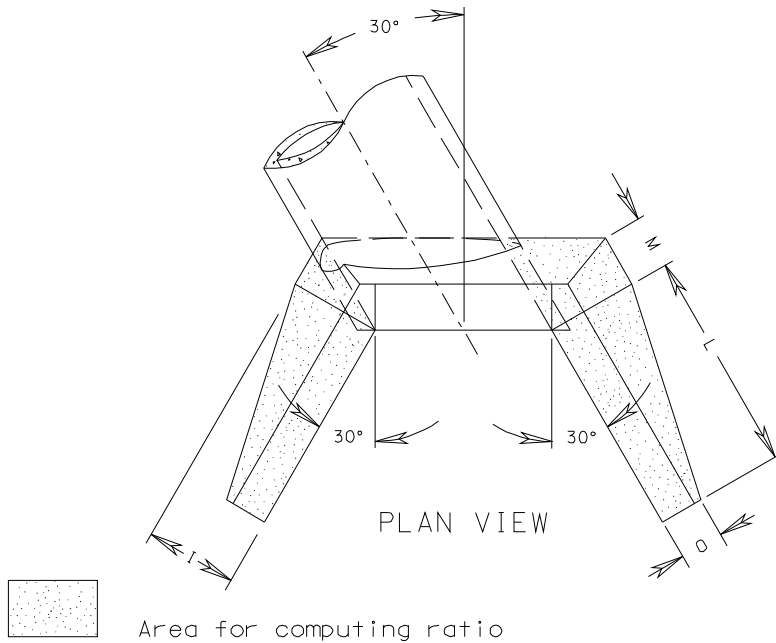
(D) Diameter* of Culvert (mm)	Area (A)	
	1 $\frac{1}{2}$:1 Slope	2:1 Slope
	Sq.Meters	Sq.Meters
1200	2.49	3.12
1350	3.06	3.83
1500	3.66	4.57
1650	4.35	5.43
1800	5.10	6.36
1950	5.86	7.39
2100	6.66	8.43

Area is given for one endwall.
Double area shown if two endwalls are used.
* Nominal sizes are shown. See St'd. EW-2
for actual "D" dimension.

TO DETERMINE RATIO	$\dfrac{A}{D \text{ (meters) X Length of Culvert}}$

Table D-18M
COMPUTATIONS OF RATIOS FOR MINOR STRUCTURE EXCAVATION
STANDARD EW-2S (30°)

45°

M_45

L_45

30°   45°

O_45

PLAN VIEW

O_45 = O + 16 mm

Area for computing ratio

(D) Diameter* of Culvert (mm)	Area (A)	
	$1\frac{1}{2}:1$ Slope Sq.Meters	2:1 Slope Sq.Meters
1200	2.96	3.71
1350	3.61	4.54
1500	4.31	5.46
1650	5.14	6.46
1800	5.97	7.54
1950	6.96	8.81
2100	7.88	10.00

Area is given for one endwall.
Double area shown if two endwalls are used.
* Nominal sizes are shown. See St'd. EW-2
for actual "D" dimension.

TO DETERMINE RATIO	$\dfrac{A}{D \text{ (meters) X Length of Culvert}}$

Table D-19M
COMPUTATIONS OF RATIOS FOR MINOR STRUCTURE EXCAVATION
STANDARD EW-2S (45°)

PLAN VIEW

Area for computing ratio

(D) Diameter of Culvert (mm)	Area (A)					
	Double Line		Triple Line		Quadruple Line	
	Conc.	C.M.	Conc.	C.M.	Conc.	C.M.
	Sq.Meters	Sq.Meters	Sq.Meters	Sq.Meters	Sq.Meters	Sq.Meters
375			0.81	0.78	0.91	0.87
450	0.92	0.90	1.04	1.01	1.16	1.11
600	1.56	1.54	1.79	1.74	2.01	1.93
750	2.22	2.18	2.52	2.45	2.82	2.71
900	2.82	2.78	3.16	3.08	3.51	3.39
	Culvert Width (T)					
	Meters	Meters	Meters	Meters	Meters	Meters
375			1.735	1.555	2.415	2.145
450	1.260	1.160	2.070	1.870	2.880	2.580
600	1.660	1.540	2.720	2.480	3.780	3.420
750	2.070	1.910	3.390	3.070	4.710	4.230
900	2.470	2.290	4.040	3.680	5.610	5.070

Area is given for one endwall.
Double area shown if two endwalls are used.

TO DETERMINE RATIO	$\dfrac{A}{T \text{ (meters) X Length of Culvert}}$

Table D-20M
COMPUTATIONS OF RATIOS FOR MINOR STRUCTURE EXCAVATION
STANDARD EW-6

PLAN VIEW

Area for computing ratio

(D) Diameter of Culvert (mm)	Area (A)					
	Double Line		Triple Line		Quadruple Line	
	Conc.	C.M.	Conc.	C.M.	Conc.	C.M.
	Sq.Meters	Sq.Meters	Sq.Meters	Sq.Meters	Sq.Meters	Sq.Meters
375			0.82	0.79	0.94	0.89
450	0.91	0.89	1.05	1.01	1.19	1.14
600	1.56	1.53	1.81	1.75	2.07	1.98
750	2.20	2.16	2.55	2.47	2.90	2.78
900	2.79	2.74	3.19	3.09	3.59	3.45
	Culvert Width (T)					
	Meters	Meters	Meters	Meters	Meters	Meters
375			1.735	1.555	2.415	2.145
450	1.260	1.160	2.070	1.870	2.880	2.580
600	1.660	1.540	2.720	2.480	3.780	3.420
750	2.070	1.910	3.390	3.070	4.710	4.230
900	2.470	2.290	4.040	3.680	5.610	5.070

Area is given for one endwall.
Double area shown if two endwalls are used.

TO DETERMINE RATIO	$\dfrac{A}{T \text{ (meters)} \times \text{Length of Culvert}}$

Table D-21M
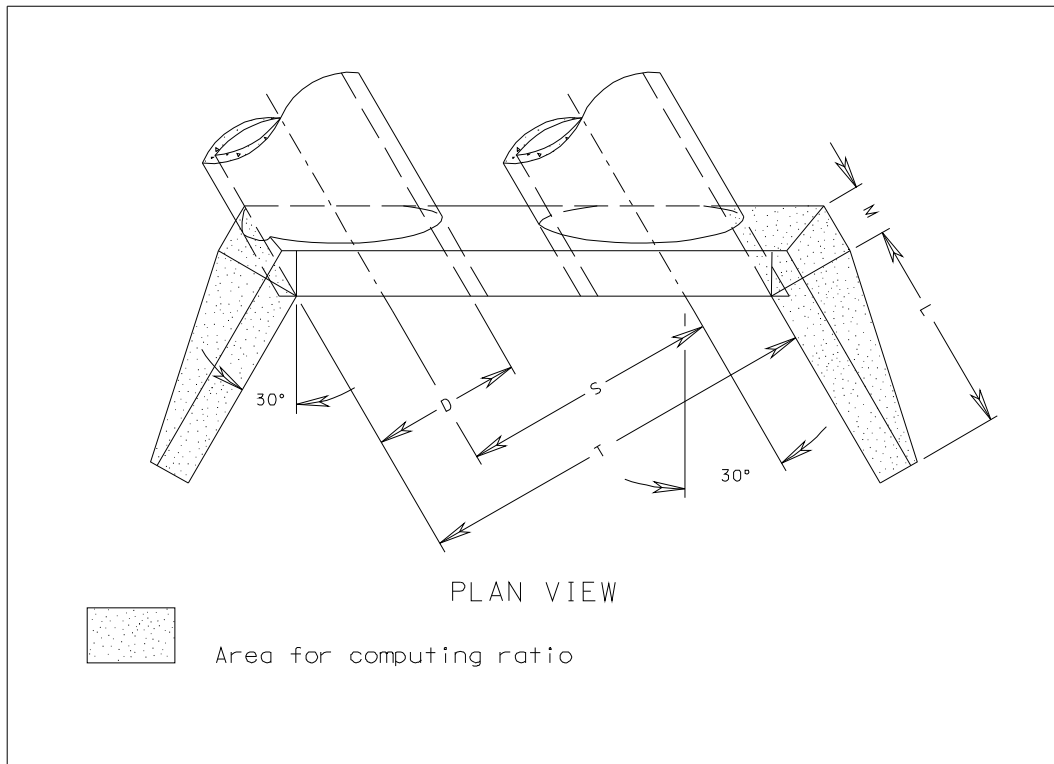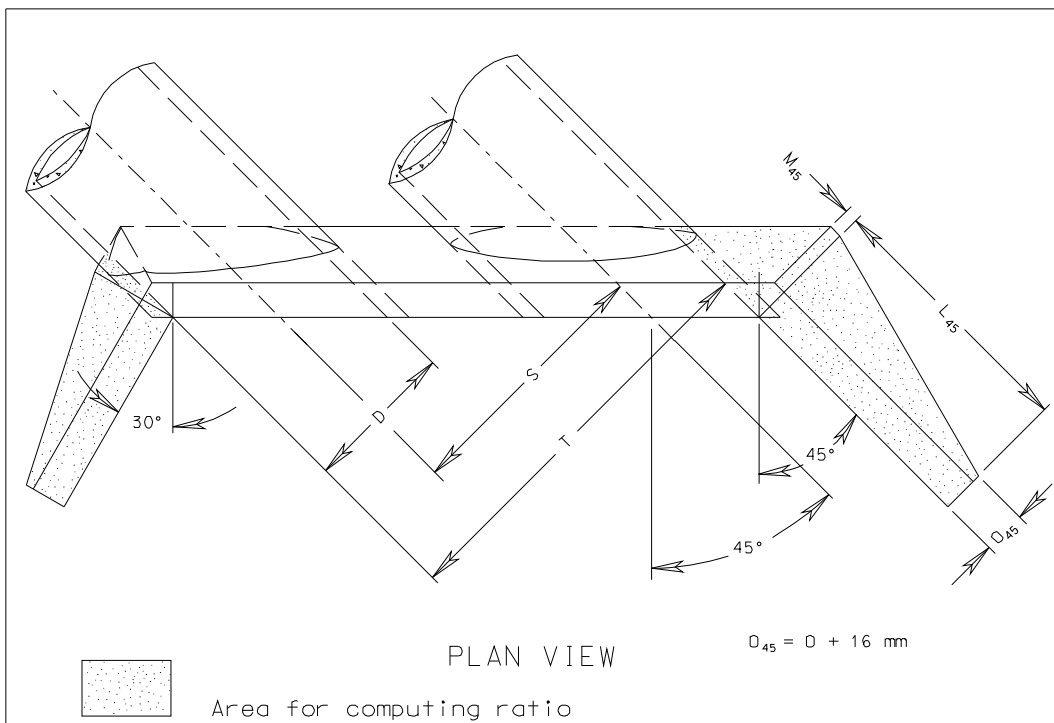COMPUTATIONS OF RATIOS FOR MINOR STRUCTURE EXCAVATION
STANDARD EW-6 (30°)

PLAN VIEW

Area for computing ratio

(D) Diameter of Culvert (mm)	Area (A)					
	Double Line		Triple Line		Quadruple Line	
	Conc.	C.M.	Conc.	C.M.	Conc.	C.M.
	Sq.Meters	Sq.Meters	Sq.Meters	Sq.Meters	Sq.Meters	Sq.Meters
375			0.84	0.81	0.98	0.93
450	0.89	0.87	1.07	1.02	1.24	1.18
600	1.54	1.51	1.86	1.79	2.17	2.07
750	2.18	2.13	2.60	2.50	3.03	2.88
900	2.73	2.68	3.22	3.11	3.71	3.54
	Culvert Width (T)					
	Meters	Meters	Meters	Meters	Meters	Meters
375			1.735	1.555	2.415	2.145
450	1.260	1.160	2.070	1.870	2.880	2.580
600	1.660	1.540	2.720	2.480	3.780	3.420
750	2.070	1.910	3.390	3.070	4.710	4.230
900	2.470	2.290	4.040	3.680	5.610	5.070

Area is given for one endwall.
Double area shown if two endwalls are used.

TO DETERMINE RATIO	$\dfrac{A}{T \text{ (meters) X Length of Culvert}}$

Table D-22M
COMPUTATIONS OF RATIOS FOR MINOR STRUCTURE EXCAVATION
STANDARD EW-6S (45°)

PLAN VIEW

Area for computing ratio

(D) Diameter* of Culvert (mm)	Area (A)		Culvert Width (T)					
	1 1/2:1 Slope	2:1 Slope	Double Line		Triple Line		Quadruple Line	
			Conc.	C.M.	Conc.	C.M.	Conc.	C.M.
	Sq.Meters	Sq.Meters	Meters	Meters	Meters	Meters	Meters	Meters
1050	2.14	2.64	2.890	2.680	4.710	4.290	6.530	5.900
1200	2.48	3.12	3.300	3.060	5.380	4.900	7.460	6.740
1350	3.06	3.83	3.700	3.440	6.030	5.510	8.360	7.580
1500	3.65	4.56	4.110	3.820	6.700	6.110	9.290	8.400
1650	4.35	5.42	4.520	4.200	7.360	6.720	10.200	9.240
1800	5.09	6.35	4.920	4.580	8.010	7.330	11.100	10.080
1950	5.86	7.39	5.330	4.960	8.680	7.940	12.030	10.920
2100	6.64	8.42	5.740	5.340	9.340	8.550	12.940	11.760

Area is given for one endwall.
Double area shown if two endwalls are used.
* Nominal sizes are shown. See St'd. EW-2
for actual "D" dimension.

TO DETERMINE RATIO	$\dfrac{A}{T \text{ (meters) X Length of Culvert}}$

Table D-23M
COMPUTATIONS OF RATIOS FOR MINOR STRUCTURE EXCAVATION
STANDARD EW-7

PLAN VIEW

Area for computing ratio

(D) Diameter* of Culvert (mm)	Area (A)		Culvert Width (T)					
	1 1/2:1 Slope	2:1 Slope	Double Line		Triple Line		Quadruple Line	
			Conc.	C.M.	Conc.	C.M.	Conc.	C.M.
	Sq.Meters	Sq.Meters	Meters	Meters	Meters	Meters	Meters	Meters
1050	2.14	2.64	2.890	2.680	4.710	4.290	6.530	5.900
1200	2.48	3.12	3.300	3.060	5.380	4.900	7.460	6.740
1350	3.06	3.83	3.700	3.440	6.030	5.510	8.360	7.580
1500	3.66	4.57	4.110	3.820	6.700	6.110	9.290	8.400
1650	4.35	5.43	4.520	4.200	7.360	6.720	10.200	9.240
1800	5.09	6.35	4.920	4.580	8.010	7.330	11.100	10.080
1950	5.86	7.39	5.330	4.960	8.680	7.940	12.030	10.920
2100	6.65	8.42	5.740	5.340	9.340	8.550	12.940	11.760

Area is given for one endwall.
Double area shown if two endwalls are used.
* Nominal sizes are shown. See St'd. EW-2
for actual "D" dimension.

TO DETERMINE RATIO	$\dfrac{A}{T \text{ (meters) X Length of Culvert}}$

Table D-24M
COMPUTATIONS OF RATIOS FOR MINOR STRUCTURE EXCAVATION
STANDARD EW-7S (30°)

PLAN VIEW

$O_{45} = O + 16$ mm

Area for computing ratio

(D) Diameter* of Culvert (mm)	Area (A)		Culvert Width (T)					
	1 1/2 :1 Slope	2:1 Slope	Double Line		Triple Line		Quadruple Line	
			Conc.	C.M.	Conc.	C.M.	Conc.	C.M.
	Sq.Meters	Sq.Meters	Meters	Meters	Meters	Meters	Meters	Meters
1050	2.51	3.11	2.890	2.680	4.710	4.290	6.530	5.900
1200	2.96	3.71	3.300	3.060	5.380	4.900	7.460	6.740
1350	3.61	4.54	3.700	3.440	6.030	5.510	8.360	7.580
1500	4.31	5.46	4.110	3.820	6.700	6.110	9.290	8.400
1650	5.14	6.46	4.520	4.200	7.360	6.720	10.200	9.240
1800	5.97	7.54	4.920	4.580	8.010	7.330	11.100	10.080
1950	6.96	8.81	5.330	4.960	8.680	7.940	12.030	10.920
2100	7.88	10.00	5.740	5.340	9.340	8.550	12.940	11.760

Area is given for one endwall.
Double area shown if two endwalls are used.
* Nominal sizes are shown. See St'd. EW-2
for actual "D" dimension.

TO DETERMINE RATIO	$\dfrac{A}{T \text{ (meters) X Length of Culvert}}$

Table D-25M
COMPUTATIONS OF RATIOS FOR MINOR STRUCTURE EXCAVATION
STANDARD EW-7S (45°)
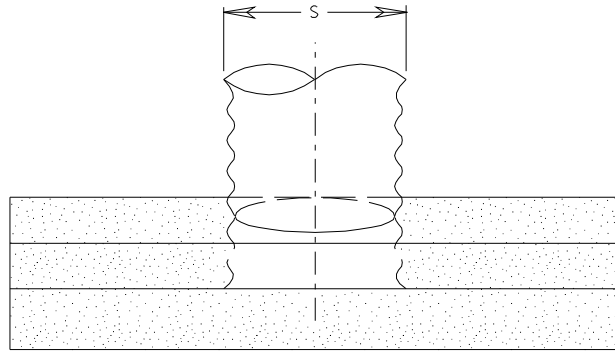
PLAN VIEW

Area for computing ratio

(S) Span of Culvert (mm)	Area (A)
	Sq. Meters
1225	2.11
* 1150	2.15
1425	2.63
* 1325	2.69

Area is given for one endwall.
Double area shown if two endwalls are used.
* 75 mm x 25 mm corrugation dimension.

TO DETERMINE RATIO	$\dfrac{A}{S \text{ (meters) X Length of Culvert}}$

Table D—26M
COMPUTATIONS OF RATIOS FOR MINOR STRUCTURE EXCAVATION
STANDARD EW—9
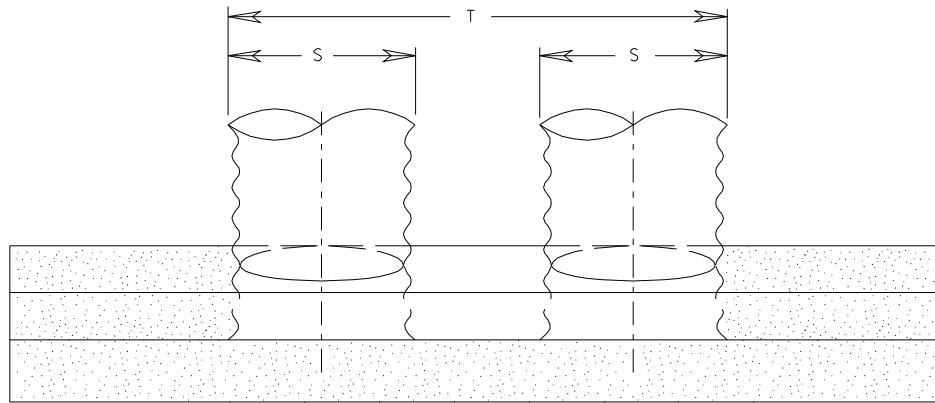
PLAN VIEW

Area for computing ratio

(S) Diameter of Culvert (mm)	Area (A)			Culvert Width (T)		
	Double Line	Triple Line	Quadruple Line	Double Line	Triple Line	Quadruple Line
	Sq.Meters	Sq.Meters	Sq.Meters	Meters	Meters	Meters
525	0.58	0.68	0.79	1.385	2.245	3.105
600	0.83	0.96	1.09	1.540	2.480	3.420
700	1.01	1.17	1.33	1.740	2.780	3.820
875	1.57	1.82	2.08	2.095	3.315	4.535
1050	2.17	2.51	2.84	2.520	3.990	5.460
*1000	2.19	2.53	2.87	2.470	3.940	5.410
1225	2.51	2.90	3.29	2.925	4.625	6.325
*1150	2.55	2.94	3.33	2.850	4.550	6.250
1425	3.05	3.49	3.92	3.405	5.385	7.365
*1325	3.11	3.55	3.98	3.305	5.285	7.265

Area is given for one endwall.

Double area shown if two endwalls are used.

* 75 mm x 25 mm corrugation dimensions.

TO DETERMINE RATIO	$\dfrac{A}{T \text{ (meters) X Length of Culvert}}$

Table D-27M

COMPUTATIONS OF RATIOS FOR MINOR STRUCTURE EXCAVATION

STANDARD EW-10
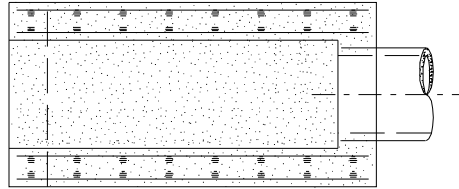
PLAN VIEW

Area for computing ratio

(D) Diameter of Culvert (mm)	Area (A)		
	3:1 Slope	4:1 Slope	6:1 Slope
	Sq.Meters	Sq.Meters	Sq.Meters
1220	10.50	13.77	20.31
1370	13.25	17.40	25.70
1520	14.40	18.30	28.05

TO DETERMINE RATIO	$\dfrac{A}{D \text{ (meters) X Length of Culvert}}$

Table D-28M
COMPUTATIONS OF RATIOS FOR MINOR STRUCTURE EXCAVATION
STANDARD EW-11
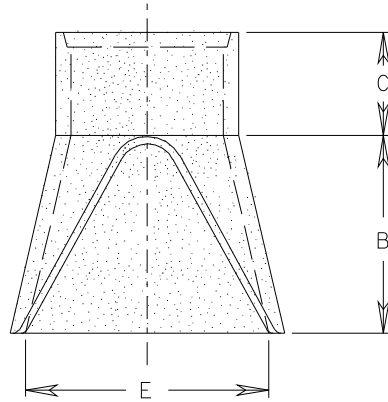
PLAN VIEW

Area for computing ratio

(D) Span of Culvert (mm)	Area (A)
	Sq. Meters
1200	4.44
1350	4.81
1500	5.22

Area is given for one end section.
Double area shown if two end sections are used.

TO DETERMINE RATIO	$\dfrac{A}{D \text{ (meters) X Length of Culvert}}$

Table D-29M
COMPUTATIONS OF RATIOS FOR MINOR STRUCTURE EXCAVATION
STANDARD ES-1

Dia.

Pay Line

Connector Section

C

B

L

Skirt Section

20°
Approx.

A

W

A

PLAN VIEW
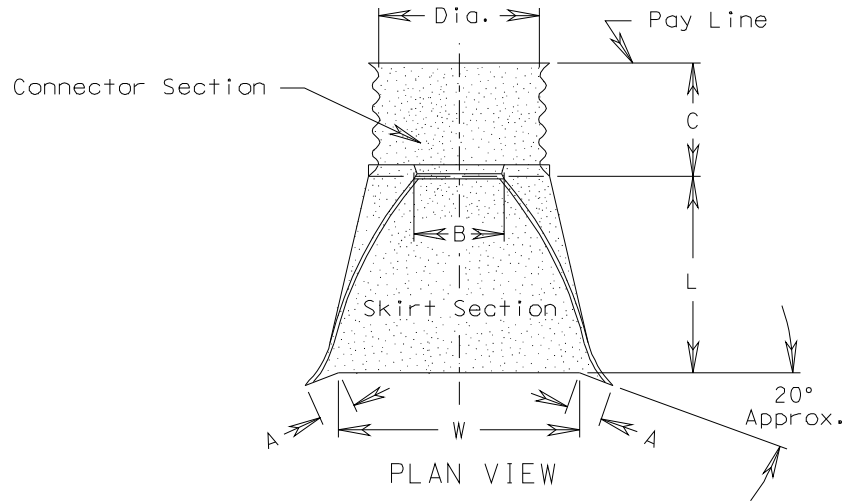
Area for computing ratio

(D) Span of Culvert (mm)	Area (A)
	Sq. Meters
1200	4.90
1350	5.81
1500	6.56

Area is given for one end section.
Double area shown if two end sections are used.

TO DETERMINE RATIO	$\dfrac{A}{D \text{ (meters) X Length of Culvert}}$

Table D-30M
COMPUTATIONS OF RATIOS FOR MINOR STRUCTURE EXCAVATION
STANDARD ES-2

PLAN VIEW
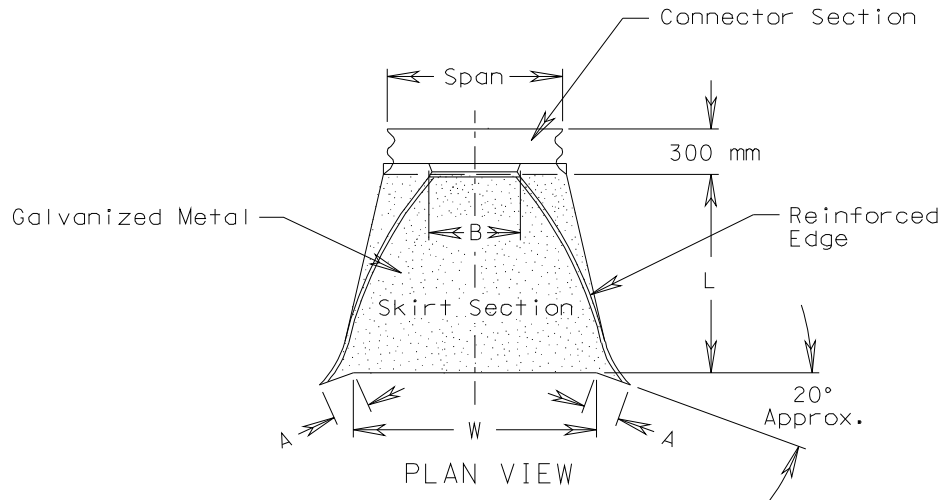
Area for computing ratio

(S) Span of Culvert (mm)	Area (A) 75 mm X 25 mm Corr. Sq.Meters	(S) Span of Culvert (mm)	Area (A) 68 mm X 13 mm Corr. Sq.Meters
1150	2.56	1150	3.29
1325	3.44	1390	4.29
1500	4.39	1630	5.42
1650	5.44		

Area is given for one end section.
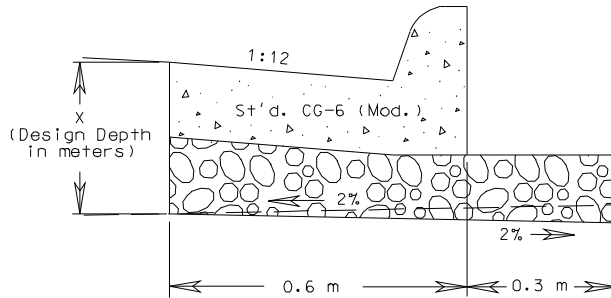Double area shown if two end sections are used.

TO DETERMINE RATIO	A / S (meters) X Length of Culvert

Table D-31M
COMPUTATIONS OF RATIOS FOR MINOR STRUCTURE EXCAVATION
STANDARD ES-3

1:12

X
(Design Depth
in meters)

St'd. CG-6

2%

2%

0.75 m

0.3 m
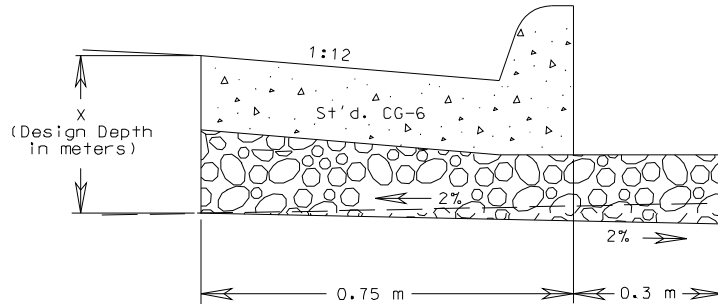
AREA (m²)

Normal = (1.05)(X) − 0.2123

Super = (1.05)(X) − 0.2343

0.75 m CURB AND GUTTER

1:12

X
(Design Depth
in meters)

St'd. CG-6 (Mod.)

2%

2%

0.6 m

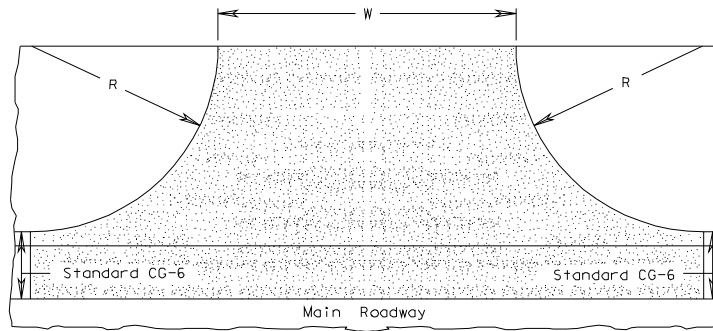0.3 m

AREA (m²)

Normal = (0.9)(X) − 0.1767

Super = (0.9)(X) − 0.2091

0.6 m CURB AND GUTTER

Figure D-2M
SUBBASE END AREAS AT CURB AND GUTTER LOCATION

W = Width of Entrance

Area for computing ratio

Width of Entrance (Meters)	No Accessible Route (R = 1.35 m)	Accessible Route (R = 2.25 m)
	Sq.Meters	Sq.Meters
4	11.21	17.55
5	13.31	20.55
6	15.41	23.55
7	17.51	26.55
8	19.61	29.55
9	21.71	32.55
10	23.81	35.55
11	25.91	38.55
12	28.01	41.55
13	30.11	44.55
14	32.21	47.55
15	34.31	50.55
Each Additional 0.1 m	0.21	0.30

Table D-32M
AREAS FOR ENTRANCE GUTTER
STANDARD CG-9D

900 I.D. MANHOLE

PIPE SIZE	375	450	525
375	86°	81°	72°
450		75°	65°
525			58°
600			
675			
750			
825			
900			
1050			
1200			

1200 I.D. MANHOLE

PIPE SIZE	375	450	525	600
375	119°	115°	111°	105°
450		111°	107°	100°
525			102°	96°
600				90°

1500 I.D. MANHOLE

PIPE SIZE	375	450	525	600	675	750	825	900
375	133°	129°	126°	122°	116°	109°	103°	95°
450		126°	123°	119°	112°	106°	100°	92°
525			120°	115°	109°	103°	96°	89°
600				111°	105°	98°	92°	84°
675					99°	92°	86°	78°
750						85°	79°	72°
825							73°	66°
900								59°

1800 I.D. MANHOLE

PIPE SIZE	375	450	525	600	675	750	825	900	1050	1200
375	142°	138°	136°	132°	128°	123°	119°	114°	104°	94°
450		136°	134°	130°	125°	121°	116°	112°	102°	92°
525			131°	127°	122°	118°	114°	109°	99°	89°
600				124°	119°	114°	110°	106°	96°	85°
675					114°	110°	106°	101°	91°	81°
750						105°	100°	96°	86°	76°
825							97°	92°	82°	72°
900								87°	77°	61°
1050									67°	57°
1200										47°

INSTRUCTIONS FOR ANGLE OF DEFLECTION CHART

1. Determine angles of deflection from plans and profiles.

2. Locate pipes on vertical and horizontal scales.

3. Check angles of deflection on charts beginning with 900 mm through 2400 mm. If the angle of deflection is less than the maximum angle given in any particular chart, but greater than the previous chart, then you have determined the proper size of manhole. In cases where there are more than two pipes in one manhole, you must analyze each pipe individually with the pipe adacent to it. The worst angle of deflection will be the deciding factor in determining the size of the manhole.

Manhole Base

Angle of Deflection

2100 I.D. MANHOLE

PIPE SIZE	375	450	525	600	675	750	825	900	1050	1200	1350
375	147°	145°	143°	140°	136°	132°	129°	126°	118°	112°	104°
450		143°	140°	137°	134°	129°	126°	123°	116°	110°	102°
525			138°	135°	132°	127°	124°	121°	113°	108°	100°
600				132°	129°	124°	121°	118°	111°	105°	97°
675					125°	120°	117°	114°	107°	101°	93°
750						116°	113°	110°	103°	97°	89°
825							110°	107°	99°	93°	86°
900								103°	96°	90°	82°
1050									89°	83°	75°
1200										76°	69°

2400 I.D. MANHOLE

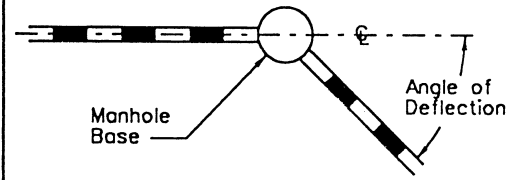| PIPE SIZE	375	450	525	600	675	750	825	900	1050	1200	1350
375	151°	149°	147°	145°	142°	138°	135°	133°	127°	122°	117°
450		147°	145°	143°	140°	136°	133°	131°	125°	120°	115°
525			143°	141°	138°	134°	131°	129°	123°	118°	113°
600				139°	135°	132°	129°	126°	121°	116°	111°
675					132°	129°	126°	123°	117°	112°	107°
750						125°	122°	120°	114°	109°	104°
825							120°	117°	111°	106°	101°
900								114°	108°	104°	98°
1050									103°	96°	93°
1200										93°	86°

TABLE D-33M
DETERMINING PROPER SIZE OF CIRCULAR MANHOLE

PAGES 31 THROUGH 37 HAS BEEN OMITTED

**IN ACCORDANCE WITH THE 2001 <u>ROAD AND BRIDGE STANDARDS</u>
THE METHOD OF COMPUTING PIPE BEDDING IS INCLUDED IN THE IIM 225**
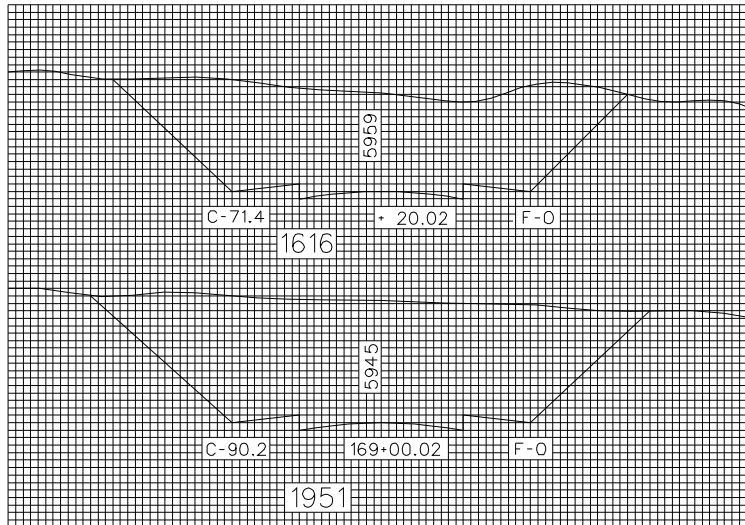
The cut area of station 163+00.02 is 90.2 square meters, and the area of station 169+20.02 is 71.4 square meters. To find the average area of the two, we would add the two and divide by two.

Thus, $\dfrac{90.2 + 71.4}{2} = \dfrac{161.6}{2} = 80.8$ Square Meters (average)

Now we must find the volume of the area between the two stations. The cross section has an average of 80.8 square meters and there is 20 meters between stations. Therefore, 80.8 multiplied by 20 equals 1616 cubic meters to be removed from between these stations.

Therefore, the volume in m^3 between two stations 20 m apart equals 10 (ten) times the sum (in m^2) of the end areas.

The formula used to determine the volume of earthwork is called the AVERAGE END AREA METHOD and is noted below. Examine it closely.

Volume $= \dfrac{L\ (A' + A'')}{2}$

L = distance between stations (m)
A' = area of one station (m^2)
A'' = area of second station (m^2)
2 gets the average of A' & A''

EXAMPLE

Volume (in m^3) $= \dfrac{20\ (90.2 + 71.4)}{2} = 1616$

Figure D-4M
EARTHWORK QUANTITY COMPUTATIONS