

Note: "H" may be reduced until "X" reaches a minimum of 100 mm where endwall would protrude above shoulder line. In no case shall top of endwall project above fill slope, ditch slope, or shoulder.

This item may be precast or cast in place.

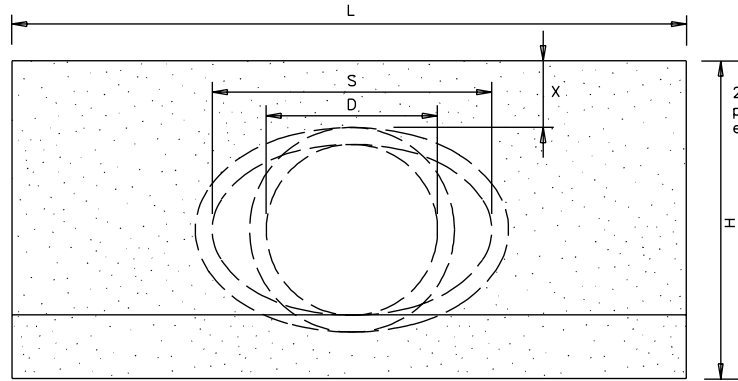
All cast in place concrete to be Class 20. For precast See Sheet 101.02
This standard to be used with straight crossings and all skews (0° to 45°).

Headwall to be beveled in all areas except where a conflict with invert or wingwalls occur.

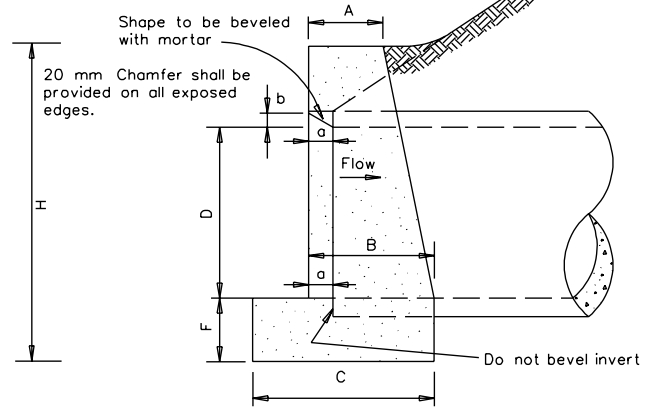
Bevel edge is required on the headwall at the inlet end of the culvert (where the flow enters the culvert).

Headwall at the outlet end of the culvert may be either square edge or bevel edge.

EW-1,1A



FRONT ELEVATION



END ELEVATION

Note: On shallow fills, where endwalls are 300 mm or less below shoulder line, the top of the endwall shall be constructed parallel to the grade of the road.

EW-1

ENDWALL FOR CIRCULAR PIPE						
DIAMETER OF PIPE CULVERT						
	300	375	450	525or600	675or750	825or900
A	150	200	220	280	300	300
B	280	330	380	450	530	610
C	400	480	530	660	760	830
D	300	375	450	525or600	675or750	825or900
F	150	200	200	220	220	220
H	680	880	960	1140	1290	1440
L	1220	1520	1820	2430	3040	3650
a	50	50	65	75	100	115
b	30	30	40	50	65	75
CUBIC METERS OF CONCRETE						
CONC.PIPE	0.18	0.37	0.52	1.00	1.54	2.16
C.M.PIPE	0.19	0.38	0.55	1.04	1.62	2.30

EW-1A

ENDWALL FOR ELLIPTICAL PIPE								
SIZE OF ELLIPTICAL PIPE CULVERT (SPAN x RISE)								
	575x365	770x490	865x550	960x610	1055x670	1150x730	1250x795	1345x855
A	200	220	250	280	280	300	300	300
B	350	430	450	500	530	550	580	580
C	500	580	630	710	730	780	810	830
D	365	490	550	610	670	730	795	855
F	200	200	220	220	220	220	220	220
H	860	990	1090	1140	1220	1270	1340	1390
L	1650	2180	2590	2790	3090	3320	3680	3930
S	575	770	865	960	1055	1150	1250	1345
a	65	75	100	115	115	115	140	140
b	40	50	65	65	75	75	90	90
CUBIC METERS OF CONCRETE								
CONC.PIPE	0.38	0.64	0.91	1.12	1.34	1.56	1.83	2.02

SPECIFICATION REFERENCE

105.04
302

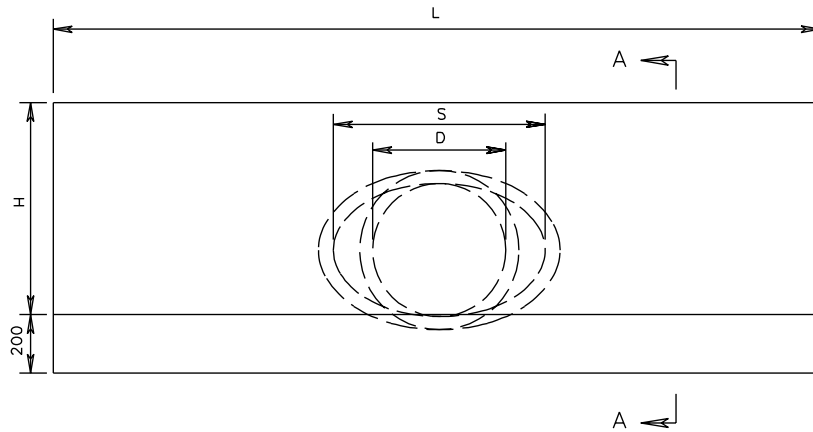
STANDARD ENDWALL FOR PIPE CULVERTS

VIRGINIA DEPARTMENT OF TRANSPORTATION

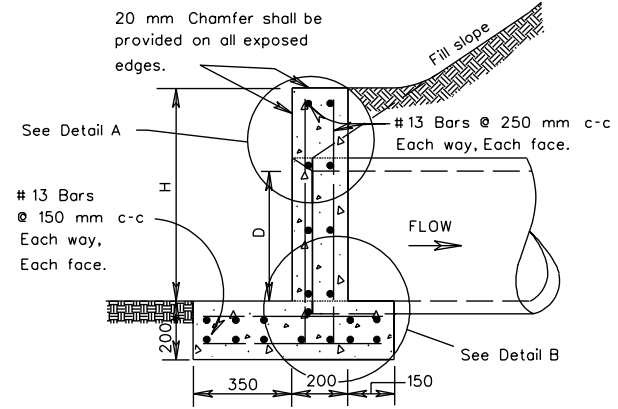
UNLESS OTHERWISE NOTED, ALL DIMENSIONS ON THIS SHEET ARE IN MILLIMETERS

101.01

EW-1,1APC



FRONT ELEVATION

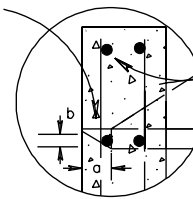


SECTION A-A

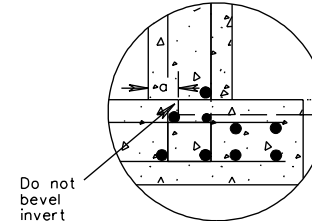
Notes:

Concrete to be 30 MPa minimum compressive strength. If pipe is to be skewed the opening will be adjusted to accommodate angles up to 45°. Reinforcing steel in accordance with ASTM A-615M (reinforcing bars). Pipe opening as required, 100 mm minimum, 200 mm maximum larger than O.D. Pipe. Dimensions shown are minimum. Actual measurements may vary with manufacturer's tolerance. In no case shall top of endwall project above fill slope, ditch slope, or shoulder. Headwall to be beveled in all areas except where a conflict with invert or wingwalls occur. Bevel edge is required on the headwall at the inlet end of the culvert (where the flow enters the culvert). Headwall at the outlet end of the culvert may be either square edge or beveled.

Shape to be beveled with mortar



DETAIL A



DETAIL B

EW-IPC

ENDWALL FOR CIRCULAR PIPE							
DIAMETER OF PIPE CULVERT							
D	300	375	450	525or600	675or750	825or900	
H	600	680	760	960	1160	1320	
L	1210	1520	1820	2430	3040	3650	
a	50	50	65	75	100	115	
b	30	30	40	50	65	75	

EW-1APC

ENDWALL FOR ELLIPTICAL PIPE									
SIZE OF ELLIPTICAL PIPE CULVERT (SPAN x RISE)									
SxD	575x365	770x490	865x550	960x610	1055x670	1150x730	1250x795	1345x855	
H	550	710	780	830	940	990	1060	1110	
L	1650	2180	2590	2790	3090	3320	3680	3930	
a	65	75	100	100	115	115	140	140	
b	40	50	65	65	75	75	90	90	

PRECAST ENDWALL FOR PIPE CULVERTS

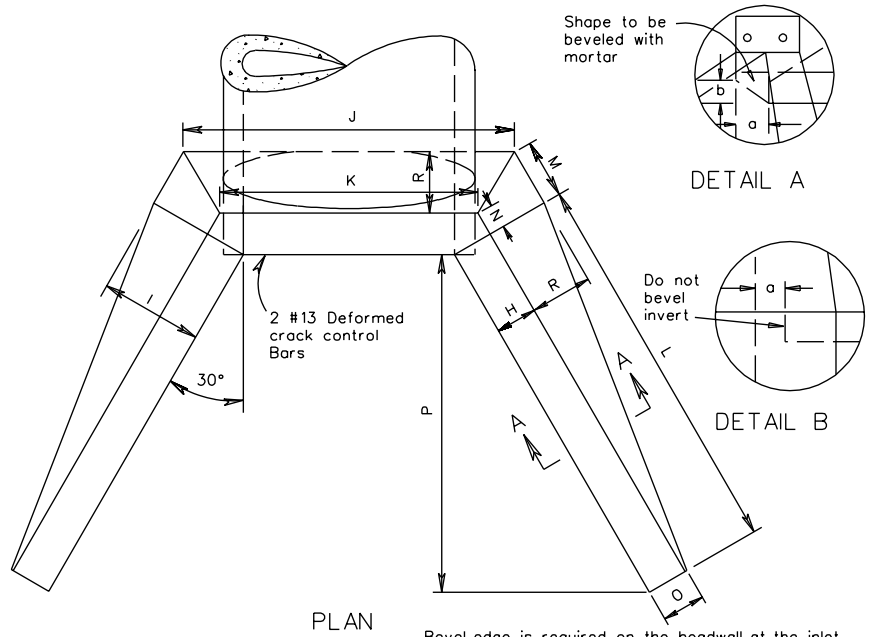
VIRGINIA DEPARTMENT OF TRANSPORTATION

SPECIFICATION REFERENCE

105
302

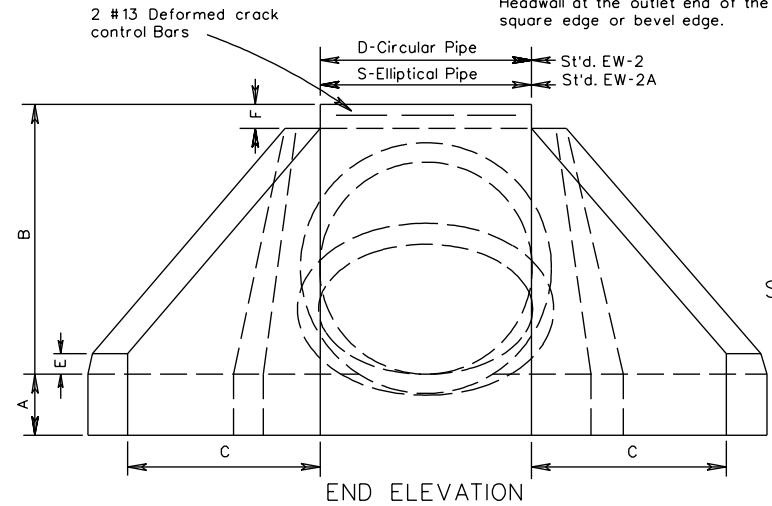
101.02

UNLESS OTHERWISE NOTED, ALL DIMENSIONS ON THIS SHEET ARE IN MILLIMETERS

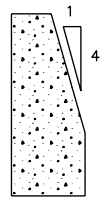


PLAN

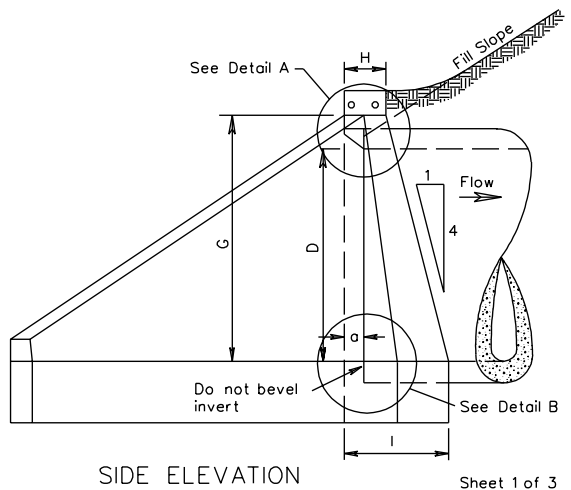
Bevel edge is required on the headwall at the inlet end of the culvert (where the flow enters the culvert). Headwall at the outlet end of the culvert may be either square edge or bevel edge.



END ELEVATION



SECTION A-A



SIDE ELEVATION

Notes:

For table of dimensions and volumes for circular pipes (Standard EW-2) see sheet 2 of 3.

For table of dimensions and volumes for elliptical pipes (Standard EW-2A) see sheet 3 of 3.

This item may be precast or cast in place.

On shallow fills, where endwalls are 300 mm or less below shoulder line, the top of the endwall shall be constructed parallel to the grade of road.

All cast in place concrete to be Class 20. For precast see Sheets 101.06 and 101.07.

In no case shall top of endwall project above fill slope, ditch slope, or shoulder.

This standard to be used with straight crossings and skew angles to 15°.

Cost of bars for crack control to be included in price bid per cubic meter concrete.

Headwall to be beveled in all areas except where a conflict with invert and wingwalls occur.

SPECIFICATION REFERENCE
105 302

STANDARD ENDWALL FOR PIPE CULVERTS

VIRGINIA DEPARTMENT OF TRANSPORTATION

UNLESS OTHERWISE NOTED, ALL DIMENSIONS ON THIS SHEET ARE IN MILLIMETERS

TABLE OF DIMENSIONS AND CONCRETE VOLUMES PER ENDWALL
FOR 1050 mm - 2100 mm CIRCULAR PIPE CULVERTS

DIAMETER OF PIPE CULVERTS

		1050	1200	1350	1500	1650	1800	1950	2100	
FOR 1-1/2:1 FILL SLOPE	A	450	450	450	450	450	450	450	450	A
	B	1460	1620	1780	1940	2120	2280	2440	2600	B
	C	1010	1140	1270	1400	1530	1660	1800	1930	C
	D	1060	1220	1370	1520	1670	1820	1980	2130	D
	E	150	150	150	150	150	150	150	150	E
	F	140	150	160	170	190	200	210	220	F
	G	1320	1470	1620	1770	1930	2080	2230	2380	G
	H	250	250	280	300	330	350	380	400	H
	I	580	610	680	740	810	870	930	990	I
	J	1730	1920	2160	2370	2610	2820	3050	3270	J
	K	1350	1510	1690	1870	2050	2220	2420	2590	K
	L	2020	2280	2550	2800	3070	3330	3600	3860	L
	M	335	350	395	425	470	500	535	570	M
	N	145	145	160	175	190	200	220	230	N
	O	290	290	310	340	360	390	420	440	O
	P	1750	1980	2200	2430	2660	2890	3120	3350	P
	R	330	360	400	440	480	520	550	590	R
	CUBIC METERS CONCRETE	CONC. PIPE	2.61	3.13	4.09	5.09	66.41	7.74	9.34	10.97
C.M. PIPE		2.80	3.38	4.45	5.57	7.06	8.54	10.37	12.26	
FOR 2:1 FILL SLOPE	C	1310	1490	1660	1840	2020	2200	2370	2550	C
	F	160	170	190	200	210	220	240	250	F
	G	1290	1440	1600	1750	1900	2050	2210	2360	G
	I	570	610	680	730	800	860	930	990	I
	J	1720	1920	2160	2360	2590	2810	3050	3270	J
	L	2630	2990	3330	3690	4040	4400	4740	5100	L
	M	330	350	395	420	460	495	535	570	M
	P	2280	2590	2890	3200	3500	3810	4110	4420	P
	R	320	360	400	430	470	510	550	590	R
	CUBIC METERS CONCRETE	CONC. PIPE	3.08	3.79	4.94	6.16	7.78	9.46	11.50	13.59
C.M. PIPE		3.27	4.04	5.31	6.63	8.41	10.26	12.53	14.89	
For 1-1/2:1 and 2:1 Fill Slopes	a	140	150	180	190	215	230	255	265	a
	b	90	100	115	125	140	150	165	180	b

For all dimensions not shown see values listed above for 1-1/2:1 fill slope

STANDARD ENDWALL FOR PIPE CULVERTS

SPECIFICATION REFERENCE

105
302

TABLE OF DIMENSIONS AND CONCRETE VOLUMES PER ENDWALL
FOR ELLIPTICAL PIPE CULVERTS

SIZE OF ELLIPTICAL PIPE CULVERTS (SPAN X RISE)

		1535x975	1730x1095	1920x1220	2110x1340	2305x1465	2495x1585	2690x1705	
FOR 1-1/2:1 FILL SLOPE	A	450	450	450	450	450	450	450	A
	B	1460	1460	1620	1780	1940	2120	2280	B
	C	1010	1010	1140	1270	1400	1530	1660	C
	D	960	1090	1220	1340	1470	1720	1720	D
	E	150	150	150	150	150	150	150	E
	F	140	140	150	160	170	190	200	F
	G	1320	1320	1470	1620	1770	1930	2080	G
	H	250	250	250	280	300	330	350	H
	I	580	580	610	680	740	810	870	I
	J	2190	2390	2630	2890	3160	3420	3690	J
	K	1810	2010	2220	2420	2660	2860	3090	K
	L	2020	2020	2280	2550	2800	3070	3330	L
	M	335	335	350	395	425	470	500	M
	N	145	145	145	160	175	190	200	N
	O	290	290	290	310	340	360	390	O
P	1750	1750	1980	2200	2430	2660	2890	P	
R	330	330	360	400	440	480	520	R	
S	1520	1720	1930	2100	2310	2480	2690	S	
CUBIC METERS CONCRETE	CONCRETE PIPE	2.79	2.69	3.23	4.22	5.25	6.41	7.98	
FOR 2:1 FILL SLOPE	C	1310	1310	1490	1660	1840	2020	2200	C
	F	160	160	170	190	200	210	220	F
	G	1290	1290	1440	1600	1750	1900	2050	G
	I	570	570	610	680	730	800	860	I
	J	2180	2380	2630	2890	3150	3400	3680	J
	L	2630	2630	2990	3330	3690	4040	4400	L
	M	330	330	350	395	420	460	495	M
	P	2280	2280	2590	2890	3200	3500	3810	P
R	320	320	360	400	430	470	510	R	
CUBIC METERS CONCRETE	CONCRETE PIPE	3.26	3.16	3.88	5.08	6.33	7.76	9.69	
For 1-1/2:1 and	a	150	180	190	215	230	255	265	a
2:1 Fill Slopes	b	100	115	125	140	150	165	180	b

For all dimensions not shown see values listed above for 1-1/2:1 fill slope

SPECIFICATION REFERENCE
105
302

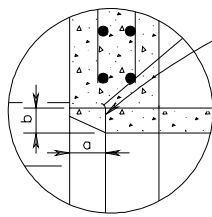
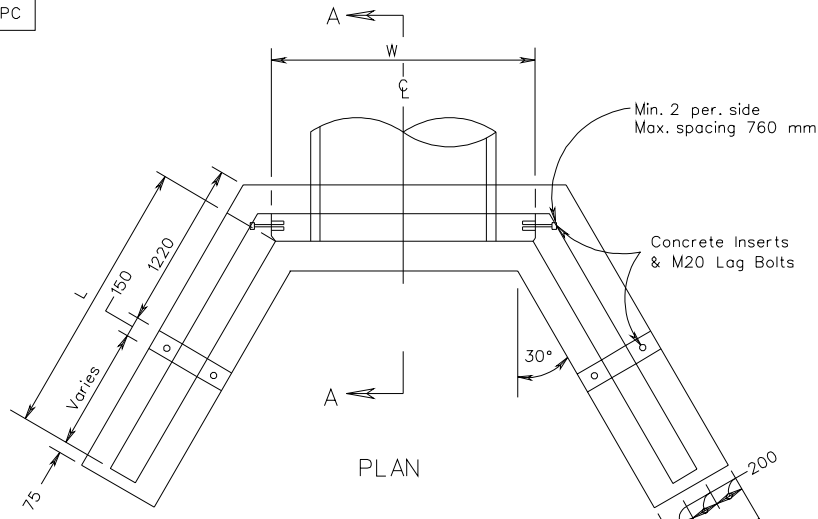
STANDARD ENDWALL FOR PIPE CULVERTS

VIRGINIA DEPARTMENT OF TRANSPORTATION

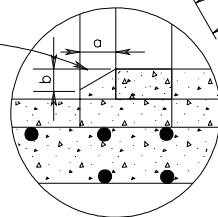
UNLESS OTHERWISE NOTED, ALL DIMENSIONS ON THIS SHEET ARE IN MILLIMETERS

101.05

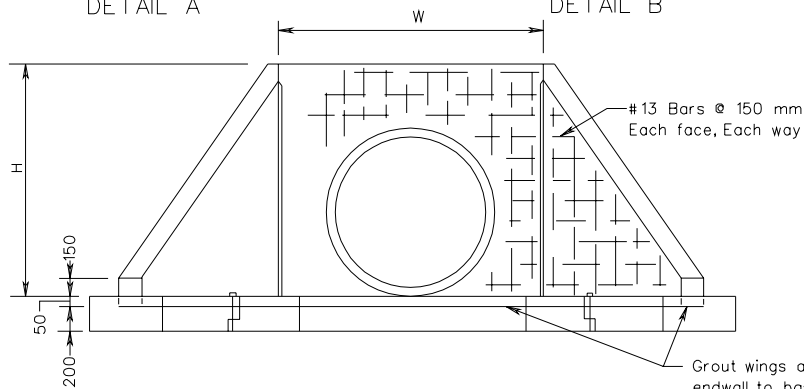
EW-2PC



DETAIL A



DETAIL B

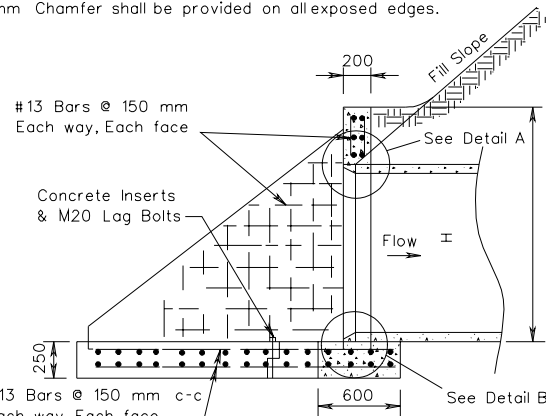


FRONT ELEVATION

- Notes:**
- Headwall to be beveled in all areas except where a conflict with invert or wingwalls occur.
 - Bevel edge as required on the headwall at the inlet end of the culvert (where the flow enters the culvert).
 - Headwall at the outlet end of the culvert may be either square edge or bevel edge.
 - 1. Concrete to be 30 MPa minimum compressive strength.
 - 2. If pipe is to be skewed, the opening will be adjusted to accommodate angles up to 15°.
 - 3. Reinforcing steel in accordance with ASTM A-615M (reinforcing bars).
 - 4. Pipe opening as required, 100 mm minimum, 200 mm maximum larger than O.D. pipe.
 - 5. Dimensions shown are minimum. Actual measurements may vary with manufacturer's tolerances.
 - 6. In no case shall top of endwall project above fill slope or shoulder.

DIMENSIONS						
D	H	W	L		a	b
			1-1/2:1 SLOPE	2:1 SLOPE		
1050	1670	1900	2020	2640	140	90
1200	1820	2080	2280	2990	150	100
1350	1980	2260	2550	3350	180	115
1500	2130	2430	2820	3690	190	125
1650	2310	2650	3080	4050	215	140
1800	2490	2830	3350	4400	230	150
1950	2650	2990	3600	4750	255	165
2100	2820	3150	3870	5100	265	180

20 mm Chamfer shall be provided on all exposed edges.



SECTION A-A

PRECAST ENDWALL FOR CIRCULAR PIPE CULVERTS

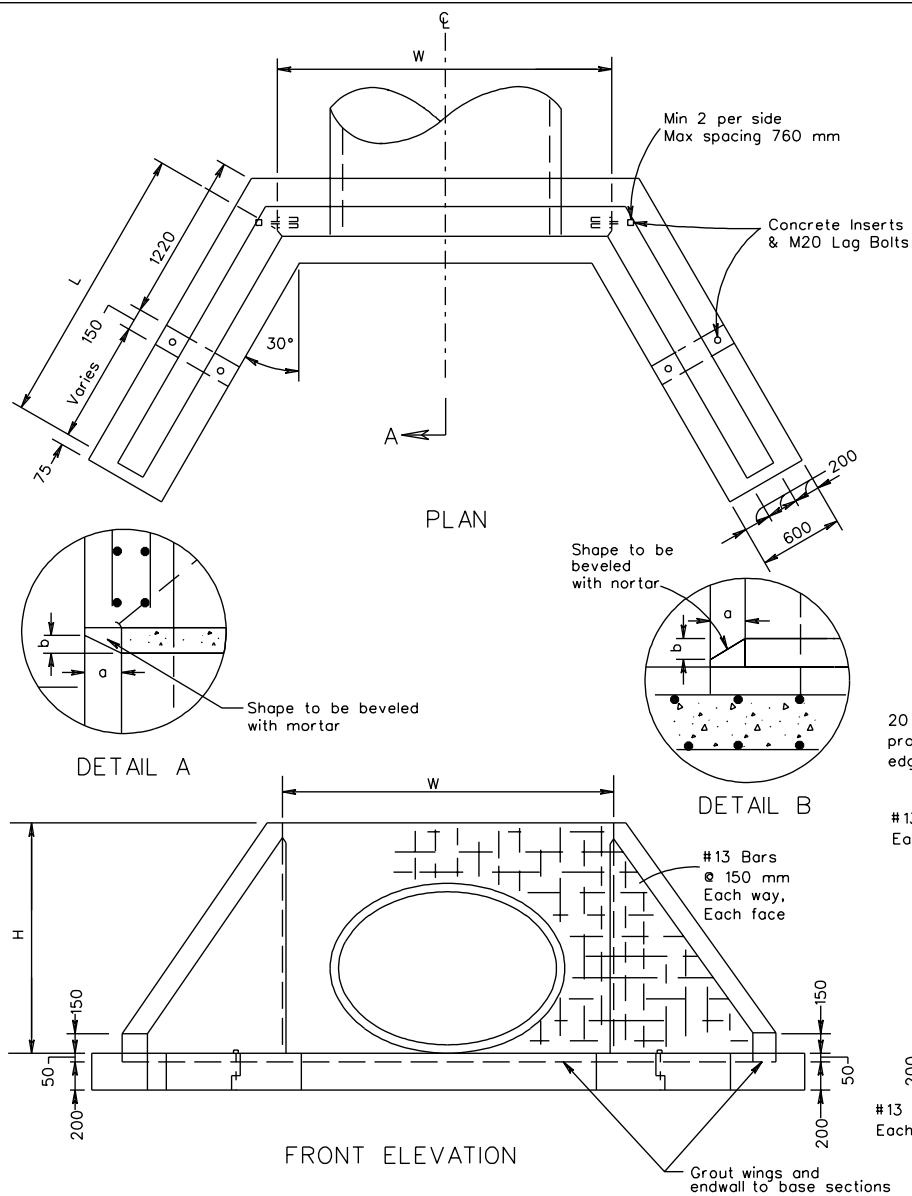
VIRGINIA DEPARTMENT OF TRANSPORTATION

101.06

UNLESS OTHERWISE NOTED, ALL DIMENSIONS ON THIS SHEET ARE IN MILLIMETERS

SPECIFICATION REFERENCE

105
302

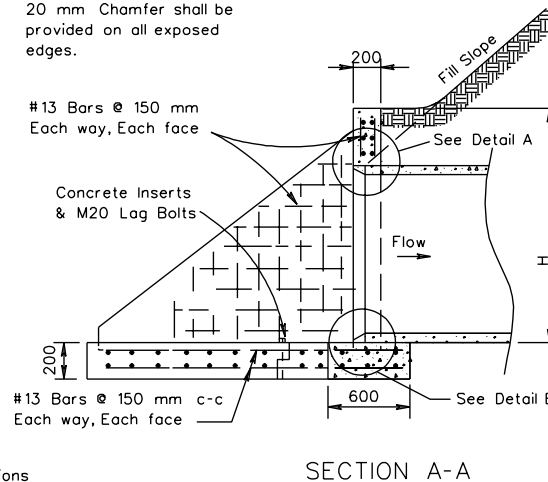


Notes:

- Headwall to be beveled in all areas except where a conflict with invert or wingwalls occur.
- Bevel edge is required on the headwall at the inlet end of the culvert (where the flow enters the culvert).
- Headwall at the outlet end of the culvert may be either square edge or bevel edge.
- Concrete to be 30 MPa minimum compressive strength.
- If pipe is to be skewed the opening will be adjusted to accommodate angles up to 15°.
- Reinforcing steel in accordance with ASTM A615M (reinforcing bars).
- Pipe opening as required, 100 mm minimum, 200 mm maximum larger than O.D. pipe.
- Dimensions shown are minimum. Actual measurements may vary with manufacturer's tolerances.
- In no case shall top of endwall project above fill slope, ditch slope, or shoulder.

Span X Rise	H	W	L		a	b
			1-1/2:1 SLOPE	2:1 SLOPE		
1535x975	1670	2410	2020	2640	150	100
1730x1095	1670	2640	2020	2640	180	115
1920x1220	1820	2870	2280	2990	190	125
2110x1340	1980	3070	2550	3350	215	140
2305x1465	2130	3300	2820	3690	230	150
2495x1585	2310	3500	3080	4050	255	165
2690x1705	2490	3730	3350	4400	265	180

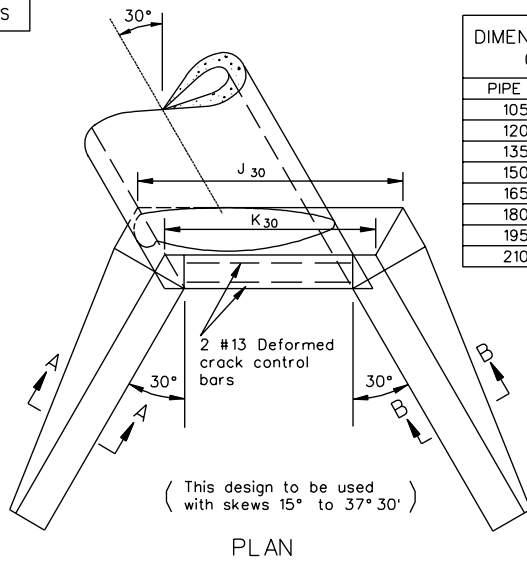
20 mm Chamfer shall be provided on all exposed edges.



SPECIFICATION REFERENCE	<h2 style="margin: 0;">PRECAST ENDWALL FOR ELLIPTICAL PIPE CULVERTS</h2> <p style="margin: 0;">VIRGINIA DEPARTMENT OF TRANSPORTATION</p>			<small>UNLESS OTHERWISE NOTED, ALL DIMENSIONS ON THIS SHEET ARE IN MILLIMETERS</small>	101.07
105 302					

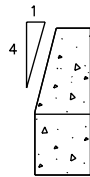
EW-2S

DIMENSIONS FOR BEVEL ON HEADWALL		
PIPE I.D.	a	b
1050	140	90
1200	150	100
1350	180	115
1500	190	125
1650	215	140
1800	230	150
1950	255	165
2100	265	180



PLAN

Notes:



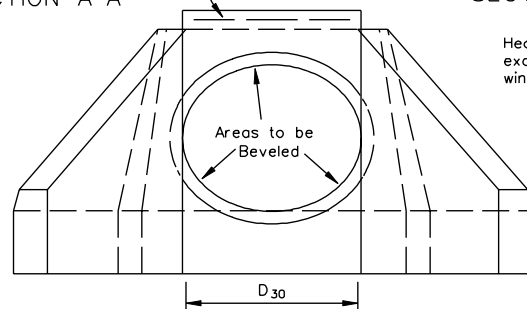
SECTION A-A

Bevel edge is required on the headwall at the inlet end of the culvert (where the flow enters the culvert). Headwall at the outlet end of the culvert may be either square edge or bevel edge.



SECTION B-B

2 #13 Deformed crack control bars.

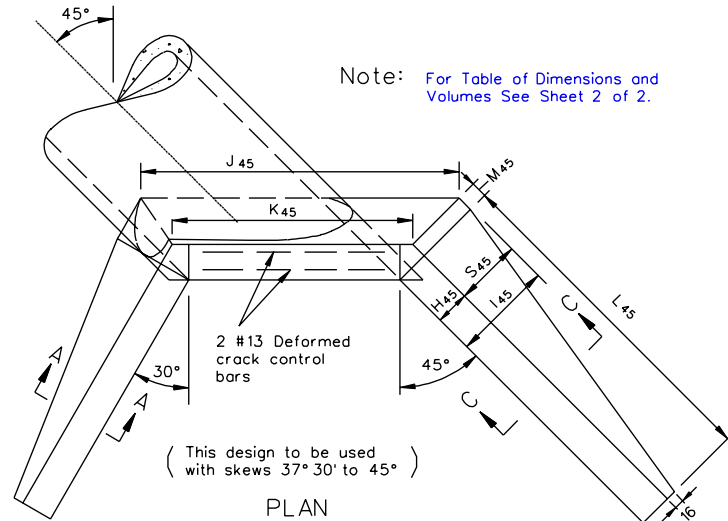


END ELEVATION
30° SKEW

Headwall to be beveled in all areas except where a conflict with invert or wingwalls occur.

20 mm Chamfer shall be provided on all exposed edges.

In no case shall top of endwall project above fill slope, ditch slope, or shoulder.



PLAN

Note: For Table of Dimensions and Volumes See Sheet 2 of 2.

Notes:

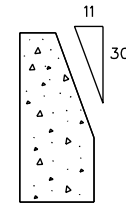
Cost of bars for crack control to be included in price bid per cubic meter concrete.

All details and dimensions not shown are the same as Standard EW-2.

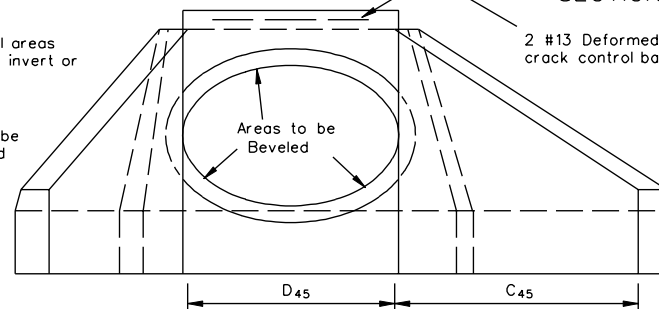
All cast in place concrete to be Class 20. For precast See Sheet 101.10.

On shallow fills, where endwalls are 300 mm or less below shoulder line, the top of the endwall shall be constructed parallel to the grade of the road.

This item may be precast or cast in place.



SECTION C-C



END ELEVATION
45° SKEW

2 #13 Deformed crack control bars.

Sheet 1 of 2

STANDARD ENDWALLS FOR 1050 mm - 2100 mm PIPE CULVERTS
30° AND 45° SKEW

SPECIFICATION REFERENCE

105
302

101.08

UNLESS OTHERWISE NOTED, ALL DIMENSIONS ON THIS SHEET ARE IN MILLIMETERS

VIRGINIA DEPARTMENT OF TRANSPORTATION

TABLE OF DIMENSIONS AND CONCRETE VOLUMES PER ENDWALL

FOR 1-1/2:1 FILL SLOPE
DIAMETER OF PIPE CULVERTS

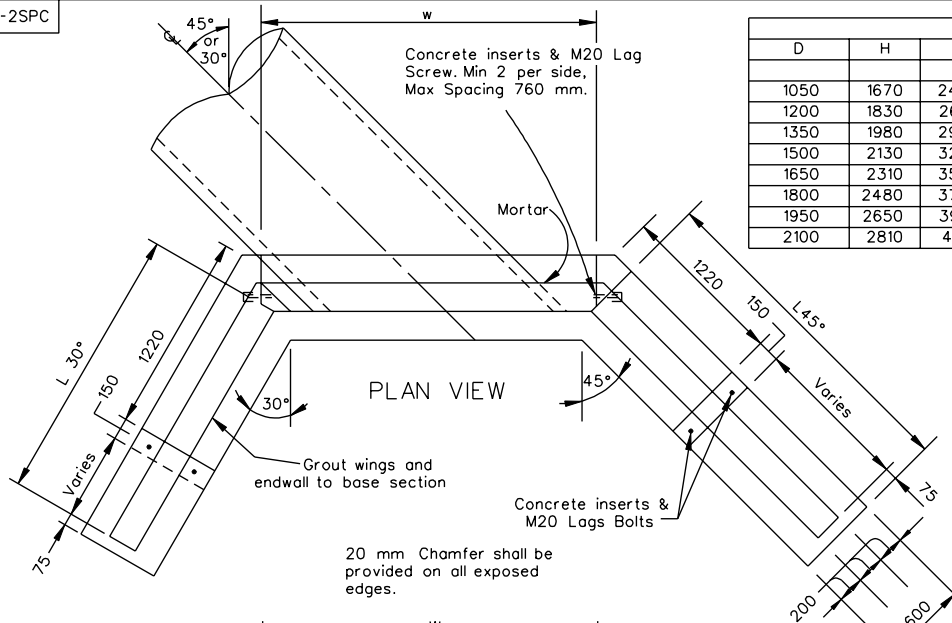
30° SKEW		1050	1200	1350	1500	1650	1800	1950	2100	
	D 30	1230	1400	1580	1760	1930	2110	2290	2460	D 30
	J 30	1900	2120	2370	2620	2870	3120	3370	3620	J 30
CUBIC METERS CONCRETE	K 30	1520	1690	1900	2110	2310	2520	2720	2930	K 30
	CONC. PIPE	2.55	3.05	3.94	4.88	6.12	7.36	8.83	10.36	CONC. PIPE
45° SKEW	C.M. PIPE	2.76	3.34	4.36	5.43	6.86	8.28	10.01	11.84	C.M. PIPE
	C 45	1750	1980	2200	2430	2660	2890	3120	3350	C 45
	D 45	1500	1720	1940	2150	2370	2580	2800	3010	D 45
	H 45	250	250	280	300	330	350	380	400	H 45
	I 45	710	770	850	920	1010	1080	1170	1240	I 45
	J 45	2280	2550	2850	3160	3460	3760	4060	4360	J 45
	K 45	1750	1970	2210	2450	2690	2940	3170	3420	K 45
	L 45	2480	2800	3120	3440	3770	4090	4420	4740	L 45
CUBIC METERS CONCRETE	M 45	100	100	110	120	130	140	150	160	M 45
	S 45	460	520	570	620	680	730	790	840	S 45
CUBIC METERS CONCRETE	CONC. PIPE	3.03	3.67	4.69	5.82	7.25	8.72	10.46	12.24	CONC. PIPE
	C.M. PIPE	3.29	4.02	5.20	6.48	8.14	9.84	11.90	14.03	C.M. PIPE

FOR 2:1 FILL SLOPE
DIAMETER OF PIPE CULVERTS

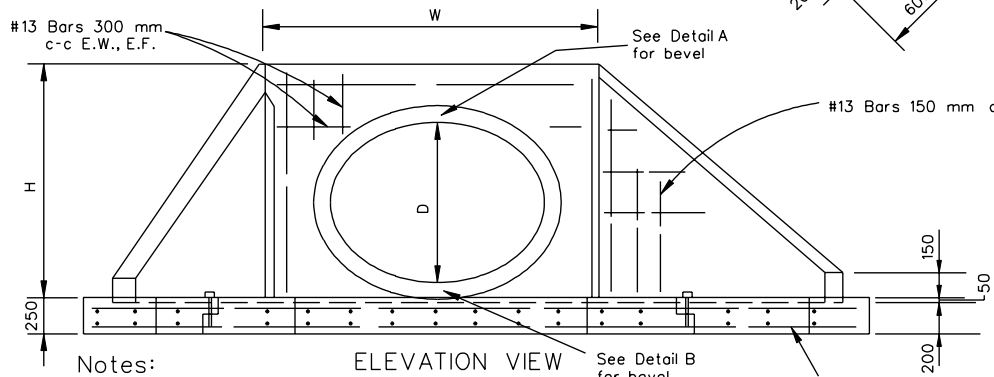
30° SKEW		1050	1200	1350	1500	1650	1800	1950	2100	
	D 30	1230	1400	1580	1760	1930	2110	2290	2460	D 30
	J 30	1890	2110	2370	2620	2870	3110	3360	3610	J 30
CUBIC METERS CONCRETE	K 30	1520	1690	1900	2110	2310	2520	2720	2930	K 30
	CONC. PIPE	2.54	3.04	3.94	4.88	6.12	7.35	8.82	10.35	CONC. PIPE
45° SKEW	C.M. PIPE	2.76	3.33	4.36	5.43	6.86	8.28	10.00	11.83	C.M. PIPE
	C 45	2280	2580	2890	3190	3500	3800	4110	4420	C 45
	D 45	1500	1720	1940	2150	2370	2580	2800	3010	D 45
	H 45	250	250	280	300	330	350	380	400	H 45
	I 45	700	760	840	920	1000	1070	1160	1230	I 45
	J 45	2270	2540	2840	3150	3450	3750	4050	4350	J 45
	K 45	1750	1970	2210	2450	2690	2940	3170	3420	K 45
	L 45	3230	3660	4090	4520	4950	5380	5820	6250	L 45
CUBIC METERS CONCRETE	M 45	100	100	110	120	130	140	150	160	M 45
	S 45	450	510	560	620	670	720	780	830	S 45
CUBIC METERS CONCRETE	CONC. PIPE	3.38	4.13	5.31	6.65	8.27	9.98	12.02	14.12	CONC. PIPE
	C.M. PIPE	3.64	4.48	5.81	7.31	9.16	11.09	13.46	15.90	C.M. PIPE

SPECIFICATION REFERENCE	<p>STANDARD ENDWALLS FOR 1050 mm - 2100 mm PIPE CULVERTS</p> <p>VIRGINIA DEPARTMENT OF TRANSPORTATION</p>	UNLESS OTHERWISE NOTED, ALL DIMENSIONS ON THIS SHEET ARE IN MILLIMETERS	101.09
105 302			

EW-2SPC



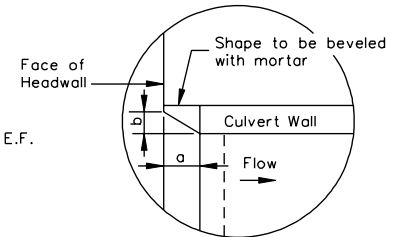
DIMENSIONS								
D	H	W	L	L	L	L	a	b
			30° 1 1/2:1	30° 2:1	45° 1 1/2:1	45° 2:1		
1050	1670	2430	2010	2640	2430	3200	140	90
1200	1830	2690	2280	2990	2800	3650	150	100
1350	1980	2940	2550	3340	3120	4110	180	115
1500	2130	3200	2810	3680	3440	4520	190	125
1650	2310	3500	3070	4050	3770	4970	215	140
1800	2480	3750	3350	4400	4100	5380	230	150
1950	2650	3960	3600	4740	4410	5790	255	165
2100	2810	4210	3870	5100	4720	6240	265	180



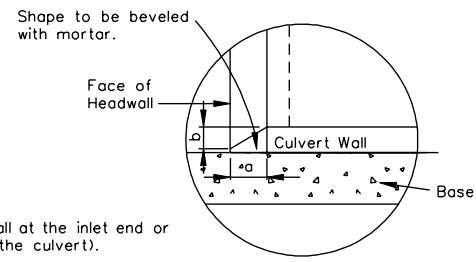
Notes:

- Concrete to be 30 MPa minimum compressive strength
- Reinforcing steel in accordance with ASTM A-615M (reinforcing bars)
- Pipe opening as required, 100 mm min., 200 mm max. larger than O.D. pipe.
- Dimensions shown are minimum. Actual measurements may vary with manufacturer's tolerances.
- In no case shall top of endwall project above fill slope, ditch slope, or shoulder.
- Headwall to be beveled in all areas except where a conflict with invert or wingwalls occur.

Bevel edge is required on the endwall at the inlet end or the culvert (where the flow enters the culvert).
Headwall at the outlet end of the culvert may be either square edge or bevel edge.



DETAIL A



DETAIL B

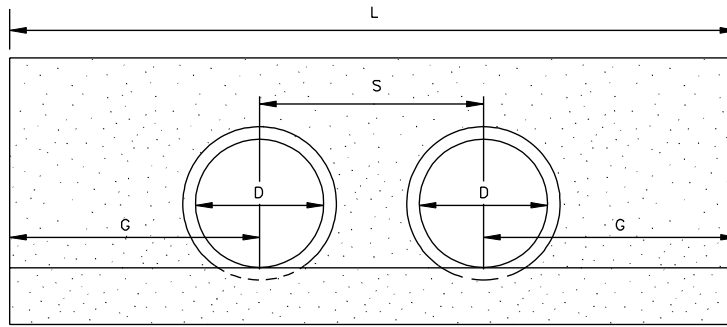
PRECAST ENDWALL FOR PIPE CULVERT

VIRGINIA DEPARTMENT OF TRANSPORTATION

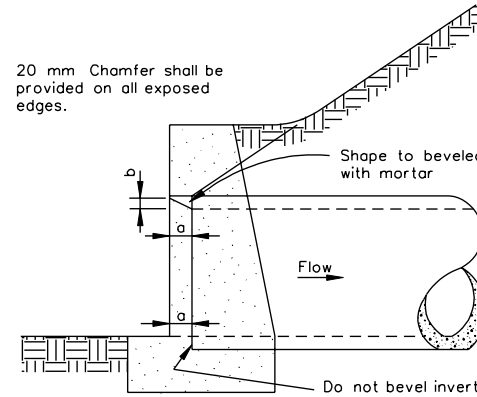
101.10 UNLESS OTHERWISE NOTED, ALL DIMENSIONS ON THIS SHEET ARE IN MILLIMETERS

SPECIFICATION REFERENCE

105
302



FRONT ELEVATION



SIDE ELEVATION

Notes:

On shallow fills, where endwalls are 300 mm or less below shoulder line, the top of the endwall shall be constructed parallel to the grade of the road.

This item may be precast or cast in place.

In no case shall top of endwall project above fill slope, ditch slope or shoulder.

This standard to be used with straight crossings and skew angles to 15°.

All cast in place Concrete to be Class 20.
For precast See Sheet 101.12.

Quantities given are for one endwall.

All dimensions not given in table are same as those for single endwalls for same size of pipe.

Headwall to be beveled in all areas except where a conflict with invert or wingwalls occur.

FOR CONCRETE PIPE							
Diameter D of Pipe	S	G	L	Cubic Meters Concrete One Double Endwall	Increase Cubic Meters For Each Additional Pipe	a	b
300	550	610	1770	0.25	0.07	50	30
375	680	760	2200	0.51	0.14	50	30
450	810	910	2630	0.72	0.19	65	40
525 or 600	1060	1220	3500	1.35	0.34	75	50
675 or 750	1320	1520	4360	2.09	0.51	100	65
825 or 900	1570	1820	5210	2.95	0.69	115	75

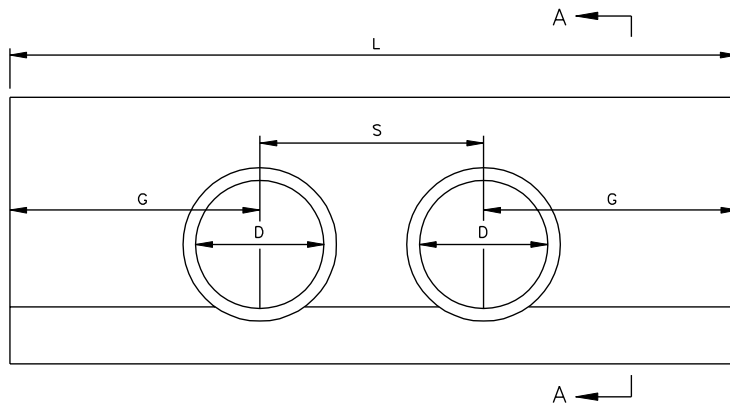
FOR CORRUGATED METAL PIPE							
Diameter D of Pipe	S	G	L	Cubic Meters Concrete One Double Endwall	Increase Cubic Meters For Each Additional Pipe	a	b
300	480	610	1700	0.26	0.07	50	30
375	590	760	2110	0.53	0.13	50	30
450	710	910	2530	0.75	0.18	65	40
600	940	1220	3380	1.41	0.34	75	50
675 or 750	1160	1520	4200	2.19	0.51	100	65
900	1390	1820	5030	3.12	0.71	115	75

Bevel edge is required on the headwall at the inlet end of the culvert (where the flow enters the culvert).

Headwall at the outlet end of the culvert may be either square edge or bevel edge.

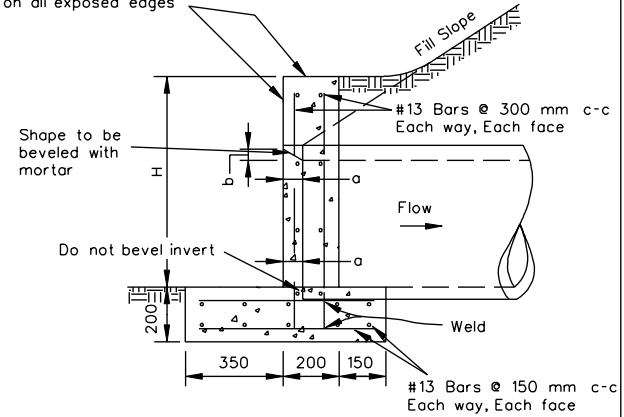
SPECIFICATION REFERENCE	STANDARD ENDWALLS FOR PIPE CULVERTS 300 mm - 900 mm PIPE		VIRGINIA DEPARTMENT OF TRANSPORTATION	UNLESS OTHERWISE NOTED, ALL DIMENSIONS ON THIS SHEET ARE IN MILLIMETERS	101.11
105 302					

EW-6PC



FRONT ELEVATION

20 mm Chamfer shall be provided on all exposed edges



SECTION A-A

FOR CIRCULAR CONCRETE OR CORRUGATED METAL PIPE						
FOR MULTIPLE PIPE ENDWALL						
Diameter D of pipe	H	L	S	G	a	b
300	610	1770	610	580	50	30
375	680	2200	680	760	50	30
450	760	2630	810	910	65	40
525 or 600	960	3500	1060	1220	75	50
675 or 750	1160	4360	1320	1520	100	65
825 or 900	1320	5210	1570	1820	115	75

Notes:

Concrete to be 30 MPa minimum compressive strength.

If pipe is to be skewed the opening will be adjusted to accommodate angles up to 15°.

Reinforcing steel in accordance with ASTM A-615M (reinforcing bars).

Pipe opening as required, 100 mm minimum, 200 mm maximum larger than O.D. pipe.

Dimensions shown are minimum. Actual measurements may vary with manufacturer's tolerances.

In no case shall top of endwall project above fill slope, ditch slope or shoulder.

Headwall to be beveled in all areas except where a conflict with invert or wingwalls occur.

Bevel edge is required on the headwall at the inlet end of the culvert (where the flow enters the culvert).

Headwall at the outlet end of the culvert may be either square edge or bevel edge.

PRECAST ENDWALL FOR MULTIPLE PIPE CULVERTS

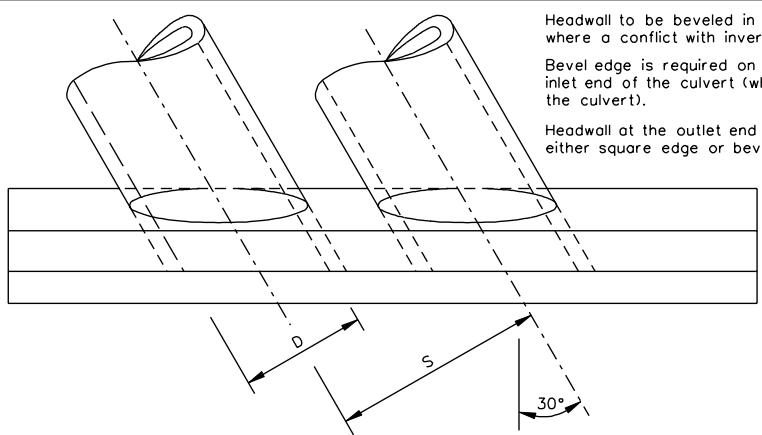
VIRGINIA DEPARTMENT OF TRANSPORTATION

101.12

UNLESS OTHERWISE NOTED, ALL DIMENSIONS ON THIS SHEET ARE IN MILLIMETERS

SPECIFICATION REFERENCE

105
302



Headwall to be beveled in all areas except where a conflict with invert or wingwalls occur.
 Bevel edge is required on the headwall at the inlet end of the culvert (where the flow enters the culvert).
 Headwall at the outlet end of the culvert may be either square edge or bevel edge.

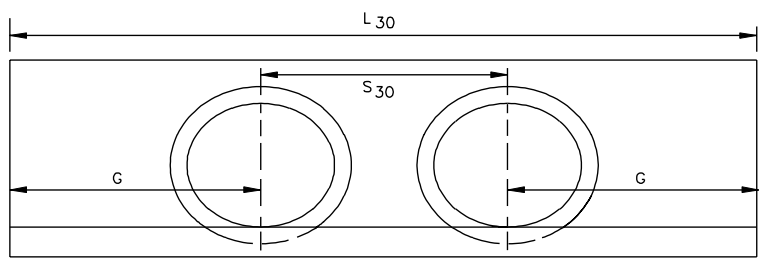
In no case shall top of endwall project above fill slope, ditch slope or shoulder.
 All cast in place concrete to be Class 20.
 For precast See Sheet 101.15.

Quantities given are for One Endwall.
 All dimensions not given in table are same as those for Single Endwalls for same size pipe.

On shallow fills, where endwalls are 300 mm or less below shoulder line, the top of the endwall shall be constructed parallel to the grade of the road.

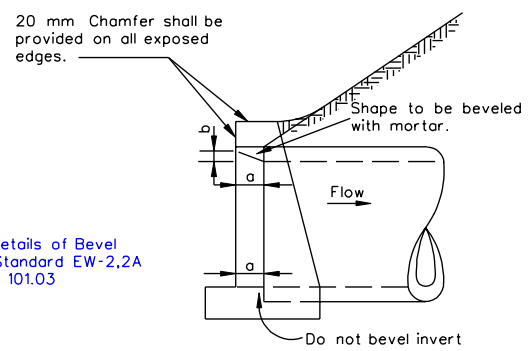
This item may be precast or cast in place.

PLAN VIEW



This standard to be used with skews 15° to 37° 30'.

FRONT VIEW



For Details of Bevel see Standard EW-2.2A Sheet 101.03

SIDE VIEW

FOR CONCRETE PIPE								
Diameter D of pipe	G	S	S ₃₀	L ₃₀	Concrete In One Double Endwall Cubic Meters	Increase For Each Additional Pipe Cubic Meters	a	b
300	610	550	635	1855	0.26	0.08	50	30
375	760	680	785	2305	0.53	0.16	50	30
450	910	810	935	2755	0.74	0.22	65	40
525 or 600	1220	1060	1225	3665	1.37	0.39	75	50
675 or 750	1520	1320	1525	4565	2.12	0.58	100	65
825 or 900	1820	1570	1815	5455	2.98	0.80	115	75

FOR CORRUGATED METAL PIPE								
Diameter D of pipe	G	S	S ₃₀	L ₃₀	Concrete In One Double Endwall Cubic Meters	Increase For Each Additional Pipe Cubic Meters	a	b
300	610	480	555	1775	0.27	0.08	50	30
375	760	590	680	2200	0.55	0.15	50	30
450	910	710	820	2640	0.77	0.21	65	40
525 or 600	1220	940	1085	3525	1.44	0.39	75	50
675 or 750	1520	1160	1340	4380	2.24	0.59	100	65
825 or 900	1820	1390	1605	5245	3.17	0.82	115	75

Sheet 1 of 2

SPECIFICATION REFERENCE	STANDARD ENDWALLS FOR MULTIPLE PIPE CULVERTS 300 mm - 900 mm PIPE - 30° SKEW
105 302	VIRGINIA DEPARTMENT OF TRANSPORTATION
	UNLESS OTHERWISE NOTED, ALL DIMENSIONS ON THIS SHEET ARE IN MILLIMETERS

EW-6S

Headwall to be beveled in all areas except where a conflict with invert or wingwalls occur.

Bevel edge is required on the headwall at the inlet end of the culvert (where the flow enters the culvert).

Headwall at the outlet end of the culvert may be either square edge or bevel edge.

All cast in place concrete to be Class 20.
For precast See Sheet 101.16.

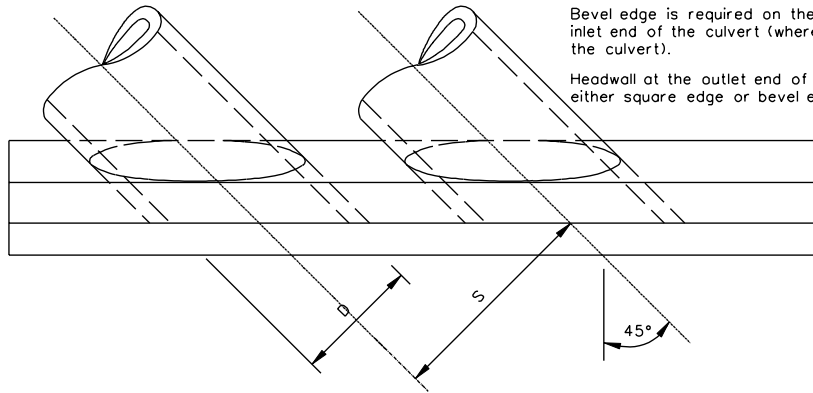
Quantities given are for One Endwall.

All dimensions not given in table are same as those for Single Endwalls for same size pipe.

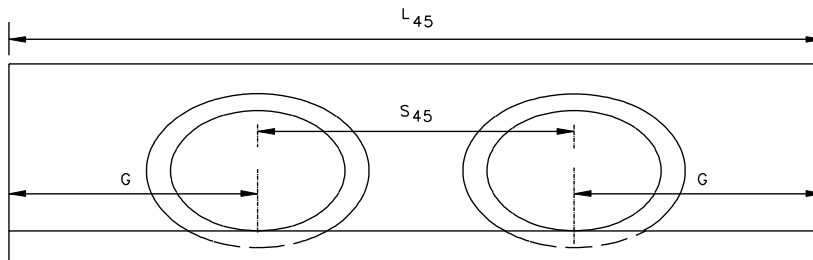
On shallow fills, where endwalls are 300 mm or less below shoulder line, the top of the endwall shall be constructed parallel to the grade of the road.

This item may be precast or cast in place.

In no case shall top of endwall project above fill slope, ditch slope or shoulder.



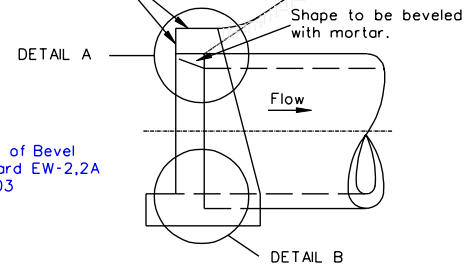
PLAN VIEW



FRONT VIEW

This standard to be used with skews 37° 30' to 45°.

20 mm Chamfer shall be provided on all exposed edges.



SIDE VIEW

For Details of Bevel see Standard EW-2,2A Sheet 101.03

FOR CONCRETE PIPE									
Diameter D of Pipe	G	S	S ₄₅	L ₄₅	Concrete In One Double Endwall Cubic Meters	Increase For Each Additional Pipe Cubic Meters	a	b	
300	610	550	780	2000	0.27	0.10	50	30	
375	760	680	960	2480	0.55	0.19	50	30	
450	910	810	1145	2965	0.76	0.26	65	40	
525 or 600	1220	1060	1500	3940	1.41	0.48	75	50	
675 or 750	1520	1320	1865	4905	2.17	0.72	100	65	
825 or 900	1820	1570	2220	5860	3.03	0.98	115	75	

FOR CORRUGATED METAL PIPE									
Diameter D of Pipe	G	S	S ₄₅	L ₄₅	Concrete In One Double Endwall Cubic Meters	Increase For Each Additional Pipe Cubic Meters	a	b	
300	610	480	680	1900	0.28	0.09	50	30	
375	760	590	835	2355	0.57	0.19	50	30	
450	910	710	1005	2825	0.80	0.26	65	40	
525 or 600	1220	940	1330	3770	1.50	0.48	75	50	
675 or 750	1520	1160	1640	4680	2.32	0.72	100	65	
825 or 900	1820	1390	1965	5605	3.27	1.01	115	75	

Sheet 2 of 2

STANDARD ENDWALLS FOR MULTIPLE PIPE CULVERTS 300 mm - 900 mm - 45° SKEW

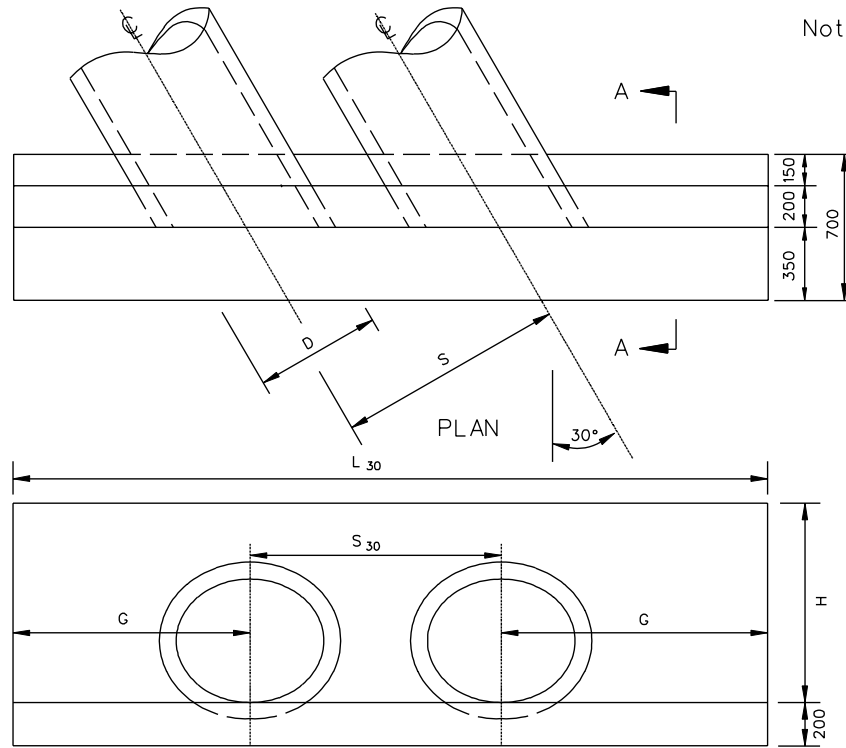
SPECIFICATION REFERENCE

101.14

UNLESS OTHERWISE NOTED, ALL DIMENSIONS ON THIS SHEET ARE IN MILLIMETERS

VIRGINIA DEPARTMENT OF TRANSPORTATION

105
302



Notes: Concrete to be 30 MPa minimum compressive strength.

Opening for skewed pipe will be adjusted to accommodate angles of 15° to 37° 30'.
Reinforcing steel in accordance with ASTM A-615M (reinforcing bars).

Pipe opening as required, 100 mm minimum 200 mm maximum larger than O.D. pipe.

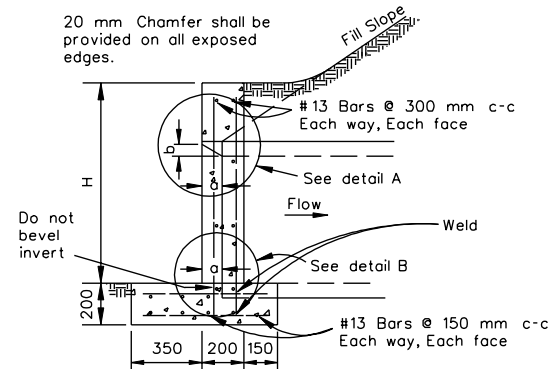
Dimensions shown are minimum. Actual measurements may vary with manufacturer's tolerances.

In no case shall top of endwall project above fill slope, ditch slope or shoulder.

Bevel edge is required on the headwall at the inlet end of the culvert (where the flow enters the culvert).

Headwall at the outlet end of the culvert may be either square edge or bevel edge.

20 mm Chamfer shall be provided on all exposed edges.

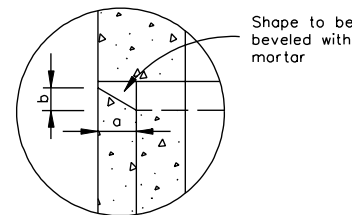


FRONT ELEVATION

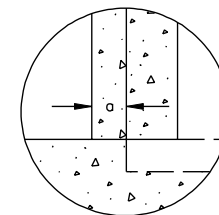
SECTION A-A

Headwall to be beveled in all areas except where a conflict with invert or wingwalls occur.

FOR CIRCULAR CONCRETE OR CORRUGATED METAL PIPE							
FOR MULTIPLE PIPE ENDWALL							
Diameter D of pipe	H	L ₃₀	S	S ₃₀	G	a	b
300	610	1855	550	635	610	50	30
375	680	2305	680	785	760	50	30
450	760	2775	810	935	910	65	40
525 or 600	960	3665	1060	1225	1220	75	50
675 or 750	1160	4565	1320	1525	1520	100	65
825 or 900	1320	5455	1570	1815	1820	115	75



DETAIL A



DETAIL B

SPECIFICATION REFERENCE

105
302

PRECAST ENDWALL FOR MULTIPLE PIPE CULVERTS
300 mm - 900 mm PIPE - 30° SKEW

VIRGINIA DEPARTMENT OF TRANSPORTATION

UNLESS OTHERWISE NOTED, ALL DIMENSIONS ON THIS SHEET ARE IN MILLIMETERS

101.15

Notes: Concrete to be 30 MPa minimum compressive strength.

Opening for skewed pipe will be adjusted to accommodate angles of 15° to 37° 30'.

Reinforcing steel in accordance with ASTM A-615M (reinforcing bars).

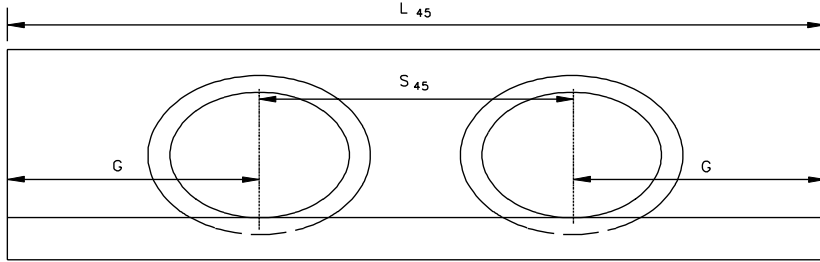
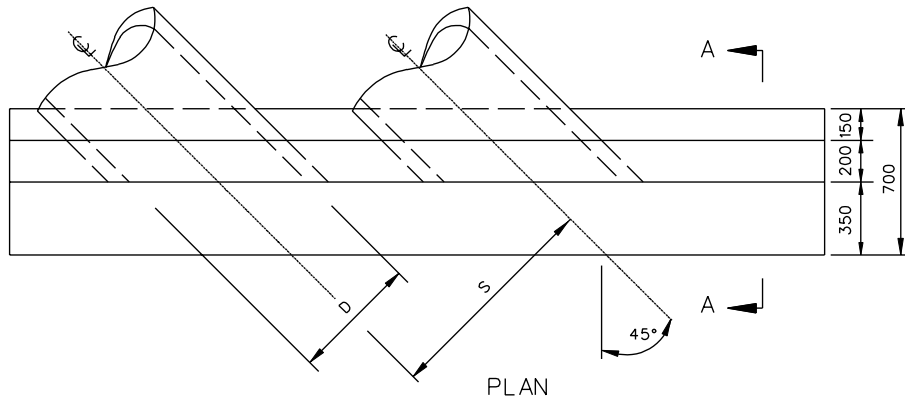
Pipe opening as required, 100 mm minimum, 200 mm maximum larger than O.D. pipe.

Dimensions shown are minimum. Actual measurements may vary with manufacturer's tolerances.

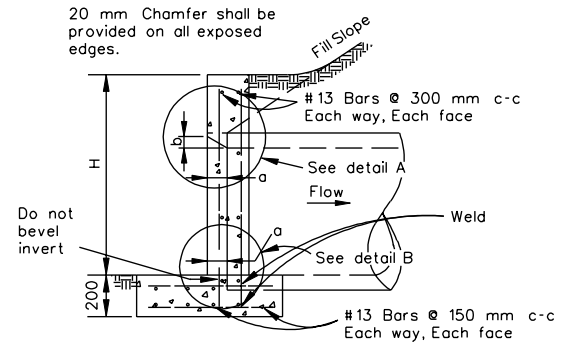
In no case shall top of endwall project above fill slope, ditch slope or shoulder.

Bevel edge is required on the headwall at the inlet end of the culvert (where the flow enters the culvert).

Headwall at the outlet end of the culvert may be either square edge or bevel edge.



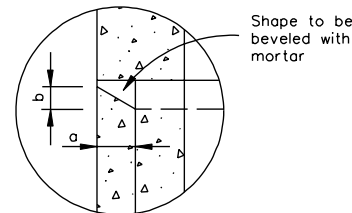
FRONT ELEVATION



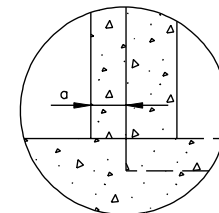
SECTION A-A

Headwall to be beveled in all areas except where a conflict with invert or wingwalls occur.

FOR CIRCULAR CONCRETE OR CORRUGATED METAL PIPE							
FOR MULTIPLE PIPE ENDWALL							
Diameter D of pipe	H	L 45	S	S 45	G	a	b
300	610	2000	550	780	610	50	30
375	680	2480	680	960	760	50	30
450	760	2965	810	1145	910	65	40
525 or 600	960	3940	1060	1500	1220	75	50
675 or 750	1160	4905	1320	1865	1520	100	65
825 or 900	1320	5860	1570	2220	1820	115	75



DETAIL A



DETAIL B

PRECAST ENDWALL FOR MULTIPLE PIPE CULVERTS
300 mm - 900 mm PIPE - 45° SKEW

SPECIFICATION REFERENCE

105
302

Notes: Cost of Bars for crack control to be included in price bid per cubic meter concrete.

All cast in place concrete to be Class 20. For precast See Sheet 101.18.

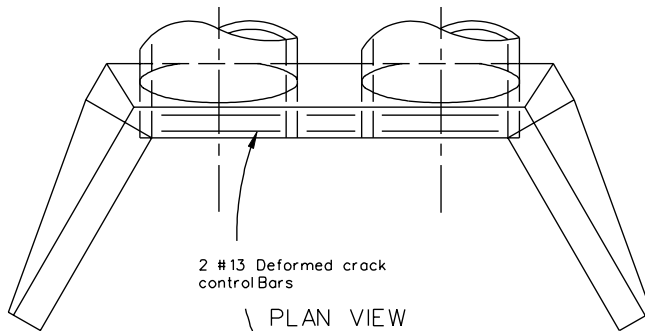
Quantities given are for one endwall.

All dimensions not given in tables are same as those for single endwalls for same size pipe.

On shallow fills, where endwalls are 300 mm or less below shoulder line, the top of the endwall shall be constructed parallel to the grade of the road.

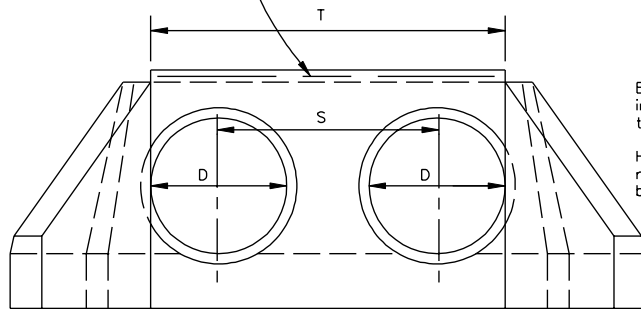
This item may be precast or cast in place.

In no case shall top of endwall project above fill slope, ditch slope or shoulder.



2 #13 Deformed crack control Bars

PLAN VIEW

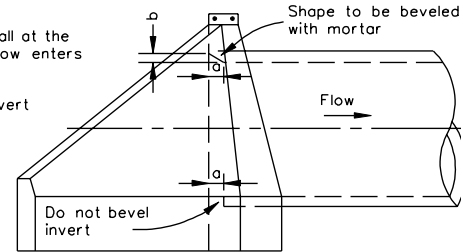


FRONT VIEW

Bevel edge is required on the headwall at the inlet end of the culvert (where the flow enters the culvert).

Headwall at the outlet end of the culvert may be either square edge or bevel edge.

Headwall to be beveled in all areas except where a conflict with invert or wingwalls occur.



SIDE VIEW

20 mm Chamfer shall be provided on all exposed edges.

This standard to be used with straight crossings and skew angles to 15°.

FOR CONCRETE PIPE									
DIA. D OF PIPE	S	T	FILL SLOPE 1-1/2:1		FILL SLOPE 2:1		a	b	
			Concrete One Dbl. Endwall	Increase For Each Additional Pipe	Concrete One Dbl. Endwall	Increase For Each Additional Pipe			
			(m ³)	(m ³)	(m ³)	(m ³)			
1050	1820	2890	3.69	0.97	4.20	0.96	140	90	
1200	2080	3300	4.56	1.22	5.20	1.20	150	100	
1350	2330	3700	5.88	1.57	6.72	1.56	180	115	
1500	2590	4110	7.41	1.99	8.50	1.97	190	125	
1650	2840	4520	9.19	2.48	10.56	2.45	215	140	
1800	3090	4920	11.21	3.03	12.91	3.00	230	150	
1950	3350	5330	13.46	3.63	15.54	3.60	255	165	
2100	3600	5740	16.17	4.35	18.64	4.29	265	180	

FOR CORRUGATED METAL PIPE									
DIA. D OF PIPE	S	T	FILL SLOPE 1-1/2:1		FILL SLOPE 2:1		a	b	
			Concrete One Dbl. Endwall	Increase For Each Additional Pipe	Concrete One Dbl. Endwall	Increase For Each Additional Pipe			
			(m ³)	(m ³)	(m ³)	(m ³)			
1050	1610	2680	3.88	0.98	4.38	0.97	140	90	
1200	1840	3060	4.81	1.24	5.45	1.22	150	100	
1350	2070	3440	6.29	1.61	7.08	1.59	180	115	
1500	2290	3820	7.89	2.05	8.97	2.03	190	125	
1650	2520	4200	9.75	2.49	11.12	2.47	215	140	
1800	2750	4580	11.98	3.11	13.68	3.08	230	150	
1950	2980	4960	14.46	3.77	16.53	3.74	255	165	
2100	3210	5340	17.38	4.51	19.88	4.48	265	180	

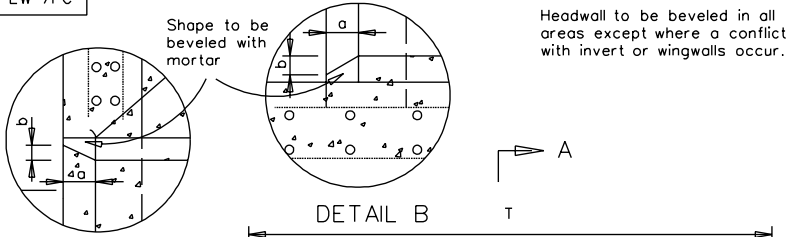
SPECIFICATION REFERENCE
105 302

STANDARD ENDWALLS FOR MULTIPLE PIPE CULVERTS
1050 mm - 2100 mm PIPE

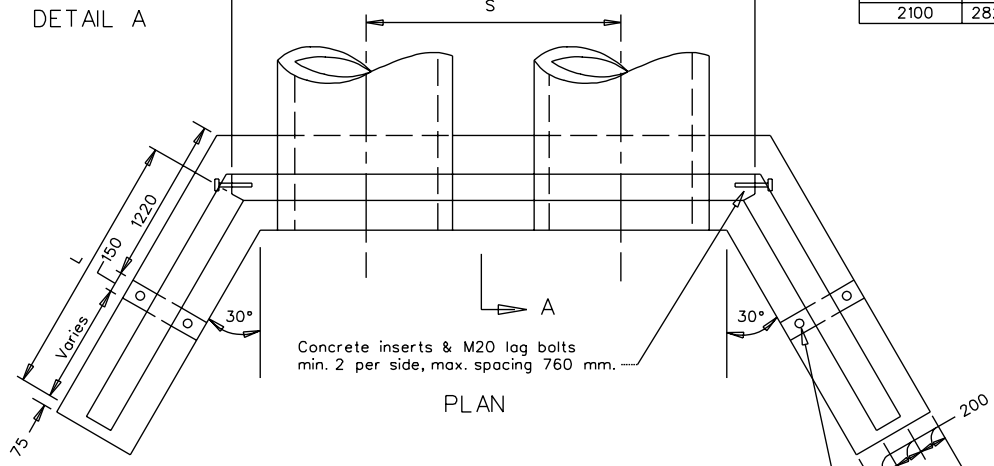
VIRGINIA DEPARTMENT OF TRANSPORTATION

UNLESS OTHERWISE NOTED, ALL DIMENSIONS ON THIS SHEET ARE IN MILLIMETERS

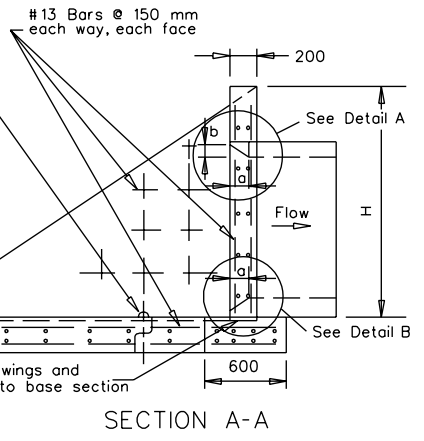
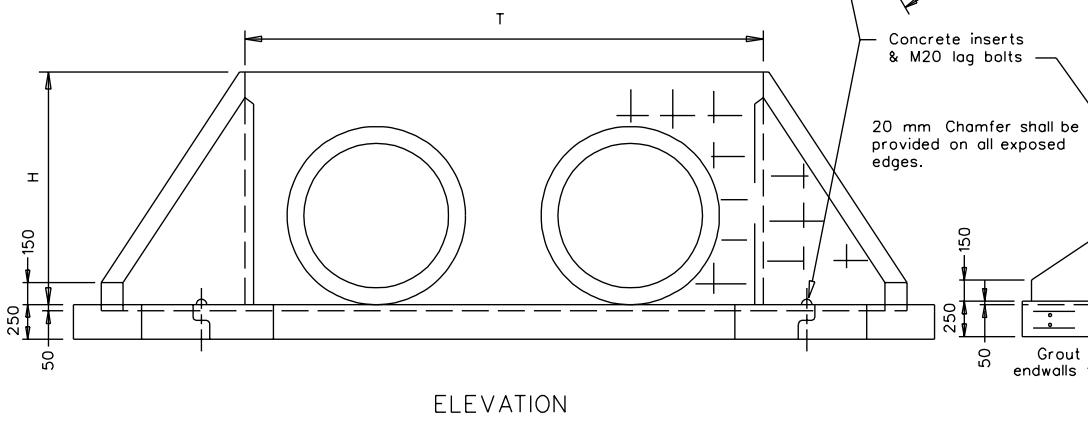
EW-7PC



FOR CONCRETE OR CORRUGATED METAL PIPE							
DIMENSIONS							
PIPE I.D.	H	T	S	L 1 1/2:1 SLOPE	L 2:1 SLOPE	a	b
1050	1670	3810	1820	2020	2640	140	90
1200	1820	4210	2080	2280	2990	150	100
1350	1980	4620	2330	2550	3350	180	115
1500	2130	5030	2590	2820	3690	190	125
1650	2310	5430	2840	3080	4050	215	140
1800	2490	5840	3090	3350	4400	230	150
1950	2650	6240	3350	3600	4750	255	165
2100	2820	6650	3600	3870	5100	265	180



Notes:
 Concrete to be 30 MPa minimum compressive strength.
 If pipe is to be skewed the opening will be adjusted to accommodate angles up to 15°.
 Reinforcing steel in accordance with ASTM A-615M (reinforcing bars).
 Pipe opening as required, 100 mm minimum, 200 mm maximum larger than outside diameter pipe.
 In no case shall top of endwall project above fill slope, ditch slope or shoulder.
 Dimensions shown are minimum. Actual measurements may vary with manufacturer's tolerances.
 Bevel edge is required on the endwall at the inlet end of the culvert (where the flow enters the culvert).
 Headwall at the outlet end of the culvert may be either square edge or bevel edge.

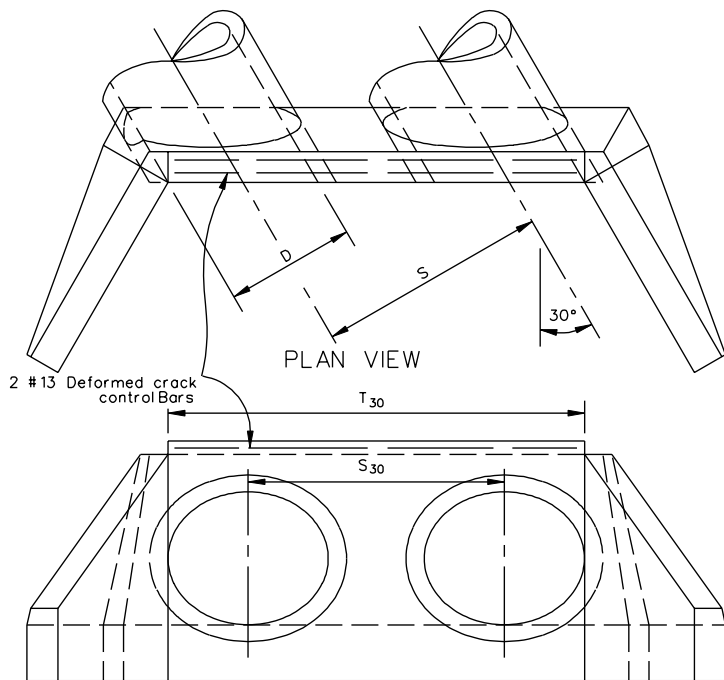


PRECAST ENDWALLS FOR MULTIPLE PIPE CULVERTS
 1050 mm - 2100 mm PIPE

101.18 UNLESS OTHERWISE NOTED, ALL DIMENSIONS ON THIS SHEET ARE IN MILLIMETERS

VIRGINIA DEPARTMENT OF TRANSPORTATION

SPECIFICATION REFERENCE
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 302



This standard to be used with skews 15° to 37° 30'.

FRONT VIEW

FOR CONCRETE PIPE OR CORRUGATED METAL PIPE		
PIPE I.D.	a	b
1050	140	90
1200	150	100
1350	180	115
1500	190	125
1650	215	140
1800	230	150
1950	255	165
2100	265	180

Headwall to be beveled in all areas except where a conflict with invert or wingwalls occur.

Bevel edge is required on the headwall at the inlet end of the culvert (where the flow enters the culvert).

Headwall at the outlet end of the culvert may be either square edge or bevel edge.

All cast in place Concrete to be Class 20.

For precast See Sheet 101.21.

Quantities given are for One Endwall.

All dimensions not given in table are same as those for Single Endwalls for same size pipe.

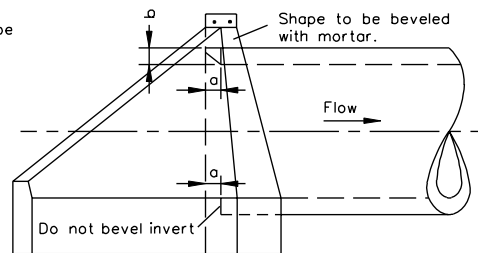
On shallow fills, where endwalls are 300 mm or less below shoulder line, the top of the endwall shall be constructed parallel to the grade of the road.

This item may be precast or cast in place.

In no case shall top of endwall project above fill slope, ditch slope or shoulder.

Cost of Bars for crack control to be included in price bid per cubic meter concrete.

20 mm Chamfer shall be provided on all exposed edges.



SIDE VIEW

FOR CONCRETE PIPE							
DIA. D OF PIPE	S	S30	T30	FILL SLOPE 1-1/2:1		FILL SLOPE 2:1	
				Concrete In One Double Endwall Cubic Meters	Increase For Each Additional Pipe	Concrete In One Double Endwall Cubic Meters	Increase For Each Additional Pipe
1050	1820	2100	3340	3.90	1.12	4.40	1.11
1200	2080	2400	3810	4.81	1.40	5.45	1.39
1350	2330	2690	4280	6.21	1.82	7.05	1.80
1500	2590	2990	4750	7.82	2.29	8.90	2.27
1650	2840	3280	5220	9.68	2.85	11.05	2.82
1800	3090	3570	5690	11.80	3.48	13.49	3.45
1950	3350	3870	6160	14.19	4.19	16.25	4.16
2100	3600	4155	6630	16.88	5.00	19.38	4.96

FOR CORRUGATED METAL PIPE							
DIA. D OF PIPE	S	S30	T30	FILL SLOPE 1-1/2:1		FILL SLOPE 2:1	
				Concrete In One Double Endwall Cubic Meters	Increase For Each Additional Pipe	Concrete In One Double Endwall Cubic Meters	Increase For Each Additional Pipe
1050	1610	1860	3090	4.10	1.12	4.60	1.10
1200	1840	2125	3530	5.09	1.41	5.73	1.40
1350	2070	2390	3970	6.68	1.84	7.44	1.82
1500	2290	2645	4410	8.35	2.34	9.43	2.32
1650	2520	2910	4850	10.39	2.93	11.74	2.89
1800	2750	3175	5290	12.74	3.62	14.40	3.56
1950	2980	3440	5730	15.34	4.35	17.40	4.32
2100	3210	3705	6170	18.31	5.22	20.81	5.18

SPECIFICATION REFERENCE

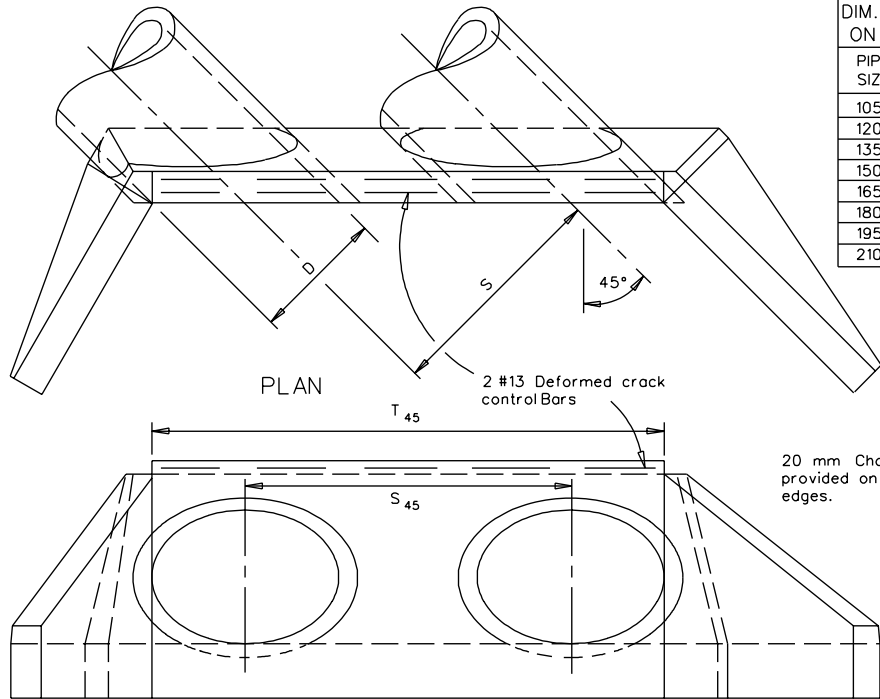
105
302

STANDARD ENDWALLS FOR MULTIPLE PIPE CULVERTS
1050 mm - 2100 mm PIPE - 30° SKEW

VIRGINIA DEPARTMENT OF TRANSPORTATION

UNLESS OTHERWISE NOTED, ALL DIMENSIONS ON THIS SHEET ARE IN MILLIMETERS

EW-7S



DIM. FOR BEVEL ON HEADWALL		
PIPE SIZE	a	b
1050	140	90
1200	150	100
1350	180	115
1500	190	125
1650	215	140
1800	230	150
1950	255	165
2100	265	180

Notes:

Headwall to be beveled in all areas except where a conflict with invert or wingwalls occur.

Bevel edge is required on the headwall at the inlet end of the culvert (where the flow enters the culvert).

Headwall at the outlet end of the culvert may be either square edge or bevel edge.

All cast in place Concrete to be Class 20.
For precast See Sheet 101.21.

Quantities given are for One Endwall.

All dimensions not given in table are same as those for Single Endwalls for same size pipe.

On shallow fills, where endwalls are 300 mm or less below shoulder line, the top of the endwall shall be constructed parallel to the grade of the road.

This item may be precast or cast in place.

In no case shall top of endwall project above fill slope, ditch slope, or shoulder.

This standard to be used with skews 37° 30' to 45°.

Cost of Bars for crack control to be included in price bid per cubic meter concrete.

FRONT VIEW * For details of Headwall bevel see Standard EW-2S sheets 101.08 & 101.09

FOR CONCRETE PIPE

DIA. D OF PIPE	S	S45	T45	FILL SLOPE 1-1/2:1		FILL SLOPE 2:1	
				Concrete In One Double Endwall	Increase For Each Additional Pipe	Concrete In One Double Endwall	Increase For Each Additional Pipe
				Cubic Meters	Cubic Meters	Cubic Meters	Cubic Meters
1050	1820	2575	4090	4.61	1.38	5.21	1.36
1200	2080	2940	4670	5.69	1.72	6.48	1.70
1350	2330	3295	5240	7.36	2.22	8.37	2.20
1500	2590	3665	5820	9.27	2.81	10.65	2.78
1650	2840	4015	6390	11.47	3.49	13.11	3.46
1800	3090	4370	6970	13.98	4.26	16.02	4.22
1950	3350	4740	7540	16.81	5.13	19.30	5.09
2100	3600	5090	8110	20.00	6.12	23.00	6.08

FOR CORRUGATED METAL PIPE

DIA. D OF PIPE	S	S45	T45	FILL SLOPE 1-1/2:1		FILL SLOPE 2:1	
				Concrete In One Double Endwall	Increase For Each Additional Pipe	Concrete In One Double Endwall	Increase For Each Additional Pipe
				Cubic Meters	Cubic Meters	Cubic Meters	Cubic Meters
1050	1610	2275	3790	4.84	1.37	5.44	1.35
1200	1840	2600	4330	6.01	1.73	6.80	1.71
1350	2070	2925	4860	7.82	2.25	8.81	2.23
1500	2290	3240	5400	9.90	2.87	11.28	2.84
1650	2520	3565	5945	12.30	3.59	13.94	3.55
1800	2750	3890	6480	15.05	4.41	17.08	4.37
1950	2980	4215	7020	18.16	5.33	20.64	5.29
2100	3210	4540	7560	21.67	6.38	24.67	6.33

STANDARD ENDWALLS FOR MULTIPLE PIPE CULVERTS
1050 mm - 2100 mm PIPE - 45° SKEW

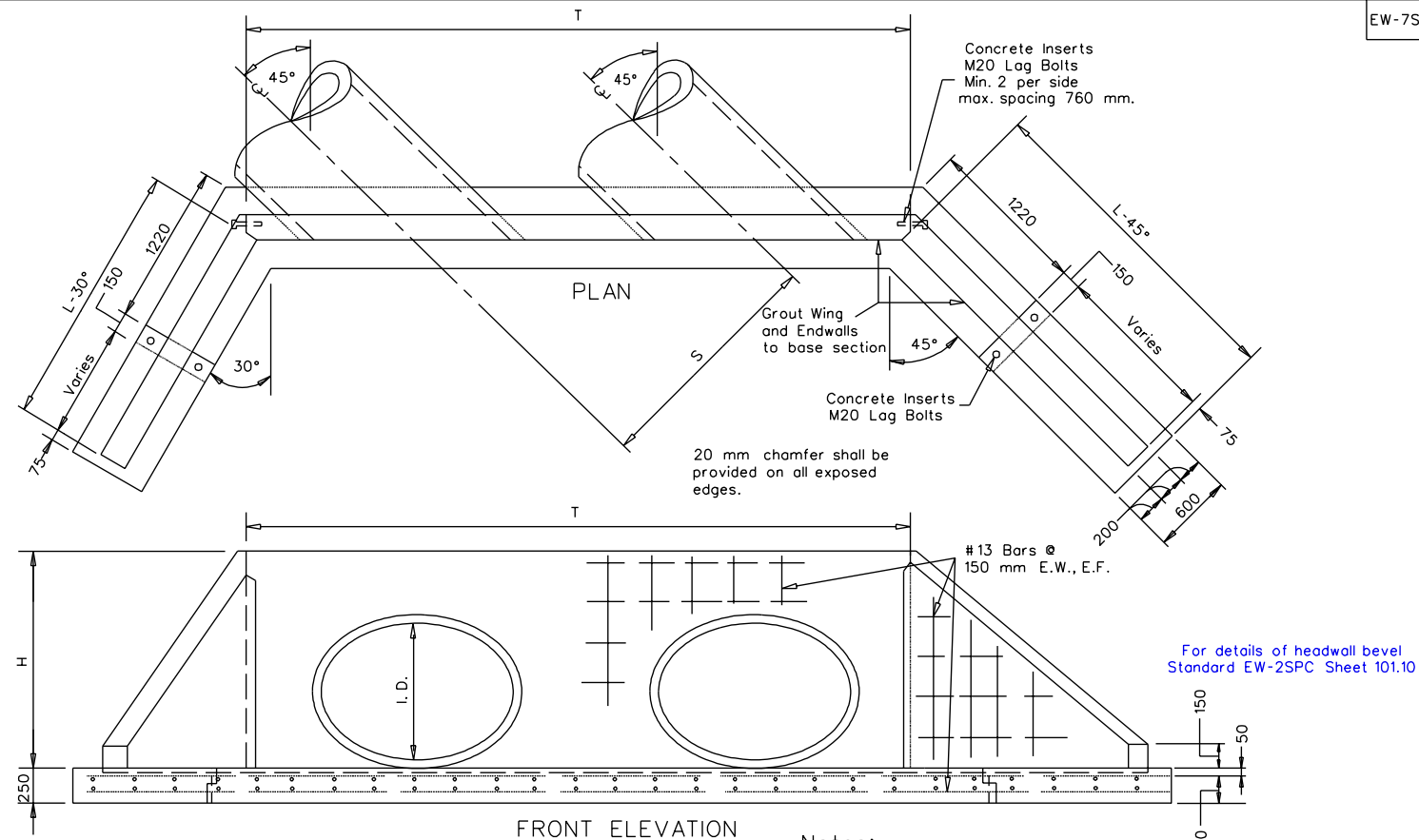
SPECIFICATION REFERENCE

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101.20

UNLESS OTHERWISE NOTED, ALL DIMENSIONS ON THIS SHEET ARE IN MILLIMETERS

VIRGINIA DEPARTMENT OF TRANSPORTATION



FOR CIRCULAR CONCRETE OR CORRUGATED METAL PIPE

PIPE I.D.	H	T	S	DIMENSIONS				a	b
				L-30° 1 1/2:1 SLOPE	L-30° 2:1 SLOPE	L-45° 1 1/2:1 SLOPE	L-45° 2:1 SLOPE		
1050	1670	5030	1820	2020	2640	2430	3200	140	90
1200	1820	5580	2080	2280	2990	2800	3650	150	100
1350	1980	6170	2330	2550	3340	3120	4110	180	115
1500	2130	6750	2590	2820	3690	3440	4520	190	125
1650	2310	7310	2840	3080	4050	3770	4970	215	140
1800	2490	7900	3090	3350	4400	4100	5380	230	150
1950	2650	8480	3350	3600	4750	4420	5790	255	165
2100	2820	9040	3600	3870	5100	4720	6240	265	180

Notes:

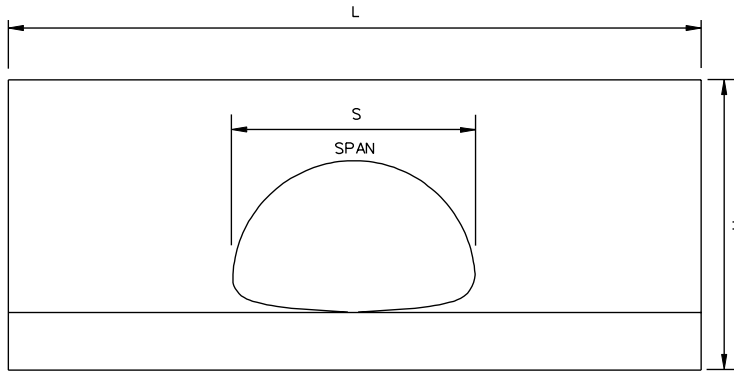
- Concrete to be 30 MPa minimum compressive strength.
- Reinforcing steel in accordance with ASTM A-615M (reinforcing bars).
- Pipe opening as required, 100 mm min., 200 mm max. larger than O.D. pipe.
- Dimensions shown are minimum. Actual Measurements may vary with manufacturer's tolerances.
- In no case shall top of Endwalls project above fill slope, ditch slope, or shoulder.
- Headwall to be beveled in all areas except where a conflict with invert or wingwalls occur.
- Bevel edge is required on the headwall at the inlet end of the culvert (where the flow enters the culvert).
- Headwall at the outlet end of the culvert may be either square edge or bevel edge.

SPECIFICATION REFERENCE
105 302

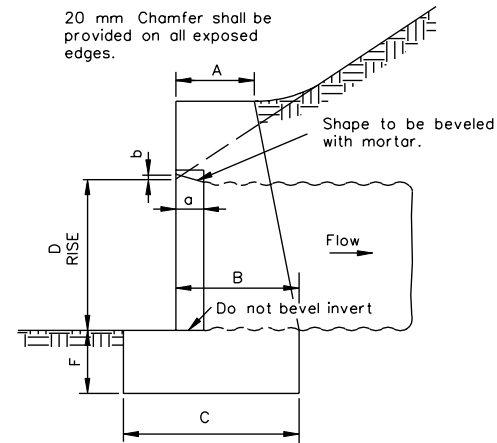
PRECAST ENDWALLS FOR MULTIPLE PIPE CULVERTS
1050 mm - 2100 mm PIPE 45° SKEW

VIRGINIA DEPARTMENT OF TRANSPORTATION

UNLESS OTHERWISE NOTED, ALL DIMENSIONS ON THIS SHEET ARE IN MILLIMETERS



FRONT ELEVATION



SIDE ELEVATION

Headwall to be beveled in all areas except where a conflict with invert or wingwalls occur.

Bevel edge is required on the headwall at the inlet end of the culvert (where the flow enters the culvert).

Headwall at the outlet end of the culvert may be either square edge or bevel edge.

Notes:

On shallow fills, where endwalls are 300 mm or less below shoulder line, the top of the endwall shall be constructed parallel to the grade of the road.

This item may be precast or cast in place.

All cast in place Concrete to be Class 20.

For precast See Sheet 101.23.

In no case shall top of endwall project above fill slope, ditch slope, or shoulder.

CORRUGATED METAL PIPE

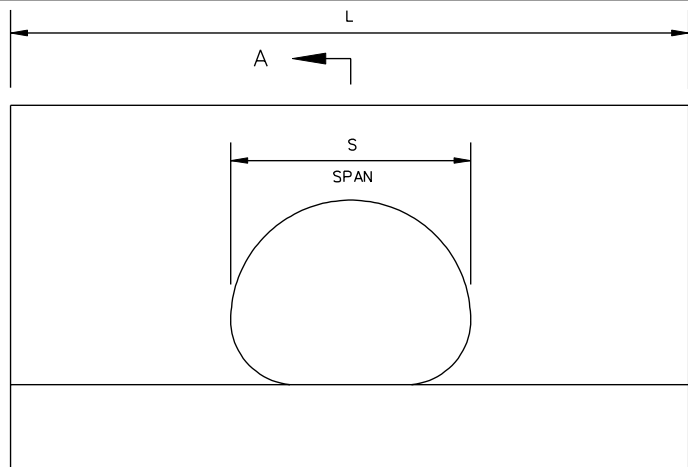
NOMINAL DIMENSIONS OF PIPE ARCH		DIMENSIONS FOR ONE SINGLE ENDWALL						CUBIC METERS CONCRETE FOR ONE ENDWALL	a	b
Span S	Rise D	A	B	C	F	H	L			
430	330	150	280	400	150	660	1290	0.20	50	30
530	380	150	280	400	150	710	1550	0.25	65	40
610	460	200	340	480	200	910	1850	0.48	75	50
710	510	220	380	530	200	960	2100	0.63	75	50
885	610	280	450	660	220	1090	2590	1.05	100	65
1060	740	300	530	760	220	1220	3150	1.58	115	75
* 1010	790	300	530	760	220	1220	3150	1.58	115	75
1240	840	300	530	760	220	1320	3630	1.93	140	90
* 1160	920	300	530	760	220	1320	3630	1.93	140	90
1440	970	300	610	830	220	1440	4210	2.62	150	100
*1340	1050	300	610	830	220	1440	4210	2.62	150	100

* 75 mm x 25 mm and 125 x 25 mm corrugation dimensions.

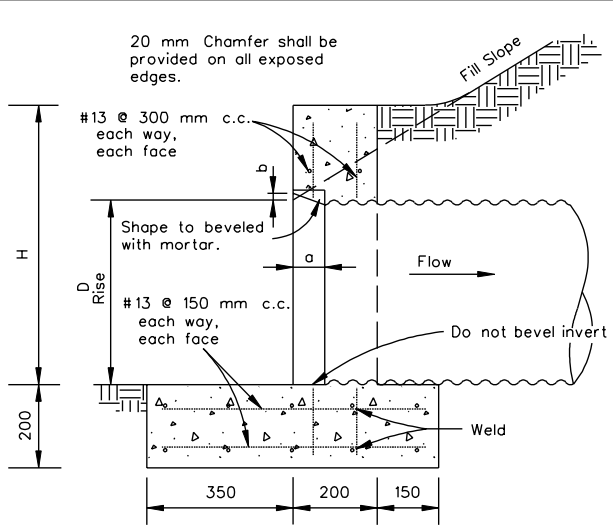
STANDARD ENDWALLS FOR PIPE ARCHES
330 mm - 1050 mm RISE

SPECIFICATION REFERENCE

105
302



FRONT ELEVATION



SECTION A-A

Concrete to be 30 MPa minimum compressive strength.

If pipe is to be skewed the opening will be adjusted to accommodate.

Reinforcing steel in accordance with ASTM A-615M (reinforcing bars)

Pipe Arch openings as required, 100 mm minimum, 200 mm larger than outside dimensions of pipe arch.

Dimensions shown are minimum. Actual measurements may vary with manufacturer's tolerance

In no case shall top of endwall project above fill slope, ditch slope, or shoulder.

Headwall to be beveled in all areas except where a conflict with invert or wingwalls occur.

Bevel edge is required on the headwall at the inlet end of the culvert (where the flow enters the culvert).

Headwall at the outlet end of the culvert may be either square edge or bevel edge.

PRECAST ENDWALL DIMENSIONS					
S SPAN	D RISE	H	L	a	b
430	330	500	1220	50	30
530	380	550	1520	65	40
610	460	710	1820	75	50
710	510	760	2130	75	50
885	610	860	2430	100	65
* 1010	790	990	3040	115	75
1060	740	990	3040	115	75
* 1160	920	1090	3650	140	90
1240	840	1090	3650	140	90
* 1340	1050	1220	3960	150	100
1440	970	1220	3960	150	100

* Dimensions for 75 mm x 25 mm and 125 x 25 mm corrugation

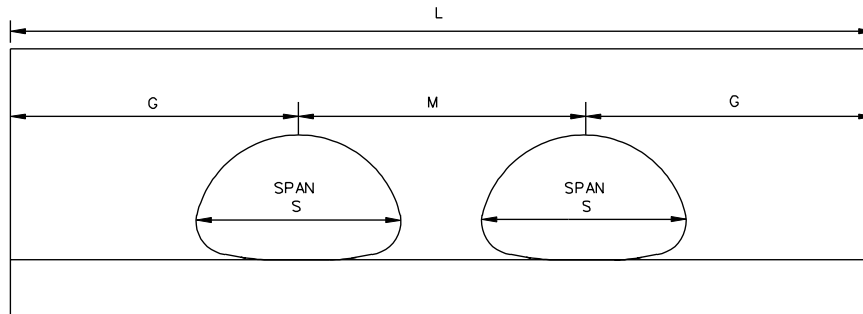
SPECIFICATION REFERENCE
105 302

PRECAST ENDWALLS FOR PIPE ARCHES
VIRGINIA DEPARTMENT OF TRANSPORTATION

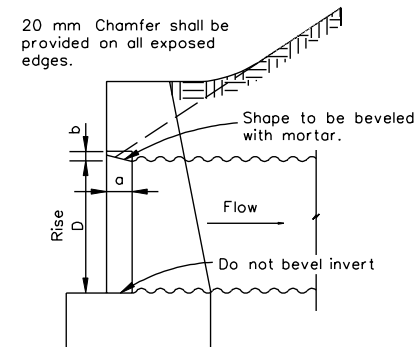
UNLESS OTHERWISE NOTED, ALL DIMENSIONS ON THIS SHEET ARE IN MILLIMETERS

REVISED ON 8/97

EW-10



FRONT ELEVATION



SIDE ELEVATION

Notes:

On shallow fills, where endwalls are 300 mm or less below shoulder line, the top of the endwall shall be constructed parallel to the grade of the road.

CORRUGATED METAL PIPE								
NOMINAL DIMENSIONS OF PIPE ARCH		DIMENSIONS FOR ONE DOUBLE ENDWALL			CUBIC METERS CONCRETE		a	b
Span S	Rise D	M	G	L	One Double Endwall	Increase For Each Additional Pipe Arch		
430	330	760	660	2080	0.31	0.11	50	30
530	380	860	780	2420	0.37	0.12	65	40
610	460	940	940	2820	0.70	0.21	75	50
710	510	1040	1060	3160	0.90	0.27	75	50
875	610	1220	1290	3800	1.45	0.40	100	65
1060	740	1470	1570	4610	2.18	0.60	115	75
* 1010	790	1470	1570	4610	2.18	0.60	115	75
1240	840	1700	1820	5340	2.64	0.71	140	90
* 1160	920	1700	1820	5340	2.64	0.71	140	90
1440	970	1980	2100	6180	3.57	0.95	150	100
* 1340	1050	1980	2100	6180	3.57	0.95	150	100

* 75 mm x 25 mm and 125 x 25 mm corrugation dimensions.

Notes:

This item may be precast or cast in place.

All dimensions not given in table are same as those for single endwalls for the same size pipe arch.

All cast in place concrete to be Class 20.
For precast See Sheet 101.25.

In no case shall top of endwall project above fill slope, ditch slope, or shoulder.

Headwall to be beveled in all areas except where a conflict with invert or wingwalls occur.

Bevel edge is required on the headwall at the inlet end of the culvert (where the flow enters the culvert).

Headwall at the outlet end of the culvert may be either square edge or bevel edge.

STANDARD ENDWALLS FOR MULTIPLE PIPE ARCHES
330 mm - 1050 mm RISE

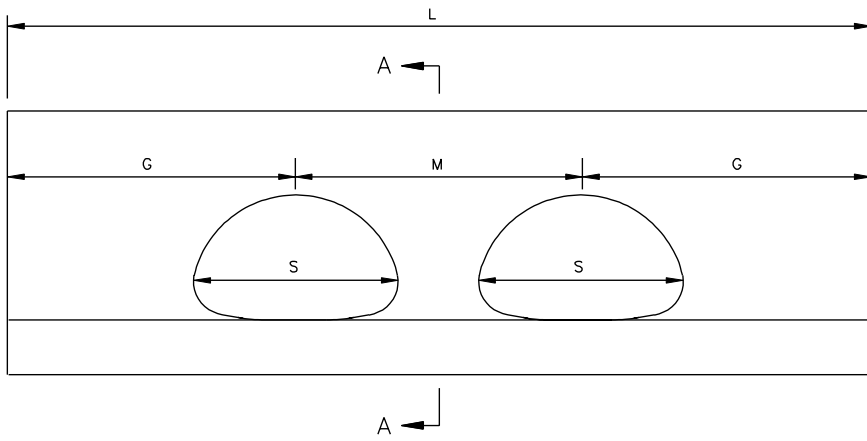
SPECIFICATION REFERENCE

105
302

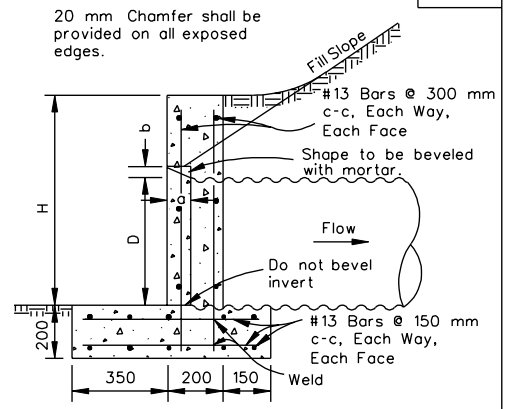
101.24

UNLESS OTHERWISE NOTED, ALL DIMENSIONS ON THIS SHEET ARE IN MILLIMETERS

VIRGINIA DEPARTMENT OF TRANSPORTATION



FRONT ELEVATION



SECTION A-A

Notes:

- Concrete to be 30 MPa minimum compressive strength.
- If pipe is to be skewed the opening will be adjusted to accommodate.
- Reinforcing steel in accordance with ASTM A615M (reinforcing bars).
- Pipe Arch opening as required 100 mm minimum, 200 mm maximum larger than outside dimensions of pipe arch.
- Dimensions shown are minimum. Actual measurements may vary with manufacturer's tolerance.
- In no case shall top of endwall project above fill slope, ditch, or shoulder.
- Headwall to be beveled in all areas except where a conflict with invert or wingwalls occur.
- Bevel edge is required on the headwall at the inlet end of the culvert (where the flow enters the culvert).
- Headwall at the outlet end of the culvert may be either square edge or bevel edge.

PRECAST ENDWALL DIMENSIONS							
S	D	M	G	L	H	a	b
430	330	760	660	2080	680	50	30
530	380	860	780	2420	730	65	40
610	460	940	940	2820	810	75	50
710	510	1040	1060	3160	860	75	50
885	610	1220	1290	3800	960	100	65
* 1010	790	1470	1570	4610	1090	115	75
1060	740	1470	1570	4610	1090	115	75
* 1160	920	1700	1820	5340	1190	140	90
1240	840	1700	1820	5340	1190	140	90
* 1340	1050	1980	2100	6180	1320	150	100
1440	970	1980	2100	6180	1320	150	100

* Dimensions for 75 x 25 mm and 125 x 25 mm corrugation

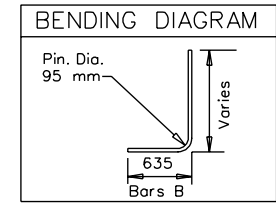
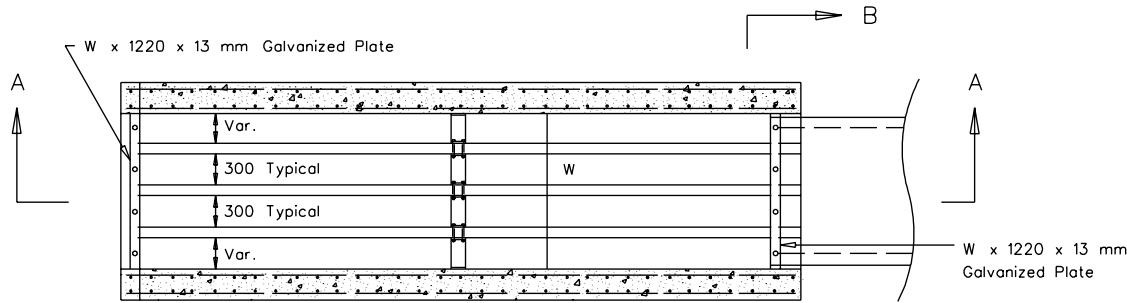
SPECIFICATION REFERENCE
105 302

PRECAST ENDWALLS FOR MULTIPLE PIPE ARCHES

VIRGINIA DEPARTMENT OF TRANSPORTATION

UNLESS OTHERWISE NOTED, ALL DIMENSIONS ON THIS SHEET ARE IN MILLIMETERS

EW-11



Standard EW-11 to be installed so the grate configuration is always perpendicular to the edge of shoulder.

Notes:

- 200 mm for 300 to 900 mm diameter Pipes
300 for 1050 mm to 1500 mm diameter Pipes
- Slope as specified on typical section.
- Weep hole with 300 x 300 mm plastic hardware cloth 6.4 mm mesh or galvanized steel wire, minimum wire diameter 0.76 mm number 4 mesh hardware cloth anchored firmly outside of structure.

PLAN VIEW

Headwall to be beveled in all areas except where a conflict with invert or wingwalls occur.
Bevel edge is required on the headwall at the inlet end of the culvert (where the flow enters the culvert).
Headwall at the outlet end of the culvert may be either square edge or bevel edge.

Notes:

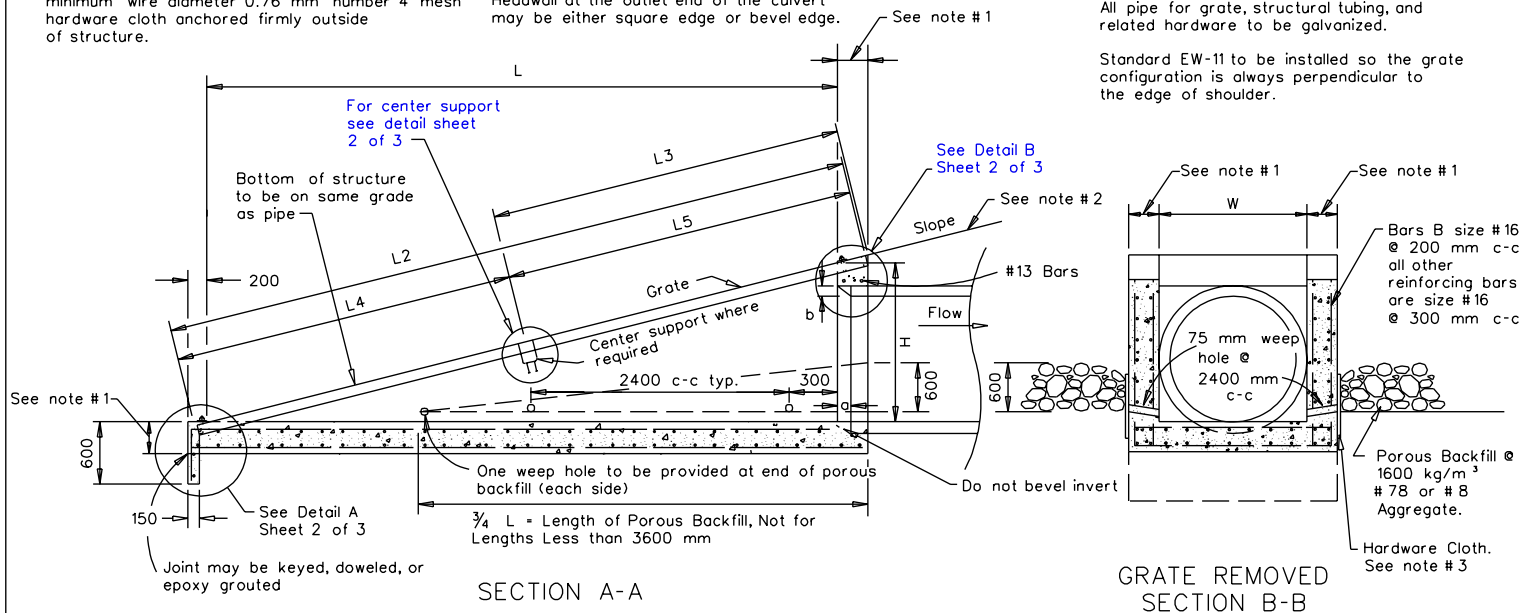
All cast in place concrete to be Class 20.
For precast use 30 MPa min.
Reinforcing steel to have a minimum 40 mm cover.

For tabulation of dimensions and quantities see Sheet 3 of 3.

This item may be precast or cast in place.

All pipe for grate, structural tubing, and related hardware to be galvanized.

Standard EW-11 to be installed so the grate configuration is always perpendicular to the edge of shoulder.



Sheet 1 of 3

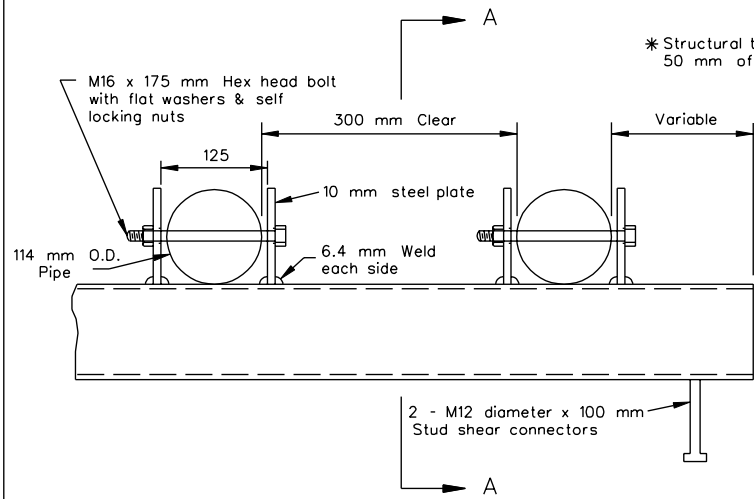
PIPE ENDWALL WITH LOAD-CARRYING GRATE
FOR 300 mm - 1500 mm PIPES

SPECIFICATION REFERENCE

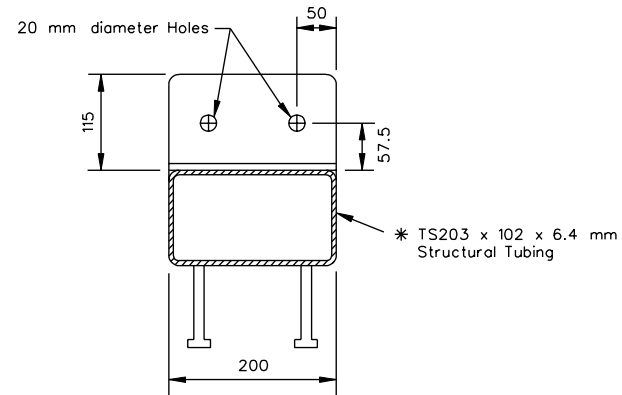
- 105
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- 302

101.26 UNLESS OTHERWISE NOTED, ALL DIMENSIONS ON THIS SHEET ARE IN MILLIMETERS

VIRGINIA DEPARTMENT OF TRANSPORTATION

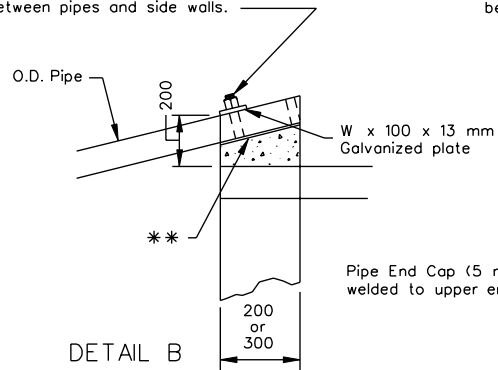


CENTER SUPPORT
(Elevation)



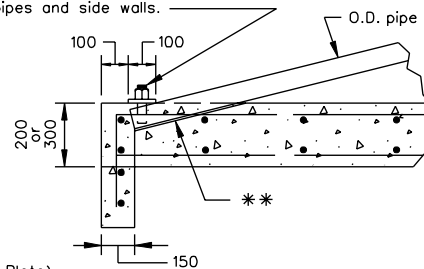
SECTION A-A

Hook Bolts M12 x 150 mm x (40 mm Right angle bend) with flat washer & self locking nut. 16 mm holes to be provided in plate, centered between pipes and side walls.

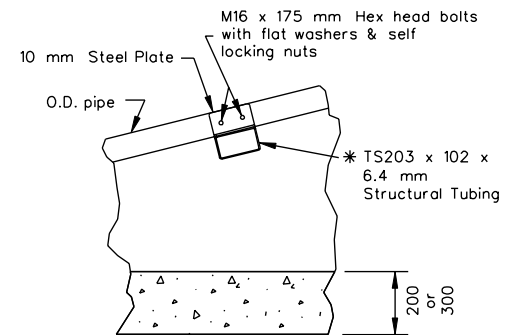


DETAIL B

Hook Bolts M12 x 150 mm x (40 mm Right angle bend) with flat washer & self locking nut. 16 mm holes to be provided in plate, centered between pipes and side walls.



DETAIL A



CENTER SUPPORT

** Notches for pipe to be formed in concrete so that pipe will fit snug but can be removed.

SPECIFICATION REFERENCE	PIPE ENDWALL WITH LOAD-CARRYING GRATE FOR 300 mm - 1500 mm PIPES		
105 233 302	VIRGINIA DEPARTMENT OF TRANSPORTATION		UNLESS OTHERWISE NOTED, ALL DIMENSIONS ON THIS SHEET ARE IN MILLIMETERS
			101.27

PIPE GRATE

TYPE I - 90 mm O.D.
 TYPE II - 100 mm O.D.
 TYPE III - 115 mm O.D.

Length of grate to be determined by L₂ x Number of pipes required

4 : 1 SLOPE									
Pipe Size	H	L	W						
				Pipe O.D.	No. Pipes Required	L ₂	L ₃	L ₄	L ₅
300	560	2240	600	90	1	2610	No Center Support Required		
375 or 450	725	2900	600	90	1	3290			
525 or 600	890	3560	900	100	2	3970			
675 or 750	1055	4220	900	100	2	4650			
825 or 900	1220	4880	1210	115	3	5335			
1050	1385	5540	1210	115	3	6015			
1200	1550	6200	1510	115	3	6770	3180	3620	3155
1350	1715	6860	1820	115	4	7455	3865	3620	3840
1500	1880	7520	1820	115	4	8140	4550	3620	4520

DIMENSIONS FOR BEVEL ON HEADWALL

Pipe I.D.	a	b
300	50	30
375 or 450	60	35
525 or 600	75	50
675 or 750	100	60
825 or 900	115	75
1050	135	90
1200	150	100
1350	175	115
1500	190	125

6 : 1 SLOPE									
Pipe Size	H	L	W						
				Pipe O.D.	No. Pipes Required	L ₂	L ₃	L ₄	L ₅
300	560	3360	600	87	1	3700	No Center Support Required		
375 or 450	725	4350	600	100	1	4705			
525 or 600	890	5340	900	112	2	5715			
675 or 750	1055	6330	900	112	2	6705			
825 or 900	1220	7320	1210	112	3	7705	1375	5295	1410
1050	1375	8250	1210	112	3	8815	2430	5295	2415
1200	1550	9300	1510	112	3	9805	3540	5295	3520
1350	1715	10290	1820	112	4	10820	4540	5295	4525
1500	1880	9400	1820	112	4	11825	5545	5295	5525
							5930	5915	5915

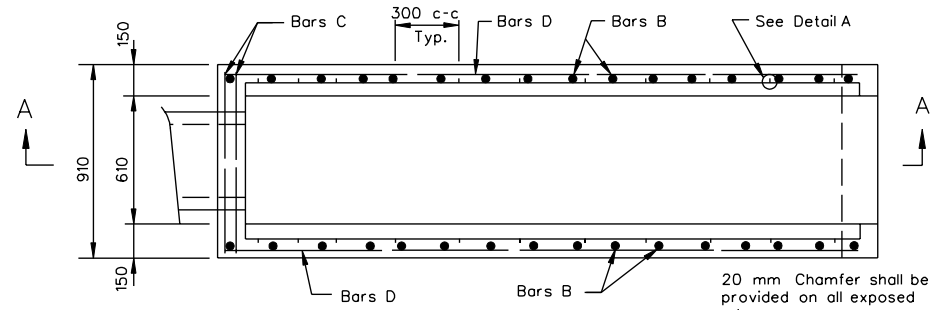
3 : 1 SLOPE							No. Center Support Required
Pipe Size	H	L	W	Pipe Grate			
				Pipe O.D.	No. Pipes Req'd.	L ₂	
300	560	1680	600	90	1	2070	
375 or 450	725	2175	600	90	1	2600	
525 or 600	890	2670	900	90	2	3120	
675 or 750	1055	3165	900	90	2	3640	
825 or 900	1220	3660	1210	100	3	4160	
1050	1385	4155	1210	100	3	4680	
1200	1550	4650	1510	115	3	5195	
1350	1715	5145	1820	115	4	5730	
1500	1880	5640	1820	115	4	6250	

APPROXIMATE QUANTITIES											
Pipe Size	3 : 1			Pipe Size	4 : 1			Pipe Size	6 : 1		
	Concrete Cubic meters		kg Reinf. Steel		Concrete Cubic meters		kg Reinf. Steel		Concrete Cubic meters		kg Reinf. Steel
	Conc. Pipe	C.M. Pipe			Conc. Pipe	C.M. Pipe			Conc. Pipe	C.M. Pipe	
300	0.73	0.74	109	300	0.90	0.90	140	300	1.25	1.27	201
375 or 450	0.97	0.99	149	375 or 450	1.21	1.23	193	375 or 450	1.74	1.77	281
525 or 600	1.76	1.80	219	525 or 600	1.87	1.90	285	525 or 600	2.72	2.75	416
675 or 750	1.82	1.87	276	675 or 750	2.30	2.30	357	675 or 750	3.33	3.37	525
825 or 900	2.51	2.59	367	825 or 900	3.21	3.28	480	825 or 900	4.60	4.66	706
1050	4.80	4.94	476	1050	6.16	6.29	621	1050	8.87	9.00	906
1200	6.17	6.34	602	1200	7.87	8.03	747	1200	11.35	11.51	1140
1350	7.67	7.87	731	1350	9.79	9.99	955	1350	14.13	14.33	1403
1500	8.55	8.80	828	1500	10.99	11.23	1085	1500	15.93	16.17	1595

PIPE ENDWALL WITH LOAD - CARRYING GRATE FOR 300 mm x 1500 mm PIPES

SPECIFICATION REFERENCE

105
233
302

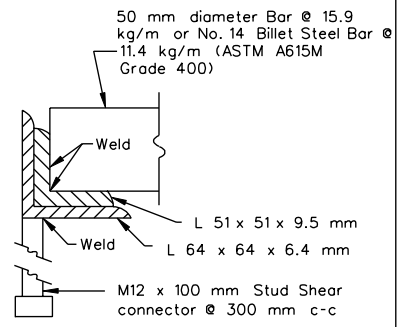


PLAN VIEW
(Grate Removed)

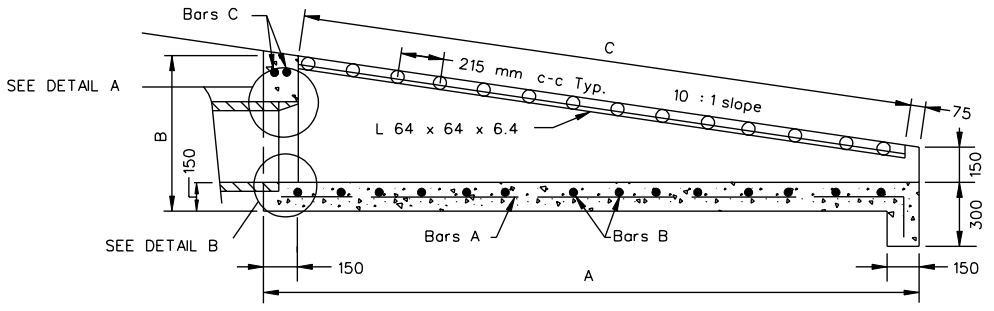
DIMENSIONS FOR BEVEL		
ON HEADWALL PIPE SIZE	a	b
300	50	30
375	50	30
450	65	40
525 or 600	75	50

20 mm Chamfer shall be provided on all exposed edges.

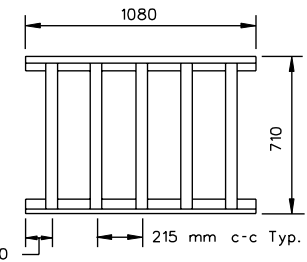
No holes are to be provided in L 51 x 51 x 9.5 mm when solid bars are used.



DETAIL A



SECTION A-A



GRATE SECTION DETAIL

Notes:

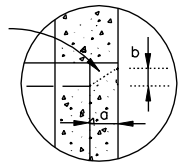
- In no case shall top of endwall project above fill slope, ditch slope, or shoulder.
- Class 20 concrete to be used if cast in place, 30 MPa if precast.
- Reinforcing steel to have a minimum 40 mm concrete cover.
- For schedule of reinforcing steel, dimensions, and quantities see sheet 2 of 2.
- This item may be precast or cast in place.
- Bottom of Structure to be on the same grade as drainage ditch.

Headwall to be beveled in all areas except where a conflict with invert or wingwalls occur.

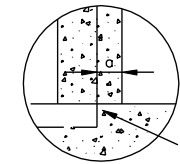
Bevel edge is required on headwall at the inlet end of the culvert (where the flow enters the culvert).

Headwall at the outlet end of the culvert may be either square edge or bevel edge.

Shape to be beveled with mortar



DETAIL A



DETAIL B

Do not bevel invert

SPECIFICATION REFERENCE
105
233
302

PIPE ENDWALL WITH LOAD - CARRYING GRATE
FOR 300 mm - 600 mm PIPES

VIRGINIA DEPARTMENT OF TRANSPORTATION

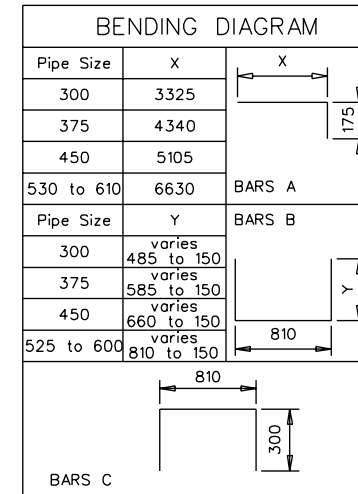
UNLESS OTHERWISE NOTED, ALL DIMENSIONS ON THIS SHEET ARE IN MILLIMETERS

DIMENSIONS					
Pipe Size	A	B	C	a	b
300	3450	635	3240	50	30
375	4470	735	4270	50	30
450	5230	810	5030	65	40
525 or 600	6755	965	6565	75	50

APPROXIMATE QUANTITIES					
Pipe Size	Concrete Cubic Meters		kg Reinf. Steel	No. of Grate Sections	Length to be cut from 1 grate
	Conc. Pipe	C.M. Pipe			
300	0.862	0.871	54	3	0
375	1.172	1.183	73	4	54
450	1.420	1.436	91	5	368
525 to 600	1.964	1.989	125	6	0

* Grates will be 84 mm short.

SCHEDULE OF REINFORCING STEEL																
Pipe Size	BARS A				BARS B				BARS C				BARS D			
	Size	No.	SPA.	Length	Size	No.	SPA.	Length	Size	No.	SPA.	Length	Size	No.	SPA.	Length
300	#13	5	200	3505	#13	17	200	varies 1115 to 1775	#13	2	-	1422	#13	4	200	varies 1270 to 3350
375	#13	5	200	4520	#13	22	200	varies 1115 to 2005	#13	2	-	1422	#13	4	200	varies 2335 to 4370
450	#13	5	200	5280	#13	26	200	varies 1115 to 2130	#13	2	-	1422	#13	6	200	varies 1320 to 5130
525 to 600	#13	5	200	6810	#13	33	200	varies 1115 to 2440	#13	2	-	1422	#13	8	200	varies 835 to 6655

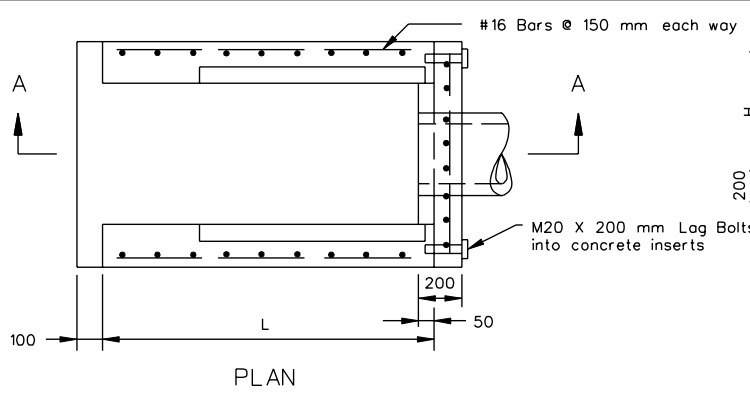


APPROXIMATE WEIGHT OF GRATE	
TYPE	kg
M50 Bar	71.98
No. 14 Billet Steel Bar	56.13

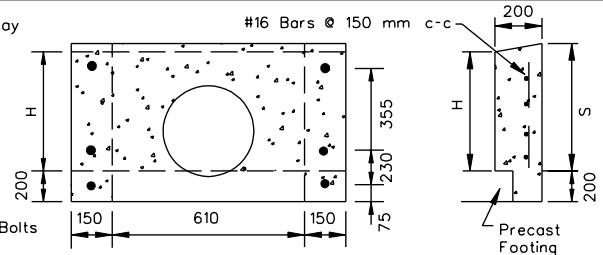
PIPE ENDWALL WITH LOAD - CARRYING GRATE
FOR 300 mm - 600 mm PIPES

SPECIFICATION REFERENCE

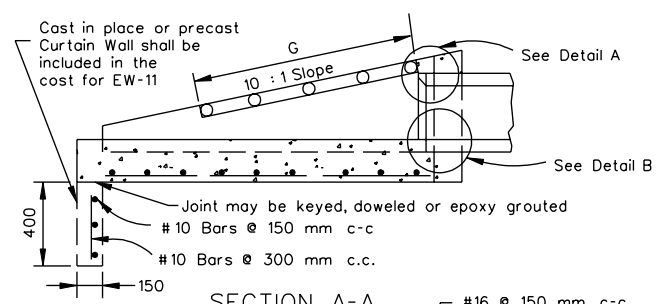
105
233
302



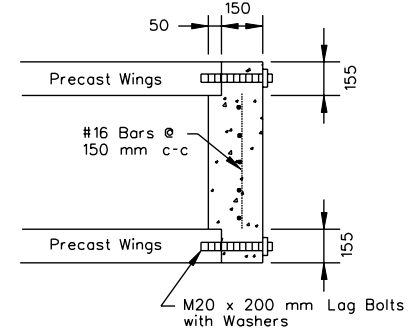
PLAN



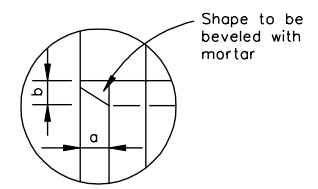
DIMENSIONS		
PIPE SIZE	H	S
300	480	500
375	585	605
450	660	680
525 or 600	810	830



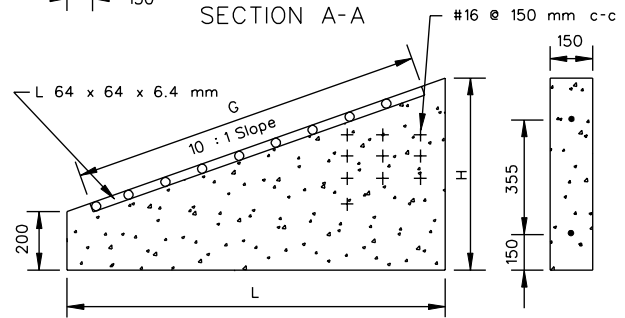
SECTION A-A



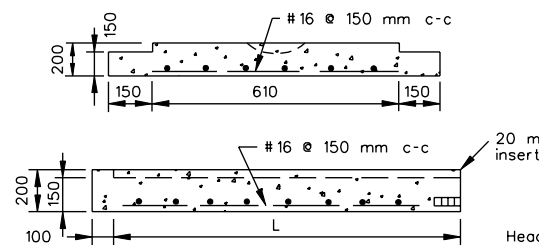
END WALL DETAIL



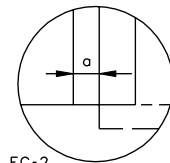
DETAIL A



WING WALL DETAIL



FOOTING DETAIL



DETAIL B

DIMENSIONS					
PIPE SIZE	L	H	G	a	b
300	3350	535	3240	50	30
375	4360	635	4245	50	30
450	5130	710	5000	65	40
525 or 600	6650	865	6555	75	50

Concrete to be 30 MPa minimum compressive strength. If pipe is to be skewed, the opening will be adjusted to accommodate. Reinforcing steel in accordance with ASTM A615M (reinforcing bars). Pipe opening as required, 100 mm min., 200 mm max. larger than O.D. pipe. Dimensions shown are minimum. Actual dimensions may vary with manufacturer. Bottom of Structure to be on the same grade as drainage ditch. For details of grate and number of grates required see EW-11A.

20 mm Chamfer shall be provided on all exposed edges.

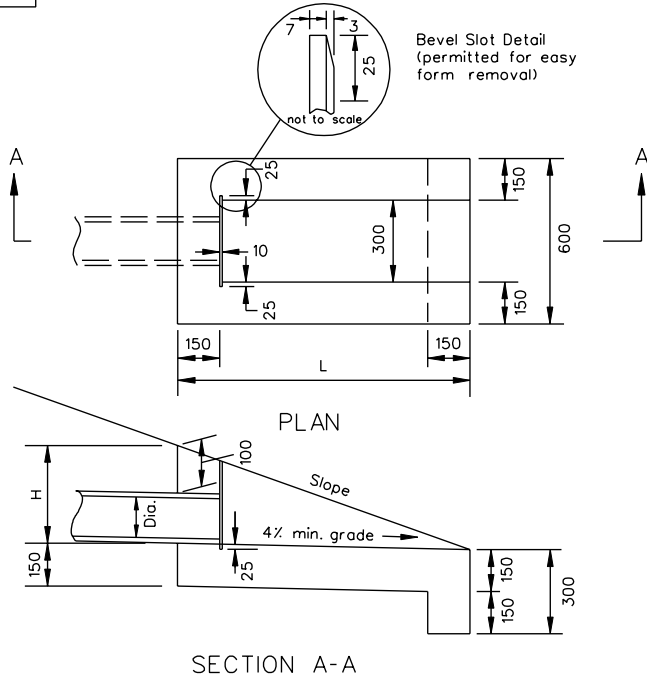
Headwall to be beveled in all areas except where a conflict with invert or wingwalls occur. Bevel edge is required on the headwall at the inlet end of the culvert (where the flow enters the culvert). Headwall at the outlet end of the culvert may be either square edge or bevel edge.

SPECIFICATION REFERENCE
105 233 302

PIPE ENDWALL WITH LOAD - CARRYING GRATE FOR 300 mm - 600 mm PIPES

REVISED ON 2/01

EW-12



Notes:

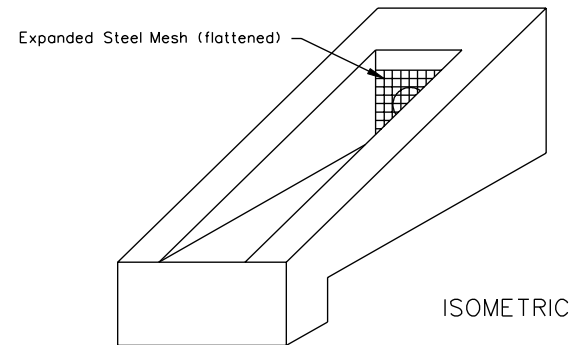
Typical endwall to be placed at the ends of all underdrain outlets. Endwall to be installed perpendicular to roadway and flush with the slope.

Outlet pipes shall be rigid nonperforated, smooth-bore pipe, meeting the requirements of 480 kPa tested according to ASTM 2412.

Expanded steel mesh (flattened) shall have openings of approx. 13 mm x 13 mm and weigh approx. 4 kg/m². Mesh shall be galvanized in accordance with ASTM A-123M. The mesh shall extend a minimum of 25 mm above the O.D. of the pipe, and is a barrier for rodents, etc. The slot for the steel mesh is to be constructed so that the mesh can be removed for cleanout purposes.

This item may be precast or cast in place.

PIPE I.D.	SLOPE	DIMENSIONS		CLASS 20 CONCRETE CUBIC METERS
		L	H	
100	2:1	750	375	0.13
100	4:1	1340	335	0.21
150	2:1	870	435	0.16
150	4:1	1600	400	0.27



STANDARD ENDWALL FOR PIPE UNDERDRAIN

VIRGINIA DEPARTMENT OF TRANSPORTATION

101.32

UNLESS OTHERWISE NOTED, ALL DIMENSIONS ON THIS SHEET ARE IN MILLIMETERS

SPECIFICATION REFERENCE

105
233
302