

NOTES:

- "H" MAY BE REDUCED UNTIL "X" REACHES A MINIMUM OF 4" 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 A3. 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.
- ON SHALLOW FILLS, WHERE ENDWALLS ARE 1' OR LESS BELOW SHOULDER LINE, THE TOP OF THE ENDWALL SHALL BE CONSTRUCTED PARALLEL TO THE GRADE OF THE ROAD.
- 3/4" CHAMFER MAY BE PROVIDED ON ALL EDGES AT MANUFACTURER'S OPTION.

EW-1

ENDWALL FOR CIRCULAR PIPE						
DIAMETER OF PIPE CULVERT						
	12"	15"	18"	21" OR 24"	27" OR 30"	33" OR 36"
A	0'-6"	0'-8"	0'-9"	0'-11"	1'-0"	1'-0"
B	0'-11"	1'-1"	1'-3"	1'-6"	1'-9"	2'-0"
C	1'-4"	1'-7"	1'-9"	2'-2"	2'-6"	2'-9"
D	1'-0"	1'-3"	1'-6"	2'-0"	2'-6"	3'-0"
F	0'-6"	0'-8"	0'-8"	0'-9"	0'-9"	0'-9"
H	2'-3"	2'-11"	3'-2"	3'-9"	4'-3"	4'-9"
L	4'-0"	5'-0"	6'-0"	8'-0"	10'-0"	12'-0"
a	0'-1/4"	0'-1 3/4"	0'-2"	0'-2 1/2"	0'-3 1/4"	0'-3 3/4"
b	0'-1"	0'-1 1/4"	0'-1 1/2"	0'-2"	0'-2 1/2"	0'-3"
CUBIC YARDS OF CONCRETE						
CONC. PIPE	0.241	0.492	0.697	1.319	2.067	2.947
C.M. PIPE	0.257	0.521	0.739	1.398	2.198	3.145

EW-1A

ENDWALL FOR ELLIPTICAL PIPE								
SIZE OF ELLIPTICAL PIPE CULVERT (SPAN x RISE)								
	23"x14"	30"x19"	34"x22"	38"x24"	42"x27"	45"x29"	49"x32"	53"x34"
A	0'-8"	0'-9"	0'-10"	0'-11"	0'-11"	1'-0"	1'-0"	1'-0"
B	1'-2"	1'-5"	1'-6"	1'-8"	1'-9"	1'-10"	1'-11"	1'-11"
C	1'-8"	1'-11"	2'-1"	2'-4"	2'-5"	2'-7"	2'-8"	2'-9"
D	1'-2"	1'-7"	1'-10"	2'-0"	2'-3"	2'-5"	2'-8"	2'-10"
F	0'-8"	0'-8"	0'-9"	0'-9"	0'-9"	0'-9"	0'-9"	0'-9"
H	2'-10"	3'-3"	3'-7"	3'-9"	4'-0"	4'-2"	4'-5"	4'-7"
L	5'-5"	7'-2"	8'-6"	9'-2"	10'-2"	10'-11"	12'-1"	12'-11"
S	1'-11"	2'-6"	2'-10"	3'-2"	3'-6"	3'-9"	4'-1"	4'-5"
a	0'-2 1/2"	0'-3 1/4"	0'-3 1/2"	0'-4"	0'-4 1/2"	0'-4 3/4"	0'-5"	0'-5 1/2"
b	0'-2"	0'-2 1/2"	0'-2 3/4"	0'-3"	0'-3 1/2"	0'-3 3/4"	0'-4"	0'-4 1/2"
CUBIC YARDS OF CONCRETE								
CONC. PIPE	0.502	0.855	1.236	1.500	1.811	2.101	2.512	2.801

SPECIFICATION REFERENCE

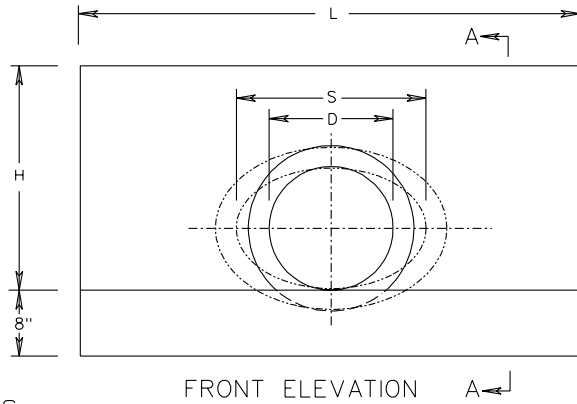
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STANDARD ENDWALL FOR PIPE CULVERTS  
12"-36" CIRCULAR AND 23"x14"-53"x34" ELLIPTICAL PIPES

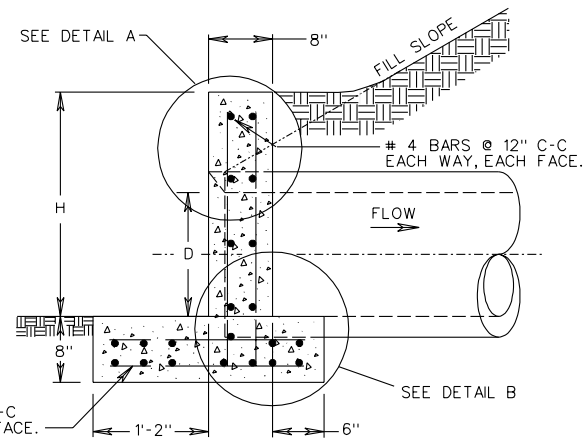
VIRGINIA DEPARTMENT OF TRANSPORTATION

101.01

EW-1,1APC



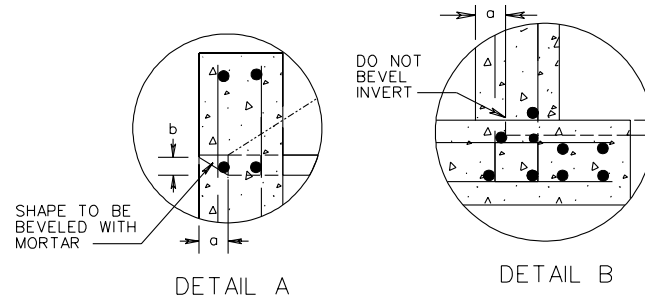
FRONT ELEVATION A-A



SECTION A-A

NOTES:

1. CONCRETE TO BE 4000 PSI MINIMUM COMPRESSIVE STRENGTH.
2. IF PIPE IS TO BE SKEWED THE OPENING WILL BE ADJUSTED TO ACCOMMODATE ANGLES UP TO 45°.
3. REINFORCING STEEL IN ACCORDANCE WITH ASTM A-615 (REINFORCING BARS).
4. PIPE OPENINGS IN PRECAST DRAINAGE UNITS SHALL NOT EXCEED 4 INCHES AT ANY GIVEN POINT BETWEEN THE PIPE AND THE PRECAST UNIT.
5. DIMENSIONS SHOWN ARE MINIMUM. ACTUAL MEASUREMENTS MAY VARY WITH MANUFACTURER'S TOLERANCE.
6. IN NO CASE SHALL TOP OF ENDWALL PROJECT ABOVE FILL SLOPE, OR SHOULDER.
7. HEADWALL TO BE BEVELED IN ALL AREAS EXCEPT WHERE A CONFLICT WITH INVERT OR WINGWALL OCCUR.
8. BEVEL EDGE IS REQUIRED ON THE HEADWALL AT THE INLET END OF THE CULVERT. HEADWALL AT OUTLET END MAY BE EITHER SQUARE EDGE OR BEVELED.
9. 3/4" CHAMFER MAY BE PROVIDED ON ALL EDGES AT MANUFACTURER'S OPTION.



DETAIL A

DETAIL B

EW-1PC

ENDWALL FOR CIRCULAR PIPE						
DIAMETER OF PIPE CULVERT						
D	12"	15"	18"	21" OR 24"	27" OR 30"	33" OR 36"
H	2'-0"	2'-3"	2'-6"	3'-2"	3'-10"	4'-4"
L	4'-0"	5'-0"	6'-0"	8'-0"	10'-0"	12'-0"
a	0'-1 1/4"	0'-1 3/4"	0'-2"	0'-2 1/2"	0'-3 1/4"	0'-3 3/4"
b	0'-1"	0'-1 1/4"	0'-1 1/2"	0'-2"	0'-2 1/2"	0'-3"

EW-1APC

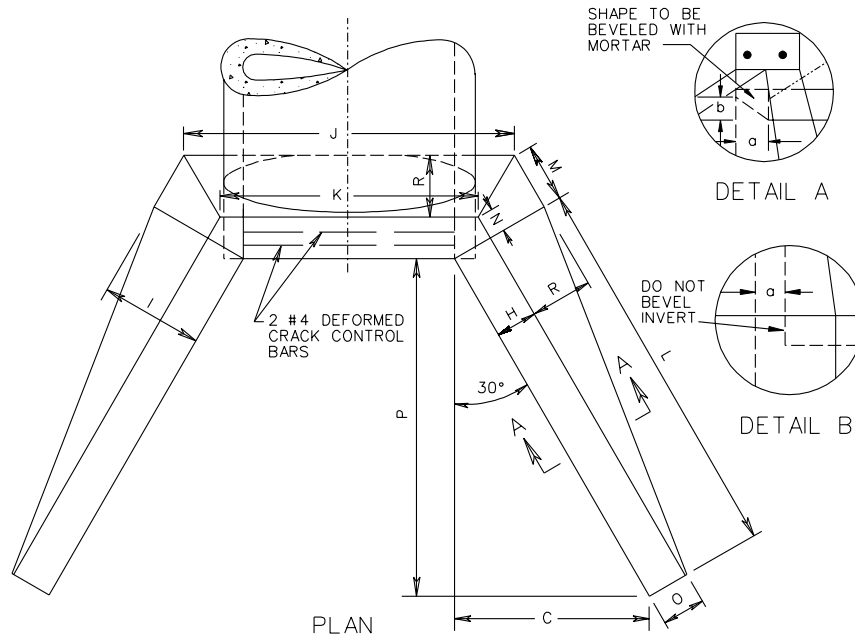
ENDWALL FOR ELLIPTICAL PIPE									
SIZE OF ELLIPTICAL PIPE CULVERT (SPAN x RISE)									
S x D	23" x 14"	30" x 19"	34" x 22"	38" x 24"	42" x 27"	45" x 29"	49" x 32"	53" x 34"	
H	1'-10"	2'-4"	2'-7"	2'-9"	3'-1"	3'-3"	3'-6"	3'-8"	
L	5'-5"	7'-2"	8'-6"	9'-2"	10'-2"	10'-11"	12'-1"	12'-11"	
a	0'-2 1/2"	0'-3 1/4"	0'-3 1/2"	0'-4"	0'-4 1/2"	0'-4 3/4"	0'-5"	0'-5 1/2"	
b	0'-2"	0'-2 1/2"	0'-2 3/4"	0'-3"	0'-3 1/2"	0'-3 3/4"	0'-4"	0'-4 1/2"	

PRECAST ENDWALL FOR PIPE CULVERTS  
 12"-36" CIRCULAR AND 23"x14"-53"x34" ELLIPTICAL PIPES  
 VIRGINIA DEPARTMENT OF TRANSPORTATION

SPECIFICATION REFERENCE

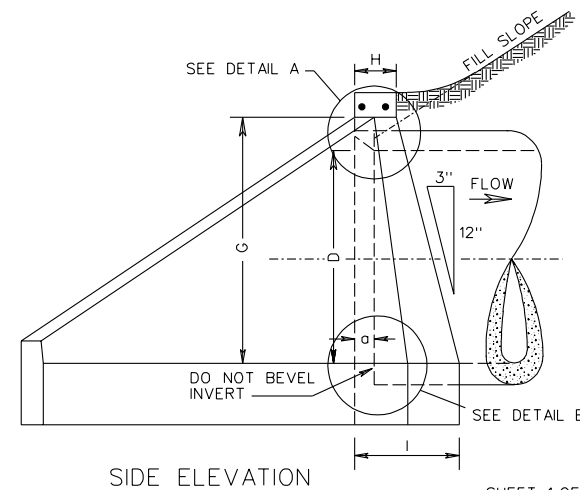
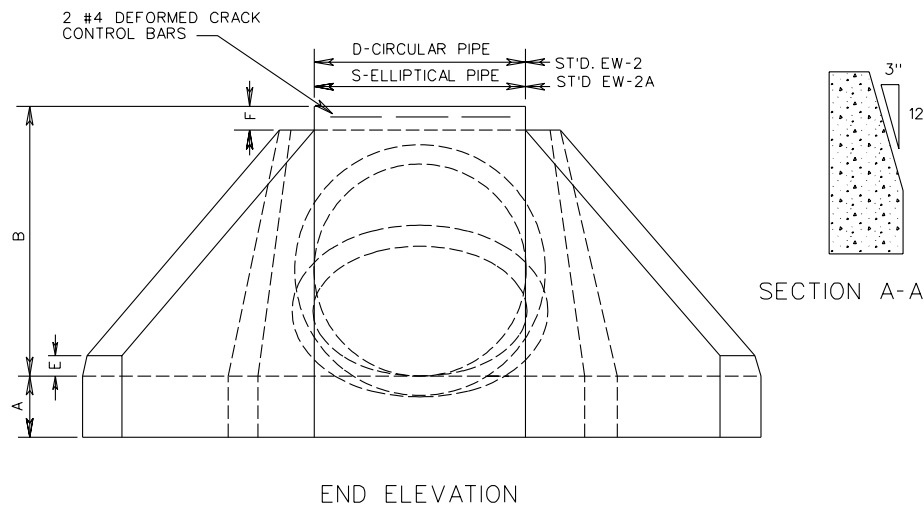
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101.02



NOTES:

1. FOR TABLE OF DIMENSIONS AND VOLUMES FOR CIRCULAR PIPES (STANDARD EW-2) SEE SHEET 2 OF 3.
2. FOR TABLE OF DIMENSIONS AND VOLUMES FOR ELLIPTICAL PIPES (STANDARD EW-2A) SEE SHEET 3 OF 3.
3. THIS ITEM MAY BE PRECAST OR CAST IN PLACE.
4. ON SHALLOW FILLS, WHERE ENDWALLS ARE 1' OR LESS BELOW SHOULDER LINE, THE TOP OF THE ENDWALL SHALL BE CONSTRUCTED PARALLEL TO THE GRADE OF ROAD.
5. ALL CAST IN PLACE CONCRETE TO BE CLASS A3. FOR PRECAST SEE SHEETS 101.06 AND 101.07.
6. IN NO CASE SHALL TOP OF ENDWALL PROJECT ABOVE FILL SLOPE, DITCH SLOPE, OR SHOULDER.
7. THIS STANDARD TO BE USED WITH STRAIGHT CROSSINGS AND SKEW ANGLES TO 15°.
8. COST OF BARS FOR CRACK CONTROL TO BE INCLUDED IN PRICE PER BID PER CUBIC YARD CONCRETE.
9. HEADWALL TO BE BEVELED IN ALL AREAS EXCEPT WHERE A CONFLICT WITH INVERT AND WINGWALLS OCCUR.
10. 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.
11. 3/4" CHAMFER MAY BE PROVIDED ON ALL EDGES AT MANUFACTURER'S OPTION.



<p>SPECIFICATION REFERENCE</p> <p>105 302</p>	<p>STANDARD ENDWALL FOR PIPE CULVERTS</p> <p>42"-96" CIRCULAR AND 60"x38"-106"x68" ELLIPTICAL PIPES</p> <p>VIRGINIA DEPARTMENT OF TRANSPORTATION</p>	<p>SHEET 1 OF 3</p> <p>101.03</p>
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TABLE OF DIMENSIONS AND CONCRETE VOLUMES PER ENDWALL  
FOR 42" - 96" CIRCULAR PIPE CULVERTS

DIAMETER OF PIPE CULVERTS

	DIMENSION	42"	48"	54"	60"	66"	72"	78"	84"	90"	96"	DIMENSION
	FOR 1/2:1 FILL SLOPE	A	1'-6"	1'-6"	1'-6"	1'-6"	1'-6"	1'-6"	1'-6"	1'-6"	1'-6"	1'-6"
B		4'-9 1/2"	5'-4"	5'-10 1/2"	6'-5"	6'-11 1/2"	7'-6"	8'-0 1/2"	8'-7"	9'-2 1/4"	9'-9 3/4"	B
C		3'-3 3/4"	3'-9"	4'-2 1/4"	4'-7"	5'-0 5/8"	5'-5 3/4"	5'-11"	6'-4 1/4"	6'-9 3/8"	7'-2 5/8"	C
D		3'-6"	4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	D
E		0'-6"	0'-6"	0'-6"	0'-6"	0'-6"	0'-6"	0'-6"	0'-6"	0'-6"	0'-6"	E
F		0'-5 1/2"	0'-6"	0'-6 1/2"	0'-7"	0'-7 1/2"	0'-8"	0'-8 1/2"	0'-9"	0'-9 1/2"	0'-10"	F
G		4'-4"	4'-10"	5'-4"	5'-10"	6'-4"	6'-10"	7'-4"	7'-10"	8'-4"	8'-10"	G
H		0'-10"	0'-10"	0'-11"	1'-0"	1'-1"	1'-2"	1'-3"	1'-4"	1'-5"	1'-6"	H
I		1'-11"	2'-0 1/2"	2'-3"	2'-5 1/2"	2'-8"	2'-10 1/2"	3'-1"	3'-3 1/2"	3'-6"	3'-8 1/2"	I
J		5'-8 1/2"	6'-4 1/4"	7'-1 1/4"	7'-10"	8'-7"	9'-4"	10'-0 3/4"	10'-9 5/8"	11'-7"	12'-4 1/8"	J
K		4'-5 1/2"	4'-11 1/2"	5'-6 3/4"	6'-1 7/8"	6'-9"	7'-4 1/8"	7'-11 1/4"	8'-6 1/2"	9'-2"	9'-9 1/8"	K
L		6'-7 5/8"	7'-6"	8'-4 1/2"	9'-2 7/8"	10'-1 1/4"	10'-11 5/8"	11'-10"	12'-8 3/8"	13'-6 7/8"	14'-5 1/4"	L
M		1'-1 1/4"	1'-2 1/8"	1'-3 5/8"	1'-5"	1'-6 1/2"	1'-8"	1'-9 3/8"	1'-10 3/4"	2'-0 3/8"	2'-2"	M
N		0'-5 3/4"	0'-5 3/4"	0'-6 3/4"	0'-6 7/8"	0'-7 1/2"	0'-8 1/8"	0'-8 5/8"	0'-9 1/4"	0'-10"	0'-10 1/2"	N
O		0'-11 1/2"	0'-11 1/2"	1'-0 1/2"	1'-1 1/2"	1'-2 1/2"	1'-3 1/2"	1'-4 1/2"	1'-5 1/2"	1'-6 1/2"	1'-7 1/2"	O
P		5'-9"	6'-6"	7'-3"	8'-0"	8'-9"	9'-6"	10'-3"	11'-0"	11'-9"	12'-6"	P
R		1'-1"	1'-2 1/2"	1'-4"	1'-5 1/2"	1'-7"	1'-8 1/2"	1'-10"	1'-11 1/2"	2'-1"	2'-2 1/2"	R
CUBIC YARDS CONCRETE		CONC. PIPE	3.558	4.373	5.635	7.089	8.776	10.702	12.861	15.303	18.195	21.285
	C.M. PIPE	3.791	4.680	6.054	7.642	9.490	11.605	13.984	16.678	19.724	23.107	C.M. PIPE
FOR 2:1 FILL SLOPE	C	4'-4"	4'-10 1/8"	5'-5 3/4"	6'-0 3/4"	6'-7 5/8"	7'-2 5/8"	7'-9 1/2"	8'-4 1/2"	8'-11 3/8"	9'-6 1/4"	C
	F	0'-6 1/2"	0'-7"	0'-7 1/2"	0'-8"	0'-8 1/2"	0'-9"	0'-9 1/2"	0'-10"	0'-10 1/2"	0'-11"	F
	G	4'-3"	4'-9"	5'-3"	5'-9"	6'-3"	6'-9"	7'-3"	7'-9"	8'-3"	8'-9"	G
	I	1'-10 3/4"	2'-0 1/4"	2'-2 3/4"	2'-5 1/4"	2'-7 3/4"	2'-10 1/4"	3'-0 3/4"	3'-3 1/4"	3'-5 3/4"	3'-8 1/4"	I
	J	5'-8 1/4"	6'-4"	7'-1"	7'-9 3/4"	8'-6 3/4"	9'-3 1/2"	10'-0 1/2"	10'-9 1/8"	11'-6 3/8"	12'-3 1/2"	J
	L	8'-8"	9'-9 3/4"	10'-11 5/8"	12'-1 1/2"	13'-3 3/8"	14'-5 1/4"	15'-7"	16'-9"	17'-10 3/4"	19'-0 5/8"	L
	M	1'-1 1/8"	1'-2"	1'-3 1/2"	1'-4 1/8"	1'-6 3/8"	1'-7 3/4"	1'-9 1/4"	1'-10 5/8"	2'-0 1/4"	2'-1 1/8"	M
	P	7'-6"	8'-6"	9'-6"	10'-6"	11'-6"	12'-6"	13'-6"	14'-6"	15'-6"	16'-6"	P
R	1'-0 3/4"	1'-2 1/4"	1'-3 3/4"	1'-5 1/4"	1'-6 3/4"	1'-8 1/4"	1'-9 3/4"	1'-11 1/4"	2'-0 3/4"	2'-2 1/4"	R	
CUBIC YARDS CONCRETE	CONC. PIPE	4.238	5.230	6.761	8.538	10.602	12.958	15.612	18.623	22.104	25.898	CONC. PIPE
	C.M. PIPE	4.469	5.536	7.177	9.088	11.312	13.856	16.730	19.993	23.618	27.704	C.M. PIPE
FOR 1 1/2:1 AND 2:1 FILL SLOPES	a	0'-4 1/2"	0'-5"	0'-5 3/4"	0'-6 1/4"	0'-7"	0'-7 1/2"	0'-8 1/4"	0'-8 3/4"	0'-9 1/2"	0'-10"	a
	b	0'-3 1/2"	0'-4"	0'-4 1/2"	0'-5"	0'-5 1/2"	0'-6"	0'-6 1/2"	0'-7"	0'-7 1/2"	0'-8"	b

FOR ALL DIMENSIONS NOT SHOWN SEE VALUES LISTED ABOVE FOR 1/2:1 FILL SLOPE

STANDARD ENDWALL FOR PIPE CULVERTS  
42"-96" CIRCULAR PIPES

VIRGINIA DEPARTMENT OF TRANSPORTATION

SPECIFICATION REFERENCE

105  
302

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

SIZE OF ELLIPTICAL PIPE CULVERTS (SPAN X RISE)

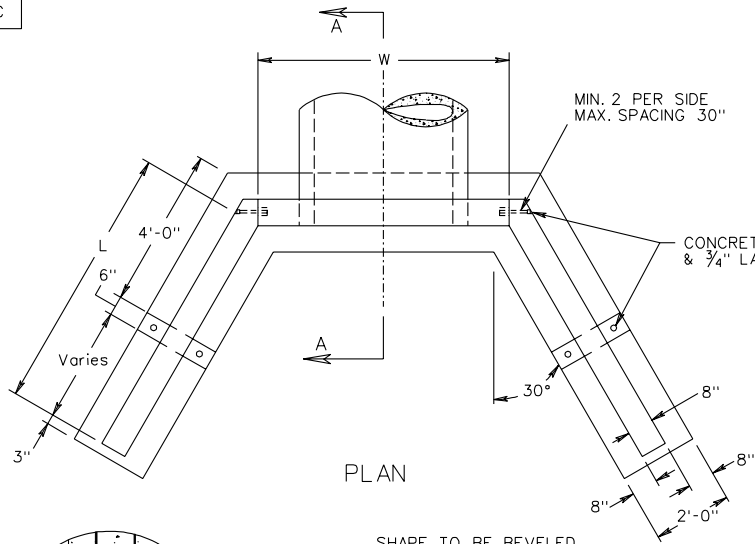
FOR 1/2:1 FILL SLOPE	DIMENSION	60 x 38	68 x 43	76 x 48	83 x 53	91 x 58	98 x 63	106 x 68	DIMENSION	
	A	1'-6"	1'-6"	1'-6"	1'-6"	1'-6"	1'-6"	1'-6"	1'-6"	A
	B	4'-9 1/2"	4'-9 1/2"	5'-4"	5'-10 1/2"	6'-5"	6'-11 1/2"	7'-6"	B	
	C	3'-3 3/4"	3'-3 3/4"	3'-9"	4'-2 1/4"	4'-7 1/2"	5'-0 5/8"	5'-5 3/4"	C	
	D	3'-2"	3'-7"	4'-0"	4'-5"	4'-10"	5'-8"	5'-8"	D	
	E	0'-6"	0'-6"	0'-6"	0'-6"	0'-6"	0'-6"	0'-6"	E	
	F	0'-5 1/2"	0'-5 1/2"	0'-6"	0'-6 1/2"	0'-7"	0'-7 1/2"	0'-8"	F	
	G	4'-4"	4'-4"	4'-10"	5'-4"	5'-10"	6'-4"	6'-10"	G	
	H	0'-10"	0'-10"	0'-10"	0'-11"	1'-0"	1'-1"	1'-2"	H	
	I	1'-11"	1'-11"	2'-0 1/2"	2'-3"	2'-5 1/2"	2'-8"	2'-10 1/2"	I	
	J	7'-2 1/2"	7'-10 1/2"	8'-8 1/4"	9'-6 1/4"	10'-5"	11'-3"	12'-2"	J	
	K	5'-11 1/2"	6'-7 1/2"	7'-3 1/2"	7'-11 3/4"	8'-8 7/8"	9'-5"	10'-2 1/8"	K	
	L	6'-7 5/8"	6'-7 5/8"	7'-6"	8'-4 1/2"	9'-2 7/8"	10'-1 1/4"	10'-11 5/8"	L	
	M	1'-1 1/4"	1'-1 1/4"	1'-2 1/8"	1'-3 5/8"	1'-5"	1'-6 1/2"	1'-8"	M	
	N	0'-5 3/4"	0'-5 3/4"	0'-5 3/4"	0'-6 3/8"	0'-6 7/8"	0'-7 1/2"	0'-8 1/2"	N	
O	0'-11 1/2"	0'-11 1/2"	0'-11 1/2"	1'-0 1/2"	1'-1 1/2"	1'-2 1/2"	1'-3 1/2"	O		
P	5'-9"	5'-9"	6'-6"	7'-3"	8'-0"	8'-9"	9'-6"	P		
R	1'-1"	1'-1"	1'-2 1/2"	1'-4"	1'-5 1/2"	1'-7"	1'-8 1/2"	R		
S	5'-0"	5'-8"	6'-4"	6'-11"	7'-7"	8'-2"	8'-10"	S		
CUBIC YARDS CONCRETE	CONCRETE PIPE	3.793	3.747	4.601	5.913	7.433	9.191	11.207	CONCRETE PIPE	
FOR 2:1 FILL SLOPE	C	4'-4"	4'-4"	4'-10 7/8"	5'-5 3/4"	6'-0 3/4"	6'-7 5/8"	7'-2 5/8"	C	
	F	0'-6 1/2"	0'-6 1/2"	0'-7"	0'-7 1/2"	0'-8"	0'-8 1/2"	0'-9"	F	
	G	4'-3"	4'-3"	4'-9"	5'-3"	5'-9"	6'-3"	6'-9"	G	
	I	1'-10 3/4"	1'-10 3/4"	2'-0 1/4"	2'-2 3/4"	2'-5 1/4"	2'-7 3/4"	2'-10 1/4"	I	
	J	7'-2 1/2"	7'-10 1/2"	8'-8 1/4"	9'-6 1/4"	10'-5"	11'-3"	12'-2"	J	
	L	8'-8"	8'-8"	9'-9 3/4"	10'-11 5/8"	12'-1 1/2"	13'-3 3/8"	14'-5 1/4"	L	
	M	1'-1 1/8"	1'-1 1/8"	1'-2"	1'-3 1/2"	1'-4 3/8"	1'-6 3/8"	1'-7 3/4"	M	
	P	7'-6"	7'-6"	8'-6"	9'-6"	10'-6"	11'-6"	12'-6"	P	
R	1'-0 3/4"	1'-0 3/4"	1'-2 1/4"	1'-3 3/4"	1'-5 1/4"	1'-6 3/4"	1'-8 1/4"	R		
CUBIC YARDS CONCRETE	CONCRETE PIPE	4.469	4.423	5.453	7.034	8.876	11.010	13.457	CONCRETE PIPE	
FOR 1/2:1 AND 2:1 FILL SLOPES	a	0'-6 1/4"	0'-7"	0'-8"	0'-8 3/4"	0'-9 1/2"	0'-10 1/4"	0'-11"	a	
	b	0'-5"	0'-5 3/4"	0'-6 1/4"	0'-7"	0'-7 1/2"	0'-8"	0'-8 3/4"	b	

FOR ALL DIMENSIONS NOT SHOWN SEE VALUES LISTED ABOVE FOR 1/2:1 FILL SLOPES

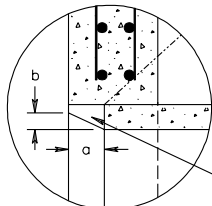
SPECIFICATION REFERENCE  
105  
302

STANDARD ENDWALL FOR PIPE CULVERTS  
60"x38"-106"x68" ELLIPTICAL PIPES  
VIRGINIA DEPARTMENT OF TRANSPORTATION

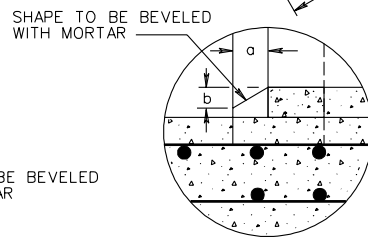
EW-2PC



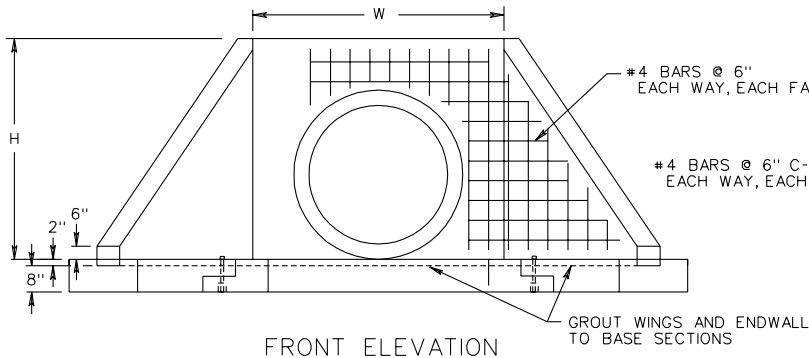
PLAN



DETAIL A



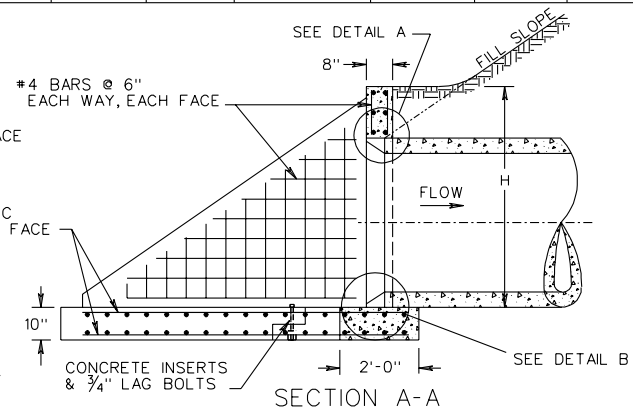
DETAIL B



FRONT ELEVATION

- NOTES:
1. CONCRETE TO BE 4000 PSI 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-615 (REINFORCING BARS).
  4. PIPE OPENINGS IN PRECAST DRAINAGE UNITS SHALL NOT EXCEED 4 INCHES AT ANY GIVEN POINT BETWEEN THE PIPE AND THE PRECAST UNIT.
  5. DIMENSIONS SHOWN ARE MINIMUM. ACTUAL MEASUREMENTS MAY VARY WITH MANUFACTURER'S TOLERANCES.
  6. IN NO CASE SHALL TOP OF ENDWALL PROTRUDE ABOVE FILL SLOPE OR SHOULDER.
  7. HEADWALL TO BE BEVELED IN ALL AREAS EXCEPT WHERE A CONFLICT WITH INVERT OR WINGWALL OCCUR.
  8. BEVEL EDGE AS REQUIRED ON THE HEADWALL AT THE INLET END OF THE CULVERT (WHERE THE FLOW ENTERS THE CULVERT).
  9. HEADWALL AT THE OUTLET END OF THE CULVERT MAY BE EITHER SQUARE EDGE OR BEVEL EDGE.
  10. 3/4" CHAMFER MAY BE PROVIDED ON ALL EDGES AT MANUFACTURER'S OPTION.

D	H	W	L		a	b
			1/2:1 SLOPE	2:1 SLOPE		
			42"	5'-6"		
48"	6'-0"	6'-10"	7'-6"	9'-10"	0'-5"	0'-4"
54"	6'-6"	7'-5"	8'-4 1/2"	11'-0"	0'-5 3/4"	0'-4 1/2"
60"	7'-0"	8'-0"	9'-3"	12'-1 1/2"	0'-6 1/4"	0'-5"
66"	7'-7"	8'-8 1/2"	10'-1 1/2"	13'-3 1/2"	0'-7"	0'-5 1/2"
72"	8'-2"	9'-3 1/2"	11'-0"	14'-5 1/2"	0'-7"	0'-5 1/2"
78"	8'-8 1/2"	9'-10"	11'-10"	15'-7"	0'-7"	0'-5 1/2"
84"	9'-3"	10'-4"	12'-8 1/2"	16'-9"	0'-7"	0'-5 1/2"
90"	9'-11"	11'-1"	13'-7"	17'-11"	0'-7"	0'-5 1/2"
96"	10'-7"	11'-8"	14'-6"	19'-1"	0'-7"	0'-5 1/2"



SECTION A-A

PRECAST ENDWALL FOR 42"-96" CIRCULAR PIPE CULVERTS

VIRGINIA DEPARTMENT OF TRANSPORTATION

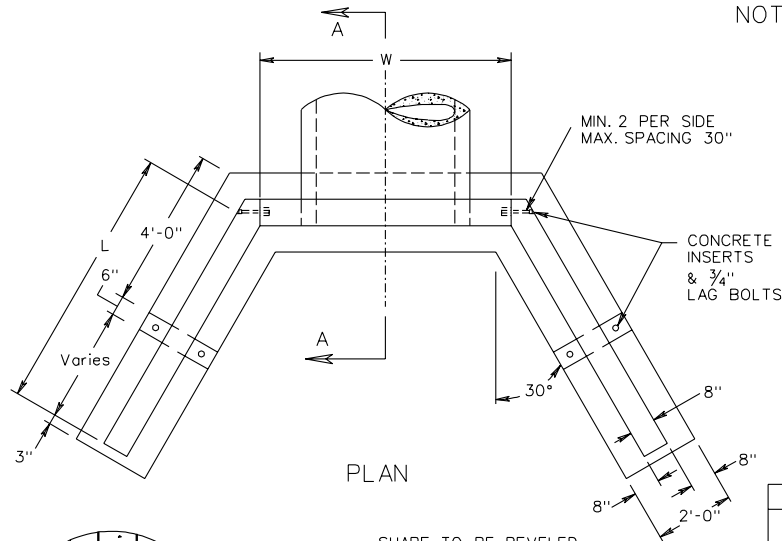
101.06

SPECIFICATION REFERENCE

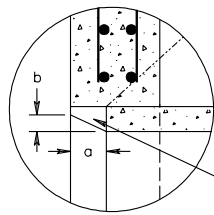
105  
302

NOTES:

1. CONCRETE TO BE 4000 PSI 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-615 (REINFORCING BARS).
4. PIPE OPENINGS IN PRECAST DRAINAGE UNITS SHALL NOT EXCEED 4 INCHES AT ANY GIVEN POINT BETWEEN THE PIPE AND THE PRECAST UNIT.
5. DIMENSIONS SHOWN ARE MINIMUM. ACTUAL MEASUREMENTS MAY VARY WITH MANUFACTURER'S TOLERANCES.
6. IN NO CASE SHALL TOP OF ENDWALL PROTRUDE ABOVE FILL SLOPE OR SHOULDER.
7. HEADWALL TO BE BEVELED IN ALL AREAS EXCEPT WHERE A CONFLICT WITH INVERT OR WINGWALL OCCUR.
8. BEVEL EDGE AS REQUIRED ON THE HEADWALL AT THE INLET END OF THE CULVERT (WHERE THE FLOW ENTERS THE CULVERT).
9. HEADWALL AT THE OUTLET END OF THE CULVERT MAY BE EITHER SQUARE EDGE OR BEVEL EDGE.
10. 3/4" CHAMFER MAY BE PROVIDED ON ALL EDGES AT MANUFACTURER'S OPTION.

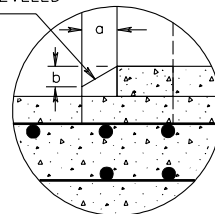


PLAN



DETAIL A

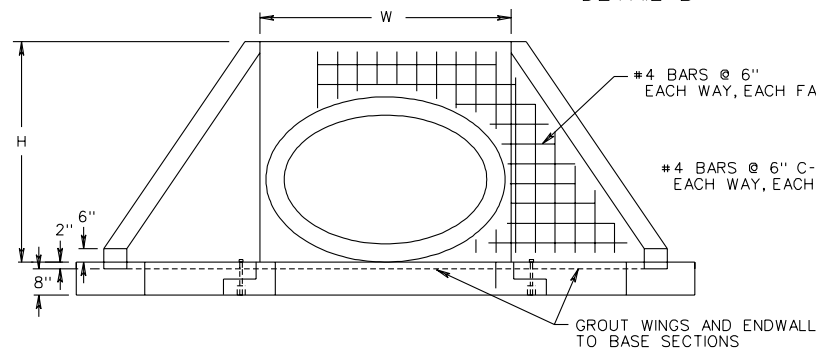
SHAPE TO BE BEVELED WITH MORTAR



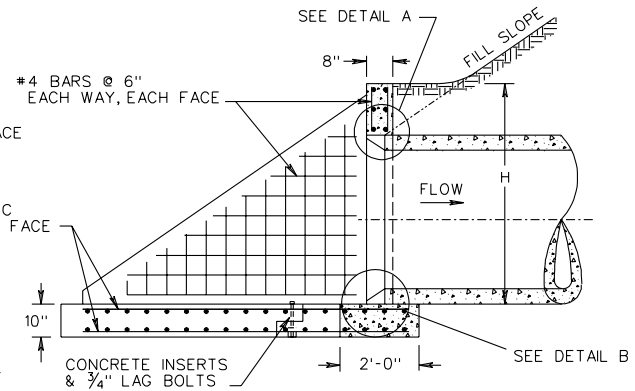
DETAIL B

SHAPE TO BE BEVELED WITH MORTAR

PIPE ID	H	W	L		a	b
			L			
			1/2:1 SLOPE	2:1 SLOPE		
60"x38"	5'-6"	7'-11"	6'-7 1/2"	8'-8"	0'-6 1/4"	0'-5"
68"x43"	5'-6"	8'-8"	6'-7 1/2"	8'-8"	0'-7"	0'-5 3/4"
76"x48"	6'-0"	9'-5"	7'-6"	9'-10"	0'-7"	0'-5 3/4"
83"x53"	6'-6"	10'-1"	8'-4 1/2"	11'-0"	0'-7"	0'-5 3/4"
91"x58"	7'-0"	10'-10"	9'-3"	12'-1 1/2"	0'-7"	0'-5 3/4"
98"x63"	7'-7"	11'-6"	10'-1 1/2"	13'-3 1/2"	0'-7"	0'-5 3/4"
106"x68"	8'-2"	12'-3"	11'-0"	14'-5 1/2"	0'-7"	0'-5 3/4"



FRONT ELEVATION



SECTION A-A

SPECIFICATION REFERENCE

105  
302

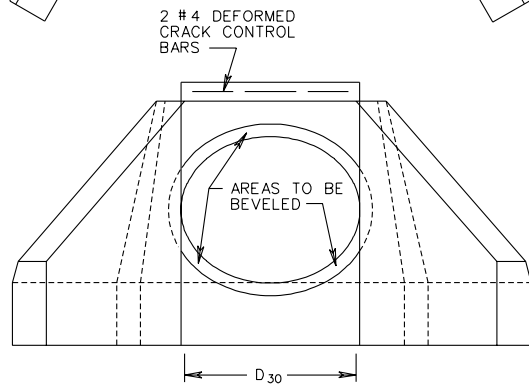
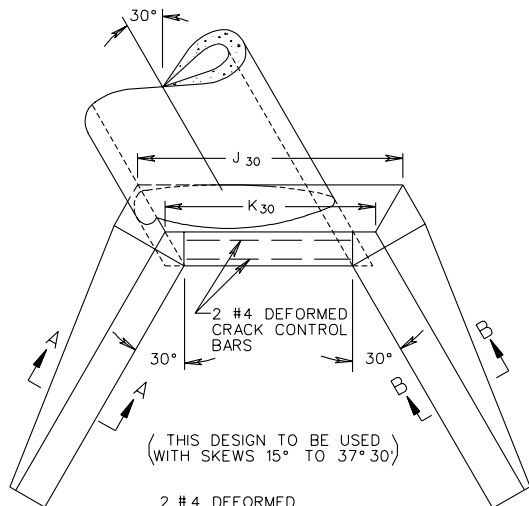
PRECAST ENDWALL FOR 60"x38"-106"x68" ELLIPTICAL PIPE CULVERTS

VIRGINIA DEPARTMENT OF TRANSPORTATION

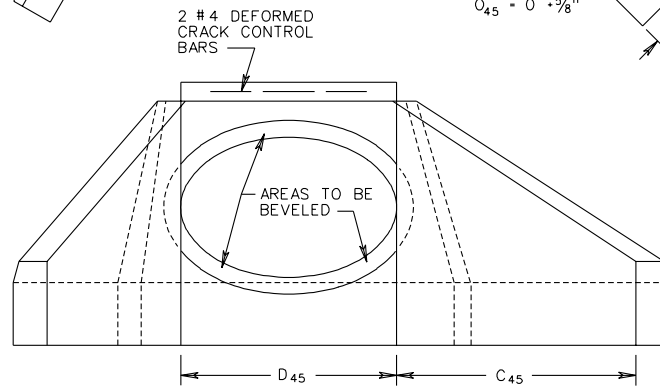
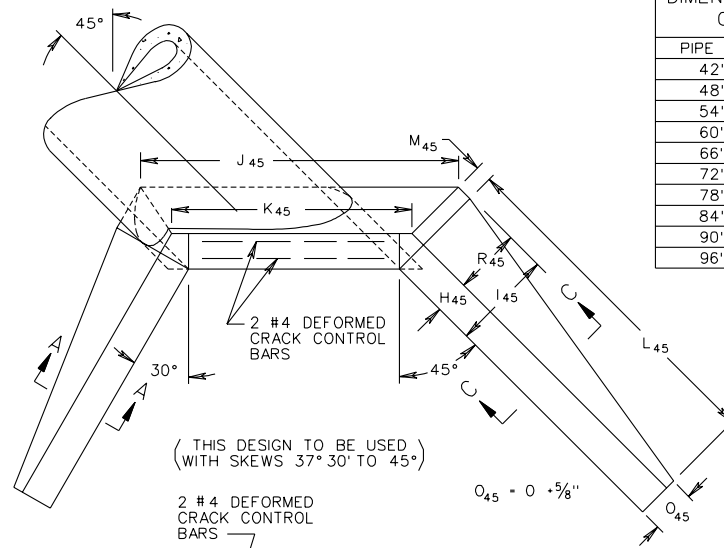
NOTES:

1. ALL DETAILS AND DIMENSIONS NOT SHOWN ARE THE SAME AS STANDARD EW-2. FOR TABLES OF DIMENSIONS AND VOLUMES SEE SHEET 2 OF 2. FOR DETAILS OF BEVEL REFER TO STANDARD EW-1, IAPC SHEET 101.02.
2. THIS ITEM MAY BE PRECAST OR CAST IN PLACE.
3. ALL CAST IN PLACE CONCRETE TO BE CLASS A3. FOR PRECAST SEE SHEET 101.10.
4. COST OF BARS FOR CRACK CONTROL TO BE INCLUDED IN PRICE BID PER CUBIC YARD CONCRETE.
5. HEADWALL TO BE BEVELED IN ALL AREAS EXCEPT WHERE A CONFLICT WITH INVERT OR WINGWALLS OCCUR.
6. BEVEL EDGE IS REQUIRED ON THE HEADWALL AT THE INLET END OF THE CULVERT (WHERE THE FLOW ENTERS THE CULVERT).
7. HEADWALL AT THE OUTLET END OF THE CULVERT MAY BE EITHER SQUARE EDGE OR BEVEL EDGE.
8. ON SHALLOW FILLS, WHERE ENDWALLS ARE 1' OR LESS BELOW SHOULDER LINE, THE TOP OF THE ENDWALL SHALL BE CONSTRUCTED PARALLEL TO THE GRADE OF THE ROAD.
9. IN NO CASE SHALL TOP OF ENDWALL PROJECT ABOVE FILL SLOPE, DITCH SLOPE, OR SHOULDER.
10. 3/4" CHAMFER MAY BE PROVIDED ON ALL EDGES AT MANUFACTURER'S OPTION.

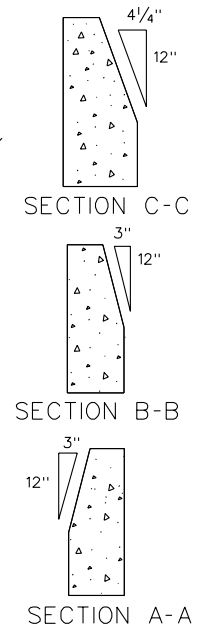
DIMENSIONS FOR BEVEL ON HEADWALL		
PIPE I.D.	a	b
42"	0'-4 1/2"	0'-3 1/2"
48"	0'-5"	0'-4"
54"	0'-5 3/4"	0'-4 1/2"
60"	0'-6 1/4"	0'-5"
66"	0'-7"	0'-5 1/2"
72"	0'-7 1/2"	0'-6"
78"	0'-8 1/4"	0'-6 1/2"
84"	0'-8 3/4"	0'-7"
90"	0'-9 1/2"	0'-7 1/2"
96"	0'-10"	0'-8"



SHEET 1 OF 2 30° SKEW



45° SKEW



STANDARD ENDWALLS FOR 42"-96" PIPE CULVERTS  
30° AND 45° SKEW

VIRGINIA DEPARTMENT OF TRANSPORTATION

SPECIFICATION REFERENCE

105  
302



TABLE OF DIMENSIONS AND CONCRETE VOLUMES PER ENDWALL

FOR 1/2:1 FILL SLOPE

DIAMETER OF PIPE CULVERTS

30° SKEW	DIMENSION	42"	48"	54"	60"	66"	72"	78"	84"	90"	96"	DIMENSION
	D 30	4'-0 1/2"	4'-7 3/8"	5'-2 3/8"	5'-9 3/8"	6'-4 1/4"	6'-11 1/8"	7'-6 1/8"	8'-1"	8'-8"	9'-2 7/8"	9'-2 7/8"
J 30	6'-3"	6'-11 5/8"	7'-9 5/8"	8'-7 3/8"	9'-5 1/4"	10'-3 1/8"	11'-0 1/8"	11'-10 1/2"	12'-8 1/2"	13'-6 1/4"	13'-6 1/4"	J 30
K 30	5'-0"	5'-6 7/8"	6'-3 1/8"	6'-11 1/8"	7'-7 1/4"	8'-3 3/8"	8'-11 3/8"	9'-7 1/2"	10'-3 1/2"	10'-11 3/4"	10'-11 3/4"	K 30
CUBIC YARDS CONCRETE	CONC. PIPE	3.631	4.459	5.745	7.223	8.934	10.885	13.076	15.544	18.456	21.582	CONC. PIPE
	C.M. PIPE	3.900	4.814	6.228	7.861	9.758	11.928	14.373	17.132	20.221	23.686	C.M. PIPE

45° SKEW	C 45	5'-9"	6'-6"	7'-3"	8'-0"	8'-9"	9'-6"	10'-3"	11'-0"	11'-9"	12'-6"	C 45
	D 45	4'-11 3/8"	5'-7 7/8"	6'-4 3/8"	7'-0 7/8"	7'-9 3/8"	8'-5 3/8"	9'-2 1/4"	9'-10 3/4"	10'-7 1/4"	10'-7 1/4"	11'-3 3/4"
I 45	2'-4 3/8"	2'-6 1/4"	2'-9 5/8"	3'-0 3/4"	3'-3 1/2"	3'-7"	3'-10 1/8"	4'-1 1/4"	4'-4 3/4"	4'-8 1/4"	4'-8 1/4"	I 45
J 45	7'-5 3/4"	8'-4 5/8"	9'-4 1/2"	10'-4 3/8"	11'-4 1/4"	12'-4 1/8"	13'-3 3/8"	14'-3 1/8"	15'-4 1/8"	16'-4 1/2"	16'-4 1/2"	J 45
K 45	5'-9 1/4"	6'-5 3/4"	7'-3 1/4"	8'-0 3/4"	8'-10 1/4"	9'-7 3/4"	10'-5 1/8"	11'-2 5/8"	12'-0 7/8"	12'-9 5/8"	12'-9 5/8"	K 45
L 45	8'-1 5/8"	9'-2 1/4"	10'-3"	11'-3 3/4"	12'-4 1/2"	13'-5 1/4"	14'-6"	15'-6 5/8"	16'-7 1/2"	17'-8 1/8"	17'-8 1/8"	L 45
M 45	0'-4 1/8"	0'-4 1/8"	0'-4 1/2"	0'-5"	0'-5 3/8"	0'-5 3/4"	0'-6 1/4"	0'-6 5/8"	0'-7"	0'-7 1/2"	0'-7 1/2"	M 45
R 45	1'-6 3/8"	1'-8 1/2"	1'-10 5/8"	2'-0 3/4"	2'-2 1/8"	2'-5"	2'-7 1/8"	2'-9 1/4"	2'-11 3/4"	3'-2 1/4"	3'-2 1/4"	R 45
CUBIC YARDS CONCRETE	CONC. PIPE	4.231	5.191	6.712	8.447	10.441	12.714	15.276	18.150	21.420	25.107	CONC. PIPE
	C.M. PIPE	4.542	5.604	7.274	9.189	11.400	13.927	16.783	19.997	23.582	27.684	C.M. PIPE

FOR 2:1 FILL SLOPE

DIAMETER OF PIPE CULVERTS

30° SKEW	D 30	42"	48"	54"	60"	66"	72"	78"	84"	90"	96"	D 30
	J 30	6'-2 3/4"	6'-11 3/8"	7'-9 3/8"	8'-7 3/8"	9'-5"	10'-2 5/8"	11'-0 5/8"	11'-10 1/4"	12'-8 1/8"	13'-6"	13'-6"
K 30	5'-0"	5'-6 5/8"	6'-3 1/8"	6'-11 1/8"	7'-7 1/4"	8'-3 3/8"	8'-11 3/8"	9'-7 1/2"	10'-3 1/2"	10'-11 3/4"	10'-11 3/4"	K 30
CUBIC YARDS CONCRETE	CONC. PIPE	4.310	5.315	6.868	8.669	10.757	13.138	15.823	18.863	22.368	26.201	CONC. PIPE
	C.M. PIPE	4.576	5.668	7.349	9.304	11.577	14.175	17.114	20.444	24.117	28.287	C.M. PIPE

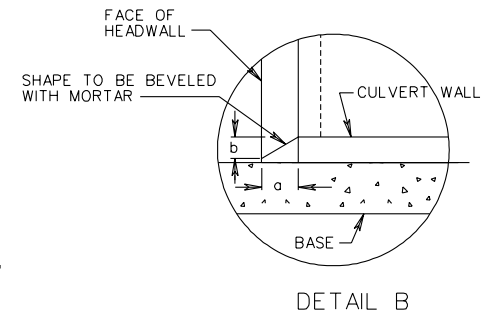
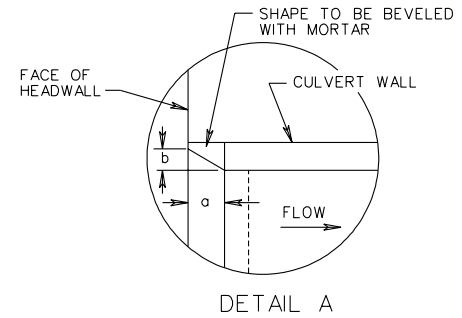
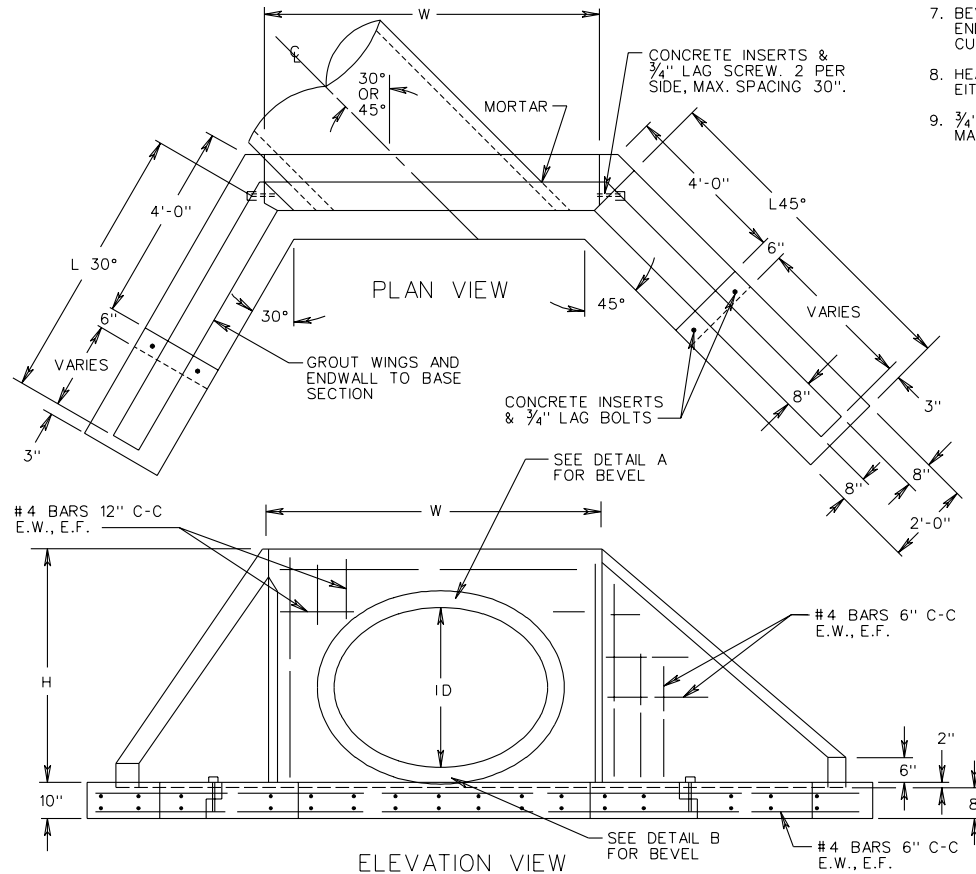
45° SKEW	C 45	7'-6"	8'-6"	9'-6"	10'-6"	11'-6"	12'-6"	13'-6"	14'-6"	15'-6"	16'-6"	C 45
	D 45	4'-11 3/8"	5'-7 7/8"	6'-4 3/8"	7'-0 7/8"	7'-9 3/8"	8'-5 3/8"	9'-2 1/4"	9'-10 3/4"	10'-7 1/4"	10'-7 1/4"	11'-3 3/4"
I 45	2'-4"	2'-6 1/8"	2'-9 1/4"	3'-0 3/8"	3'-3 1/2"	3'-6 5/8"	3'-9 3/4"	4'-0 7/8"	4'-4 3/8"	4'-7 7/8"	4'-7 7/8"	I 45
J 45	7'-5 3/8"	8'-4 1/4"	9'-4 1/8"	10'-4"	11'-3 7/8"	12'-3 5/8"	13'-3 1/2"	14'-3 1/4"	15'-3 3/4"	16'-4"	16'-4"	J 45
K 45	5'-9 1/4"	6'-5 3/4"	7'-3 1/4"	8'-0 3/4"	8'-10 1/4"	9'-7 3/4"	10'-5 1/8"	11'-2 5/8"	12'-0 7/8"	12'-9 5/8"	12'-9 5/8"	K 45
L 45	10'-7 1/4"	12'-0 1/4"	13'-5 1/4"	14'-10 1/4"	16'-3 1/8"	17'-8 1/8"	19'-1 1/8"	20'-6 1/8"	21'-11"	23'-4"	23'-4"	L 45
M 45	0'-4 1/8"	0'-4 1/8"	0'-4 1/2"	0'-5"	0'-5 3/8"	0'-5 3/4"	0'-6 1/4"	0'-6 5/8"	0'-6 5/8"	0'-6 3/4"	0'-6 3/4"	M 45
R 45	1'-6"	1'-8 1/8"	1'-10 1/4"	2'-0 3/8"	2'-2 1/2"	2'-4 5/8"	2'-6 3/4"	2'-8 1/8"	2'-11 3/8"	3'-1 1/8"	3'-1 1/8"	R 45
CUBIC YARDS CONCRETE	CONC. PIPE	5.043	6.254	8.071	10.295	12.637	15.429	18.585	22.142	26.158	30.689	CONC. PIPE
	C.M. PIPE	5.351	6.664	8.629	11.033	13.590	16.635	20.086	23.981	28.298	33.241	C.M. PIPE

SPECIFICATION REFERENCE	STANDARD ENDWALLS FOR 42"-96" PIPE CULVERTS 30° AND 45° SKEW
105 302	VIRGINIA DEPARTMENT OF TRANSPORTATION

ID	H	W	DIMENSIONS					
			1/2:1 SLOPE		2:1 SLOPE		a	b
			L 30°	L 45°	L 30°	L 45°		
42"	5'-6"	8'-0"	6'-7 1/2"	8'-0"	8'-8"	10'-6"	0'-4 1/2"	0'-3 1/2"
48"	6'-0"	8'-10"	7'-6"	9'-2 1/2"	9'-9 3/4"	12'-0"	0'-5"	0'-4"
54"	6'-6"	9'-8"	8'-4 1/2"	10'-3"	10'-11 1/2"	13'-6"	0'-5 3/4"	0'-4 1/2"
60"	7'-0"	10'-6"	9'-3"	11'-3 1/2"	12'-1 1/4"	14'-10 1/4"	0'-6 1/4"	0'-5"
66"	7'-7"	11'-6"	10'-1 1/4"	12'-4 1/2"	13'-3 1/2"	16'-4"	0'-7"	0'-5 1/2"
72"	8'-2"	12'-4"	11'-0"	13'-5 1/2"	14'-5 1/2"	17'-8"	0'-7"	0'-6"
78"	8'-8 1/2"	13'-0"	11'-10"	14'-6"	15'-7"	19'-0"	0'-7"	0'-6 1/2"
84"	9'-3"	13'-10"	12'-8 1/2"	15'-6"	16'-9"	20'-6"	0'-7"	0'-7"
90"	9'-11"	14'-10"	13'-7"	16'-7 1/2"	17'-11"	21'-11"	0'-7"	0'-7 1/2"
96"	10'-7"	15'-10"	14'-5 1/4"	17'-8 1/4"	19'-1"	23'-4"	0'-7"	0'-8"

NOTES:

1. CONCRETE TO BE 4000 PSI MINIMUM COMPRESSIVE STRENGTH.
2. REINFORCING STEEL IN ACCORDANCE WITH ASTM A-615 (REINFORCING BARS).
3. PIPE OPENINGS IN PRECAST DRAINAGE UNITS SHALL NOT EXCEED 4 INCHES AT ANY GIVEN POINT BETWEEN THE PIPE AND THE PRECAST UNIT.
4. DIMENSIONS SHOWN ARE MINIMUM. ACTUAL MEASUREMENTS MAY VARY WITH MANUFACTURER'S TOLERANCES.
5. IN NO CASE SHALL TOP OF ENDWALL PROTRUDE ABOVE FILL SLOPE OR SHOULDER.
6. HEADWALL TO BE BEVELED IN ALL AREAS EXCEPT WHERE A CONFLICT WITH INVERT OR WINGWALL OCCUR.
7. BEVEL EDGE AS REQUIRED ON THE HEADWALL AT THE INLET END OF THE CULVERT (WHERE THE FLOW ENTERS THE CULVERT).
8. HEADWALL AT THE OUTLET END OF THE CULVERT MAY BE EITHER SQUARE EDGE OR BEVEL EDGE.
9. 3/4" CHAMFER MAY BE PROVIDED ON ALL EDGES AT MANUFACTURER'S OPTION.



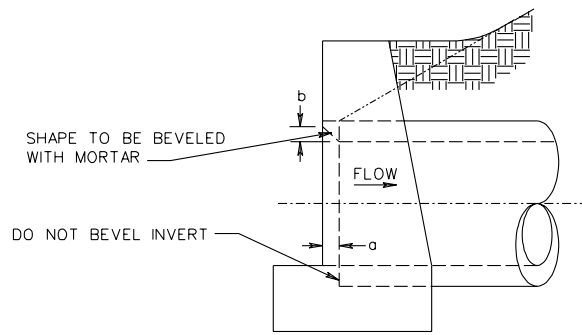
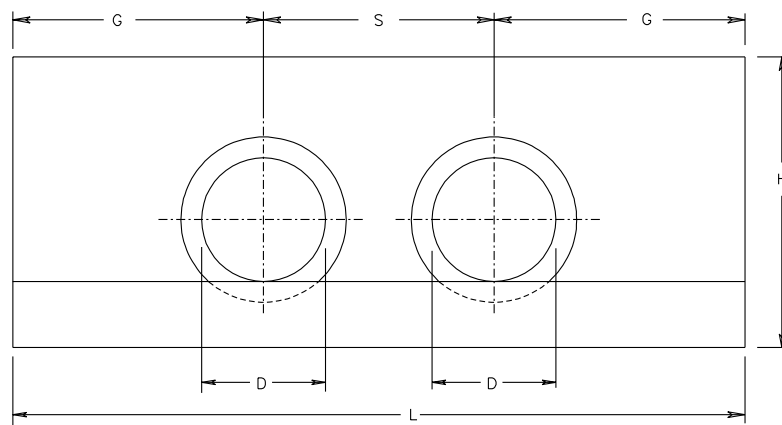
PRECAST ENDWALL FOR PIPE CULVERT  
42"-96" PIPE CULVERTS-30° AND 45° SKEW

101.10

VIRGINIA DEPARTMENT OF TRANSPORTATION

SPECIFICATION  
REFERENCE

105  
302

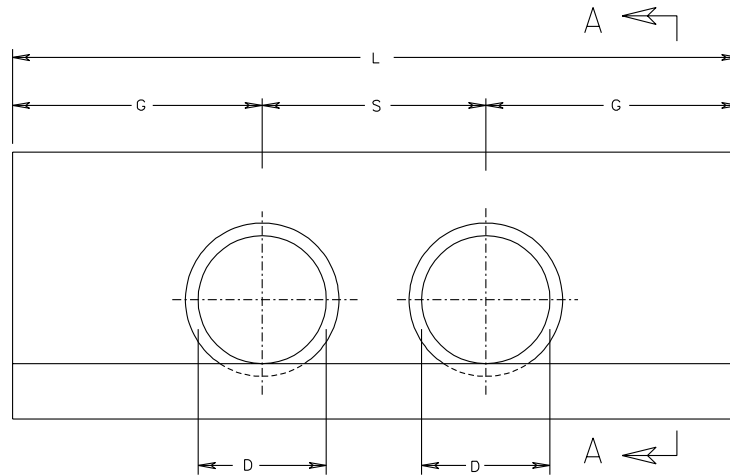


NOTES:

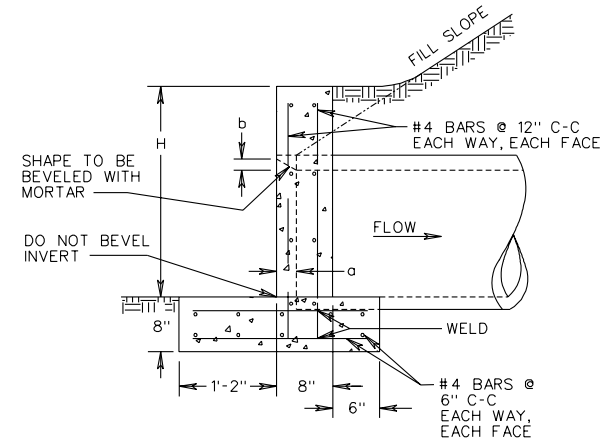
1. IN NO CASE SHALL TOP OF ENDWALL PROJECT ABOVE FILL SLOPE, DITCH SLOPE, OR SHOULDER.
2. THIS ITEM MAY BE PRECAST OR CAST IN PLACE.
3. ALL CAST IN PLACE CONCRETE TO BE CLASS A3. [FOR PRECAST SEE SHEET 101.12.](#)
4. THIS STANDARD TO BE USED WITH STRAIGHT CROSSINGS AND SKEW ANGLES TO 15°.
5. HEADWALL TO BE BEVELED IN ALL AREAS EXCEPT WHERE A CONFLICT WITH INVERT OR WINGWALLS OCCUR.
6. BEVEL EDGE IS REQUIRED ON THE HEADWALL AT THE INLET END OF THE CULVERT (WHERE THE FLOW ENTERS THE CULVERT).
7. HEADWALL AT THE OUTLET END OF THE CULVERT MAY BE EITHER SQUARE EDGE OR BEVEL EDGE.
8. ON SHALLOW FILLS, WHERE ENDWALLS ARE 1' OR LESS BELOW SHOULDER LINE, THE TOP OF THE ENDWALL SHALL BE CONSTRUCTED PARALLEL TO THE GRADE OF THE ROAD.
9. 3/4" CHAMFER MAY BE PROVIDED ON ALL EDGES AT MANUFACTURER'S OPTION.
10. QUANTITIES GIVEN ARE FOR ONE ENDWALL. [PLEASE REFER TO STANDARD EW-1, SHEET 101.01 FOR ALL DIMENSIONS NOT GIVEN IN TABLES.](#)

FOR CONCRETE PIPE							
D	S	G	L	CUBIC YARDS CONCRETE ONE DOUBLE ENDWALL	INCREASE FOR EACH ADDITIONAL PIPE	a	b
12"	1'-10"	2'-0"	5'-10"	0.329	0.088	0'-1 1/4"	0'-1"
15"	2'-3"	2'-6"	7'-3"	0.671	0.179	0'-1 3/4"	0'-1 1/4"
18"	2'-8"	3'-0"	8'-8"	0.941	0.244	0'-2"	0'-1 1/2"
21" OR 24"	3'-6"	4'-0"	11'-6"	1.763	0.444	0'-2 1/2"	0'-2"
27" OR 30"	4'-4"	5'-0"	14'-4"	2.730	0.663	0'-3 1/4"	0'-2 1/2"
33" OR 36"	5'-2"	6'-0"	17'-2"	3.854	0.907	0'-3 3/4"	0'-3"

FOR CORRUGATED METAL PIPE							
D	S	G	L	CUBIC YARDS CONCRETE ONE DOUBLE ENDWALL	INCREASE FOR EACH ADDITIONAL PIPE	a	b
12"	1'-7"	2'-0"	5'-7"	0.344	0.087	0'-1 1/4"	0'-1"
15"	1'- 11/2"	2'-6"	6'-11/2"	0.696	0.175	0'-1 3/4"	0'-1 1/4"
18"	2'-4"	3'-0"	8'-4"	0.980	0.241	0'-2"	0'-1 1/2"
24"	3'-1"	4'-0"	11'-1"	1.840	0.442	0'-2 1/2"	0'-2"
27" OR 30"	3'-10"	5'-0"	13'-10"	2.868	0.670	0'-3 1/4"	0'-2 1/2"
36"	4'-7"	6'-0"	16'-7"	4.076	0.931	0'-3 3/4"	0'-3"



FRONT ELEVATION



SECTION A-A

FOR CIRCULAR CONCRETE OR CORRUGATED METAL PIPE						
FOR MULTIPLE PIPE ENDWALL						
D	H	L	S	G	a	b
12"	2'-0"	5'-10"	2'-0"	1'-11"	0'-1 <sup>1</sup> / <sub>4</sub> "	0'-1"
15"	2'-3"	7'-3"	2'-3"	2'-6"	0'-1 <sup>3</sup> / <sub>4</sub> "	0'-1 <sup>1</sup> / <sub>4</sub> "
18"	2'-6"	8'-8"	2'-8"	3'-0"	0'-2"	0'-1 <sup>1</sup> / <sub>2</sub> "
21" OR 24"	3'-2"	11'-6"	3'-6"	4'-0"	0'-2 <sup>1</sup> / <sub>2</sub> "	0'-2"
27" OR 30"	3'-10"	14'-4"	4'-4"	5'-0"	0'-3 <sup>1</sup> / <sub>4</sub> "	0'-2 <sup>1</sup> / <sub>2</sub> "
33" OR 36"	4'-4"	17'-2"	5'-2"	6'-0"	0'-3 <sup>3</sup> / <sub>4</sub> "	0'-3"

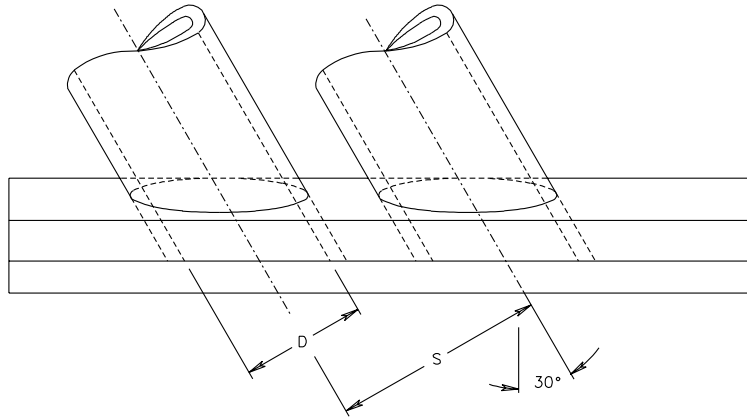
NOTES:

1. CONCRETE TO BE 4000 PSI 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-615 (REINFORCING BARS).
4. PIPE OPENINGS IN PRECAST DRAINAGE UNITS SHALL NOT EXCEED 4 INCHES AT ANY GIVEN POINT BETWEEN THE PIPE AND THE PRECAST UNIT.
5. DIMENSIONS SHOWN ARE MINIMUM. ACTUAL MEASUREMENTS MAY VARY WITH MANUFACTURER'S TOLERANCE.
6. IN NO CASE SHALL TOP OF ENDWALL PROJECT ABOVE FILL SLOPE, DITCH SLOPE, OR SHOULDER.
7. HEADWALL TO BE BEVELED IN ALL AREAS EXCEPT WHERE A CONFLICT WITH INVERT OR WINGWALL OCCUR.
8. BEVEL EDGE IS REQUIRED ON THE HEADWALL AT THE INLET END OF THE CULVERT (WHERE THE FLOW ENTERS THE CULVERT). HEADWALL AT OUTLET END MAY BE EITHER SQUARE EDGE OR BEVELED.
9. 3/4" CHAMFER MAY BE PROVIDED ON ALL EDGES AT MANUFACTURER'S OPTION.

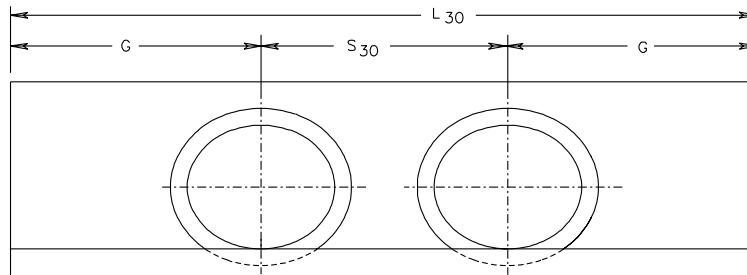
PRECAST ENDWALL FOR MULTIPLE PIPE CULVERTS  
12"-36" PIPE CULVERTS

SPECIFICATION  
REFERENCE

105  
302



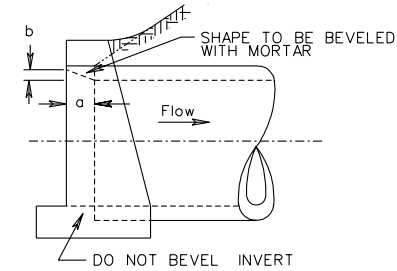
PLAN VIEW



FRONT VIEW

NOTES:

1. QUANTITIES GIVEN ARE FOR ONE ENDWALL. PLEASE REFER TO STANDARD EW-1, SHEET 101.01 FOR ALL DIMENSIONS NOT GIVEN IN TABLES.
2. FOR DETAILS OF BEVEL SEE STANDARD EW-2, 2A, SHEET 101.03.
3. THIS ITEM MAY BE PRECAST OR CAST IN PLACE.
4. ON SHALLOW FILLS, WHERE ENDWALLS ARE 1' OR LESS BELOW SHOULDER LINE, THE TOP OF THE ENDWALL SHALL BE CONSTRUCTED PARALLEL TO THE GRADE OF ROAD.
5. ALL CAST IN PLACE CONCRETE TO BE CLASS A3. FOR PRECAST SEE SHEET 101.15.
6. IN NO CASE SHALL TOP OF ENDWALL PROJECT ABOVE FILL SLOPE, DITCH SLOPE, OR SHOULDER.
7. THIS STANDARD TO BE USED WITH SKEW ANGLES FROM 15° TO 37° 30'.
8. HEADWALL TO BE BEVELED IN ALL AREAS EXCEPT WHERE A CONFLICT WITH INVERT AND WINGWALLS OCCUR.
9. 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.
10. 3/4" CHAMFER MAY BE PROVIDED ON ALL EDGES AT MANUFACTURER'S OPTION.



SIDE VIEW

FOR CONCRETE PIPE

D	G	S	S <sub>30</sub>	L <sub>30</sub>	CONCRETE IN ONE DOUBLE ENDWALL CUBIC YDS.	INCREASE FOR EACH ADDITIONAL PIPE CUBIC YDS.	a	b
12"	2'-0"	1'-10"	2'-13/8"	6'-13/8"	0.336	0.101	0'-1/4"	0'-1"
15"	2'-6"	2'-3"	2'-7/8"	7'-7/8"	0.688	0.207	0'-13/4"	0'-1/4"
18"	3'-0"	2'-8"	3'-1"	9'-1"	0.962	0.283	0'-2"	0'-1/2"
21" OR 24"	4'-0"	3'-6"	4'-0 1/2"	12'-0 1/2"	1.794	0.512	0'-2 1/2"	0'-2"
27" OR 30"	5'-0"	4'-4"	5'-0"	15'-0"	2.769	0.765	0'-3 1/4"	0'-2 1/2"
33" OR 36"	6'-0"	5'-2"	5'-11 5/8"	17'-11 5/8"	3.895	1.048	0'-3 3/4"	0'-3"

FOR CORRUGATED METAL PIPE

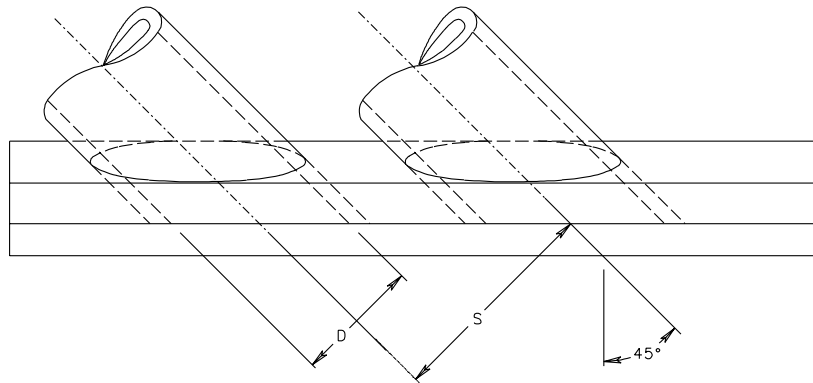
D	G	S	S <sub>30</sub>	L <sub>30</sub>	CONCRETE IN ONE DOUBLE ENDWALL CUBIC YDS.	INCREASE FOR EACH ADDITIONAL PIPE CUBIC YDS.	a	b
12"	2'-0"	1'-7"	1'-10"	5'-10"	0.354	0.100	0'-1/4"	0'-1"
15"	2'-6"	1'-11 1/2"	2'-3 3/8"	7'-3 3/8"	0.714	0.201	0'-1 3/4"	0'-1/4"
18"	3'-0"	2'-4"	2'-8 3/8"	8'-8 3/8"	1.005	0.278	0'-2"	0'-1/2"
24"	4'-0"	3'-1"	3'-6 3/4"	11'-6 3/4"	1.882	0.510	0'-2 1/2"	0'-2"
27" OR 30"	5'-0"	3'-10"	4'-5 5/8"	14'-5 5/8"	2.929	0.775	0'-3 1/4"	0'-2 1/2"
36"	6'-0"	4'-7"	5'-3 1/2"	17'-3 1/2"	4.153	1.075	0'-3 3/4"	0'-3"

SPECIFICATION REFERENCE

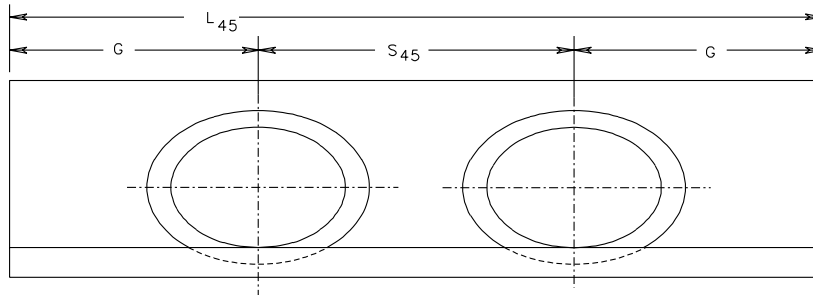
105  
302

STANDARD ENDWALLS FOR MULTIPLE PIPE CULVERTS  
12"-36" PIPE-30° SKEW

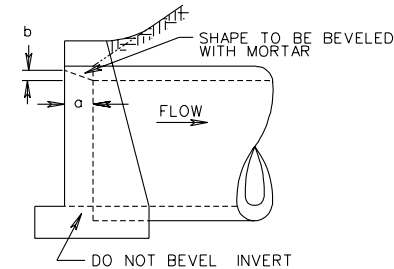
VIRGINIA DEPARTMENT OF TRANSPORTATION



PLAN VIEW



FRONT VIEW



SIDE VIEW

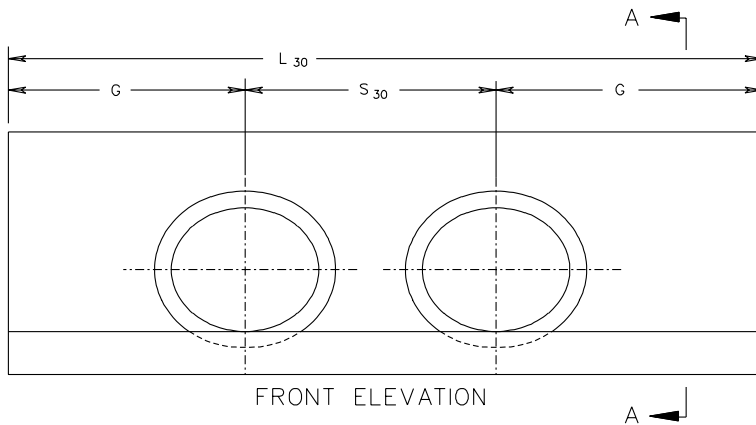
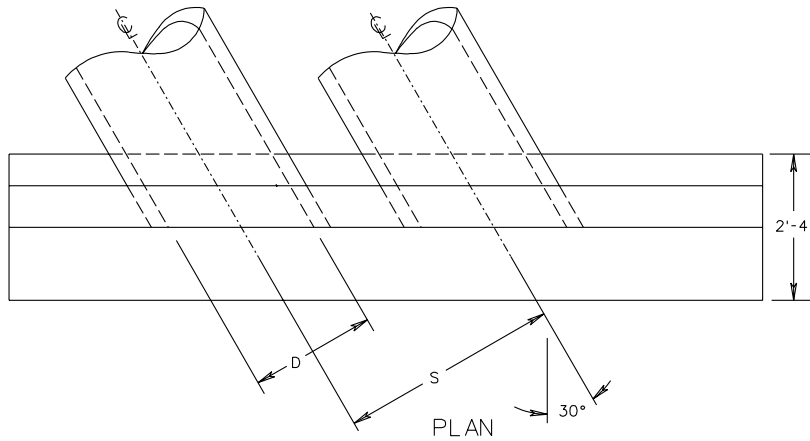
NOTES:

1. QUANTITIES GIVEN ARE FOR ONE ENDWALL. PLEASE REFER TO STANDARD EW-1, SHEET 101.01 FOR ALL DIMENSIONS NOT GIVEN IN TABLES.
2. FOR DETAILS OF BEVEL SEE STANDARD EW-2, 2A, SHEET 101.03.
3. THIS ITEM MAY BE PRECAST OR CAST IN PLACE.
4. ON SHALLOW FILLS, WHERE ENDWALLS ARE 1' OR LESS BELOW SHOULDER LINE, THE TOP OF THE ENDWALL SHALL BE CONSTRUCTED PARALLEL TO THE GRADE OF ROAD.
5. ALL CAST IN PLACE CONCRETE TO BE CLASS A3. FOR PRECAST SEE SHEET 101.16.
6. IN NO CASE SHALL TOP OF ENDWALL PROJECT ABOVE FILL SLOPE, DITCH SLOPE, OR SHOULDER.
7. THIS STANDARD TO BE USED WITH SKEW ANGLES FROM 37° 30' TO 45°.
8. HEADWALL TO BE BEVELED IN ALL AREAS EXCEPT WHERE A CONFLICT WITH INVERT AND WINGWALLS OCCUR.
9. 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.
10. 3/8" CHAMFER MAY BE PROVIDED ON ALL EDGES AT MANUFACTURER'S OPTION.

FOR CONCRETE PIPE									
D	G	S	S <sub>45</sub>	L <sub>45</sub>	CONCRETE IN ONE DOUBLE ENDWALL CUBIC YDS.	INCREASE FOR EACH ADDITIONAL PIPE CUBIC YDS.	a	b	
12"	2'-0"	1'-10"	2'-7/8"	6'-7/8"	0.350	0.125	0'-1/4"	0'-1"	
15"	2'-6"	2'-3"	3'-2/8"	8'-2/8"	0.714	0.235	0'-1 3/4"	0'-1 1/4"	
18"	3'-0"	2'-8"	3'-9/4"	9'-9/4"	0.995	0.346	0'-2"	0'-1 1/2"	
21" OR 24"	4'-0"	3'-6"	4'-11 3/8"	12'-11 3/8"	1.846	0.626	0'-2 1/2"	0'-2"	
27" OR 30"	5'-0"	4'-4"	6'-1 1/2"	16'-1 1/2"	2.834	0.937	0'-3 1/4"	0'-2 1/2"	
33" OR 36"	6'-0"	5'-2"	7'-3 5/8"	19'-3 5/8"	3.966	1.281	0'-3 3/4"	0'-3"	

FOR CORRUGATED METAL PIPE									
D	G	S	S <sub>45</sub>	L <sub>45</sub>	CONCRETE IN ONE DOUBLE ENDWALL CUBIC YDS.	INCREASE FOR EACH ADDITIONAL PIPE CUBIC YDS.	a	b	
12"	2'-0"	1'-7"	2'-2 7/8"	6'-2 7/8"	0.369	0.122	0'-1/4"	0'-1"	
15"	2'-6"	1'-11 1/2"	2'-9/4"	7'-9/4"	0.746	0.246	0'-1 3/4"	0'-1 1/4"	
18"	3'-0"	2'-4"	3'-3 5/8"	9'-3 5/8"	1.047	0.340	0'-2"	0'-1 1/2"	
24"	4'-0"	3'-1"	4'-4 3/8"	12'-4 3/8"	1.956	0.625	0'-2 1/2"	0'-2"	
27" OR 30"	5'-0"	3'-10"	5'-5"	15'-5"	3.030	0.948	0'-3 1/4"	0'-2 1/2"	
36"	6'-0"	4'-7"	6'-5 3/4"	18'-5 3/4"	4.280	1.316	0'-3 3/4"	0'-3"	

STANDARD ENDWALLS FOR MULTIPLE PIPE CULVERTS  
12"-36" PIPE-45° SKEW

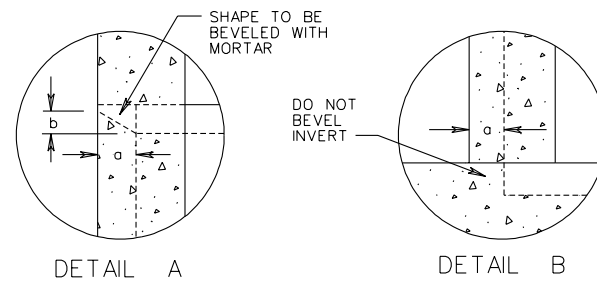
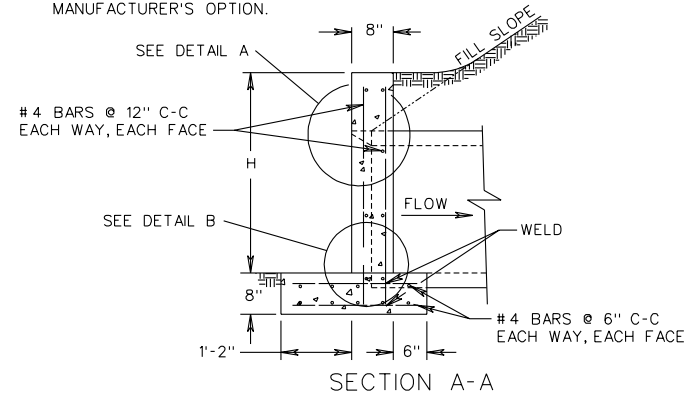


FOR CIRCULAR CONCRETE OR CORRUGATED METAL PIPE

FOR MULTIPLE PIPE ENDWALL							
Diameter D of pipe	H	L <sub>30</sub>	S	S <sub>30</sub>	G	a	b
12"	2'-0"	6'-1 <sup>3</sup> / <sub>8</sub> "	1'-10"	2'-1 <sup>3</sup> / <sub>8</sub> "	2'-0"	0'-1 <sup>1</sup> / <sub>4</sub> "	0'-1"
15"	2'-3"	7'-7 <sup>7</sup> / <sub>8</sub> "	2'-3"	2'-7 <sup>7</sup> / <sub>8</sub> "	2'-6"	0'-1 <sup>3</sup> / <sub>4</sub> "	0'-1 <sup>1</sup> / <sub>4</sub> "
18"	2'-6"	9'-1"	2'-8"	3'-1"	3'-0"	0'-2"	0'-1 <sup>1</sup> / <sub>2</sub> "
21" OR 24"	3'-2"	12'-0 <sup>1</sup> / <sub>2</sub> "	3'-6"	4'-0 <sup>1</sup> / <sub>2</sub> "	4'-0"	0'-2 <sup>1</sup> / <sub>2</sub> "	0'-2"
27" OR 30"	3'-10"	15'-0"	4'-4"	5'-0"	5'-0"	0'-3 <sup>1</sup> / <sub>4</sub> "	0'-2 <sup>1</sup> / <sub>2</sub> "
33" OR 36"	4'-4"	17'-11 <sup>5</sup> / <sub>8</sub> "	5'-2"	5'-11 <sup>5</sup> / <sub>8</sub> "	6'-0"	0'-3 <sup>3</sup> / <sub>4</sub> "	0'-3"

NOTES:

1. CONCRETE TO BE 4000 PSI MINIMUM COMPRESSIVE STRENGTH.
2. IF PIPE IS TO SKEWED THE OPENING WILL BE ADJUSTED TO ACCOMMODATE ANGLES OF 15° TO 37° 30'.
3. REINFORCING STEEL IN ACCORDANCE WITH ASTM A-615 (REINFORCING BARS).
4. PIPE OPENINGS IN PRECAST DRAINAGE UNITS SHALL NOT EXCEED 4 INCHES AT ANY GIVEN POINT BETWEEN THE PIPE AND THE PRECAST UNIT.
5. DIMENSIONS SHOWN ARE MINIMUM. ACTUAL MEASUREMENTS MAY VARY WITH MANUFACTURER'S TOLERANCE.
6. IN NO CASE SHALL TOP OF ENDWALL PROJECT ABOVE FILL SLOPE, DITCH SLOPE, OR SHOULDER.
7. HEADWALL TO BE BEVELED IN ALL AREAS EXCEPT WHERE A CONFLICT WITH INVERT OR WINGWALL OCCUR.
8. BEVEL EDGE IS REQUIRED ON THE HEADWALL AT THE INLET END OF THE CULVERT (WHERE THE FLOW ENTERS THE CULVERT). HEADWALL AT OUTLET END MAY BE EITHER SQUARE EDGE OR BEVELED.
9. 3/4" CHAMFER MAY BE PROVIDED ON ALL EDGES AT MANUFACTURER'S OPTION.

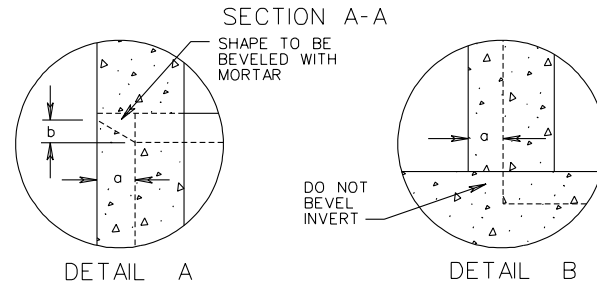
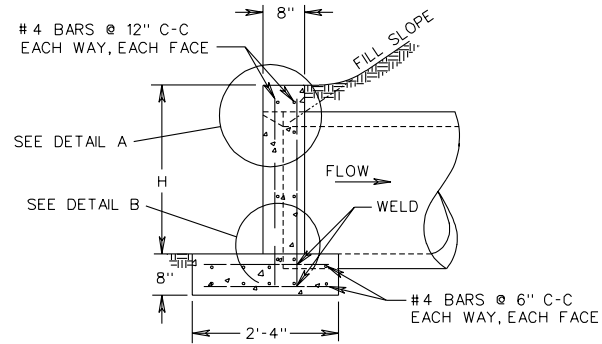
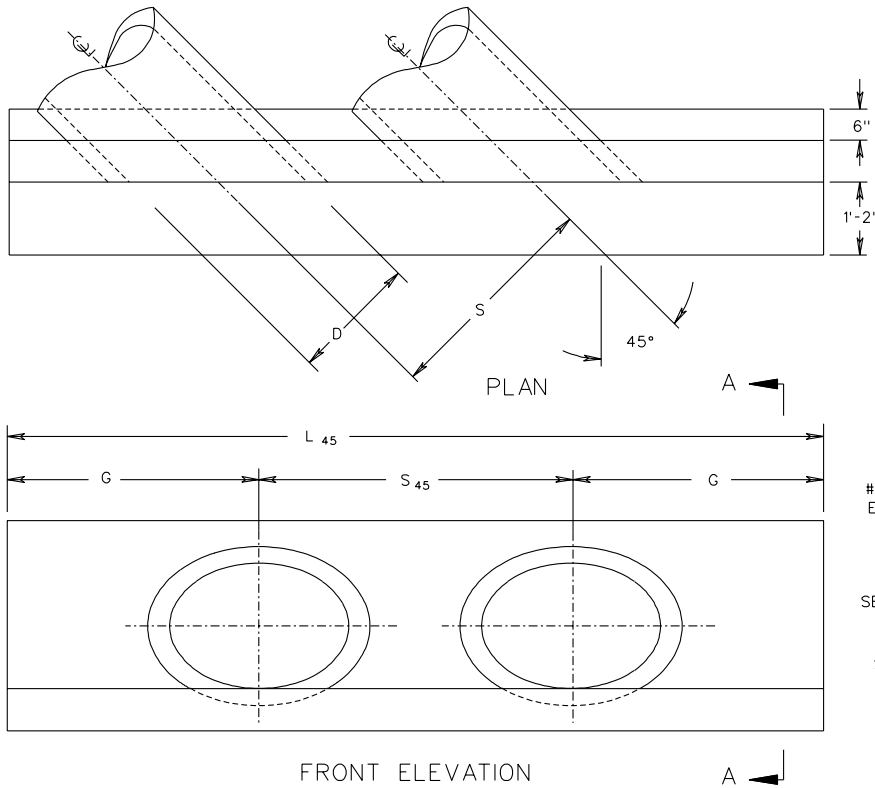


PRECAST ENDWALL FOR MULTIPLE PIPE CULVERTS  
12"-36" PIPE-30° SKEW

SPECIFICATION REFERENCE

105  
302

- NOTES:
1. CONCRETE TO BE 4000 PSI MINIMUM COMPRESSIVE STRENGTH.
  2. IF PIPE IS TO BE SKEWED THE OPENING WILL BE ADJUSTED TO ACCOMMODATE ANGLES OF 37° 30' TO 45°.
  3. REINFORCING STEEL IN ACCORDANCE WITH ASTM A-615 (REINFORCING BARS).
  4. PIPE OPENINGS IN PRECAST DRAINAGE UNITS SHALL NOT EXCEED 4 INCHES AT ANY GIVEN POINT BETWEEN THE PIPE AND THE PRECAST UNIT.
  5. DIMENSIONS SHOWN ARE MINIMUM. ACTUAL MEASUREMENTS MAY VARY WITH MANUFACTURER'S TOLERANCE.
  6. IN NO CASE SHALL TOP OF ENDWALL PROJECT ABOVE FILL SLOPE, DITCH SLOPE, OR SHOULDER.
  7. HEADWALL TO BE BEVELED IN ALL AREAS EXCEPT WHERE A CONFLICT WITH INVERT OR WINGWALL OCCUR.
  8. BEVEL EDGE IS REQUIRED ON THE HEADWALL AT THE INLET END OF THE CULVERT (WHERE THE FLOW ENTERS THE CULVERT). HEADWALL AT OUTLET END MAY BE EITHER SQUARE EDGE OR BEVELED.
  9. 3/4" CHAMFER MAY BE PROVIDED ON ALL EDGES AT MANUFACTURER'S OPTION.



FOR CIRCULAR CONCRETE OR CORRUGATED METAL PIPE							
FOR MULTIPLE PIPE ENDWALL							
D	H	L45	S	S45	G	a	b
12"	2'-0"	6'-7 <sup>7</sup> / <sub>8</sub> "	1'-10"	2'-7 <sup>7</sup> / <sub>8</sub> "	2'-0"	0'-1 <sup>1</sup> / <sub>4</sub> "	0'-1"
15"	2'-3"	8'-2 <sup>7</sup> / <sub>8</sub> "	2'-3"	3'-2 <sup>7</sup> / <sub>8</sub> "	2'-6"	0'-1 <sup>3</sup> / <sub>4</sub> "	0'-1 <sup>1</sup> / <sub>4</sub> "
18"	2'-6"	9'-9 <sup>1</sup> / <sub>4</sub> "	2'-8"	3'-9 <sup>1</sup> / <sub>4</sub> "	3'-0"	0'-2"	0'-1 <sup>1</sup> / <sub>2</sub> "
21" OR 24"	3'-2"	12'-11 <sup>3</sup> / <sub>8</sub> "	3'-6"	4'-11 <sup>3</sup> / <sub>8</sub> "	4'-0"	0'-2 <sup>1</sup> / <sub>2</sub> "	0'-2"
27" OR 30"	3'-10"	16'-1 <sup>1</sup> / <sub>2</sub> "	4'-4"	6'-1 <sup>1</sup> / <sub>2</sub> "	5'-0"	0'-3 <sup>1</sup> / <sub>4</sub> "	0'-2 <sup>1</sup> / <sub>2</sub> "
33" OR 36"	4'-4"	19'-3 <sup>5</sup> / <sub>8</sub> "	5'-2"	7'-3 <sup>5</sup> / <sub>8</sub> "	6'-0"	0'-4 <sup>1</sup> / <sub>2</sub> "	0'-3"

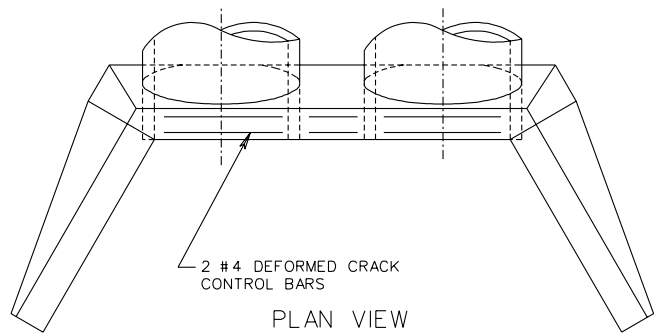
PRECAST ENDWALL FOR MULTIPLE PIPE CULVERTS  
12"-36" PIPE-45° SKEW

VIRGINIA DEPARTMENT OF TRANSPORTATION

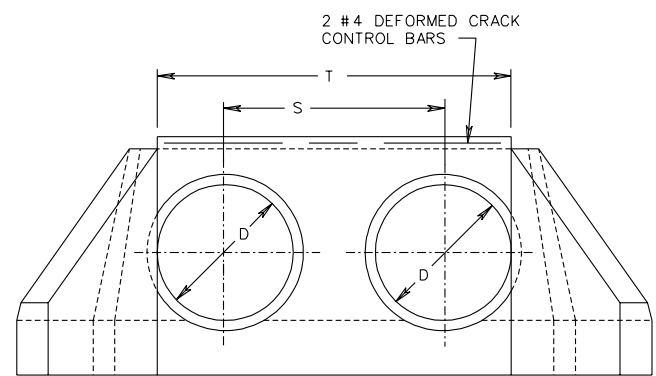
SPECIFICATION  
REFERENCE

105  
302

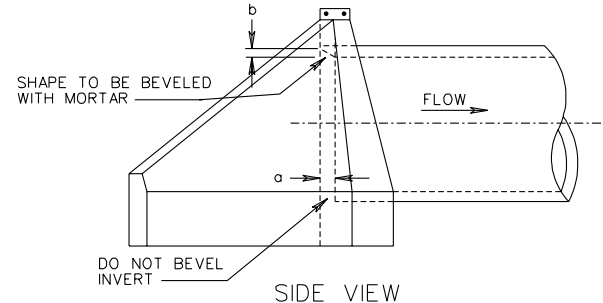




PLAN VIEW



FRONT VIEW



SIDE VIEW

NOTES:

1. QUANTITIES GIVEN ARE FOR ONE ENDWALL.
2. PLEASE REFER TO STANDARD EW-2, SHEET 101.04, FOR ALL DIMENSIONS NOT GIVEN IN TABLES.
3. THIS ITEM MAY BE PRECAST OR CAST IN PLACE.
4. ON SHALLOW FILLS, WHERE ENDWALLS ARE 1' OR LESS BELOW SHOULDER LINE, THE TOP OF THE ENDWALL SHALL BE CONSTRUCTED PARALLEL TO THE GRADE OF ROAD.
5. ALL CAST IN PLACE CONCRETE TO BE CLASS A3. FOR PRECAST SEE SHEET 101.18.
6. IN NO CASE SHALL TOP OF ENDWALL PROJECT ABOVE FILL SLOPE, DITCH SLOPE, OR SHOULDER.
7. THIS STANDARD TO BE USED WITH STRAIGHT CROSSINGS AND SKEW ANGLES TO 15°.
8. COST OF BARS FOR CRACK CONTROL TO BE INCLUDED IN PRICE PER BID PER CUBIC YARD CONCRETE.
9. HEADWALL TO BE BEVELED IN ALL AREAS EXCEPT WHERE A CONFLICT WITH INVERT AND WINGWALLS OCCUR.
10. 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.
11. 3/4" CHAMFER MAY BE PROVIDED ON ALL EDGES AT MANUFACTURER'S OPTION.

FOR CONCRETE PIPE

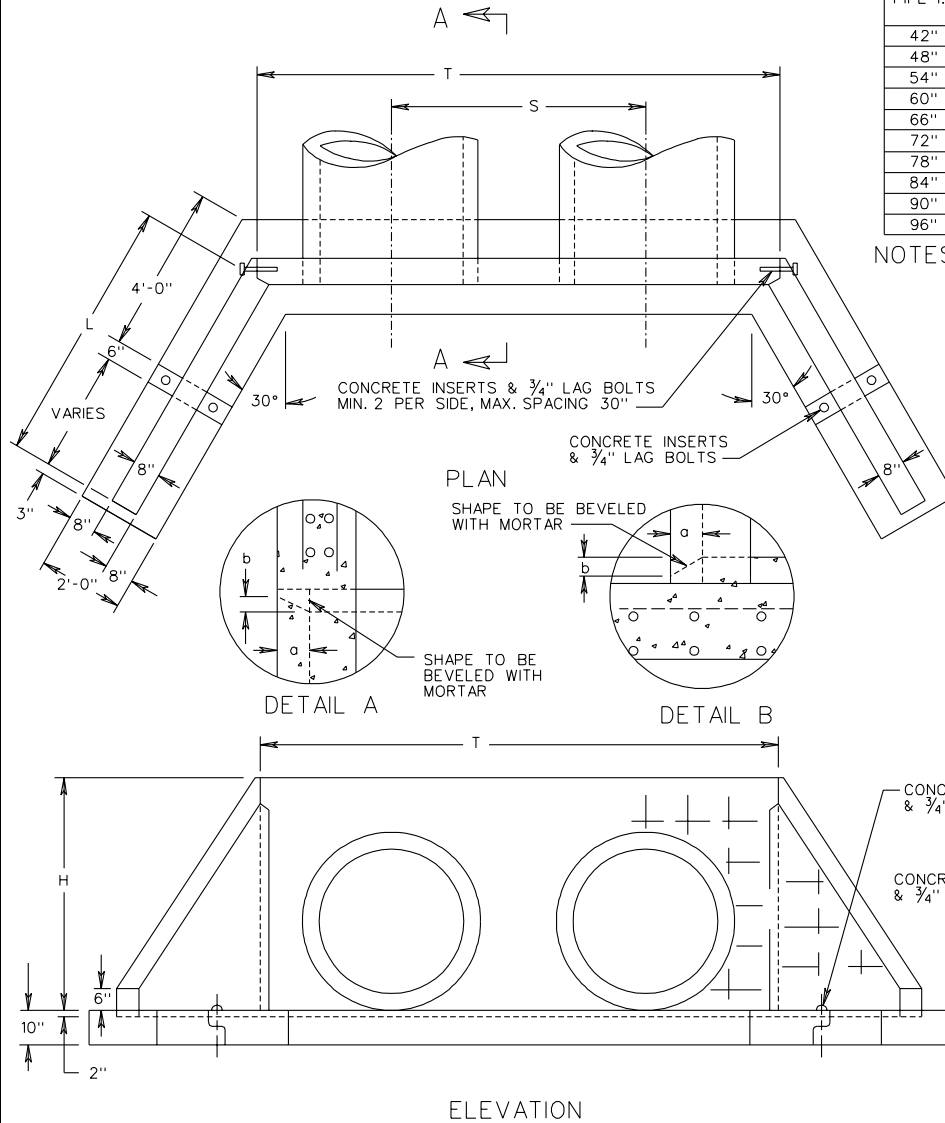
D	S	T	FILL SLOPE 1/2:1		FILL SLOPE 2:1		a	b
			CONCRETE ONE DBL. ENDWALL CUBIC YARDS	INCREASE FOR EACH ADDITIONAL PIPE CUBIC YDS.	CONCRETE ONE DBL. ENDWALL CUBIC YARDS	INCREASE FOR EACH ADDITIONAL PIPE CUBIC YDS.		
42"	6'-0"	9'-6"	4.829	1.271	5.493	1.255	0'-4 1/2"	0'-3 1/2"
48"	6'-10"	10'-10"	5.964	1.591	6.802	1.572	0'-5"	0'-4"
54"	7'-8"	12'-2"	7.692	2.057	8.796	2.035	0'-5 3/4"	0'-4 1/2"
60"	8'-6"	13'-6"	9.689	2.600	11.112	2.574	0'-6 1/4"	0'-5"
66"	9'-4"	14'-10"	12.016	3.240	13.811	3.209	0'-7"	0'-5 1/2"
72"	10'-2"	16'-2"	14.663	3.961	16.885	3.927	0'-7 1/2"	0'-6"
78"	11'-0"	17'-6"	17.612	4.751	20.325	4.713	0'-8 1/4"	0'-6 1/2"
84"	11'-10"	18'-10"	21.148	5.696	24.387	5.617	0'-8 3/4"	0'-7"
90"	12'-8"	20'-2"	25.115	6.920	28.976	6.872	0'-9 1/2"	0'-7 1/2"
96"	13'-6"	21'-6"	29.439	8.153	33.999	8.101	0'-10"	0'-8"

FOR CORRUGATED METAL PIPE

D	S	T	FILL SLOPE 1/2:1		FILL SLOPE 2:1		a	b
			CONCRETE ONE DBL. ENDWALL CUBIC YARDS	INCREASE FOR EACH ADDITIONAL PIPE CUBIC YDS.	CONCRETE ONE DBL. ENDWALL CUBIC YARDS	INCREASE FOR EACH ADDITIONAL PIPE CUBIC YDS.		
42"	5'-3 1/2"	8'-9 1/2"	5.070	1.279	5.732	1.263	0'-4 1/2"	0'-3 1/2"
48"	6'-0 1/2"	10'-0 1/2"	6.296	1.616	7.132	1.596	0'-5"	0'-4"
54"	6'-9 1/2"	11'-3 1/2"	8.228	2.104	9.258	2.081	0'-5 3/4"	0'-4 1/2"
60"	7'-6 1/2"	12'-6 1/2"	10.319	2.677	11.738	2.650	0'-6 1/4"	0'-5"
66"	8'-3 1/2"	13'-9 1/2"	12.751	3.261	14.543	3.231	0'-7"	0'-5 1/2"
72"	9'-0 1/2"	15'-0 1/2"	15.673	4.068	17.889	4.033	0'-7 1/2"	0'-6"
78"	9'-9 1/2"	16'-3 1/2"	18.918	4.934	21.623	4.893	0'-8 1/4"	0'-6 1/2"
84"	10'-6 1/2"	17'-6 1/2"	22.733	5.905	25.999	5.860	0'-8 3/4"	0'-7"
90"	11'-3 1/2"	18'-9 1/2"	26.800	7.076	30.643	7.025	0'-9 1/2"	0'-7 1/2"
96"	12'-0 1/2"	20'-0 1/2"	31.460	8.353	36.000	8.296	0'-10"	0'-8"

SPECIFICATION REFERENCE  
105  
302

STANDARD ENDWALLS FOR MULTIPLE PIPE CULVERTS  
42"-96" PIPE

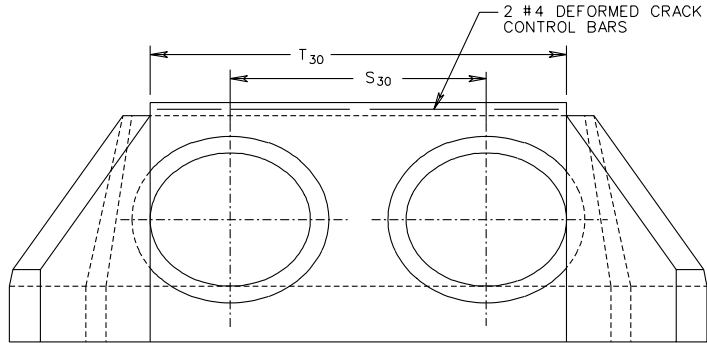
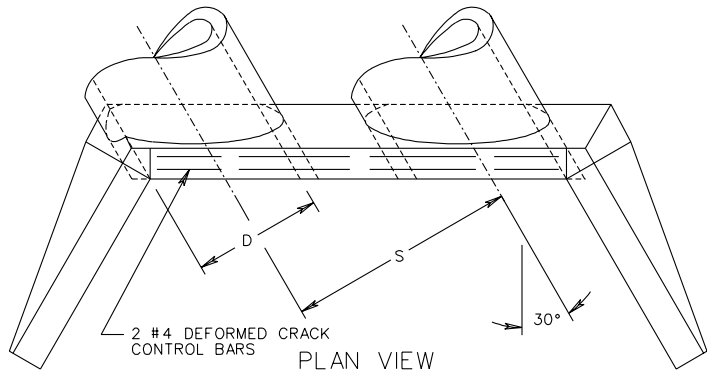


FOR CONCRETE OR CORRUGATED METAL PIPE							
PIPE I.D.	H	T	S	L 1/2:1 SLOPE	L 2:1 SLOPE	a	b
42"	5'-6"	12'-6"	6'-0"	6'-7 1/2"	8'-8"	0'-4 1/2"	0'-3 1/2"
48"	6'-0"	13'-10"	6'-10"	7'-6"	9'-10"	0'-5"	0'-4"
54"	6'-6"	15'-2"	7'-8"	8'-4 1/2"	11'-0"	0'-5 3/4"	0'-4 1/2"
60"	7'-0"	16'-6"	8'-6"	9'-3"	12'-1 1/2"	0'-6 1/4"	0'-5"
66"	7'-7"	17'-10"	9'-4"	10'-1 1/2"	13'-3 1/2"	0'-7"	0'-5 1/2"
72"	8'-2"	19'-2"	10'-2"	11'-0"	14'-5 1/2"	0'-7"	0'-5 1/2"
78"	8'-8 1/2"	20'-6"	11'-0"	11'-10"	15'-7"	0'-7"	0'-5 1/2"
84"	9'-3"	21'-10"	11'-10"	12'-8 1/2"	16'-9"	0'-7"	0'-5 1/2"
90"	9'-11"	23'-5"	12'-9"	13'-7"	17'-11"	0'-7"	0'-5 1/2"
96"	10'-7"	25'-0"	13'-7"	14'-6"	19'-0 1/2"	0'-7"	0'-5 1/2"

- NOTES:
1. CONCRETE TO BE 4000 PSI 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-615 (REINFORCING BARS).
  4. PIPE OPENINGS IN PRECAST DRAINAGE UNITS SHALL NOT EXCEED 4 INCHES AT ANY GIVEN POINT BETWEEN THE PIPE AND THE PRECAST UNIT.
  5. DIMENSIONS SHOWN ARE MINIMUM. ACTUAL MEASUREMENTS MAY VARY WITH MANUFACTURER'S TOLERANCES.
  6. IN NO CASE SHALL TOP OF ENDWALL PROTRUDE ABOVE FILL SLOPE OR SHOULDER.
  7. HEADWALL TO BE BEVELED IN ALL AREAS EXCEPT WHERE A CONFLICT WITH INVERT OR WINGWALL OCCUR.
  8. BEVEL EDGE AS REQUIRED ON THE HEADWALL AT THE INLET END OF THE CULVERT (WHERE THE FLOW ENTERS THE CULVERT).
  9. HEADWALL AT THE OUTLET END OF THE CULVERT MAY BE EITHER SQUARE EDGE OR BEVEL EDGE.
  10. 3/4" CHAMFER MAY BE PROVIDED ON ALL EDGES AT MANUFACTURER'S OPTION.

PRECAST ENDWALLS FOR MULTIPLE PIPE CULVERTS  
 42"-96" PIPE  
 VIRGINIA DEPARTMENT OF TRANSPORTATION

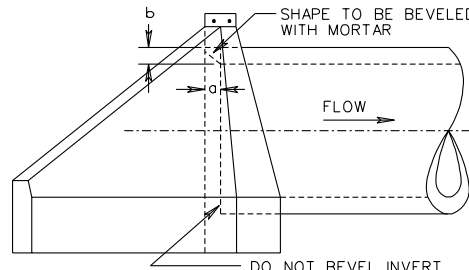
SPECIFICATION REFERENCE
105 302



FRONT VIEW

NOTES:

1. QUANTITIES GIVEN ARE FOR ONE ENDWALL.
2. PLEASE REFER TO STANDARD EW-2S, SHEETS 101.08 AND 101.09, FOR ALL DIMENSIONS NOT GIVEN IN TABLES.
3. THIS ITEM MAY BE PRECAST OR CAST IN PLACE.
4. ON SHALLOW FILLS, WHERE ENDWALLS ARE 1' OR LESS BELOW SHOULDER LINE, THE TOP OF THE ENDWALL SHALL BE CONSTRUCTED PARALLEL TO THE GRADE OF ROAD.
5. ALL CAST IN PLACE CONCRETE TO BE CLASS A3. FOR PRECAST SEE SHEET 101.21.
6. IN NO CASE SHALL TOP OF ENDWALL PROJECT ABOVE FILL SLOPE, DITCH SLOPE, OR SHOULDER.
7. THIS STANDARD TO BE USED WITH SKEW ANGLES FROM 15° TO 37° 30'.
8. COST OF BARS FOR CRACK CONTROL TO BE INCLUDED IN PRICE PER BID PER CUBIC YARD CONCRETE.
9. HEADWALL TO BE BEVELED IN ALL AREAS EXCEPT WHERE A CONFLICT WITH INVERT AND WINGWALLS OCCUR.
10. 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.
11. 3/4" CHAMFER MAY BE PROVIDED ON ALL EDGES AT MANUFACTURER'S OPTION.



SIDE VIEW

FOR CONCRETE PIPE OR CORRUGATED METAL PIPE		
PIPE I.D.	a	b
42"	0'-4 1/2"	0'-3 1/2"
48"	0'-5"	0'-4"
54"	0'-5 3/4"	0'-4 1/2"
60"	0'-6 1/4"	0'-5"
66"	0'-7"	0'-5 1/2"
72"	0'-7 1/2"	0'-6"
78"	0'-8 1/4"	0'-6 1/2"
84"	0'-8 3/4"	0'-7"
90"	0'-9 1/2"	0'-7 1/2"
96"	0'-10"	0'-8"

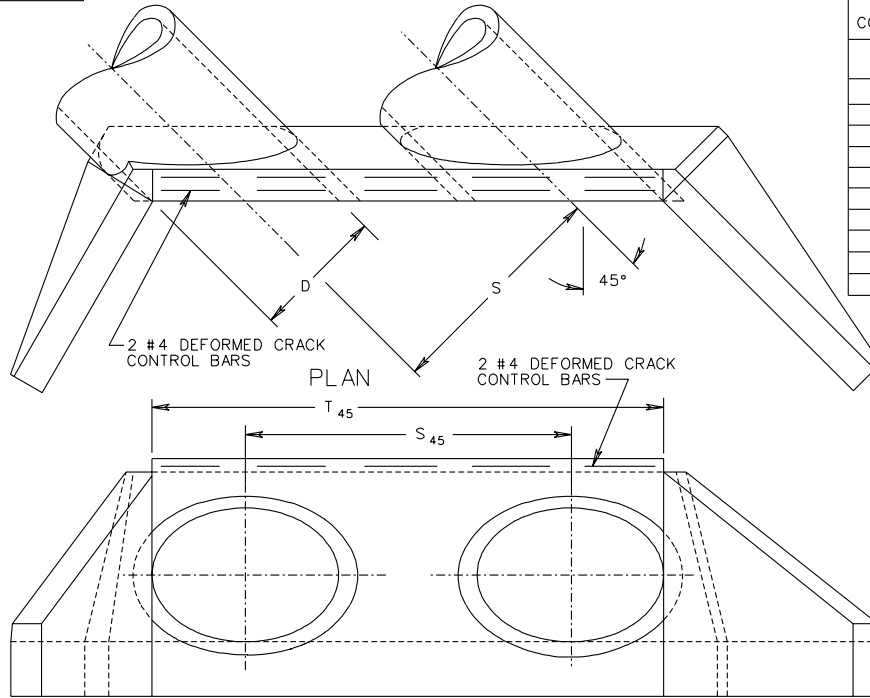
FOR CONCRETE PIPE							
D	S	S30	T30	FILL SLOPE 1 1/2:1		FILL SLOPE 2:1	
				CONCRETE IN ONE DOUBLE ENDWALL CUBIC YARDS	INCREASE FOR EACH ADDITIONAL PIPE CUBIC YDS.	CONCRETE IN ONE DOUBLE ENDWALL CUBIC YDS.	INCREASE FOR EACH ADDITIONAL PIPE CUBIC YDS.
42"	6'-0"	6'-11 1/8"	10'-11 5/8"	5.098	1.467	7.759	1.449
48"	6'-10"	7'-10 5/8"	12'-6 1/8"	6.295	1.836	7.129	1.814
54"	7'-8"	8'-10 1/4"	14'-0 3/8"	8.121	2.376	9.218	2.350
60"	8'-6"	9'-9 3/8"	15'-7"	10.224	3.001	11.640	2.971
66"	9'-4"	10'-9 3/8"	17'-1 1/2"	12.663	3.729	14.450	3.693
72"	10'-2"	11'-8 3/8"	18'-8"	15.437	4.552	17.650	4.512
78"	11'-0"	12'-8 3/8"	20'-2 1/2"	18.558	5.482	21.261	5.438
84"	11'-10"	13'-8"	21'-9"	22.081	6.537	25.351	6.488
90"	12'-8"	14'-7 1/2"	23'-3 1/2"	26.445	8.207	30.302	7.934
96"	13'-6"	15'-7"	24'-10"	30.998	9.654	35.556	9.348

FOR CORRUGATED METAL PIPE							
D	S	S30	T30	FILL SLOPE 1 1/2:1		FILL SLOPE 2:1	
				CONCRETE IN ONE DOUBLE ENDWALL CUBIC YDS.	INCREASE FOR EACH ADDITIONAL PIPE CUBIC YDS.	CONCRETE IN ONE DOUBLE ENDWALL CUBIC YDS.	INCREASE FOR EACH ADDITIONAL PIPE CUBIC YDS.
42"	5'-3 1/2"	6'-1 3/8"	10'-1 1/8"	5.364	1.464	6.021	1.445
48"	6'-0 1/2"	6'-11 3/8"	11'-7 1/8"	6.663	1.849	7.494	1.827
54"	6'-9 1/2"	7'-10 1/8"	13'-0 1/2"	8.737	2.409	9.731	2.382
60"	7'-6 1/2"	8'-8 1/2"	14'-5 3/4"	10.927	3.066	12.339	3.035
66"	8'-3 1/2"	9'-6 1/8"	15'-11 1/8"	13.585	3.827	15.354	3.777
72"	9'-0 1/2"	10'-5 1/4"	17'-4 3/8"	16.666	4.738	18.834	4.659
78"	9'-9 1/2"	11'-3 5/8"	18'-9 3/4"	20.066	5.693	22.761	5.647
84"	10'-6 1/2"	12'-2 1/8"	20'-3 1/8"	23.954	6.822	27.214	6.770
90"	11'-3 1/2"	13'-0 1/2"	21'-8 1/2"	28.395	8.174	32.232	8.115
96"	12'-0 1/2"	13'-10 1/8"	23'-1 3/4"	33.328	9.647	37.863	9.582

STANDARD ENDWALLS FOR MULTIPLE PIPE CULVERTS  
42"-96" PIPE-30° SKEW

SPECIFICATION REFERENCE  
105  
302

EW-7S



FRONT VIEW

FOR CONCRETE PIPE  
OR  
CORRUGATED METAL PIPE

PIPE I.D.	a	b
42"	0'-4 $\frac{1}{2}$ "	0'-3 $\frac{1}{2}$ "
48"	0'-5"	0'-4"
54"	0'-5 $\frac{3}{4}$ "	0'-4 $\frac{1}{2}$ "
60"	0'-6 $\frac{1}{4}$ "	0'-5"
66"	0'-7"	0'-5 $\frac{1}{2}$ "
72"	0'-7 $\frac{1}{2}$ "	0'-6"
78"	0'-8 $\frac{1}{4}$ "	0'-6 $\frac{1}{2}$ "
84"	0'-8 $\frac{3}{4}$ "	0'-7"
90"	0'-9 $\frac{1}{2}$ "	0'-7 $\frac{1}{2}$ "
96"	0'-10"	0'-8"

NOTES:

1. QUANTITIES GIVEN ARE FOR ONE ENDWALL.
2. PLEASE REFER TO STANDARD EW-2S, SHEET 101.08 AND 101.09, FOR ALL DIMENSIONS NOT GIVEN IN TABLES.
3. THIS ITEM MAY BE PRECAST OR CAST IN PLACE.
4. ON SHALLOW FILLS, WHERE ENDWALLS ARE 1' OR LESS BELOW SHOULDER LINE, THE TOP OF THE ENDWALL SHALL BE CONSTRUCTED PARALLEL TO THE GRADE OF ROAD.
5. ALL CAST IN PLACE CONCRETE TO BE CLASS A3. FOR PRECAST SEE SHEET 101.21.
6. IN NO CASE SHALL TOP OF ENDWALL PROJECT ABOVE FILL SLOPE, DITCH SLOPE, OR SHOULDER.
7. THIS STANDARD TO BE USED WITH SKEW ANGLES FROM 37° 30' TO 45°.
8. COST OF BARS FOR CRACK CONTROL TO BE INCLUDED IN PRICE BID PER CUBIC YARD CONCRETE.
9. HEADWALL TO BE BEVELED IN ALL AREAS EXCEPT WHERE A CONFLICT WITH INVERT AND WINGWALLS OCCUR.
10. 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.
11. FOR DETAILS OF HEADWALL BEVEL SEE STANDARD EW-2S, SHEETS 101.08 AND 101.09.
12.  $\frac{3}{4}$ " CHAMFER MAY BE PROVIDED ON ALL EDGES AT MANUFACTURER'S OPTION.

FOR CONCRETE PIPE

D	S	S45	T45	FILL SLOPE 1 $\frac{1}{2}$ :1		FILL SLOPE 2:1	
				CONCRETE IN ONE DOUBLE ENDWALL CUBIC YARDS	INCREASE FOR EACH ADDITIONAL PIPE CUBIC YARDS	CONCRETE IN ONE DOUBLE ENDWALL CUBIC YDS.	INCREASE FOR EACH ADDITIONAL PIPE CUBIC YDS.
42"	6'-0"	8'-5 $\frac{7}{8}$ "	13'-5 $\frac{1}{4}$ "	6.030	1.799	6.819	1.776
48"	6'-10"	9'-8"	15'-3 $\frac{5}{8}$ "	7.443	2.252	8.479	2.225
54"	7'-8"	10'-10 $\frac{1}{8}$ "	17'-2 $\frac{1}{2}$ "	9.621	2.909	10.949	2.878
60"	8'-6"	12'-0 $\frac{1}{4}$ "	19'-1 $\frac{1}{8}$ "	12.124	3.677	13.935	3.640
66"	9'-4"	13'-2 $\frac{3}{8}$ "	20'-11 $\frac{3}{4}$ "	15.003	4.562	17.148	4.520
72"	10'-2"	14'-4 $\frac{1}{2}$ "	22'-10 $\frac{3}{8}$ "	18.287	5.573	20.953	5.524
78"	11'-0"	15'-6 $\frac{5}{8}$ "	24'-9"	21.991	6.715	25.247	6.662
84"	11'-10"	16'-8 $\frac{1}{8}$ "	26'-7 $\frac{5}{8}$ "	26.158	8.008	30.089	7.947
90"	12'-8"	17'-11"	28'-6 $\frac{1}{4}$ "	31.209	9.789	35.937	9.779
96"	13'-6"	19'-1 $\frac{1}{8}$ "	30'-4 $\frac{7}{8}$ "	36.640	11.533	42.212	11.523

FOR CORRUGATED METAL PIPE

D	S	S45	T45	FILL SLOPE 1 $\frac{1}{2}$ :1		FILL SLOPE 2:1	
				CONCRETE IN ONE DOUBLE ENDWALL CUBIC YDS.	INCREASE FOR EACH ADDITIONAL PIPE CUBIC YDS.	CONCRETE IN ONE DOUBLE ENDWALL CUBIC YDS.	INCREASE FOR EACH ADDITIONAL PIPE CUBIC YDS.
42"	5'-3 $\frac{1}{2}$ "	7'-5 $\frac{3}{4}$ "	12'-5 $\frac{1}{4}$ "	6.331	1.789	7.118	1.767
48"	6'-0 $\frac{1}{2}$ "	8'-6 $\frac{1}{8}$ "	14'-2 $\frac{3}{4}$ "	7.866	2.262	8.900	2.236
54"	6'-9 $\frac{1}{2}$ "	9'-7 $\frac{1}{4}$ "	15'-11 $\frac{5}{8}$ "	10.223	2.949	11.526	2.917
60"	7'-6 $\frac{1}{2}$ "	10'-8"	17'-8 $\frac{1}{8}$ "	12.944	3.755	14.750	3.717
66"	8'-3 $\frac{1}{2}$ "	11'-8 $\frac{3}{4}$ "	19'-6"	16.090	4.690	18.236	4.646
72"	9'-0 $\frac{1}{2}$ "	12'-9 $\frac{1}{2}$ "	21'-3 $\frac{1}{4}$ "	19.690	5.763	22.347	5.712
78"	9'-9 $\frac{1}{2}$ "	13'-10 $\frac{1}{8}$ "	23'-0 $\frac{1}{2}$ "	23.757	6.974	27.003	6.917
84"	10'-6 $\frac{1}{2}$ "	14'-10 $\frac{1}{8}$ "	24'-9 $\frac{3}{4}$ "	28.347	8.350	32.265	8.284
90"	11'-3 $\frac{1}{2}$ "	15'-11 $\frac{5}{8}$ "	26'-7"	33.600	10.007	38.292	9.983
96"	12'-0 $\frac{1}{2}$ "	17'-0 $\frac{5}{8}$ "	28'-4 $\frac{1}{8}$ "	39.499	11.815	45.031	11.790

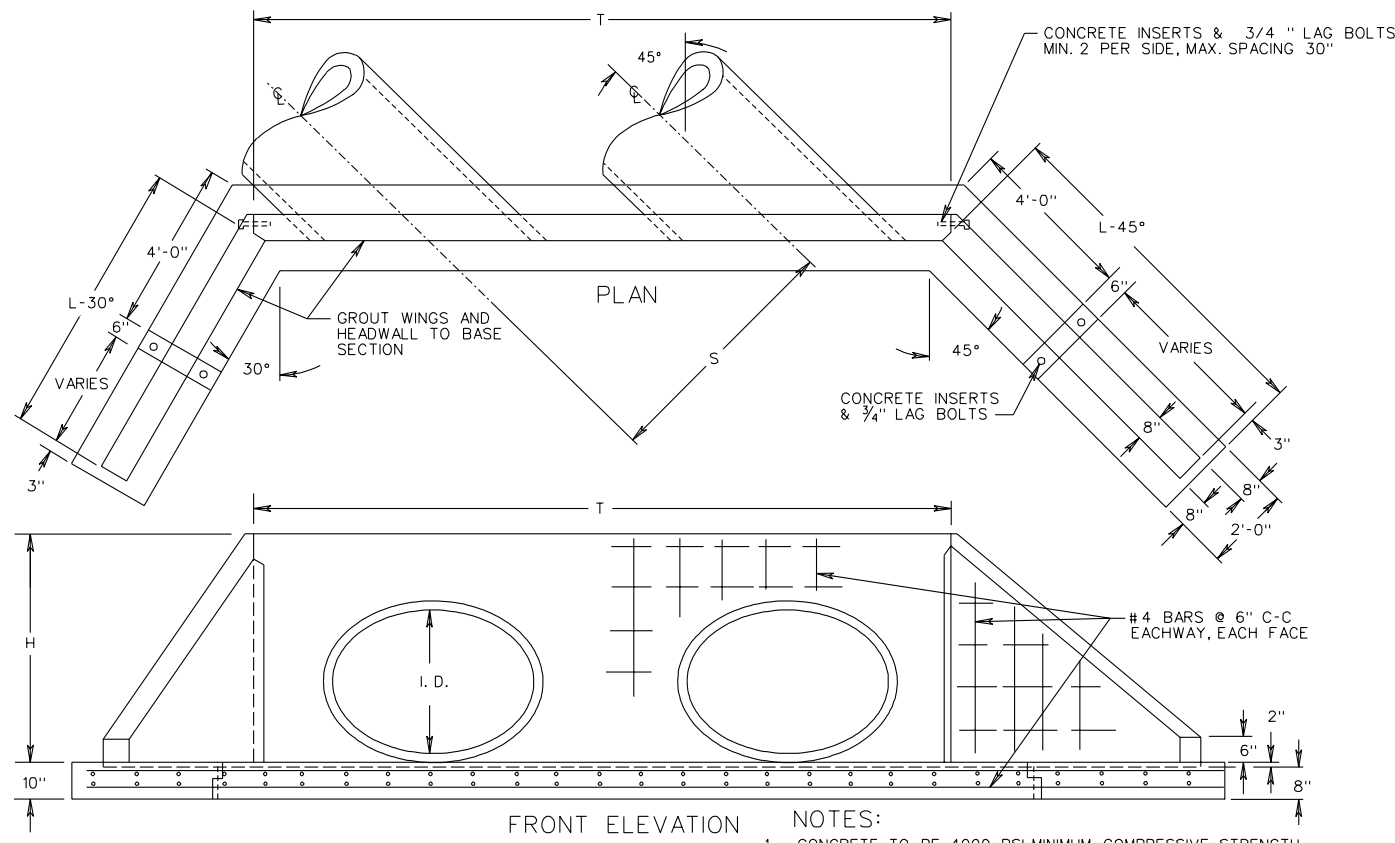
STANDARD ENDWALLS FOR MULTIPLE PIPE CULVERTS  
42"-96" PIPE-45° SKEW

VIRGINIA DEPARTMENT OF TRANSPORTATION

SPECIFICATION  
REFERENCE

105  
302

101.20



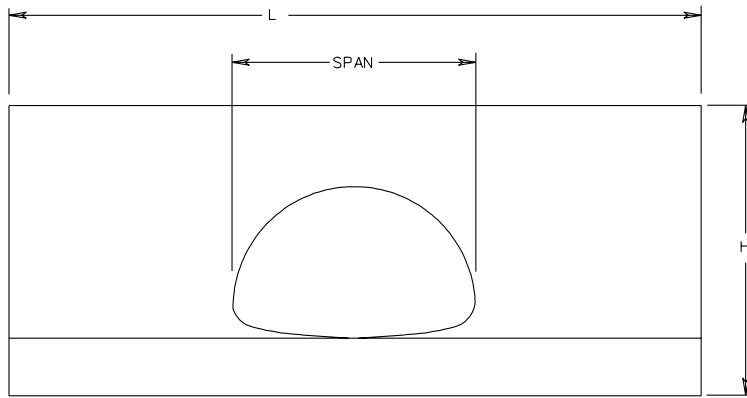
- NOTES:
1. CONCRETE TO BE 4000 PSI MINIMUM COMPRESSIVE STRENGTH.
  2. FOR DETAILS OF HEADWALL BEVEL SEE STANDARD EW-2SPC, SHEET 101.10.
  3. REINFORCING STEEL IN ACCORDANCE WITH ASTM A-615 (REINFORCING BARS).
  4. PIPE OPENINGS IN PRECAST DRAINAGE UNITS SHALL NOT EXCEED 4 INCHES AT ANY GIVEN POINT BETWEEN THE PIPE AND THE PRECAST UNIT.
  5. DIMENSIONS SHOWN ARE MINIMUM. ACTUAL MEASUREMENTS MAY VARY WITH MANUFACTURER'S TOLERANCES.
  6. IN NO CASE SHALL TOP OF ENDWALL PROTRUDE ABOVE FILL SLOPE OR SHOULDER.
  7. HEADWALL TO BE BEVELLED IN ALL AREAS EXCEPT WHERE A CONFLICT WITH INVERT OR WINGWALL OCCUR.
  8. BEVEL EDGE AS REQUIRED ON THE HEADWALL AT THE INLET END OF THE CULVERT (WHERE THE FLOW ENTERS THE CULVERT).
  9. HEADWALL AT THE OUTLET END OF THE CULVERT MAY BE EITHER SQUARE EDGE OR BEVEL EDGE.
  10. 3/4" CHAMFER MAY BE PROVIDED ON ALL EDGES AT MANUFACTURER'S OPTION.

FOR CIRCULAR CONCRETE OR CORRUGATED METAL PIPE									
DIMENSIONS									
PIPE I.D.	H	T	S	L-30° 1/2:1 SLOPE	L-30° 2:1 SLOPE	L-45° 1/2:1 SLOPE	L-45° 2:1 SLOPE	a	b
42"	5'-6"	16'-6"	6'-0"	6'-7 1/2"	8'-8"	8'-0"	10'-6"	0'-4 1/2"	0'-3 1/2"
48"	6'-0"	18'-4"	6'-10"	7'-6"	9'-9 3/4"	9'-2 1/2"	12'-0"	0'-5"	0'-4"
54"	6'-6"	20'-3"	7'-8"	8'-4 1/2"	10'-11 1/2"	10'-3"	13'-6"	0'-5 3/4"	0'-4 1/2"
60"	7'-0"	22'-2"	8'-6"	9'-3"	12'-1 1/4"	11'-3 1/2"	14'-10 1/4"	0'-6 1/4"	0'-5"
66"	7'-7"	24'-0"	9'-4"	10'-1 1/4"	13'-3 1/2"	12'-4 1/2"	16'-4"	0'-7"	0'-5 1/2"
72"	8'-2"	25'-11"	10'-2"	11'-0"	14'-5 1/2"	13'-5 1/2"	17'-8"	0'-7"	0'-5 1/2"
78"	8'-8 1/2"	27'-10"	11'-0"	11'-10"	15'-7"	14'-6"	19'-0"	0'-7"	0'-5 1/2"
84"	9'-3"	29'-8"	11'-10"	12'-8 1/2"	16'-9"	15'-6"	20'-6"	0'-7"	0'-5 1/2"
90"	9'-11"	31'-8"	12'-8"	13'-7"	17'-11"	16'-7 1/2"	21'-11"	0'-7"	0'-5 1/2"
96"	10'-7"	33'-8"	13'-6"	14'-5 1/4"	19'-1"	17'-8 1/4"	23'-4"	0'-7"	0'-5 1/2"

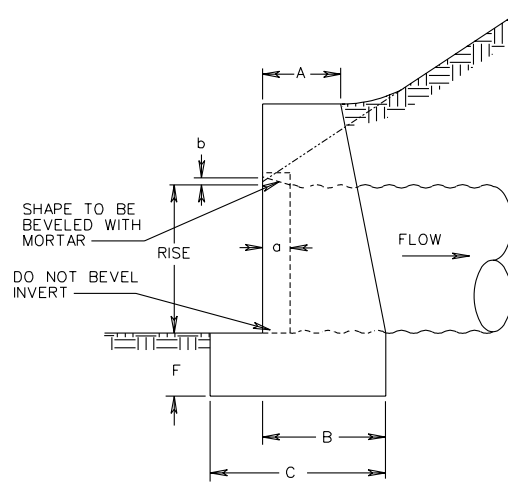
SPECIFICATION REFERENCE
105
302

PRECAST ENDWALLS FOR MULTIPLE PIPE CULVERTS  
 42"-96" PIPE-45° SKEW  
 VIRGINIA DEPARTMENT OF TRANSPORTATION

EW-9



FRONT ELEVATION



SIDE ELEVATION

NOTES:

1. THIS ITEM MAY BE PRECAST OR CAST IN PLACE.
2. ON SHALLOW FILLS, WHERE ENDWALLS ARE 1' OR LESS BELOW SHOULDER LINE, THE TOP OF THE ENDWALL SHALL BE CONSTRUCTED PARALLEL TO THE GRADE OF ROAD.
3. ALL CAST IN PLACE CONCRETE TO BE CLASS A3. FOR PRECAST SEE SHEET 101.22.
4. IN NO CASE SHALL TOP OF ENDWALL PROJECT ABOVE FILL SLOPE, DITCH SLOPE, OR SHOULDER.
5. HEADWALL TO BE BEVELED IN ALL AREAS EXCEPT WHERE A CONFLICT WITH INVERT AND WINGWALLS OCCUR.
6. 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.
7. 3/4" CHAMFER MAY BE PROVIDED ON ALL EDGES AT MANUFACTURER'S OPTION.

CORRUGATED METAL PIPE

NOMINAL DIMENSIONS OF PIPE ARCH		DIMENSIONS FOR ONE SINGLE ENDWALL						CUBIC YARDS CONCRETE FOR ONE ENDWALL	a	b
SPAN	RISE	A	B	C	F	H	L			
17"	13"	0'-6"	0'-11"	1'-4"	0'-6"	2'-2"	4'-3"	0.258	0'-2"	0'-1 1/4"
21"	15"	0'-6"	0'-11"	1'-4"	0'-6"	2'-4"	5'-1"	0.322	0'-2 1/2"	0'-1 1/2"
24"	18"	0'-8"	1'-1 1/2"	1'-7"	0'-8"	3'-0"	6'-1"	0.626	0'-3"	0'-2"
28"	20"	0'-9"	1'-3"	1'-9"	0'-8"	3'-2"	6'-11"	0.823	0'-3"	0'-2"
35"	24"	0'-11"	1'-6"	2'-2"	0'-9"	3'-7"	8'-6"	1.371	0'-4"	0'-2 1/2"
42"	29"	1'-0"	1'-9"	2'-6"	0'-9"	4'-0"	10'-4"	2.072	0'-4 1/2"	0'-3"
*40"	31"									
49"	33"	1'-0"	1'-9"	2'-6"	0'-9"	4'-4"	11'-11"	2.520	0'-5 1/2"	0'-3 1/2"
*46"	36"									
57"	38"	1'-0"	2'-0"	2'-9"	0'-9"	4'-9"	13'-10"	3.427	0'-6"	0'-4"
*53"	41"									

\*3" x 1" AND 5" x 1" CORRUGATION DIMENSIONS.

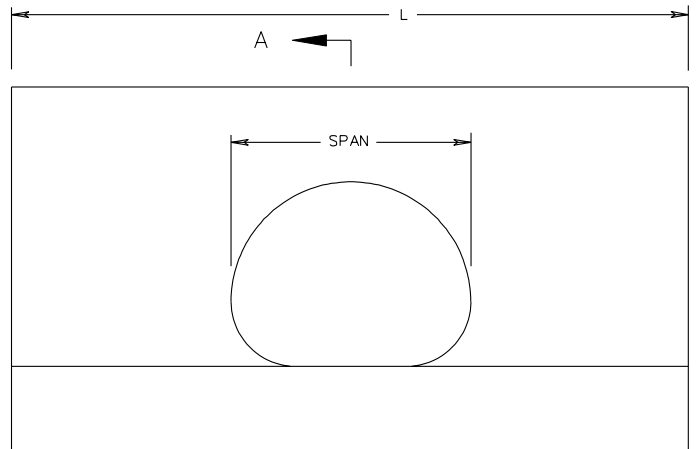
STANDARD ENDWALLS FOR PIPE ARCHES  
13"-38" RISE

VIRGINIA DEPARTMENT OF TRANSPORTATION

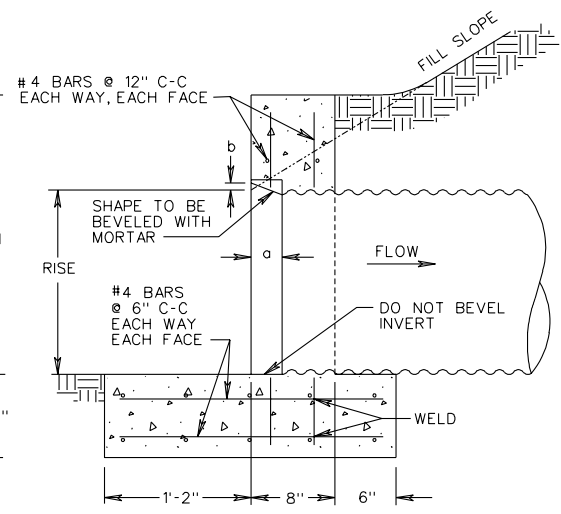
SPECIFICATION REFERENCE

105  
302

101.22



A ←  
FRONT ELEVATION



SECTION A-A

NOTES:

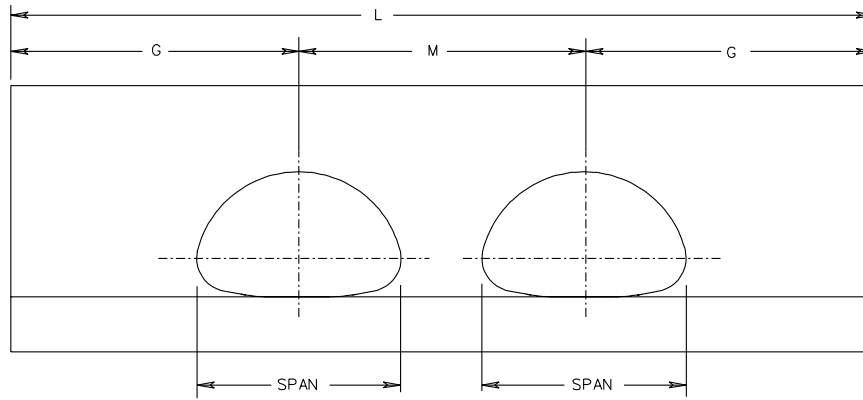
1. CONCRETE TO BE 4000 PSI MINIMUM COMPRESSIVE STRENGTH.
2. IF PIPE IS TO BE SKEWED THE OPENING WILL BE ADJUSTED TO ACCOMMODATE.
3. REINFORCING STEEL IN ACCORDANCE WITH ASTM A-615 (REINFORCING BARS).
4. PIPE ARCH OPENINGS IN PRECAST DRAINAGE UNITS SHALL NOT EXCEED 4 INCHES AT ANY GIVEN POINT BETWEEN THE PIPE AND THE PRECAST UNIT.
5. DIMENSIONS SHOWN ARE MINIMUM. ACTUAL MEASUREMENTS MAY VARY WITH MANUFACTURER'S TOLERANCE.
6. IN NO CASE SHALL TOP OF ENDWALL PROJECT ABOVE FILL SLOPE, OR SHOULDER.
7. HEADWALL TO BE BEVELED IN ALL AREAS EXCEPT WHERE A CONFLICT WITH INVERT OR WINGWALL OCCUR.
8. BEVEL EDGE IS REQUIRED ON THE HEADWALL AT THE INLET END OF THE CULVERT HEADWALL AT OUTLET END MAY BE EITHER SQUARE EDGE OR BEVELED.
9. 3/4" CHAMFER MAY BE PROVIDED ON ALL EDGES AT MANUFACTURER'S OPTION.

PRECAST ENDWALL DIMENSIONS					
SPAN	RISE	H	L	a	b
17"	13"	1'-8"	4'-0"	0'-2"	0'-1/4"
21"	15"	1'-10"	5'-0"	0'-2 1/2"	0'-1 1/2"
24"	18"	2'-4"	6'-0"	0'-3"	0'-2"
28"	20"	2'-6"	7'-0"	0'-3"	0'-2"
35"	24"	2'-10"	8'-0"	0'-4"	0'-2 1/2"
* 40"	31"	3'-3"	10'-0"	0'-4 1/2"	0'-3"
42"	29"				
* 46"	36"	3'-7"	12'-0"	0'-5 1/2"	0'-3 1/2"
49"	33"				
* 53"	41"	4'-0"	13'-0"	0'-6"	0'-4"
57"	38"				

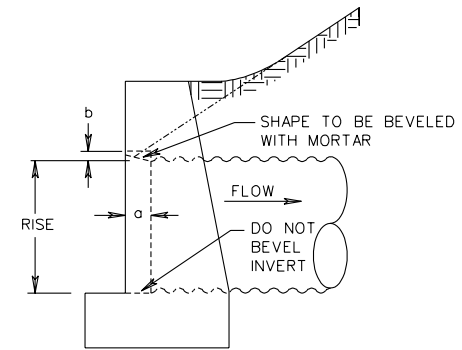
\* DIMENSIONS FOR 3" x 1" AND 5" x 1" CORRUGATIONS

SPECIFICATION REFERENCE
105 302

PRECAST ENDWALLS FOR PIPE ARCHES  
13"-38" RISE  
VIRGINIA DEPARTMENT OF TRANSPORTATION



FRONT ELEVATION



SIDE ELEVATION

CORRUGATED METAL PIPE								
NOMINAL DIMENSIONS OF PIPE ARCH		DIMENSIONS FOR ONE DOUBLE ENDWALL			CUBIC YARDS CONCRETE		a	b
SPAN	RISE	M	G	L	ONE DOUBLE ENDWALL	INCREASE FOR EACH ADDITIONAL PIPE ARCH		
17"	13"	2'-6"	2'-2"	6'-10"	0.402	0.138	0'-2"	0'-1/4"
21"	15"	2'-10"	2'-7"	8'-0"	0.487	0.159	0'-2 1/2"	0'-1/2"
24"	18"	3'-1"	3'-1"	9'-3"	0.913	0.277	0'-3"	0'-2"
28"	20"	3'-5"	3'-6"	10'-5"	1.182	0.348	0'-3"	0'-2"
35"	24"	4'-0"	4'-3"	12'-6"	1.900	0.529	0'-4"	0'-2 1/2"
42"	29"	4'-10"	5'-2"	15'-2"	2.852	0.780	0'-4 1/2"	0'-3"
* 40"	31"							
49"	33"	5'-7"	6'-0"	17'-7"	3.455	0.924	0'-5 1/2"	0'-3 1/2"
* 46"	36"							
57"	38"	6'-6"	6'-11"	20'-4"	4.664	1.237	0'-6"	0'-4"
* 53"	41"							

\* 3" X 1" AND 5" X 1" CORRUGATION DIMENSIONS.

NOTES:

1. THIS ITEM MAY BE PRECAST OR CAST IN PLACE.
2. REFER TO STANDARD EW-9, SHEET 101.22, FOR ALL DIMENSIONS NOT GIVEN IN TABLE.
3. ON SHALLOW FILLS, WHERE ENDWALLS ARE 1' OR LESS BELOW SHOULDER LINE, THE TOP OF THE ENDWALL SHALL BE CONSTRUCTED PARALLEL TO THE GRADE OF ROAD.
4. ALL CAST IN PLACE CONCRETE TO BE CLASS A3. FOR PRECAST SEE SHEET 101.25.
5. IN NO CASE SHALL TOP OF ENDWALL PROJECT ABOVE FILL SLOPE, DITCH SLOPE, OR SHOULDER.
6. HEADWALL TO BE BEVELED IN ALL AREAS EXCEPT WHERE A CONFLICT WITH INVERT AND WINGWALLS OCCUR.
7. 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.
8. 3/4" CHAMFER MAY BE PROVIDED ON ALL EDGES AT MANUFACTURER'S OPTION.

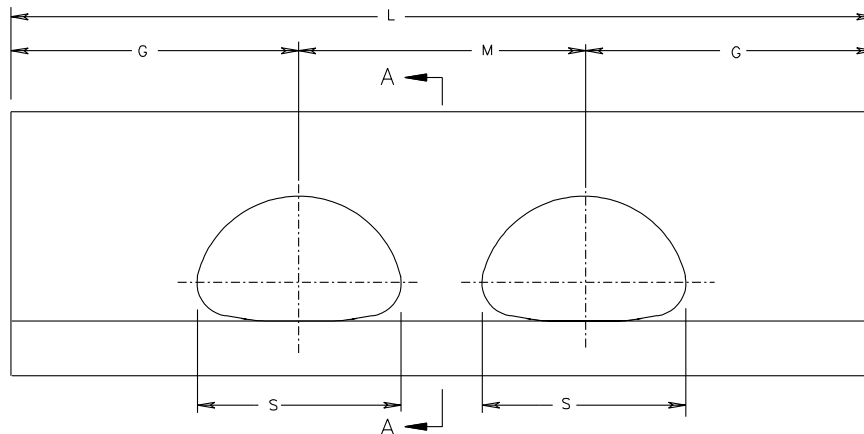
STANDARD ENDWALLS FOR MULTIPLE PIPE ARCHES  
13"-38" RISE

VIRGINIA DEPARTMENT OF TRANSPORTATION

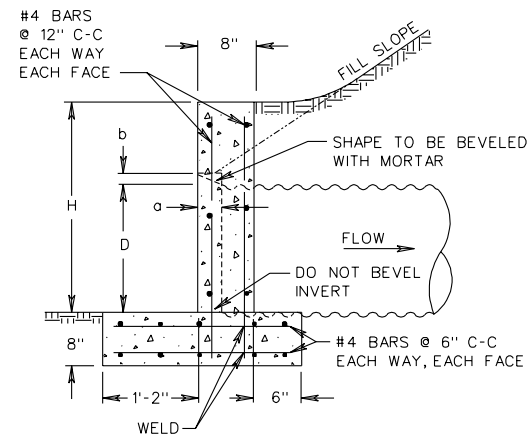
SPECIFICATION REFERENCE

105  
302





FRONT ELEVATION



SECTION A-A

NOTES:

1. CONCRETE TO BE 4000 PSI MINIMUM COMPRESSIVE STRENGTH.
2. IF PIPE IS TO BE SKEWED THE OPENING WILL BE ADJUSTED TO ACCOMMODATE.
3. REINFORCING STEEL IN ACCORDANCE WITH ASTM A-615 (REINFORCING BARS).
4. PIPE ARCH OPENINGS IN PRECAST DRAINAGE UNITS SHALL NOT EXCEED 4 INCHES AT ANY GIVEN POINT BETWEEN THE PIPE AND THE PRECAST UNIT.
5. DIMENSIONS SHOWN ARE MINIMUM. ACTUAL MEASUREMENTS MAY VARY WITH MANUFACTURER'S TOLERANCE.
6. IN NO CASE SHALL TOP OF ENDWALL PROJECT ABOVE FILL SLOPE, OR SHOULDER.
7. HEADWALL TO BE BEVELED IN ALL AREAS EXCEPT WHERE A CONFLICT WITH INVERT OR WINGWALL OCCUR.
8. BEVEL EDGE IS REQUIRED ON THE HEADWALL AT THE INLET END OF THE CULVERT HEADWALL AT OUTLET END MAY BE EITHER SQUARE EDGE OR BEVELED.
9. 3/4" CHAMFER MAY BE PROVIDED ON ALL EDGES AT MANUFACTURER'S OPTION.

PRECAST ENDWALL DIMENSIONS							
S	D	M	G	L	H	a	b
17"	13"	2'-6"	2'-2"	6'-10"	2'-3"	0'-2"	0'-1/4"
21"	15"	2'-10"	2'-7"	8'-0"	2'-5"	0'-2 1/2"	0'-1 1/2"
24"	18"	3'-1"	3'-1"	9'-3"	2'-8"	0'-3"	0'-2"
28"	20"	3'-5"	3'-6"	10'-5"	2'-10"	0'-3"	0'-2"
35"	24"	4'-0"	4'-3"	12'-6"	3'-2"	0'-4"	0'-2 1/2"
* 40"	31"	4'-10"	5'-2"	15'-2"	3'-7"	0'-4 1/2"	0'-3"
42"	29"						
* 46"	36"	5'-7"	6'-0"	17'-7"	3'-11"	0'-5 1/2"	0'-3 1/2"
49"	33"						
* 53"	41"	6'-6"	6'-11"	20'-4"	4'-4"	0'-6"	0'-4"
57"	38"						

\* DIMENSIONS FOR 3" X 1" AND 5" X 1" CORRUGATION

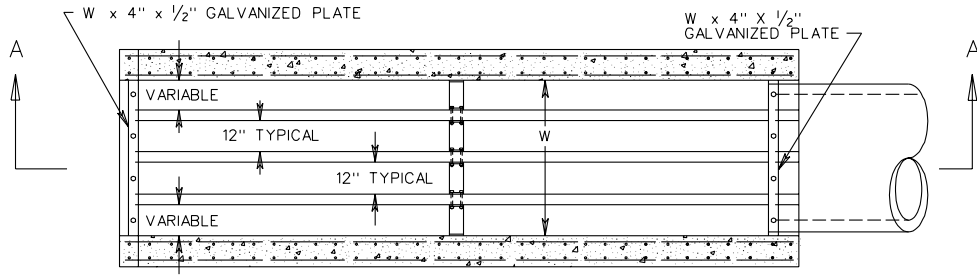
SPECIFICATION REFERENCE

105  
302

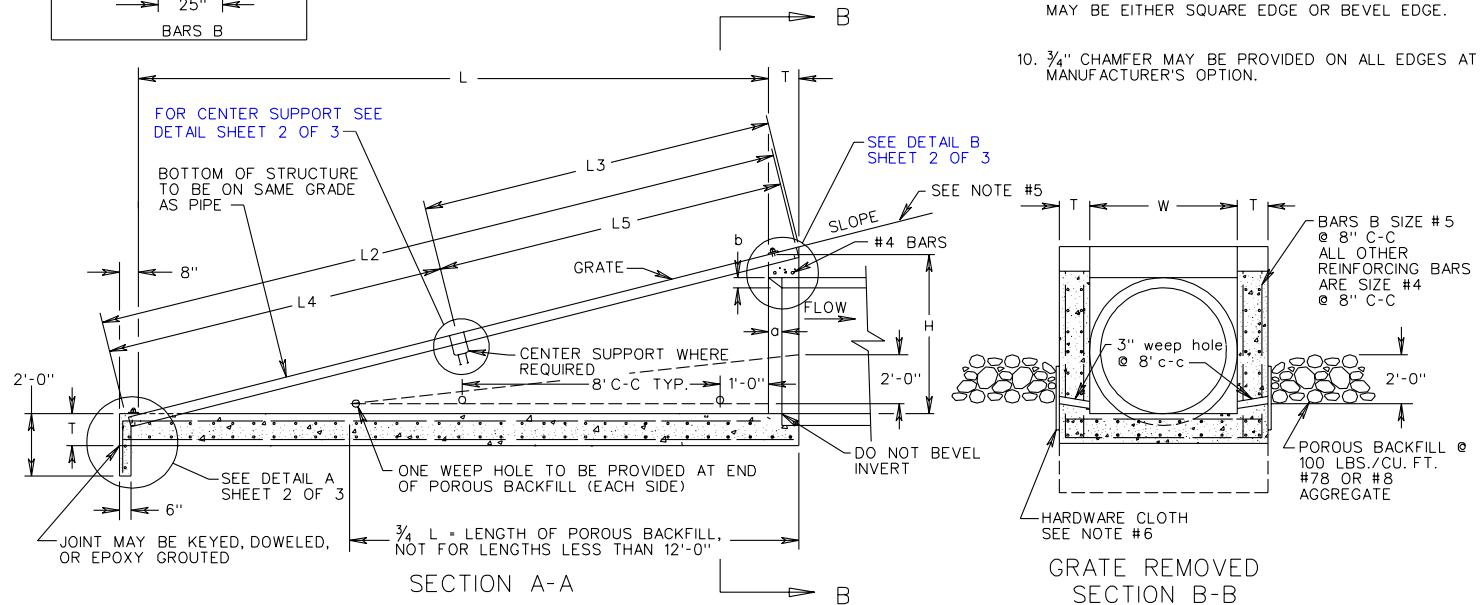
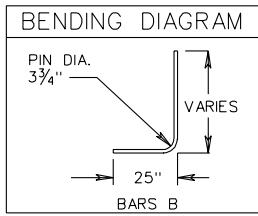
PRECAST ENDWALLS FOR MULTIPLE PIPE ARCHES  
13"-38" RISE

VIRGINIA DEPARTMENT OF TRANSPORTATION

101.25



PLAN VIEW



NOTES:

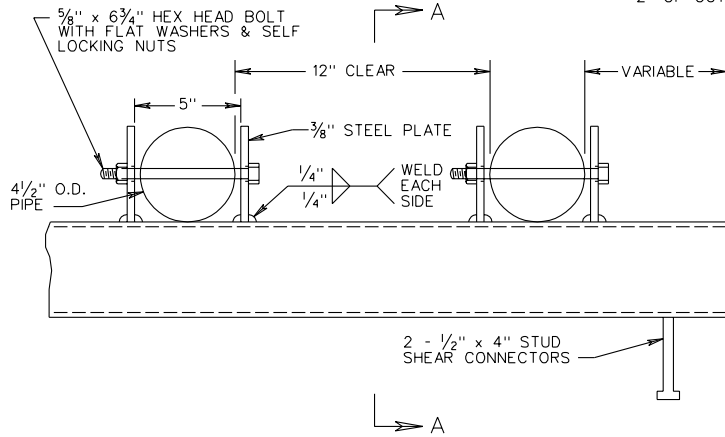
1. THIS ITEM MAY BE PRECAST OR CAST IN PLACE. ALL CAST CONCRETE TO BE CLASS A3, FOR PRECAST USE 4000 PSI MINIMUM. REINFORCING STEEL TO HAVE A MINIMUM 1/2" COVER.
2. FOR TABULATION OF DIMENSIONS AND QUANTITIES SEE SHEET 3 OF 3.
3. ALL PIPE FOR GRATE, STRUCTURAL TUBING, AND RELATED HARDWARE TO BE GALVANIZED.
4. STANDARD EW-11 TO BE INSTALLED SO THE GRATE CONFIGURATION IS ALWAYS PERPENDICULAR TO THE EDGE OF THE SHOULDER.
5. SLOPE AS SPECIFIED ON TYPICAL SECTION.
6. WEEP HOLE WITH 12" X 12" PLASTIC HARDWARE CLOTH 1/4" MESH OR GALVANIZED STEEL WIRE, MINIMUM WIRE DIAMETER 0.03" NUMBER 4 MESH HARDWARE CLOTH ANCHORED FIRMLY OUTSIDE OF STRUCTURE.
7. HEADWALL TO BE BEVELED IN ALL AREAS EXCEPT WHERE A CONFLICT WITH INVERT OR WINGWALLS OCCUR.
8. BEVEL EDGE IS REQUIRED ON THE HEADWALL OF THE INLET END OF THE CULVERT (WHERE THE FLOW ENTERS THE CULVERT).
9. HEADWALL AT THE OUTLET END OF THE CULVERT MAY BE EITHER SQUARE EDGE OR BEVEL EDGE.
10. 3/4" CHAMFER MAY BE PROVIDED ON ALL EDGES AT MANUFACTURER'S OPTION.

PIPE ENDWALL WITH LOAD-CARRYING GRATE  
FOR 12"-60" PIPES  
VIRGINIA DEPARTMENT OF TRANSPORTATION

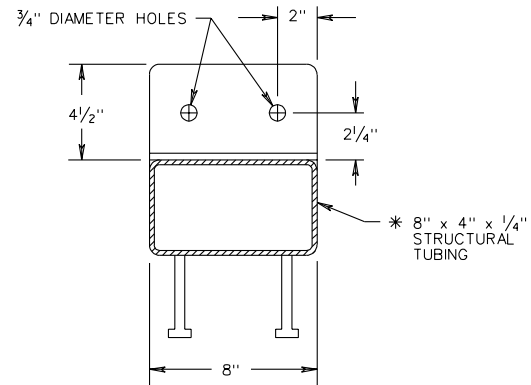
SPECIFICATION  
REFERENCE

105  
233  
302

\* STRUCTURAL TUBING TO BE EXTENDED TO WITHIN 2" OF OUTSIDE FACE OF SIDEWALL

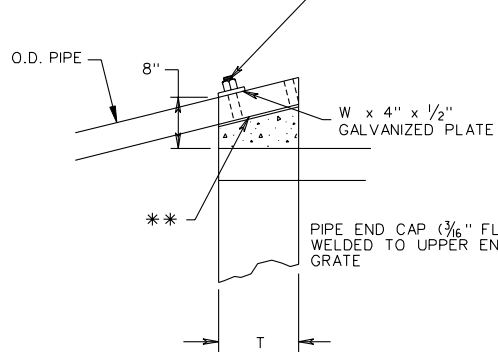


CENTER SUPPORT  
(ELEVATION)



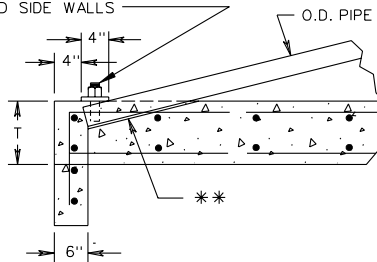
SECTION A-A

HOOK BOLTS 1/2" x 6" x (1/2" RIGHT ANGLE BEND) WITH FLAT WASHER & SELF LOCKING NUT. 5/8" HOLES TO BE PROVIDED IN PLATE, CENTERED BETWEEN PIPES AND SIDE WALLS

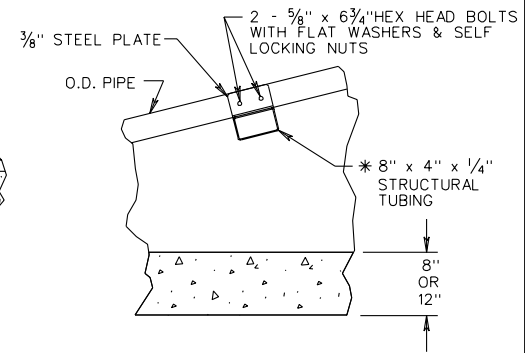


DETAIL B

HOOK BOLTS 1/2" x 6" x (1/2" RIGHT ANGLE BEND) WITH FLAT WASHER & SELF LOCKING NUT. 5/8" 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
105
233
302

PIPE ENDWALL WITH LOAD-CARRYING GRATE FOR 12"-60" PIPES

VIRGINIA DEPARTMENT OF TRANSPORTATION

PIPE GRATE

TYPE I = 3/2" O.D.  
 TYPE II = 4" O.D.  
 TYPE III = 4 1/2" O.D.

LENGTH OF GRATE TO BE DETERMINED  
 BY L<sub>2</sub> x NUMBER OF PIPES REQUIRED

4 : 1 SLOPE										
Pipe Size	H	L	W	T	No Center Support Required					
					Pipe O.D.	No. Pipes Required	L <sub>2</sub>	L <sub>3</sub>	L <sub>4</sub>	L <sub>5</sub>
12"	1'-10"	7'-4"	2'-0"	8"	3 1/2"	1	8'-6 3/4"			
15" or 18"	2'-4 1/2"	9'-6"	2'-0"	8"	3 1/2"	1	10'-9 1/2"			
21" or 24"	2'-11"	11'-8"	3'-0"	8"	4"	2	13'-0 1/4"			
27" or 30"	3'-5 1/2"	13'-10"	3'-0"	8"	4"	2	15'-3"			
33" or 36"	4'-0"	16'-0"	4'-0"	8"	4 1/2"	3	17'-6"			
42"	4'-6 1/2"	18'-2"	4'-0"	12"	4 1/2"	3	19'-8 3/4"			
48"	5'-1"	20'-4"	5'-0"	12"	4 1/2"	3	22'-2 5/8"	10'-5 1/4"	11'-10 1/2"	10'-4 1/4"
54"	5'-7 1/2"	22'-6"	6'-0"	12"	4 1/2"	4	24'-5 1/2"	12'-8 1/8"	11'-10 1/2"	12'-7 1/8"
60"	6'-2"	24'-8"	6'-0"	12"	4 1/2"	4	26'-8 1/2"	14'-11"	11'-10 1/2"	14'-10"

DIMENSIONS FOR BEVEL ON HEADWALL

Pipe I.D.	a	b
12"	0'-1 1/4"	0'-1"
15" or 18"	0'-2"	0'-1 1/2"
21" or 24"	0'-2 1/2"	0'-2"
27" or 30"	0'-3 1/4"	0'-2 1/2"
33" or 36"	0'-3 3/4"	0'-3"
42"	0'-4 1/2"	0'-3 1/2"
48"	0'-5"	0'-4"
54"	0'-5 3/4"	0'-4 1/2"
60"	0'-6 1/4"	0'-5"

6 : 1 SLOPE										
Pipe Size	H	L	W	T	No Center Support Required					
					Pipe O.D.	No. Pipes Required	L <sub>2</sub>	L <sub>3</sub>	L <sub>4</sub>	L <sub>5</sub>
12"	1'-10"	11'-0"	2'-0"	8"	3 1/2"	1	12'-13 1/4"			
15" or 18"	2'-4 1/2"	14'-3"	2'-0"	8"	4"	1	15'-5 1/4"			
21" or 24"	2'-11"	17'-6"	3'-0"	8"	4 1/2"	2	18'-9"			
27" or 30"	3'-5 1/2"	20'-9"	3'-0"	8"	4 1/2"	2	22'-0"	4'-8 1/8"	17'-4 1/2"	4'-7 1/2"
33" or 36"	4'-0"	24'-0"	4'-0"	8"	4 1/2"	3	25'-3 3/8"	7'-11 5/8"	17'-4 1/2"	7'-11"
42"	4'-6"	27'-3"	4'-0"	12"	4 1/2"	3	28'-11"	11'-7 1/4"	17'-4 1/2"	11'-6 1/2"
48"	5'-1"	30'-6"	5'-0"	12"	4 1/2"	3	32'-2"	14'-10 3/4"	17'-4 1/2"	14'-10 1/8"
54"	5'-7 1/2"	33'-9"	6'-0"	12"	4 1/2"	4	35'-6"	18'-2 1/4"	17'-4 1/2"	18'-1 1/2"
60"	6'-2"	37'-0"	6'-0"	12"	4 1/2"	4	38'-9 1/2"	19'-5 1/2"	19'-4 3/4"	19'-4 3/4"

3 : 1 SLOPE										
Pipe Size	H	L	W	T	Pipe Grate			No. Pipes Required	L <sub>2</sub>	No Center Support Required
					Pipe O.D.	No. Pipes Req'd.	L <sub>2</sub>			
12"	1'-10"	5'-6"	2'-0"	8"	3 1/2"	1	6'-9 1/2"			
15" or 18"	2'-4 1/2"	7'-1 1/2"	2'-0"	8"	3 1/2"	1	8'-6 1/4"			
21" or 24"	2'-11"	8'-9"	3'-0"	8"	3 1/2"	2	10'-2 3/4"			
27" or 30"	3'-5 1/2"	10'-4 1/2"	3'-0"	8"	3 1/2"	2	11'-11 1/4"			
33" or 36"	4'-0"	12'-0"	4'-0"	8"	4"	3	13'-7 3/4"			
42"	4'-6 1/2"	13'-7 1/2"	4'-0"	12"	4"	3	15'-4 1/4"			
48"	5'-1"	15'-3"	5'-0"	12"	4 1/2"	3	17'-0 1/2"			
54"	5'-7 1/2"	16'-10 1/2"	6'-0"	12"	4 1/2"	4	18'-9 1/2"			
60"	6'-2"	18'-6"	6'-0"	12"	4 1/2"	4	20'-6"			

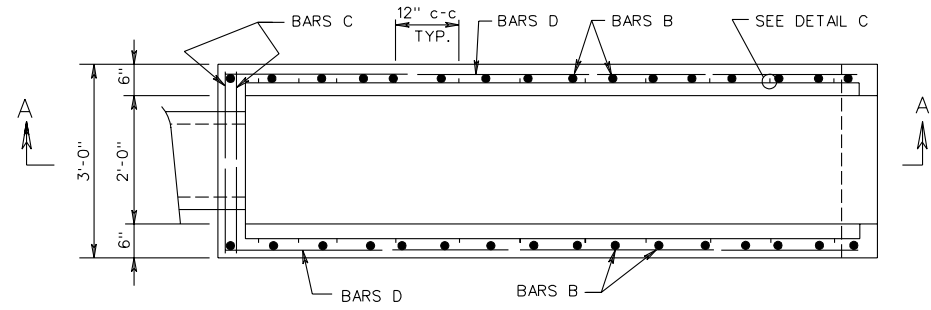
APPROXIMATE QUANTITIES											
Pipe Size	3 : 1			Pipe Size	4 : 1			Pipe Size	6 : 1		
	Concrete Cubic yards	lbs. Reinf. Steel	Reinf. Steel		Concrete Cubic yards	lbs. Reinf. Steel	Reinf. Steel		Concrete Cubic yards	lbs. Reinf. Steel	Reinf. Steel
12"	.95	.97	240	12"	1.17	1.18	308	12"	1.64	1.66	443
15" or 18"	1.27	1.29	328	15" or 18"	1.59	1.61	425	15" or 18"	2.28	2.31	618
21" or 24"	2.30	2.35	483	21" or 24"	2.44	2.49	628	21" or 24"	3.55	3.59	917
27" or 30"	2.38	2.44	608	27" or 30"	3.01	3.01	788	27" or 30"	4.35	4.41	1157
33" or 36"	3.28	3.38	809	33" or 36"	4.20	4.29	1059	33" or 36"	6.01	6.09	1556
42"	6.27	6.46	1050	42"	8.05	8.22	1368	42"	11.59	11.76	1997
48"	8.07	8.29	1327	48"	10.29	10.50	1647	48"	14.84	15.04	2514
54"	10.02	10.29	1612	54"	12.80	13.06	2105	54"	18.47	18.73	3094
60"	11.18	11.50	1826	60"	14.36	14.68	2391	60"	20.82	21.14	3517

PIPE ENDWALL WITH LOAD - CARRYING GRATE  
 FOR 12"-60" PIPES

VIRGINIA DEPARTMENT OF TRANSPORTATION

SPECIFICATION REFERENCE

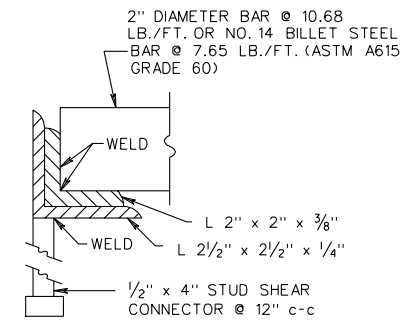
105  
 233  
 302



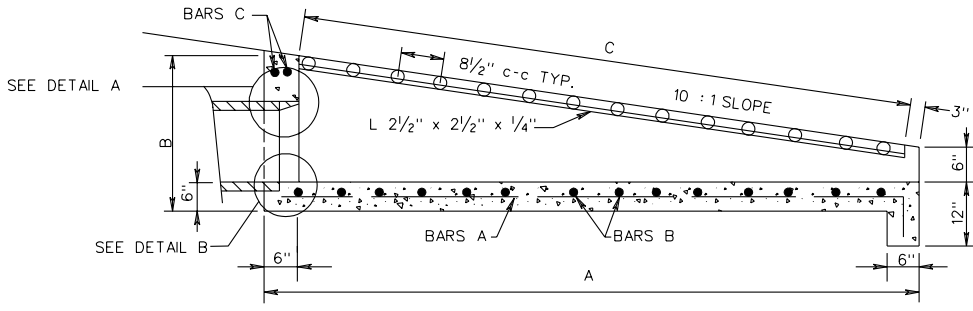
PLAN VIEW  
(GRATE REMOVED)

DIMENSIONS FOR BEVEL		
ON HEADWALL PIPE SIZE	a	b
12"	0'-1 1/4"	0'-1"
15"	0'-1 3/4"	0'-1 1/4"
18"	0'-2"	0'-1 1/2"
21" OR 24"	0'-2 1/2"	0'-2"

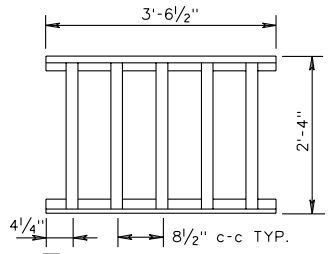
NO HOLES ARE TO BE PROVIDED IN L 2" x 2" x 3/8" WHEN SOLID BARS ARE USED.



DETAIL C



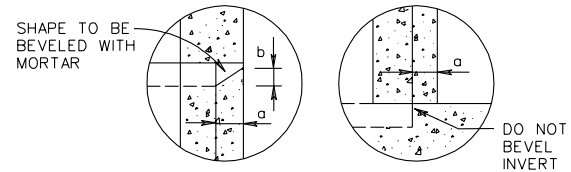
SECTION A-A



GRATE SECTION DETAIL

NOTES:

- IN NO CASE SHALL TOP OF ENDWALL PROJECT ABOVE FILL SLOPE, DITCH, SLOPE, OR SHOULDER.
- CLASS A3 CONCRETE TO BE USED IF CAST IN PLACE, 4000 PSIF PRECAST.
- REINFORCING STEEL TO HAVE A MINIMUM 1/2" 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.
- 3/4" CHAMFER MAY BE PROVIDED ON ALL EDGES AT MANUFACTURER'S OPTION.
- 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 SQUARE EDGE OR BEVEL EDGE.
- THE NUMBER OF GRATE SECTIONS TO BE USED FOR EACH EW-11A IS BASED ON THE LENGTH "C" SEE QUANTITIES CHART ON SHEET 2 OF 2.



DETAIL A

DETAIL B

SPECIFICATION REFERENCE
105
233
302

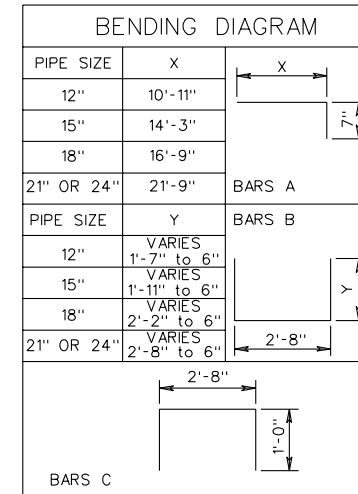
PIPE ENDWALL WITH LOAD - CARRYING GRATE  
FOR 12"-24" PIPES  
VIRGINIA DEPARTMENT OF TRANSPORTATION

DIMENSIONS					
PIPE SIZE	A	B	C	a	b
12"	11'-4"	2'-1"	10'-7½"	0'-1¼"	0'-1"
15"	14'-8"	2'-5"	14'-0"	0'-1¾"	0'-1¼"
18"	17'-2"	2'-8"	16'-6"	0'-2"	0'-1½"
21" OR 24"	22'-2"	3'-2"	21'-6½"	0'-2½"	0'-2"

APPROXIMATE QUANTITIES					
PIPE SIZE	NO. OF GRATE SECTIONS	CONCRETE CUBIC YARDS		LBS. REINF. STEEL	LENGTH TO BE CUT FROM 1 GRATE
		CONC. PIPE	C.M. PIPE		
12"	3	1.127	1.139	119	0
15"	4	1.532	1.547	161	2⅛"
18"	5	1.856	1.877	201	1'-2½"
21" OR 24"	6	2.567	2.600	276	* 0

\* GRATES WILL BE 3⅝" 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
12"	# 4	5	8"	11'-6"	# 4	17	8"	VARIES 3'-8" to 5'-10"	# 4	2	-	4'-8"	# 4	4	8"	VARIES 4'-2" to 11'-0"
15"	# 4	5	8"	14'-10"	# 4	22	8"	VARIES 3'-8" to 6'-7"	# 4	2	-	4'-8"	# 4	4	8"	VARIES 7'-8" to 14'-4"
18"	# 4	5	8"	17'-4"	# 4	26	8"	VARIES 3'-8" to 7'-0"	# 4	2	-	4'-8"	# 4	6	8"	VARIES 4'-4" to 16'-10"
21" OR 24"	# 4	5	8"	22'-4"	# 4	33	8"	VARIES 3'-8" to 8'-0"	# 4	2	-	4'-8"	# 4	8	8"	VARIES 2'-9" to 21'-10"



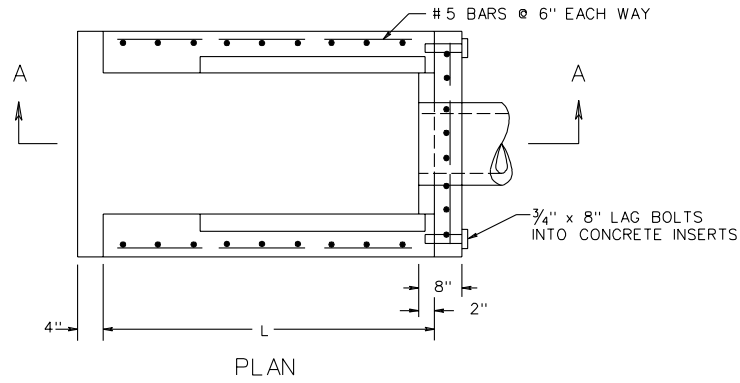
APPROXIMATE WEIGHT OF GRATE	
TYPE	LBS.
2" DIA. BAR	158.55
NO. 14 BILLET STEEL BAR	123.64

PIPE ENDWALL WITH LOAD - CARRYING GRATE FOR 12"-24" PIPES

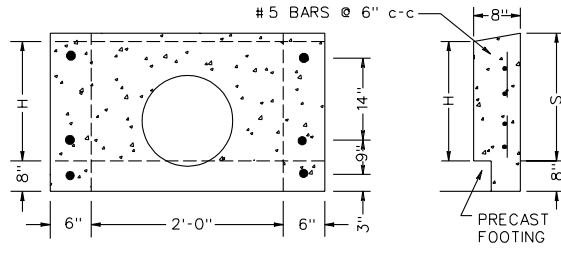
VIRGINIA DEPARTMENT OF TRANSPORTATION

SPECIFICATION REFERENCE

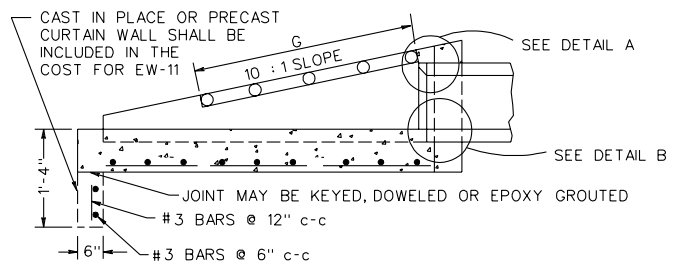
105  
233  
302



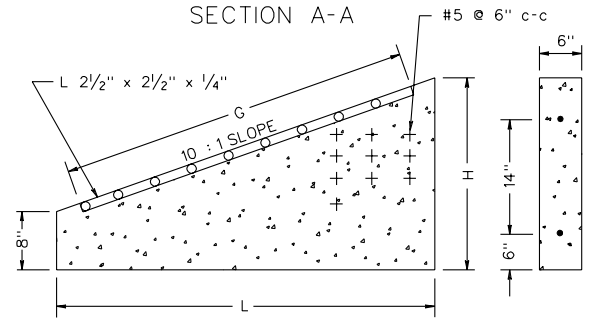
PLAN



DIMENSIONS		
PIPE SIZE	H	S
12"	1'-7"	1'-7 3/4"
15"	1'-11"	1'-11 3/4"
18"	2'-2"	2'-2 3/4"
21" OR 24"	2'-8"	2'-8 3/4"

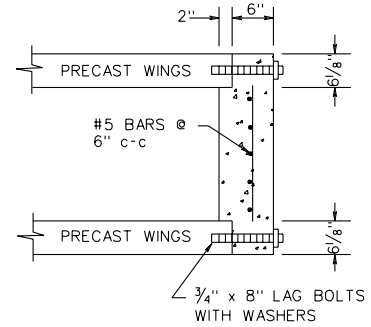


SECTION A-A

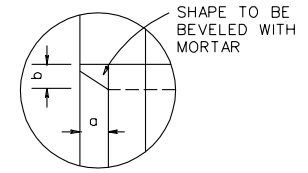


WING WALL DETAIL

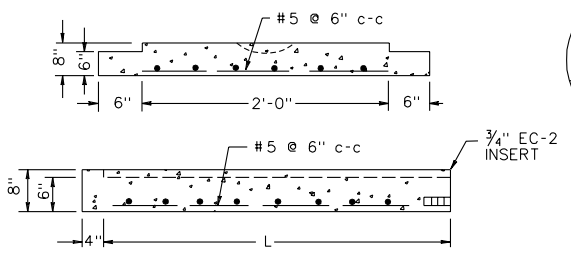
DIMENSIONS					
PIPE SIZE	L	H	G	a	b
12"	11'-0"	1'-9"	10'-7 1/2"	0'-1 1/4"	0'-1"
15"	14'-4"	2'-1"	14'-0"	0'-1 3/4"	0'-1 1/4"
18"	16'-10"	2'-4"	16'-6"	0'-2"	0'-1 1/2"
21" OR 24"	21'-10"	2'-10"	21'-6 1/2"	0'-2 1/2"	0'-2"



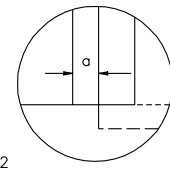
END WALL DETAIL



DETAIL A



FOOTING DETAIL



DETAIL B

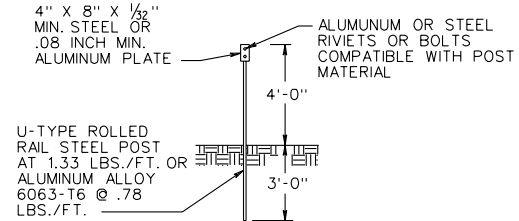
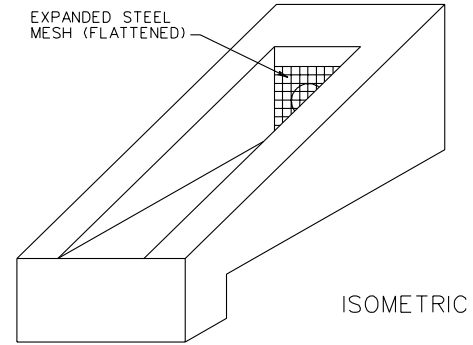
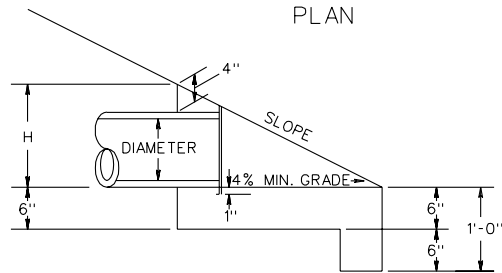
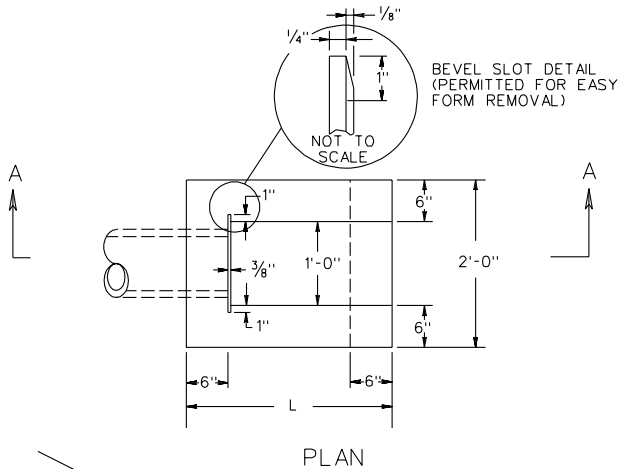
CONCRETE TO BE 4000 PSI MINIMUM COMPRESSIVE STRENGTH. IF PIPE IS TO BE SKEWED, THE OPENING WILL BE ADJUSTED TO ACCOMMODATE. REINFORCING STEEL IN ACCORDANCE WITH ASTM A615 (REINFORCING BARS). PIPE DIMENSIONS SHOWN ARE MINIMUM. ACTUAL DIMENSIONS MAY VARY WITH MANUFACTURER. BOTTOM OF STRUCTURE TO BE ON THE SAME GRADE AS DRAINAGE DITCH. FOR DETAILS OF GRATE AND NUMBER OF GRATES REQUIRED SEE EW-11A. 3/4" CHAMFER MAY BE PROVIDED ON ALL EDGES AT MANUFACTURER'S OPTION.

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. PIPE OPENINGS IN PRECAST DRAINAGE UNITS SHALL NOT EXCEED 4 INCHES AT ANY GIVEN POINT BETWEEN THE PIPE AND THE PRECAST UNIT.

SPECIFICATION REFERENCE
105
233
302

## PRECAST PIPE ENDWALL WITH LOAD - CARRYING GRATE FOR 12"-24" PIPES

VIRGINIA DEPARTMENT OF TRANSPORTATION



UNDERDRAIN OUTLET  
MARKER DETAIL

NOTES:

1. TYPICAL ENDWALL TO BE PLACED AT THE ENDS OF ALL UNDERDRAIN OUTLETS, BARRING LOCATIONS WHERE UNDERDRAIN IS TIED INTO OTHER DRAINAGE STRUCTURES. ENDWALL TO BE INSTALLED PERPENDICULAR TO ROADWAY AND FLUSH WITH THE SLOPE.
2. OUTLET PIPES SHALL BE RIGID NONPERFORATED, SMOOTH-BORE PIPE, MEETING THE REQUIREMENTS OF 70 PSITESTED ACCORDING TO ASTM 2412.
3. EXPANDED STEEL MESH (FLATTENED) SHALL HAVE OPENINGS OF APPROX. 1/2" X 1" AND WEIGH APPROX. 0.82 LBS. PER SQ. FT. MESH SHALL BE GALVANIZED IN ACCORDANCE WITH ASTM A-123. THE MESH SHALL EXTEND A MINIMUM OF 1" 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.
4. THIS ITEM MAY BE PRECAST OR CAST IN PLACE.
5. STEEL POSTS AND PLATES TO BE PAINTED OR GALVANIZED IN ACCORDANCE WITH THE ROAD AND BRIDGE SPECIFICATIONS. IF PAINTED THE FINAL COAT SHALL BE NO. 13 ALUMINUM PAINT OR NO. 11 WHITE PAINT.
6. MARKER TO BE PLACED AT OUTLET END OF ALL UNDERDRAIN INSTALLATIONS BARRING LOCATIONS WHERE UNDERDRAIN IS TIED INTO OTHER DRAINAGE STRUCTURES.
7. MARKER WILL BE PAID FOR IN ACCORDANCE WITH SECTION 501 OF THE ROAD AND BRIDGE SPECIFICATIONS.

PIPE I.D.	SLOPE	DIMENSIONS		CLASS A3 CONCRETE CUBIC YARDS
		L	H	
4"	2:1	2'-5 1/2"	1'-2 3/4"	0.17
4"	4:1	4'-5"	1'-1 1/4"	0.28
6"	2:1	2'-10 1/2"	1'-5 1/4"	0.21
6"	4:1	5'-3"	1'-3 3/4"	0.35

STANDARD ENDWALL FOR PIPE UNDERDRAIN

VIRGINIA DEPARTMENT OF TRANSPORTATION