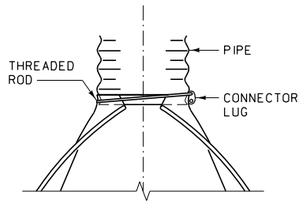
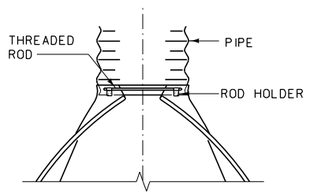
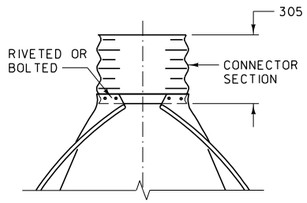
CONNECTIONS



TYPE 1



TYPE 2



TYPE 3

NOTES:

PROVIDE TOE PLATE WHEN SPECIFIED.

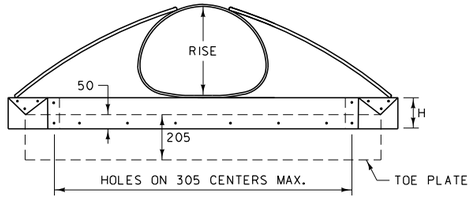
GALVANIZE ALL PARTS IN ACCORDANCE WITH AASHTO M 36M.

PAINT ANY AREAS WHERE GALVANIZING IS BROKEN OR METAL IS BARE WITH ONE COAT OF ZINC CHROMATE PRIME AND TWO COATS OF ALUMINUM PAINT.

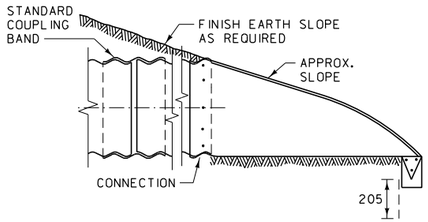
MINOR VARIATIONS IN DESIGN MAY BE ACCEPTABLE ON APPROVAL OF THE ENGINEER.

SEAMS OR JOINTS LENGTHWISE OF THE APRON ARE ACCEPTABLE IF SECURELY BOLTED OR WELDED AND PAINTED AS PROVIDED ABOVE.

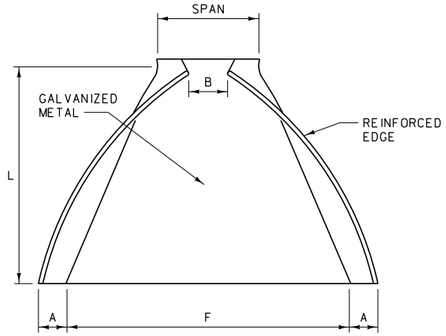
ARCH PIPE



ELEVATION



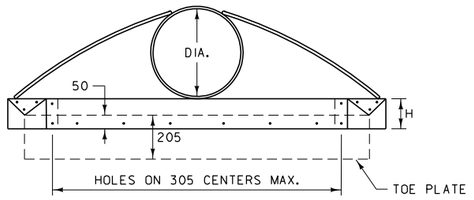
TYPICAL CROSS-SECTION
(ILLUSTRATED WITH TYPE 3 CONNECTION)



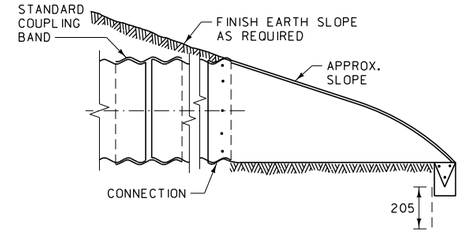
PLAN

SPAN x RISE	MINIMUM THICKNESS *	DIMENSIONS					APPROX. SLOPE	TYPE CONNECTOR
		A 25 TOL.	B MAX.	H 25 TOL.	L 40 TOL.	F 50 TOL.		
68 x 13 CORRUGATIONS								
430 x 330	1.63	130	230	150	510	710	2.13:1	2
530 x 380	1.63	150	280	150	610	860	2:1	2
610 x 460	1.63	180	300	150	710	1020	2.13:1	2
710 x 510	1.63	180	410	150	810	1170	2:1	2
885 x 610	2.01	230	410	150	990	1470	1.88:1	2
1060 x 740	2.01	280	460	180	1170	1850	1.88:1	3
1240 x 840	2.77	300	530	230	1350	2080	1.75:1	3
1440 x 970	2.77	410	660	300	1570	2240	1.88:1	3
1620 x 1100	2.77	430	760	300	1750	2540	1.88:1	3
1800 x 1200	2.77	430	910	300	1960	2840	1.88:1	3
1950 x 1320	2.77	430	910	300	1960	3150	1.63:1	3
2100 x 1450	2.77	430	1120	300	1960	3300	1.5:1	3
75 x 25 CORRUGATIONS								
1340 x 1050	2.77	430	660	300	1600	2240	1.75:1	3
1520 x 1170	2.77	430	910	300	1780	2540	1.88:1	3
1670 x 1300	2.77	430	910	300	1960	2840	1.75:1	3
1850 x 1400	2.77	430	910	300	1960	3150	1.5:1	3
2050 x 1500	2.77	430	1120	300	1960	3450	1.63:1	3

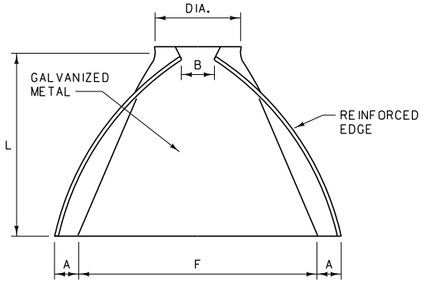
ROUND PIPE



ELEVATION



TYPICAL CROSS-SECTION
(ILLUSTRATED WITH TYPE 3 CONNECTION)



PLAN

PIPE DIA.	MINIMUM THICKNESS *	DIMENSIONS					APPROX. SLOPE	TYPE CONNECTOR
		A 25 TOL.	B MAX.	H 25 TOL.	L 40 TOL.	F 50 TOL.		
300	1.63	125	180	150	535	560	2.25:1	1
375	1.63	150	205	150	660	710	2.25:1	1
450	1.63	180	255	150	785	865	2.13:1	1
525	1.63	205	305	150	915	1015	2.13:1	1
600	1.63	230	330	150	1040	1170	2.13:1	1
750	2.01	280	405	205	1295	1395	2.13:1	2
900	2.01	330	485	230	1525	1780	2:1	2
1050	2.77	380	635	255	1755	2085	2.13:1	3
1200	2.77	430	735	305	1980	2235	2:1	3
1350	2.77	430	840	305	2135	2540	2:1	3
1500	2.77	430	915	305	2210	2845	1.88:1	3
1650	2.77	430	990	305	2210	2995	1.63:1	3
1800	2.77	430	1120	305	2210	3050	1.5:1	3
1950	2.77	430	1220	305	2210	3300	1.38:1	3
2100	2.77	430	1320	305	2210	3455	1.33:1	3

* THICKNESSES SHOWN ARE FOR STEEL CULVERTS. FOR THICKNESS OF ALUMINUM, SUBTRACT 0.10 mm.

ALL DIMENSIONS ARE MILLIMETERS (mm) UNLESS OTHERWISE NOTED.

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 603, 709

DWG. NO. 603-02

CMP FLARED END TERMINAL SECTION (FETS)

EFFECTIVE: FEBRUARY 2005

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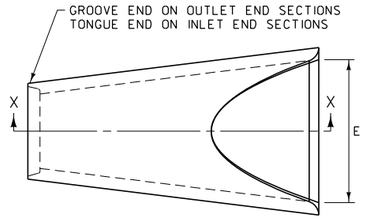
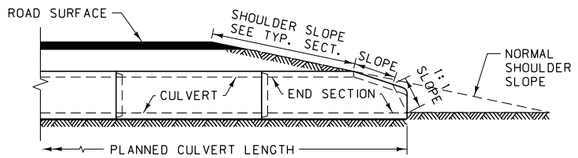
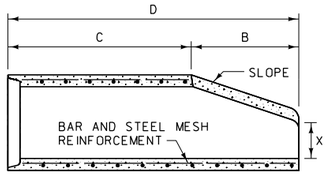
TYPE "A"



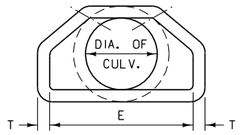
PLAN



SLOPE DETAIL



SECTION X-X

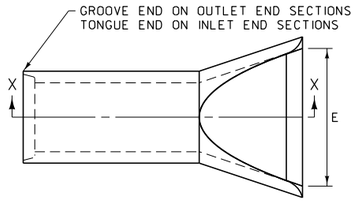


END VIEW

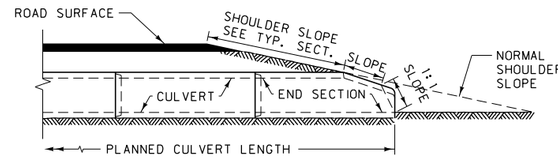
TYPE "A"							
DIA.	SLOPE	X	B	C	D	E	T *
300	2.4:1	101.6	609.6	1219.2	1828.8	609.6	50.8
375	2.4:1	152.4	685.8	1143.0	1828.8	762.0	57.2
450	2.3:1	228.6	685.8	1143.0	1828.8	914.4	63.5
600	2.5:1	241.3	1104.9	723.9	1828.8	1219.2	76.2
750	2.5:1	304.8	1371.6	457.2	1828.8	1524.0	88.9
900	2.5:1	381.0	1600.2	889.0	2489.2	1828.8	101.6
1050	2.5:1	533.4	1600.2	889.0	2489.2	1981.2	114.3
1200	2.5:1	609.6	1828.8	660.4	2489.2	2133.6	127.0
1350	2.0:1	685.8	1651.0	850.9	2501.9	2286.0	139.7

* WALL "B" THICKNESS

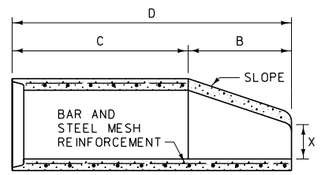
TYPE "B"



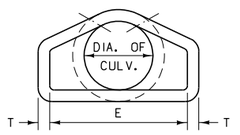
PLAN



SLOPE DETAIL



SECTION X-X



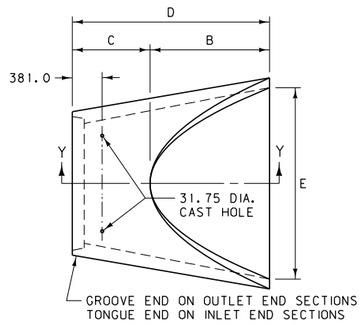
END VIEW

TYPE "B"							
DIA.	SLOPE	X	B	C	D	E	T *
300	2.4:1	101.6	609.6	1219.2	1828.8	609.6	50.8
375	2.4:1	152.4	685.8	1143.0	1828.8	762.0	57.2
450	2.3:1	228.6	685.8	1143.0	1828.8	914.4	63.5
600	2.5:1	241.3	1104.9	723.9	1828.8	1219.2	76.2
750	2.5:1	304.8	1371.6	457.2	1828.8	1524.0	88.9
900	2.5:1	381.0	1600.2	889.0	2489.2	1828.8	101.6
1050	2.5:1	533.4	1600.2	889.0	2489.2	1981.2	114.3
1200	2.5:1	609.6	1828.8	660.4	2489.2	2133.6	127.0
1350	2.0:1	685.8	1651.0	850.9	2501.9	2286.0	139.7

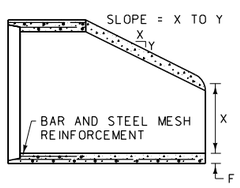
* WALL "B" THICKNESS

TOLERANCES IN THE ADJACENT TABLES MAY NOT VARY MORE THAN ±1.5% FOR THE DIMENSIONS SHOWN. OTHERWISE THEY MUST CONFORM TO AASHTO M 170M.

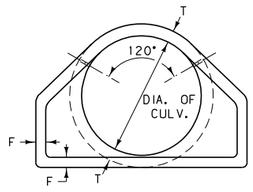
LARGE DIAMETER PIPE



PLAN



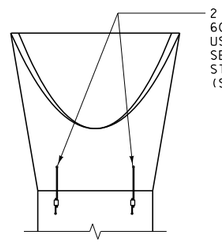
SECTION Y-Y



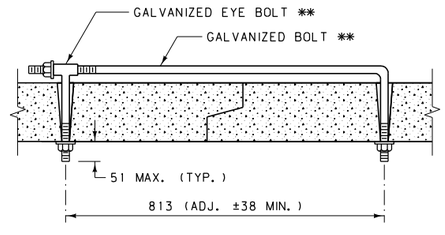
END VIEW

LARGE DIAMETER CULVERT								
DIA.	SLOPE	T *	X	B	C	D	E	F
1500	1.9:1	152.4	889.0	1524.0	990.6	2514.6	2438.4	127.0
1650	1.7:1	165.1	762.0	1828.8	685.8	2514.6	2590.8	139.7
1800	1.9:1	177.8	914.4	1981.2	533.4	2514.6	2743.2	152.4
1950	1.8:1	190.5	914.4	2286.0	533.4	2819.4	2895.6	165.1
2100	1.5:1	203.2	914.4	2298.7	533.4	2832.1	3048.0	165.1
2250	1.5:1	215.9	1041.4	2222.5	609.6	2832.1	3352.8	165.1

* WALL "B" THICKNESS



TIE BOLT CONNECTION



** M20 FOR 300 TO 1350 DIA. RCP
M24 FOR 1500 TO 2100 DIA. RCP

TIE BOLT DETAIL
(TWO PER END SECTION)

ALL DIMENSIONS ARE MILLIMETERS (mm) UNLESS OTHERWISE NOTED.

TIE BOLTS: USE TWO TIE BOLTS ON ALL FLARED END SECTIONS, ONE ON EACH SIDE AT 60° TO THE VERTICAL. GALVANIZE ALL PARTS. SEE TIE BOLT DETAIL.

CONSTRUCTION: CONSTRUCT ACCORDING TO CLASS III, AASHTO M 170M, AS FAR AS DESIGN WILL PERMIT.

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 603, 708

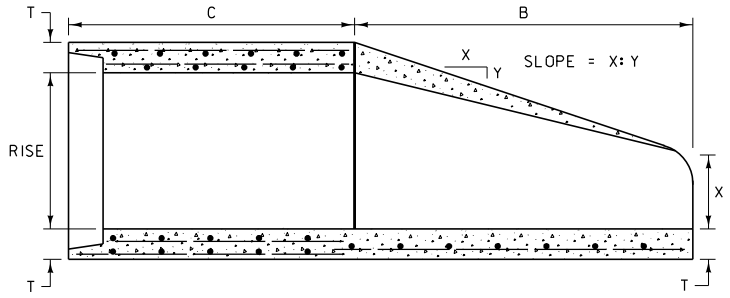
DWG. NO. 603-08

PREFABRICATED RCP FLARED END TERMINAL SECTION (FETS)

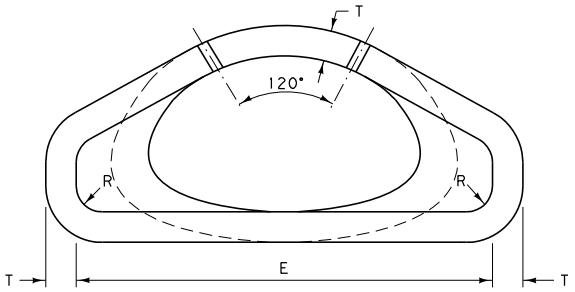
--REVISED--
January 2008

EFFECTIVE: FEBRUARY 2005

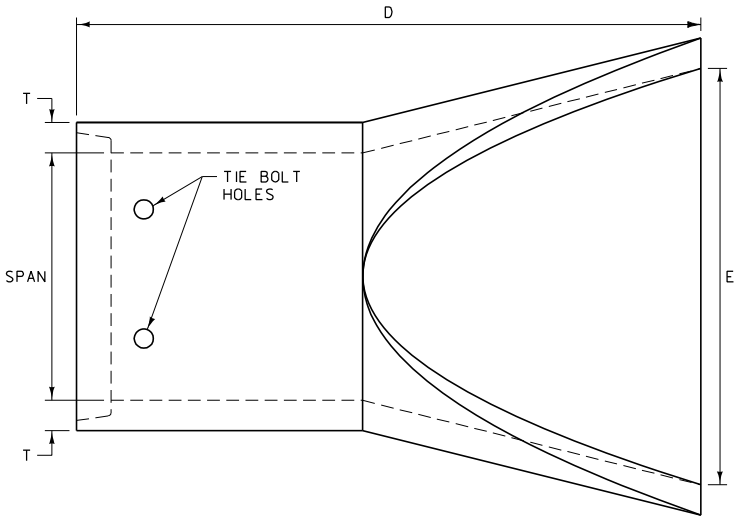
MONTANA DEPARTMENT OF TRANSPORTATION
serving you with pride



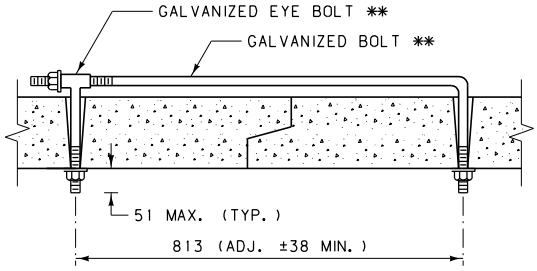
LONGITUDINAL SECTION



END VIEW



PLAN VIEW



** M20 FOR 560 x 345 TO
1650 x 1015 RCPA

M24 FOR 1855 x 1145 TO
2235 x 1370 RCPA

TIE BOLT DETAIL
(TWO PER END SECTION)

TIE BOLTS: USE TIE BOLTS ON ALL FLARED END SECTIONS, ONE ON EACH SIDE AT 60° TO THE VERTICAL. GALVANIZE ALL PARTS. SEE TIE BOLT DETAIL.

CONSTRUCTION: CONSTRUCT ACCORDING TO CLASS A-III, AASHTO M 206M, AS FAR AS DESIGN WILL PERMIT.

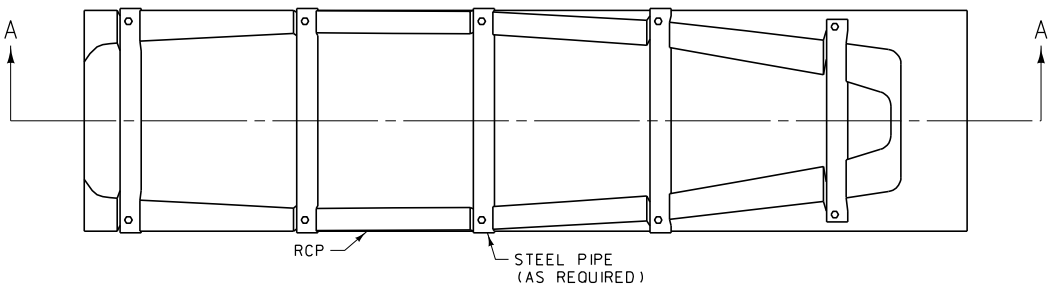
EQUIV. SIZE	SPAN	RISE	T *	X	B	C	D	E	R	SLOPE
450	560	345	63.5	177.8	685.8	1143.0	1828.8	914.4	76.2	3:1
600	725	460	88.9	215.9	990.6	838.2	1828.8	1219.2	76.2	3:1
750	920	570	101.6	241.3	1270.0	1168.4	2438.4	1524.0	76.2	3:1
900	1110	675	114.3	282.6	1524.0	914.4	2438.4	1828.8	152.4	3:1
1050	1300	795	114.3	401.6	1524.0	914.4	2438.4	1981.2	152.4	3:1
1200	1485	915	127.0	533.4	1524.0	914.4	2438.4	2133.6	152.4	3:1
1350	1650	1015	139.7	647.7	1524.0	914.4	2438.4	2286.0	152.4	3:1
1500	1855	1145	152.4	787.4	1524.0	914.4	2438.4	2438.4	152.4	3:1
1800	2235	1370	177.8	787.4	1524.0	914.4	2438.4	3048.0	152.4	2:1
2100	2590	1575	203.2	546.1	2133.6	609.6	2743.2	3657.6	152.4	2:1

* WALL "B" THICKNESS

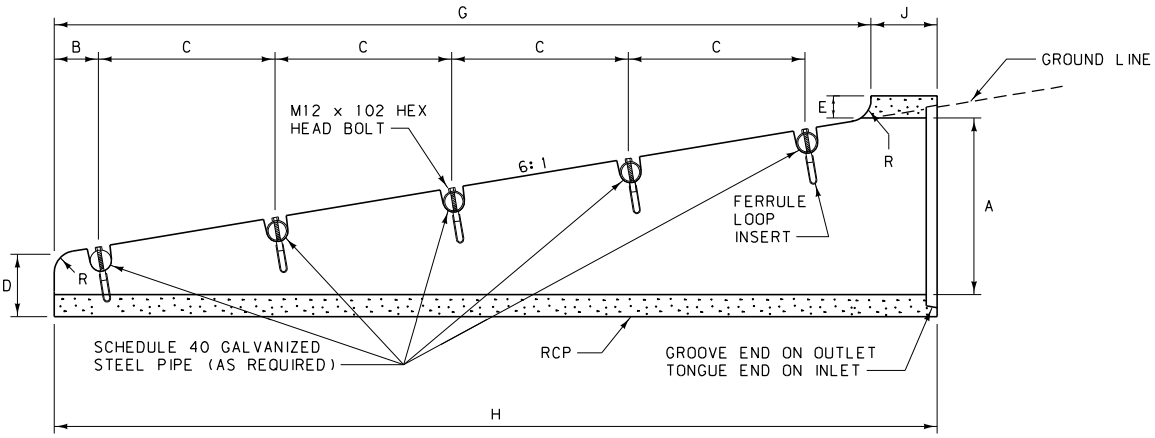
ALL DIMENSIONS ARE MILLIMETERS (mm) UNLESS OTHERWISE NOTED.

DETAILED DRAWING	
REFERENCE STANDARD SPEC. SECTION 603	DWG. NO. 603-10
PREFABRICATED RCP ARCH FLARED END TERMINAL SECTION (FETS)	
EFFECTIVE: FEBRUARY 2005	
MDT serving you with pride — MONTANA DEPARTMENT OF TRANSPORTATION	

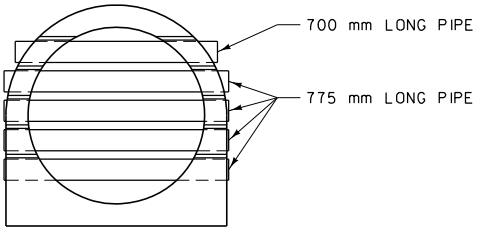
ROAD APPROACH CULVERT END TREATMENT										
QUANTITIES (FOR ESTIMATING ONLY)										
DIA. A RCP	H PIPE LENGTH	M12 x 105 FERRULE LOOP INSERT, EACH	LENGTH 63 DIA. SCHEDULE 40 GALV. PIPE	DIMENSIONS						
				B	C	D	E	G	R	J
375	1448	~	~	~	~	210	82	1219	76	229
450	1981	~	~	~	~	216	76	1752	76	229
600	3048	10	3800	152	610	229	64	2819	76	229



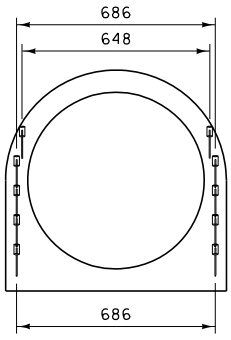
PLAN VIEW



SECTION A-A



END VIEW



VIEW OF INSERTS

NOTE:
PAINT ALL NON-GALVANIZED PARTS
IN ACCORDANCE WITH SECTION 710
OF THE STANDARD SPECIFICATIONS.

ALL DIMENSIONS ARE MILLIMETERS (mm) UNLESS OTHERWISE NOTED.

DETAILED DRAWING

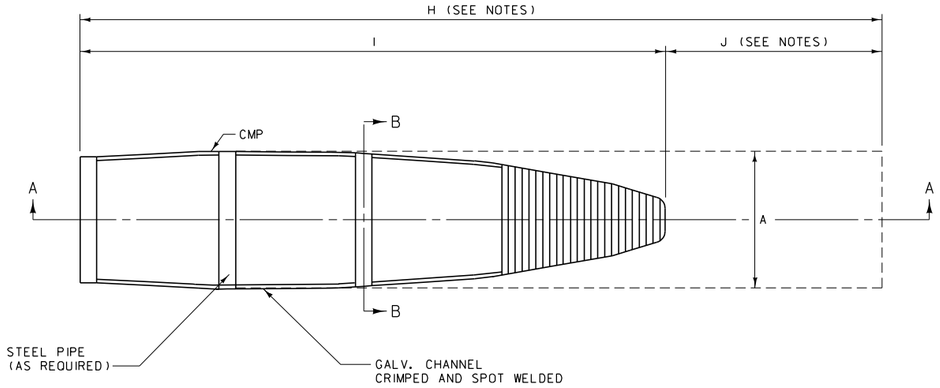
REFERENCE STANDARD SPEC. SECTION 603, 710

DWG. NO. 603-12

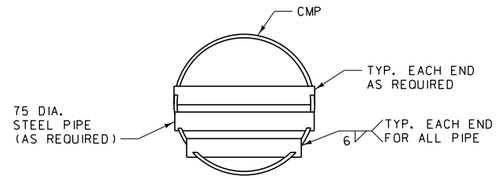
RCP ROAD APPROACH CULVERT END TREATMENT (RACET)

EFFECTIVE: FEBRUARY 2005

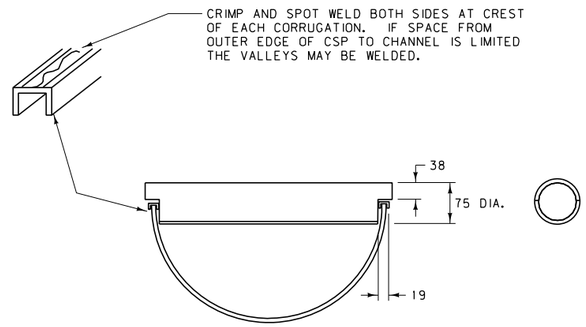
MDT serving you with pride — MONTANA DEPARTMENT OF TRANSPORTATION



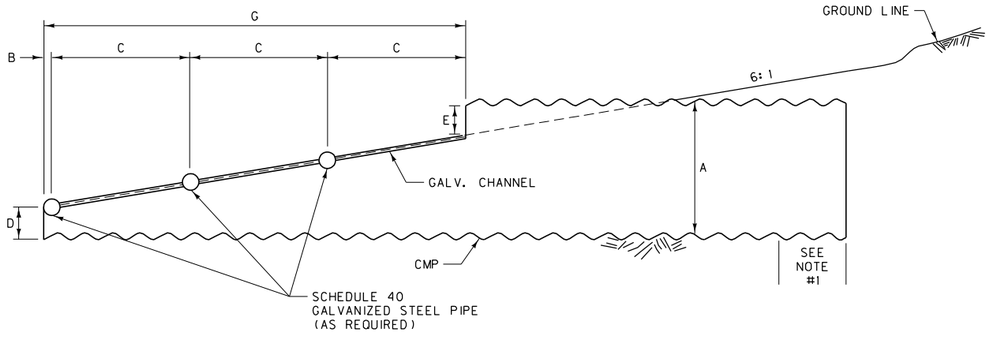
PLAN VIEW



END VIEW



SECTION B-B



SECTION A-A

ILLUSTRATED WITH 600 mm
CMP (750 mm CMP UTILIZES
FOUR GALV. STEEL PIPES)

ROAD APPROACH CULVERT END TREATMENT

QUANTITIES (FOR ESTIMATING ONLY)

DIA. A CMP	H PIPE LENGTH	19 x 10 x 3.2 GALV. CHANNEL	LENGTH 75 DIA. SCHEDULE 40 GALV. PIPE	DIMENSIONS						
				B	C	D	E	G	I	J
375	2134	3048	~	~	~	61	61	1524	1829	305
450	2438	3048	~	~	~	101	101	1524	2133	305
600	3048	3656	1800	46	594	152	152	1828	2743	305
750	3810	4874	3000	61	594	183	183	2437	3505	305

NOTES:

1) PIPE TO HAVE ANNULAR CORRUGATION OR REROLLED ENDS. USE ONLY APPROVED COUPLING BAND PER STANDARD SPECIFICATION 709.02 CMP. FOR RCP END TREATMENT, SEE DTL. DWG. NO. 603-26 FOR CONNECTION.

2) THE TWO 19 mm CHANNELS MAY BE ELIMINATED FROM THE CULVERT END TREATMENT IF:

   A. THE CULVERT IS FABRICATED WITH 12 GAGE (2.8 mm THICK) MATERIAL.

   B. HALF CIRCLE NOTCHES ARE CUT IN THE CULVERT FOR THE STEEL PIPE WITH CONTINUOUS WELD OF THE PERIPHERY IN CONTACT PROVIDED.

   C. ALL WELDS AND OTHER NON-GALVANIZED PARTS ARE PAINTED IN ACCORDANCE WITH STANDARD SPECIFICATIONS SECTION 710.

3) CONNECTIONS MADE PER DTL. DWG. NO. 603-26 REQUIRE PIPE LENGTHS H AND J TO BE INCREASED BY 76 mm.

ALL DIMENSIONS ARE MILLIMETERS (mm) UNLESS OTHERWISE NOTED.

DETAILED DRAWING

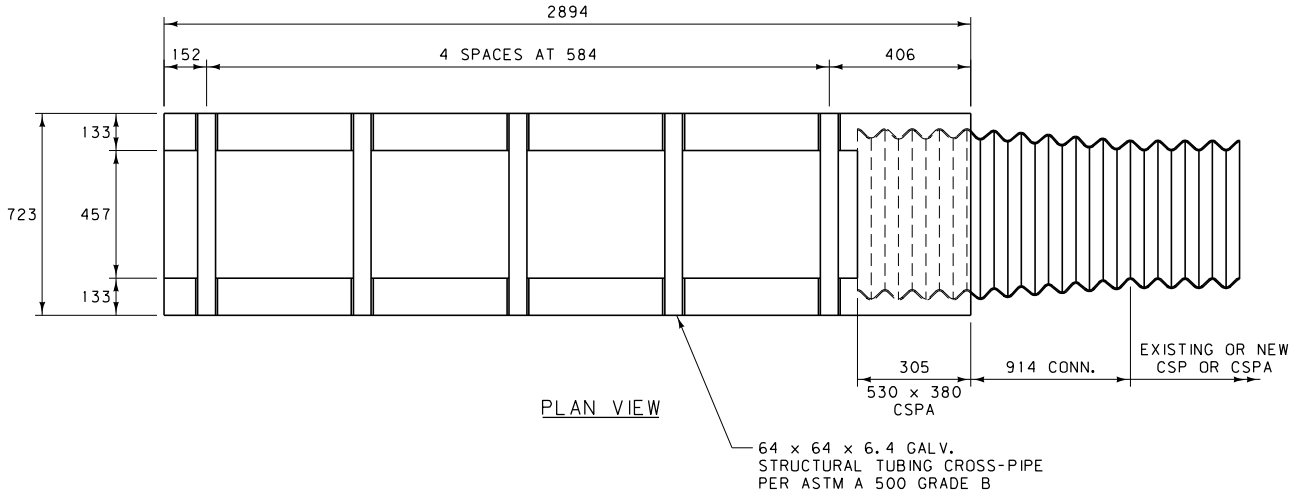
REFERENCE STANDARD SPEC. SECTION 603, 709, 710

DWG. NO. 603-14

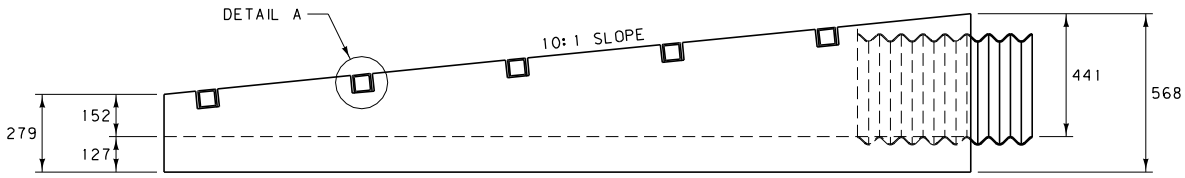
CMP ROAD APPROACH CULVERT END TREATMENT (RACET)

EFFECTIVE: FEBRUARY 2005

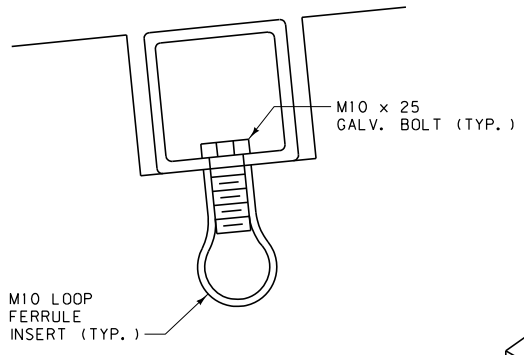
MDT serving you with pride — MONTANA DEPARTMENT OF TRANSPORTATION



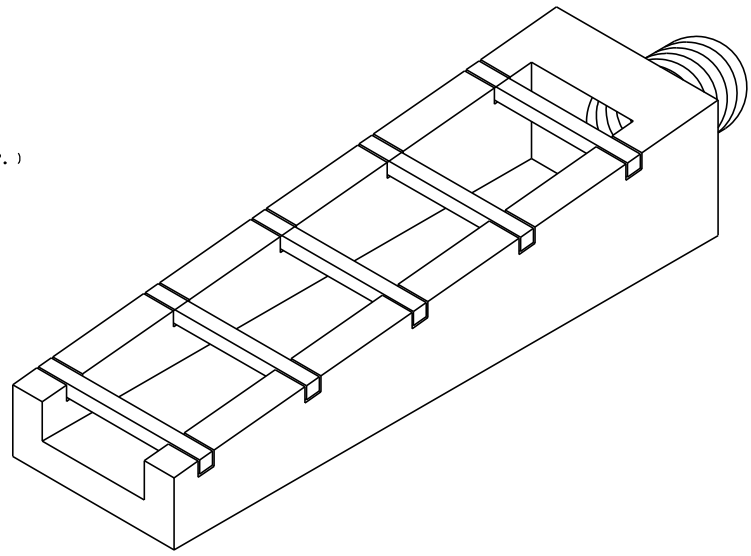
PLAN VIEW



ELEVATION



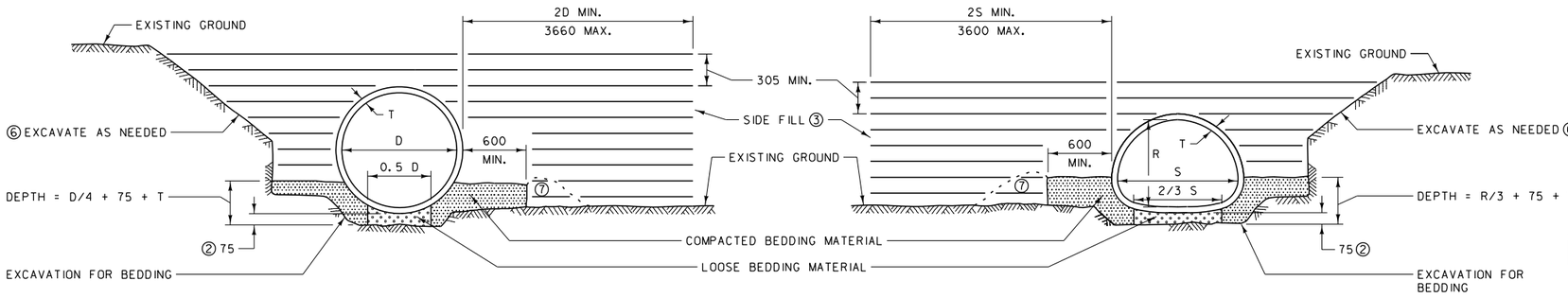
DETAIL A



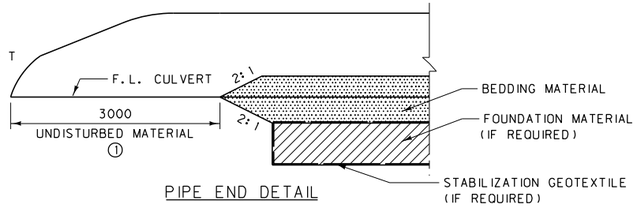
ALL DIMENSIONS ARE MILLIMETERS (mm) UNLESS OTHERWISE NOTED.

NOTE:
PAINT ALL EXPOSED METAL PARTS WITH ONE COAT OF ZINC RICH PAINT AND TWO COATS OF ALUMINUM PAINT ACCORDING TO STANDARD SPECIFICATION SECTION 710.

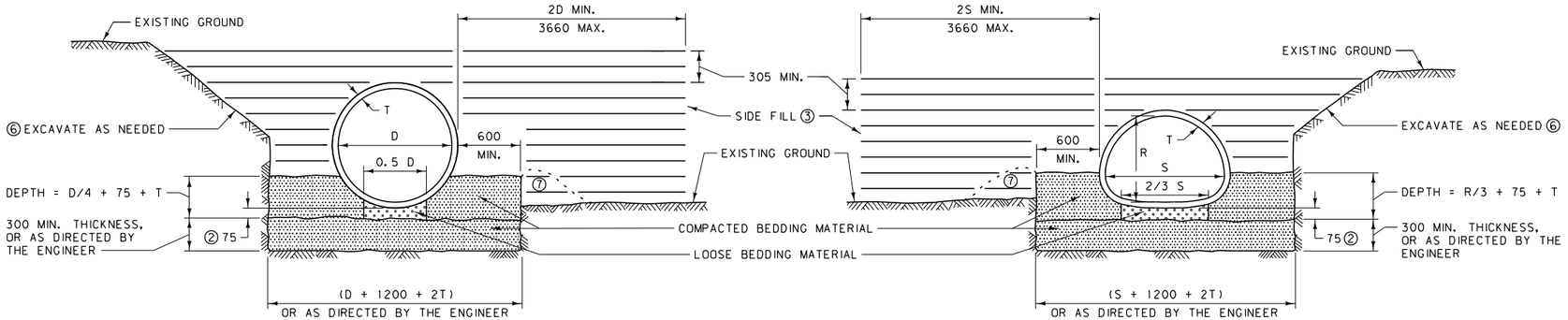
DETAILED DRAWING	
REFERENCE STANDARD SPEC. SECTION 603, 708, 710	DWG. NO. 603-17
PRECAST MEDIAN U-TURN CROSS DRAIN AND CONC. BEVELED END	
EFFECTIVE: FEBRUARY 2005	
MDT serving you with pride — MONTANA DEPARTMENT OF TRANSPORTATION	



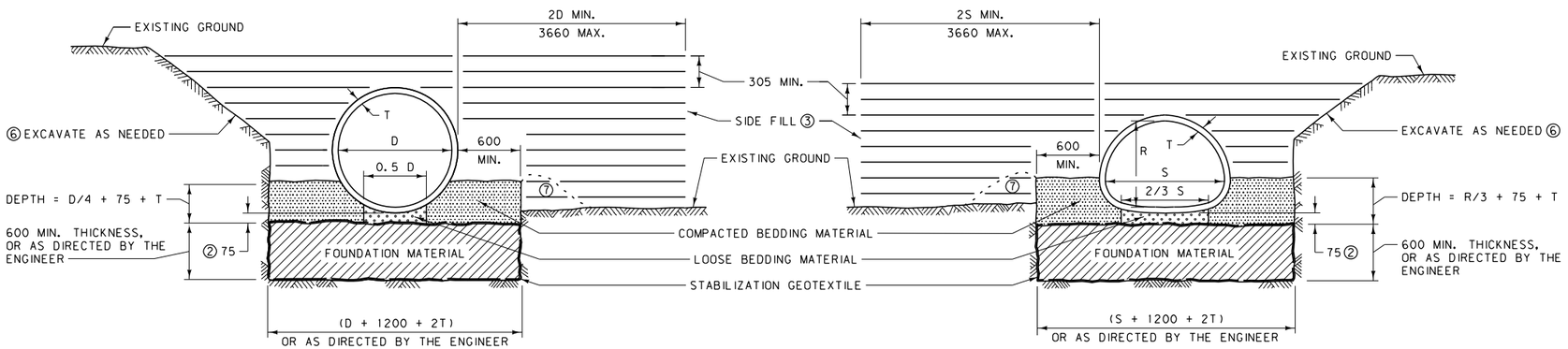
1-STANDARD BEDDING INSTALLATION



PIPE END DETAIL



2-ROCK



3-FOUNDATION STABILIZATION

NOTES:

① DO NOT EXTEND BEDDING MATERIAL TO THE END OF THE PIPE. LEAVE 3000 mm OF UNDISTURBED MATERIAL AT EACH END UNLESS OTHERWISE NOTED IN PLANS. SEE PIPE END DETAIL.

② PLACE LOOSE BEDDING MATERIAL UNIFORMLY IN THE BOTTOM OF THE TRENCH AND SHAPE TO FIT BOTTOM OF PIPE. THE MINIMUM THICKNESS BEFORE PLACING PIPE IS 75 mm. 1050 mm AND 1200 mm RCP IRR. REQUIRE 100 mm DEPTH OF LOOSE BEDDING MATERIAL TO ACCOMODATE BELL THICKNESS. AFTER LAYING CULVERT, COMPACT BEDDING MATERIAL AT HAUNCHES AND SIDES OF PIPE.

③ COMPACT SIDE FILL IN 155 mm LOOSE LAYERS TO DENSITY SPECIFIED FOR ADJACENT EMBANKMENT. SEE SECTION 203.03.3 OF THE STANDARD SPECIFICATIONS FOR THE DENSITY REQUIREMENTS.

④ SEE SECTION 701.04 OF THE STANDARD SPECIFICATIONS FOR BEDDING AND FOUNDATION MATERIAL REQUIREMENTS.

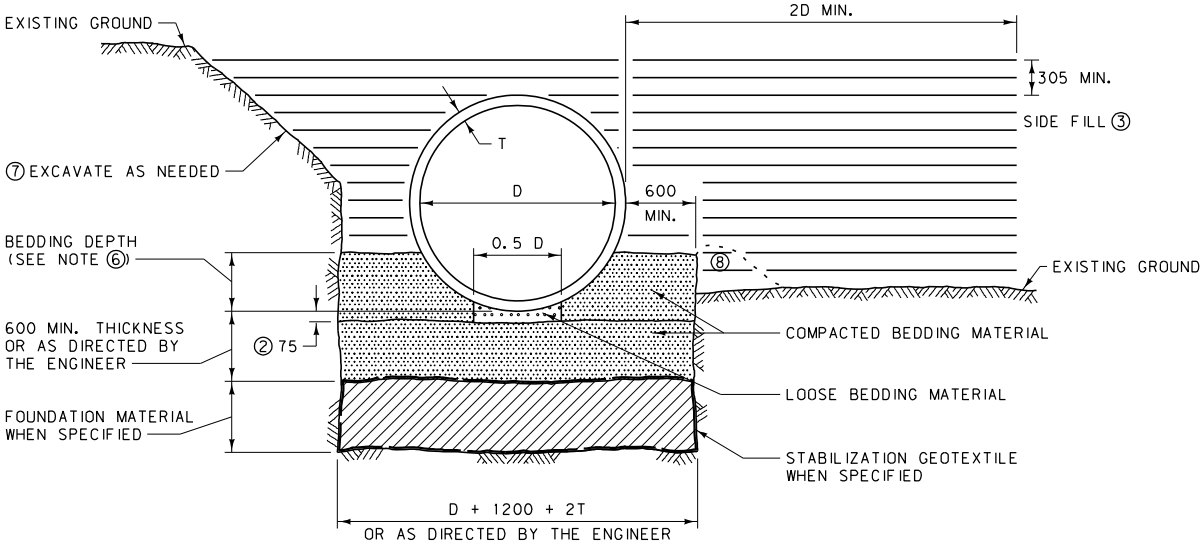
⑤ DIMENSIONS D, S AND R ARE INSIDE PIPE DIAMETER, SPAN AND RISE. DIMENSION T IS THE CULVERT SHELL THICKNESS FOR CONCRETE OR CORRUGATION WIDTH FOR METAL. CORRUGATION WIDTHS ARE TYPICALLY 13 mm FOR 1200 mm EQUIVALENT SIZE METAL CULVERTS AND SMALLER.

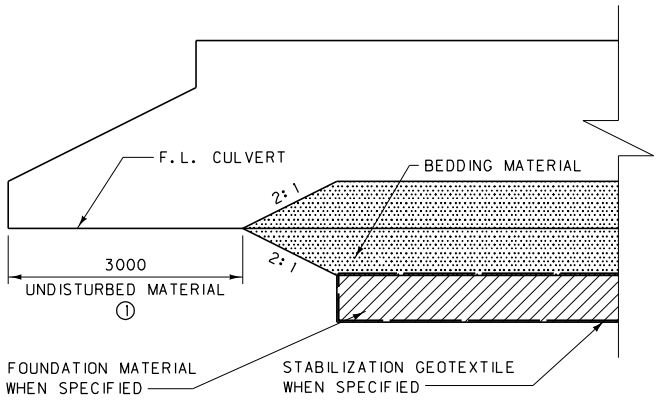
⑥ EXCAVATE A SUFFICIENT AMOUNT TO PROVIDE A SAFE WORKING ENVIRONMENT AND TO ALLOW ACHIEVEMENT OF ALL CULVERT INSTALLATION AND COMPACTION REQUIREMENTS. SLOPE, BENCH OR PROVIDE SHORING FOR ALL EXCAVATIONS IN ACCORDANCE WITH THE U.S. DEPARTMENT OF LABOR, OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) SAFETY AND HEALTH REGULATIONS FOR CONSTRUCTION.

⑦ BUILD BERM WITH FILL MATERIAL AS NEEDED TO CONTAIN THE BEDDING MATERIAL TO THE PROPER DEPTH.

ALL DIMENSIONS ARE MILLIMETERS (mm) UNLESS OTHERWISE NOTED.

DETAILED DRAWING	
REFERENCE STANDARD SPEC. SECTION 207, 603, 701	DWG. NO. 603-18
BEDDING FOR MAINLINE & PUBLIC APPROACH CULVERTS 1200 mm EQUIV. & SMALLER	
--REVISED-- January 2008	EFFECTIVE: APRIL 2006
	MDT serving you with pride — MONTANA DEPARTMENT OF TRANSPORTATION





PIPE END DETAIL

NOTES:

① DO NOT EXTEND BEDDING MATERIAL TO THE END OF THE PIPE. LEAVE 3000 mm OF UNDISTURBED MATERIAL AT EACH END UNLESS OTHERWISE NOTED IN PLANS. SEE PIPE END DETAIL.

② PLACE LOOSE BEDDING MATERIAL UNIFORMLY IN THE BOTTOM OF THE TRENCH AND SHAPE TO FIT BOTTOM OF PIPE. THE MINIMUM THICKNESS BEFORE PLACING PIPE IS 75 mm. RCP IRR. REQUIRE GREATER THAN 75 mm OF LOOSE BEDDING MATERIAL TO ACCOMODATE BELL THICKNESS. AFTER LAYING CULVERT, COMPACT BEDDING MATERIAL AT HAUNCHES AND SIDES OF PIPE.

③ COMPACT SIDE FILL IN 155 mm LOOSE LAYERS TO DENSITY SPECIFIED FOR ADJACENT EMBANKMENT. SEE SECTION 203.03.3 OF THE STANDARD SPECIFICATIONS FOR THE DENSITY REQUIREMENTS.

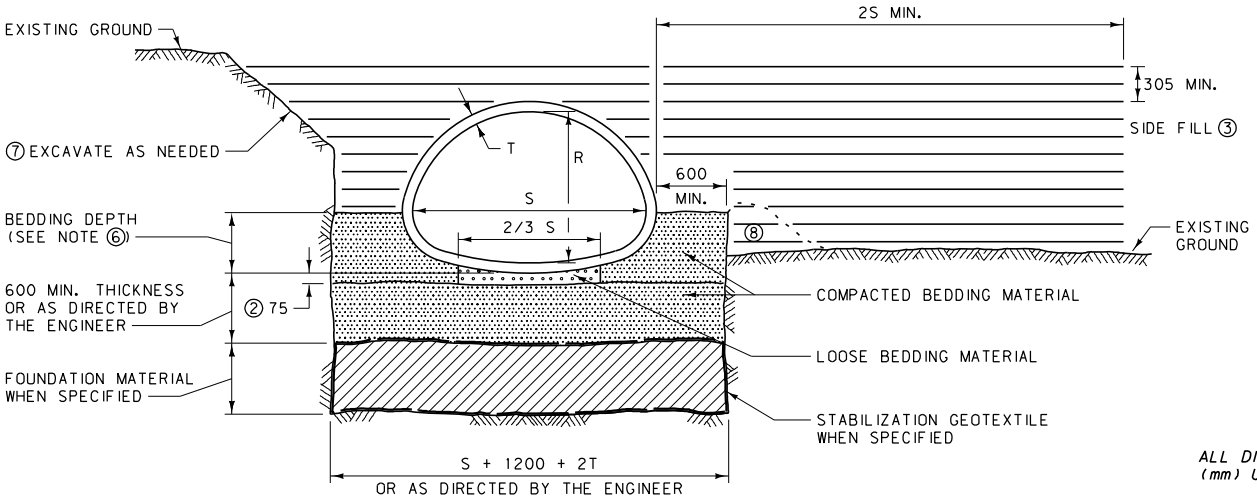
④ SEE SECTION 701.04 OF THE STANDARD SPECIFICATIONS FOR BEDDING AND FOUNDATION MATERIAL REQUIREMENTS.

⑤ DIMENSIONS D, S, AND R ARE THE INSIDE PIPE DIAMETER, SPAN, AND RISE. DIMENSION T IS THE CULVERT SHELL THICKNESS FOR CONCRETE OR CORRUGATION WIDTH FOR METAL.

⑥ THE BEDDING DEPTH FOR CONCRETE PIPE IS D/4 + T OR R/3 + T. THE BEDDING DEPTH FOR METAL PIPE IS "X" + T. SEE DTL. DWG. NO. 603-32 AND 603-34 FOR "X" DIMENSIONS OF METAL PIPES.

⑦ EXCAVATE A SUFFICIENT AMOUNT TO PROVIDE A SAFE WORKING ENVIRONMENT AND TO ALLOW ACHIEVEMENT OF ALL CULVERT INSTALLATION AND COMPACTION REQUIREMENTS. SLOPE, BENCH OR PROVIDE SHORING FOR ALL EXCAVATIONS IN ACCORDANCE WITH THE U.S. DEPARTMENT OF LABOR, OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) SAFETY AND HEALTH REGULATIONS FOR CONSTRUCTION.

⑧ BUILD BERM WITH FILL MATERIAL AS NEEDED TO CONTAIN THE BEDDING MATERIAL TO THE PROPER DEPTH.



ALL DIMENSIONS ARE MILLIMETERS (mm) UNLESS OTHERWISE NOTED.

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 207, 603, 701

DWG. NO. 603-19

BEDDING FOR CULVERTS 1350 mm EQUIVALENT & LARGER

--REVISED-- January 2008

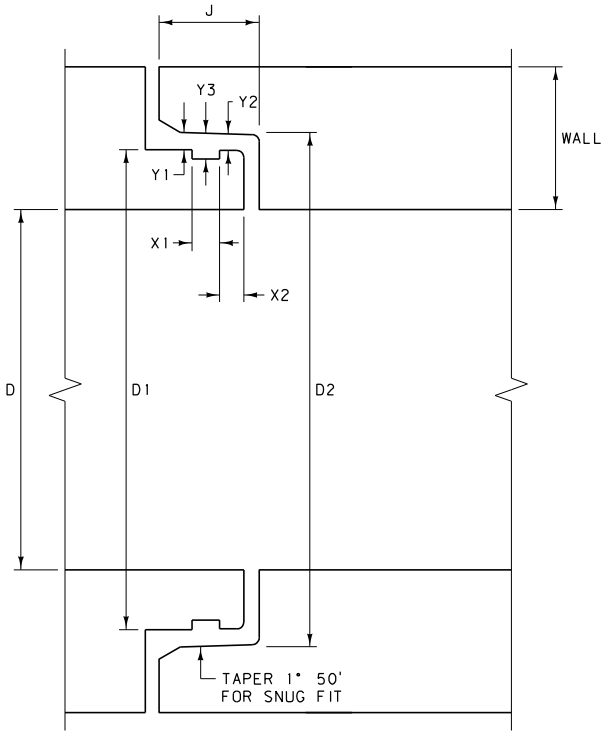
EFFECTIVE: APRIL 2006

MONTANA DEPARTMENT OF TRANSPORTATION

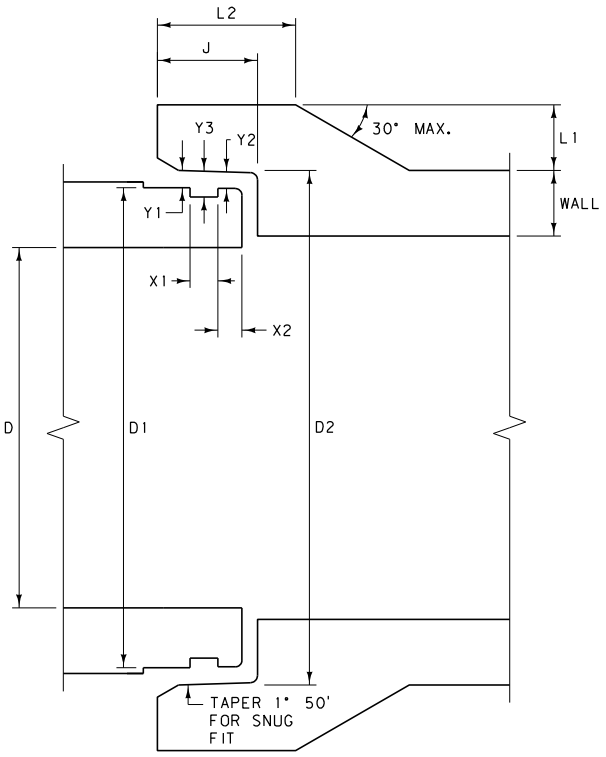
serving you with pride

DIA. D	APPROX. DIA. GASKET MATL. NOT STRETCHED	LENGTH OF JOINT J	D1	D2	L2 (MIN.)	L1 (WALL "B")	L1 (WALL "C")	X1	X2	Y1	Y2	Y3
300	16.67	92.08	386.66	389.41	127.00	50.80	~	25.40	22.23	1.57	2.29	7.95
375	16.67	92.08	475.56	478.31	120.65	55.56	~	25.40	22.23	1.57	2.29	7.95
450	16.67	92.08	561.29	564.03	127.00	60.33	~	25.40	22.23	1.57	2.29	7.95
525	16.67	98.43	650.24	653.39	133.35	65.09	~	25.40	22.23	1.57	2.29	7.95
600	16.67	98.43	735.97	739.11	139.70	69.85	50.80	25.40	22.23	1.57	2.29	7.95
675	16.67	101.60	824.89	828.24	139.70	69.85	50.80	25.40	22.23	1.57	2.29	7.95
750	16.67	101.60	913.79	917.14	139.70	69.85	50.80	25.40	22.23	1.57	2.29	7.95
825	16.67	104.78	1002.69	1006.25	146.05	73.03	53.98	25.40	22.23	1.57	2.29	7.95
900	16.67	104.78	1091.59	1095.15	152.40	79.38	60.33	25.40	22.23	1.57	2.29	7.95
1050	19.05	117.48	1274.65	1274.65	171.45	95.25	76.20	30.16	25.40	1.70	3.28	9.55
1200	19.05	120.65	1448.38	1452.70	184.15	104.78	85.73	30.16	25.40	1.70	3.28	9.55
1350	19.05	127.00	1600.38	1605.08	190.50	92.08	73.03	30.16	25.40	1.70	3.28	9.55
1500	19.05	127.00	1752.78	1757.48	190.50	79.38	60.33	30.16	25.40	1.70	3.28	9.55
1650	20.64	127.00	1905.18	1909.88	190.50	69.85	50.80	30.16	25.40	1.70	3.28	9.55
1800	20.64	133.35	2012.95	2016.76	~	~	~	30.16	31.75	2.36	4.83	9.55
1950	20.64	133.35	2190.75	2194.56	~	~	~	30.16	31.75	2.36	4.83	9.55
2100	20.64	133.35	2324.10	2327.91	~	~	~	30.16	31.75	2.36	4.83	9.55
2250	20.64	133.35	2482.85	2486.66	~	~	~	30.16	31.75	2.36	4.83	9.55
2400	20.64	133.35	2647.95	2651.76	~	~	~	30.16	31.75	2.36	4.83	9.55
2550	20.64	133.35	2813.05	2816.86	~	~	~	30.16	31.75	2.36	4.83	9.55
2700	20.64	133.35	2978.15	2981.96	~	~	~	30.16	31.75	2.36	4.83	9.55

1800 DIA. PIPES AND LARGER



1650 DIA. PIPES AND SMALLER



NOTES:

TYPICAL FOR STORM DRAIN AND IRRIGATION APPLICATIONS (FOR HEADS UP TO 6.1 m).

USE RUBBER GASKETS THAT MEET THE REQUIREMENTS OF STANDARD SPECIFICATION 707.02.1.

ALL DIMENSIONS ARE MILLIMETERS (mm) UNLESS OTHERWISE NOTED.

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 603, 707, 708

DWG. NO. 603-22

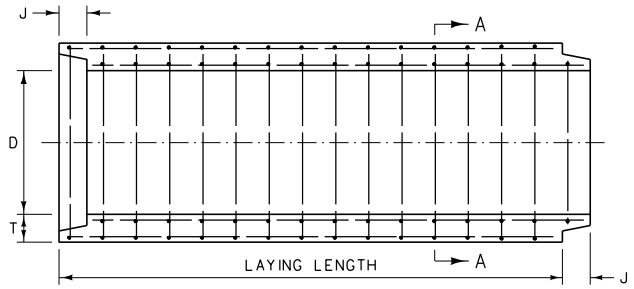
WATER TIGHT JOINT FOR REINFORCED CONCRETE PIPE

EFFECTIVE: FEBRUARY 2005

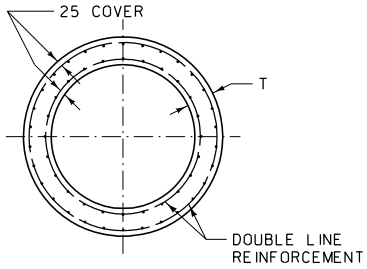
MDT serving you with pride — MONTANA DEPARTMENT OF TRANSPORTATION

DIA. D	XSEC. WATER AREA (m^2)	WT. PER m OF PIPE (kg)	T * MIN. WALL THICKNESS	J LENGTH OF JOINT	A (NOMINAL) = $\frac{D2 - D1}{2}$	D1	D2	D3	D4
300	0.073	136.9	50.8	44.45	4.76	336.55	346.08	352.43	361.95
375	0.114	189.0	57.2	50.80	4.76	419.10	428.63	438.15	447.68
450	0.164	250.0	63.5	57.15	4.76	498.48	508.00	517.53	527.05
525	0.223	318.5	69.9	63.50	4.76	581.03	590.55	603.25	612.78
600	0.292	394.4	76.2	69.85	4.76	660.40	669.93	685.80	695.33
675	0.369	479.2	82.6	76.20	4.76	742.95	752.48	768.35	777.88
750	0.456	571.5	88.9	82.55	4.76	822.33	831.85	850.90	860.43
825	0.552	672.6	95.3	88.90	6.35	901.70	914.40	933.45	946.15
900	0.657	779.8	101.6	95.25	6.35	984.25	996.95	1016.00	1028.70
1050	0.894	1019.4	114.3	101.60	6.35	1146.18	1152.53	1181.10	1193.80
1200	1.167	1290.2	127.0	107.95	6.35	1308.10	1320.80	1346.20	1358.90
1350	1.478	1592.3	139.7	114.30	6.35	1470.03	1482.73	1508.13	1520.83
1500	1.824	1928.7	152.4	127.00	6.35	1631.95	1644.65	1676.40	1689.10
1650	2.207	2294.7	165.1	139.70	6.35	1793.88	1806.58	1841.50	1854.20
1800	2.627	2693.6	177.8	152.40	6.35	1955.80	1968.50	2006.60	2019.30
1950	3.083	3122.2	190.5	165.10	6.35	2117.73	2130.43	2174.88	2192.87
2100	3.575	3586.5	203.2	177.80	6.35	2279.65	2292.35	2339.98	2352.68
2250	4.104	4077.6	215.9	177.80	6.35	2432.05	2444.75	2492.38	2505.08
2400	4.670	4390.1	228.6	177.80	6.35	2593.98	2606.68	2654.30	2667.00
2550	5.272	4576.1	241.3	190.50	6.35	2768.60	2781.30	2832.10	2844.80
2700	5.910	5759.2	254.0	190.50	6.35	2933.70	2946.40	2997.20	3009.90

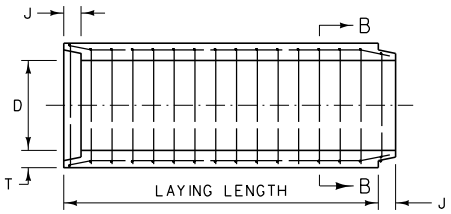
* WALL "B" THICKNESS



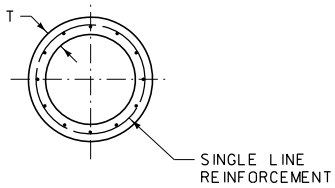
TYPICAL LONGITUDINAL SECTION
900 DIAMETER PIPES AND LARGER



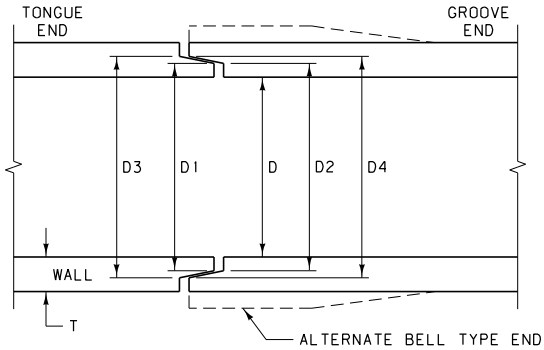
SECTION A-A



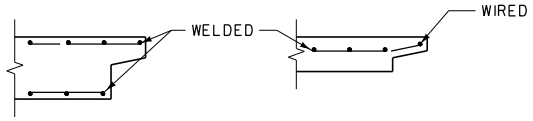
TYPICAL LONGITUDINAL SECTION
825 DIAMETER PIPES AND SMALLER



SECTION B-B



JOINT DETAIL



REINFORCING AT ENDS OF PIPE

NOTES:

TOLERANCES IN DIMENSIONS IN ACCORDANCE WITH AASHTO M 170M.

TYPICAL FOR DRAINAGE APPLICATIONS.

ALL DIMENSIONS ARE MILLIMETERS (mm) UNLESS OTHERWISE NOTED.

DETAILED DRAWING

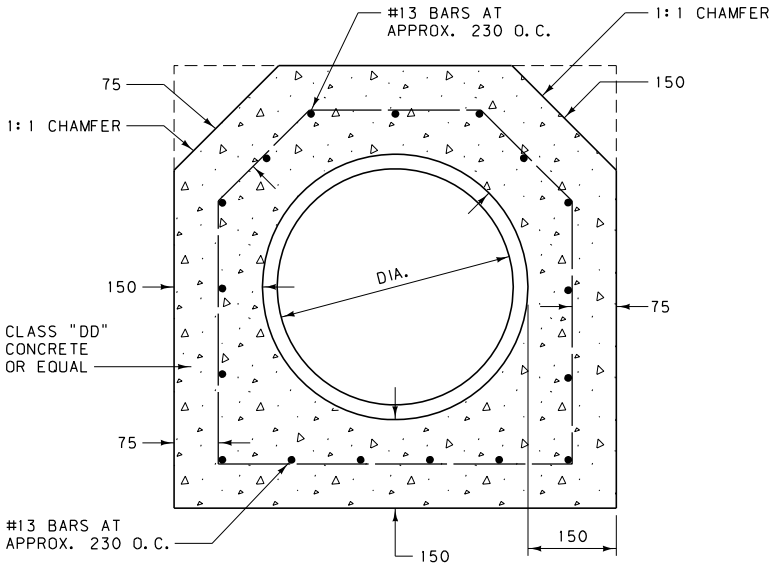
REFERENCE STANDARD SPEC. SECTION 603, 708

DWG. NO. 603-24

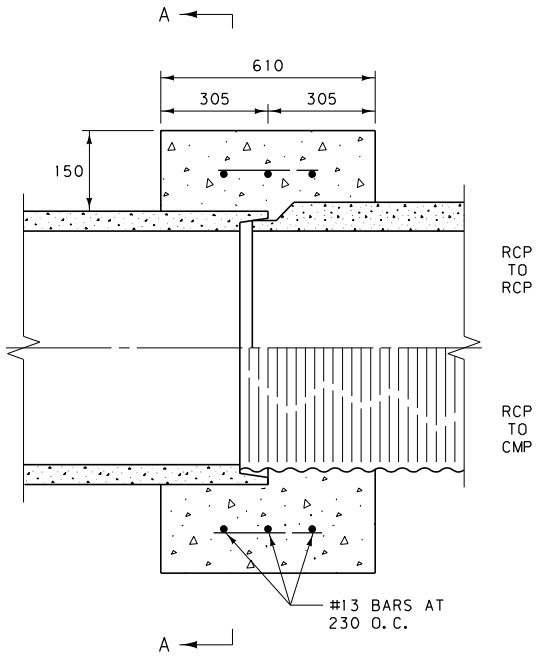
REINFORCED CONCRETE PIPE JOINT

EFFECTIVE: FEBRUARY 2005

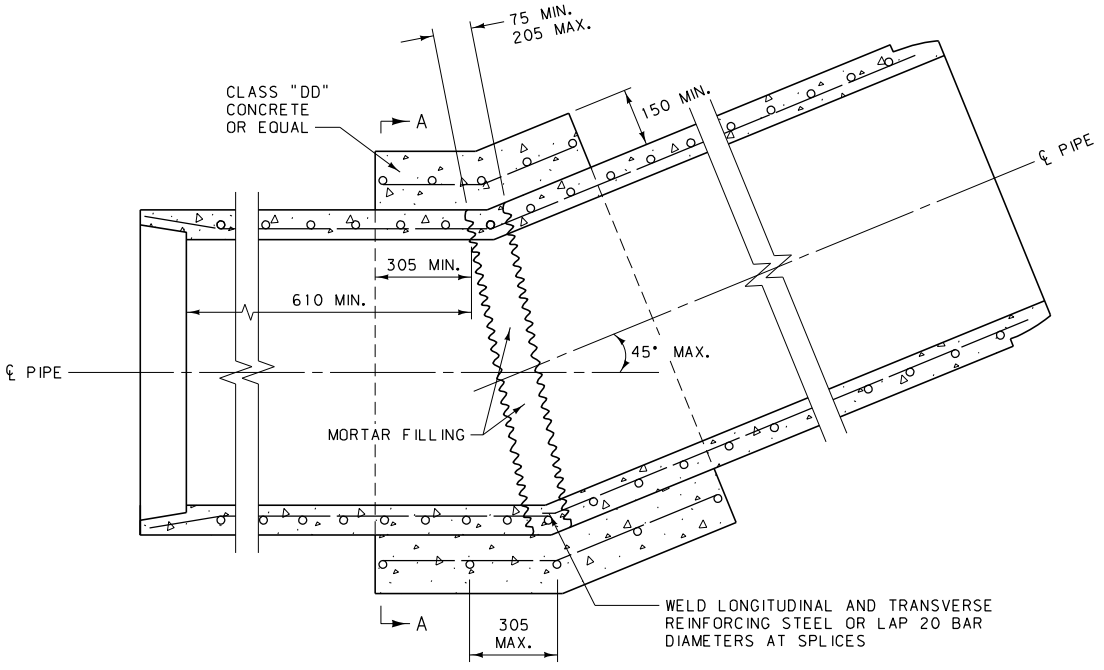
MDT serving you with pride — MONTANA DEPARTMENT OF TRANSPORTATION



SECTION A-A



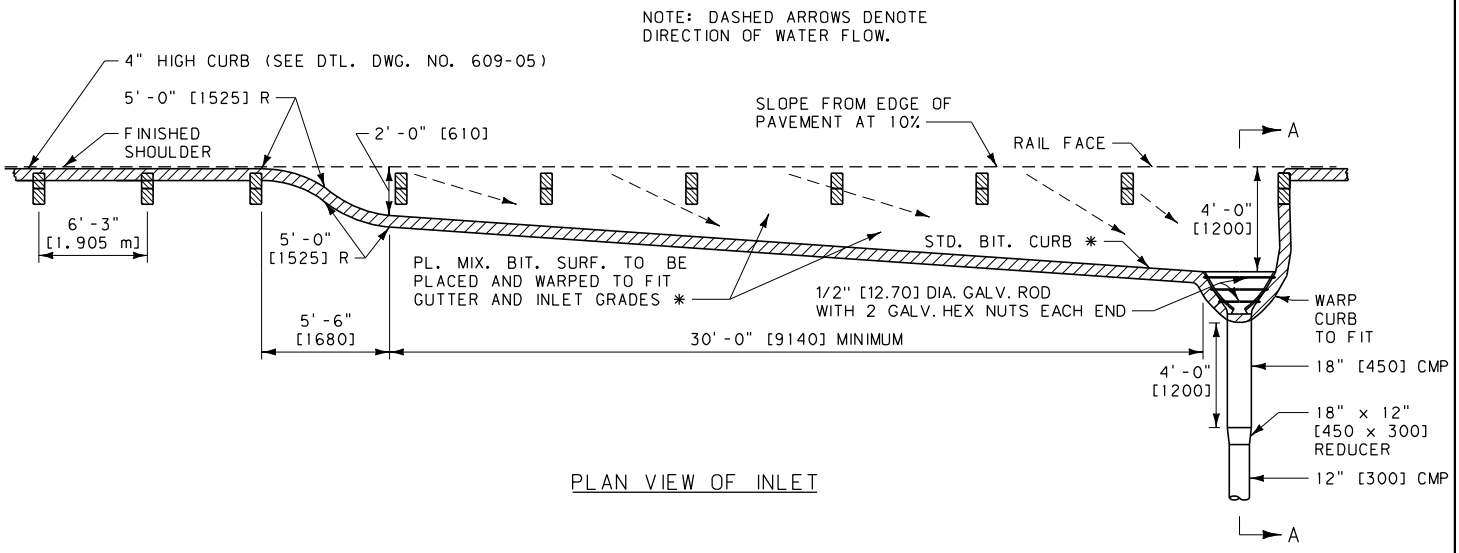
CONNECTION DETAILS



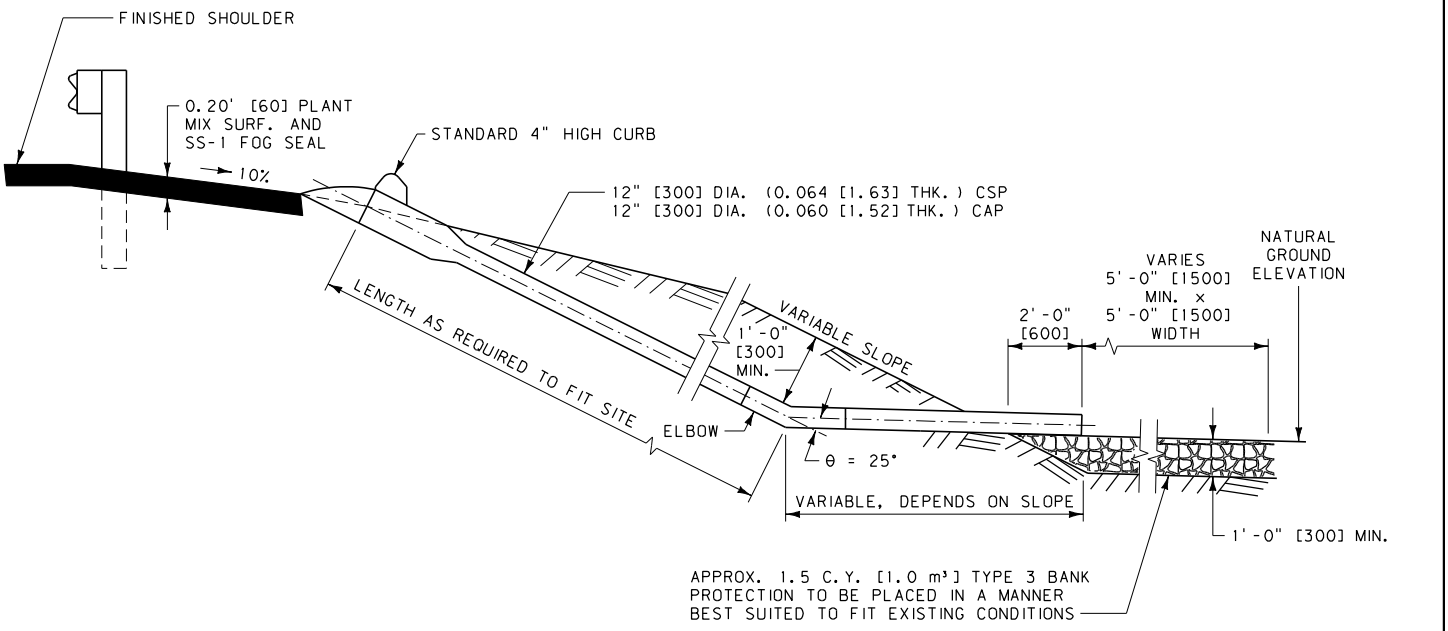
TYPICAL FIELD CAST CONCRETE BEND

DETAILED DRAWING	
REFERENCE STANDARD SPEC. SECTION 603, 708	DWG. NO. 603-26
TYPICAL FIELD CAST CONCRETE CONNECTIONS	
EFFECTIVE: FEBRUARY 2005	
MDT serving you with pride — MONTANA DEPARTMENT OF TRANSPORTATION	

ALL DIMENSIONS ARE MILLIMETERS (mm) UNLESS OTHERWISE NOTED.



PLAN VIEW OF INLET



OUTLET DETAIL

SECTION A-A

NOTES:

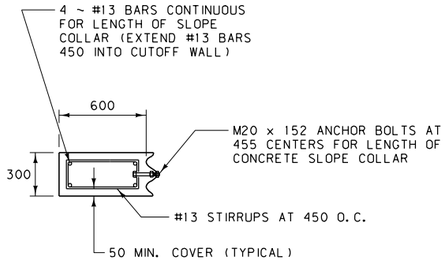
CORRUGATION MAY BE EITHER ANNULAR OR HELICAL.
BEND ON ELBOW (θ) IS AS SHOWN UNLESS OTHERWISE SPECIFIED IN THE PLANS OR BY THE PROJECT MANAGER.

* INCLUDED WITH ROADWAY QUANTITIES.

UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.

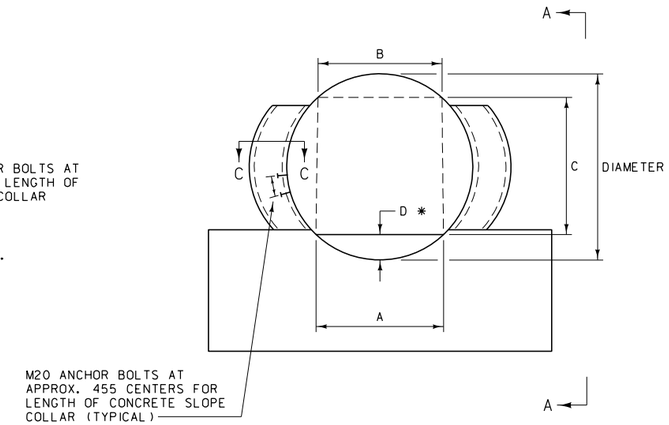
DETAILED DRAWING	
REFERENCE STANDARD SPEC. SECTION 603	DWG. NO. 603-28
EMBANKMENT PROTECTOR	
--REVISED-- MAY 2011	EFFECTIVE: FEBRUARY 2005

MONTANA DEPARTMENT OF TRANSPORTATION

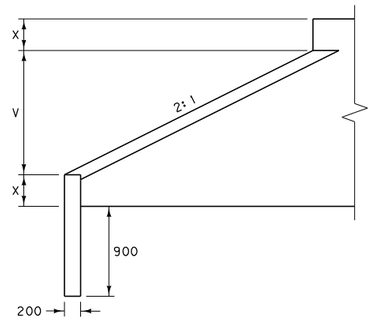


NOTE:
SEE DTL. DWG. NO. 552-00
FOR ANCHOR BOLT DETAILS.

SECTION C-C



ELEVATION



SECTION A-A

NOTES:

DESIGNATE THESE STRUCTURES, IN PLANS AND PROPOSAL, AS "VEHICULAR UNDERPASS." CONFORM MATERIALS, INSTALLATION, AND OTHER PROVISIONS TO THE STANDARD SPECIFICATIONS. USE THE TERM "VEHICULAR UNDERPASS," REGARDLESS OF THE USE OR PURPOSE OF THE STRUCTURE.

PROVIDE END TREATMENT FOR ALL VEHICULAR UNDERPASSES INCLUDING CUTOFF WALLS, BACKFILL RETAINING WALLS AND CONCRETE SLOPE COLLARS.

PROVIDE SURFACING FOR THE INSIDE OF THE STRUCTURE, CROSS-SLOPED TO ALLOW A DRAINAGE COURSE ALONG ONE SIDE.

FOR PLATE THICKNESS SEE ROAD DESIGN MANUAL FILL HEIGHT TABLES.

USE CLASS "DD" CONCRETE OR EQUAL.

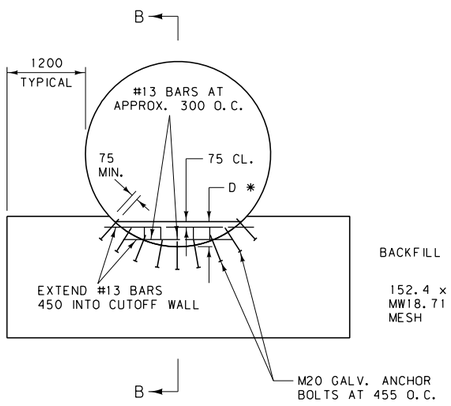
SEE DTL. DWG. NO. 552-08 FOR QUANTITIES.

DEPTH OF SURFACING *		
MATERIAL	ALTERNATE "A"	ALTERNATE "B"
PL. MIX SURF.	—	60
CRUSHED AGGREGATE COURSE	BAL.	BAL.

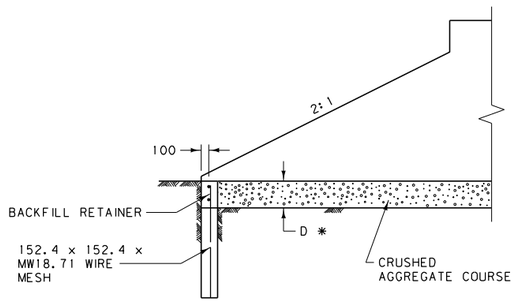
DIAMETER	A (m)	B (m)	C (m)	V (m)	X (m)	* D	BACKFILL RETAINER (m³)	CONCRETE COLLAR (m³)
2400	1.2	1.2	2.078	1.200	0.600	173	0.03	0.50
3000	2.1	2.1	2.142	1.500	0.750	441	0.13	0.63
3.825 m	3.0	2.4	2.683	1.916	0.957	750	0.32	0.80
4.135 m	3.0	2.4	3.114	2.071	1.035	669	0.28	0.87
4.755 m	3.6	3.0	3.407	2.381	1.190	848	0.43	1.00
4.910 m	3.6	3.0	3.622	2.459	1.229	809	0.41	1.03
5.220 m	3.6	3.0	4.035	2.613	1.307	744	0.38	1.10
5.530 m	3.6	3.0	4.431	2.770	1.384	690	0.35	1.16
5.840 m	4.8	3.6	3.975	2.924	1.462	1279	0.87	1.23
6.150 m	4.8	3.6	4.428	3.079	1.540	1176	0.80	1.29

SURFACING QUANTITIES PER METER FOR DEPTH "D" *						
	ALTERNATE "A"	ALTERNATE "B"				
	m³ SURFACING	TONS SURFACING		m³ SURFACING	TONS BIT. MATL.		
DIAMETER	CRUSHED AGGREGATE COURSE	COVER MATERIAL	PLANT MIX	CRUSHED AGGREGATE COURSE	PLANT MIX	PRIME	SEAL
2400	0.147	0.0175	0.158	0.078	0.0095	0.0015	0.0020
3000	0.649	0.0299	0.284	0.525	0.0170	0.0029	0.0034
3.825 m	1.604	0.0429	0.414	1.423	0.0248	0.0042	0.0049
4.135 m	1.420	0.0430	0.414	1.239	0.0248	0.0042	0.0049
4.755 m	2.159	0.0513	0.496	1.942	0.0298	0.0051	0.0059
4.910 m	2.056	0.0514	0.496	1.839	0.0298	0.0051	0.0059
5.220 m	1.882	0.0514	0.496	1.665	0.0298	0.0051	0.0059
5.530 m	1.741	0.0515	0.496	1.524	0.0298	0.0050	0.0059
5.840 m	4.368	0.0681	0.661	4.079	0.0397	0.0068	0.0078
6.150 m	3.985	0.0681	0.661	3.696	0.0397	0.0068	0.0078

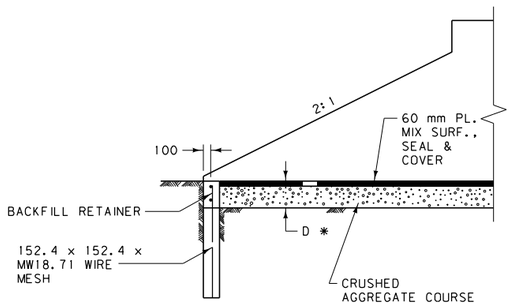
BACKFILL RETAINER & CUTOFF WALL DETAIL



ELEVATION



SECTION B-B
(ALTERNATE "A")



SECTION B-B
(ALTERNATE "B")

NOTE:
INCLUDE CONCRETE COLLAR
WHEN SPECIFIED.

ALL DIMENSIONS ARE MILLIMETERS (mm) UNLESS OTHERWISE NOTED.

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 552.603

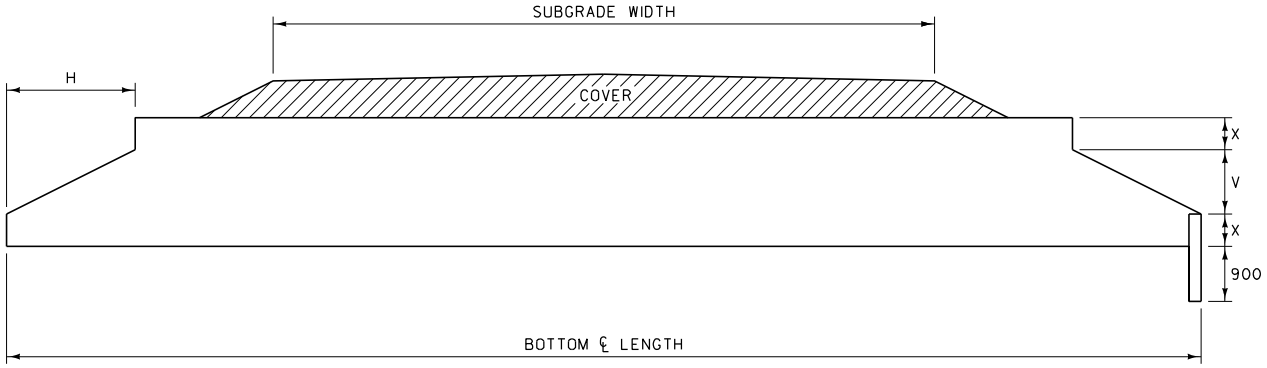
DWG. NO. 603-30

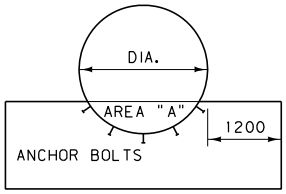
VEHICULAR UNDERPASS AND BACKFILL RETAINER & CUTOFF WALL DETAIL

--REVISED--
January 2008

EFFECTIVE: FEBRUARY 2005

MDT serving you with pride — MONTANA DEPARTMENT OF TRANSPORTATION





NOTE:
FOR DETAILS COVERING CUTOFF WALLS
SEE DTL. DWG. NO. 552-00.

DIA.	X (m)	V (m)	H (m) FOR BEVELS:		AREA "A" (m²) *
			1.5:1	2:1	
CSP 75 x 25 OR 125 x 25 CORRUGATIONS					
1350	0.338	0.674	1.011	1.348	0.30
1500	0.375	0.750	1.125	1.500	0.37
1650	0.412	0.826	1.239	1.652	0.44
1800	0.450	0.900	1.350	1.800	0.52
1950	0.488	0.974	1.461	1.948	0.61
2100	0.525	1.050	1.575	2.100	0.70
2250	0.563	1.124	1.686	2.248	0.81
2400	0.600	1.200	1.800	2.400	0.92
2550	0.637	1.276	1.914	2.552	1.03
2700	0.675	1.350	2.025	2.700	1.15
2850	0.712	1.426	2.139	2.852	1.28
3000	0.750	1.500	2.250	3.000	1.42

DIA.	X (m)	V (m)	H (m) FOR BEVELS:		AREA "A" (m²) *
			1.5:1	2:1	
SSPP 152 x 51 CORRUGATIONS					
3.205	0.802	1.605	2.408	3.210	1.67
3.360	0.841	1.682	2.523	3.364	1.83
3.515	0.880	1.760	2.640	3.520	2.00
3.670	0.919	1.837	2.756	3.674	2.17
3.825	0.957	1.916	2.874	3.832	2.36
3.980	0.996	1.993	2.990	3.986	2.55
4.135	1.035	2.071	3.107	4.142	2.74
4.290	1.074	2.148	3.222	4.296	2.95
4.445	1.113	2.225	3.338	4.450	3.16
4.600	1.152	2.302	3.453	4.604	3.38
4.755	1.190	2.381	3.572	4.762	3.61
4.910	1.229	2.459	3.689	4.918	3.84
5.065	1.268	2.536	3.804	5.072	4.09
5.220	1.307	2.613	3.920	5.226	4.34
5.375	1.346	2.690	4.035	5.380	4.59
5.530	1.384	2.770	4.155	5.540	4.86
5.685	1.423	2.847	4.271	5.694	5.13
5.840	1.462	2.924	4.386	5.848	5.41
5.995	1.501	3.001	4.502	6.002	5.69
6.150	1.540	3.079	4.619	6.158	5.99
6.305	1.578	3.158	4.737	6.316	6.29
6.460	1.617	3.235	4.853	6.470	6.60

* AREA "A" IS TO THE MIDDLE OF THE CORRUGATIONS.

NOMINAL DIAMETER

ALL DIMENSIONS ARE MILLIMETERS (mm) UNLESS OTHERWISE NOTED.

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 603

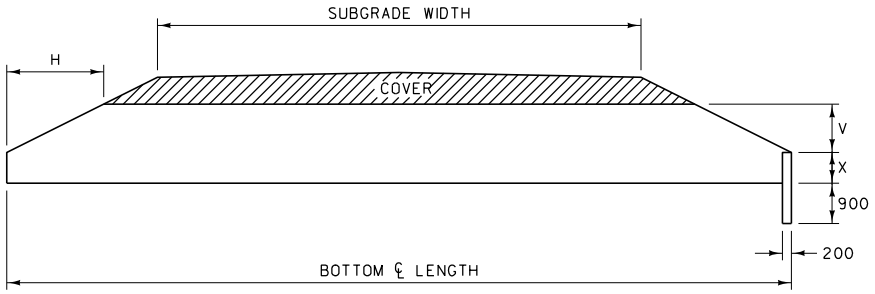
DWG. NO. 603-32

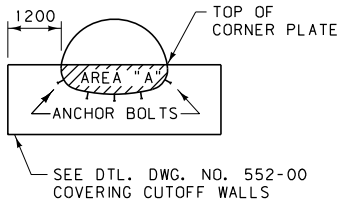
STEP BEVEL FOR CIRCULAR METAL CULVERT

EFFECTIVE: APRIL 2006

MDT serving you with pride

MONTANA DEPARTMENT OF TRANSPORTATION





SPAN (m)	RISE (m)	X (m)	V (m)	H (m) FOR BEVELS: 1.5:1	2:1	2.5:1	AREA "A" (m²)
SSPPA 152 x 51 CORRUGATIONS WITH 457 CORNER RADIUS							
1.850	1.400	0.533	0.867	1.301	1.734	2.168	0.88
1.930	1.450	0.521	0.929	1.394	1.858	2.323	0.91
2.060	1.500	0.559	0.941	1.412	1.882	2.353	1.01
2.130	1.550	0.544	1.006	1.509	2.012	2.515	1.04
2.210	1.600	0.528	1.072	1.608	2.144	2.680	1.06
2.340	1.650	0.569	1.081	1.622	2.162	2.703	1.18
2.410	1.700	0.551	1.149	1.724	2.298	2.873	1.19
2.490	1.750	0.531	1.219	1.829	2.438	3.048	1.21
2.620	1.800	0.577	1.223	1.835	2.446	3.058	1.34
2.690	1.850	0.556	1.294	1.941	2.588	3.235	1.35
2.840	1.910	0.605	1.305	1.958	2.610	3.263	1.50
2.900	1.960	0.582	1.378	2.067	2.756	3.445	1.50
2.970	2.010	0.556	1.454	2.181	2.908	3.635	1.50
3.120	2.060	0.610	1.450	2.175	2.900	3.625	1.66
3.250	2.110	0.663	1.447	2.171	2.894	3.618	1.85
3.330	2.160	0.638	1.522	2.283	3.044	3.805	1.84
3.480	2.210	0.696	1.514	2.271	3.028	3.785	2.04
3.530	2.260	0.668	1.592	2.388	3.184	3.980	2.03
3.610	2.310	0.640	1.670	2.505	3.340	4.175	2.01
3.760	2.360	0.698	1.662	2.493	3.324	4.155	2.22
3.810	2.410	0.671	1.739	2.609	3.478	4.348	2.20
3.860	2.460	0.640	1.820	2.730	3.640	4.550	2.17
3.910	2.540	0.610	1.930	2.895	3.860	4.825	2.13
4.090	2.570	0.671	1.899	2.849	3.798	4.748	2.37
SSPPA 152 x 51 CORRUGATIONS WITH 787 CORNER RADIUS							
4.040	2.840	1.189	1.651	2.477	3.302	4.128	4.25
4.110	2.900	1.158	1.742	2.613	3.484	4.355	4.21
4.270	2.950	1.219	1.731	2.597	3.462	4.328	4.56
4.320	3.000	1.158	1.842	2.763	3.684	4.605	4.42
4.390	3.050	1.128	1.922	2.883	3.844	4.805	4.40
4.550	3.100	1.219	1.881	2.822	3.762	4.703	4.87
4.670	3.150	1.311	1.839	2.759	3.678	4.598	5.35
4.750	3.200	1.250	1.950	2.925	3.900	4.875	5.20
4.830	3.250	1.189	2.061	3.092	4.122	5.153	5.03
4.950	3.300	1.311	1.989	2.984	3.978	4.973	5.68
5.030	3.350	1.250	2.100	3.150	4.200	5.250	5.52
5.180	3.400	1.341	2.059	3.089	4.118	5.148	6.02
5.230	3.450	1.311	2.139	3.209	4.278	5.348	6.00
5.310	3.510	1.250	2.260	3.390	4.520	5.650	5.82
5.460	3.560	1.311	2.249	3.374	4.498	5.623	6.18
5.510	3.610	1.280	2.330	3.495	4.660	5.825	6.17
5.660	3.660	1.372	2.288	3.432	4.576	5.720	6.71
5.720	3.710	1.311	2.399	3.599	4.798	5.998	6.51
5.870	3.760	1.402	2.358	3.537	4.716	5.895	7.08
5.940	3.810	1.341	2.469	3.704	4.938	6.173	6.88
5.990	3.860	1.311	2.549	3.824	5.098	6.373	6.84
6.070	3.910	1.250	2.660	3.990	5.320	6.650	6.63
6.220	3.960	1.341	2.619	3.929	5.238	6.548	7.21
6.270	4.010	1.311	2.699	4.049	5.398	6.748	7.17

SPAN	RISE	X (m)	V (m)	H (m) FOR BEVELS: 1.5:1	2:1	2.5:1	AREA "A" (m²)
CSPA 75 x 25 CORRUGATIONS (SEE NOTE ⊗)							
1010	790	0.330	0.460	0.690	0.920	~	0.29
1160	920	0.395	0.525	0.788	1.050	~	0.40
1340	1050	0.385	0.665	0.998	1.330	~	0.38
1520	1170	0.520	0.650	0.975	1.300	~	0.65
1670	1300	0.580	0.720	1.080	1.440	~	0.80
1850	1400	0.640	0.760	1.140	1.520	~	0.99
2050	1500	0.605	0.895	1.343	1.790	~	1.03
2200	1620	0.655	0.965	1.448	1.930	~	1.22
2400	1720	0.705	1.015	1.523	2.030	~	1.42
2600	1820	0.755	1.065	1.598	2.130	~	1.65
2840	1920	0.805	1.115	1.673	2.230	~	1.88
2970	2020	0.855	1.165	1.748	2.330	~	2.14
3240	2120	0.905	1.215	1.823	2.430	~	2.40
3470	2220	0.955	1.265	1.898	2.530	~	2.69
3600	2320	1.005	1.315	1.973	2.630	~	2.99
CSPA 68 x 13 CORRUGATIONS (SEE NOTE ⊗)							
1440	970	0.330	0.640	0.960	1.280	~	0.41
1620	1100	0.370	0.730	1.095	1.460	~	0.52
1800	1200	0.415	0.785	1.178	1.570	~	0.64
1950	1320	0.455	0.865	1.298	1.730	~	0.76
2100	1450	0.495	0.955	1.433	1.910	~	0.89

NOTES:

BEVEL TO TOP OF CORNER PLATE.

PIPE ENDS ARE SQUARE (PERPENDICULAR TO CENTERLINE OF PIPE) AND FILL SLOPES ARE WARPED TO ACCOMMODATE THE SQUARE ENDS UNLESS SPECIFIED OTHERWISE ON PLANS.

⊗ TABULATED VALUES BASED ON NOMINAL PIPE DIMENSIONS. IN PLACE DIMENSIONS SUBJECT TO TOLERANCES LISTED IN CURRENT AASHTO M 36M AND M 196M.

ALL DIMENSIONS ARE MILLIMETERS (mm) UNLESS OTHERWISE NOTED.

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 603

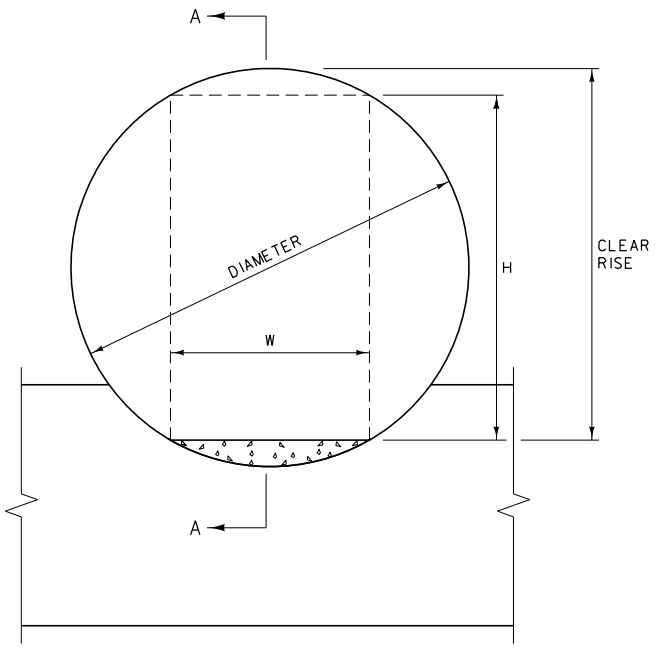
DWG. NO. 603-34

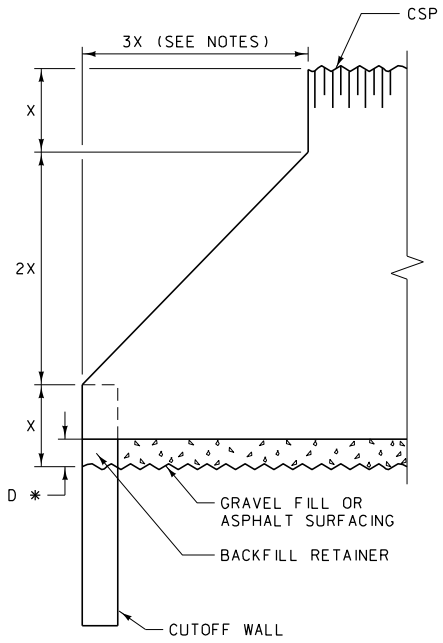
BEVEL ON ARCH METAL CULVERT

EFFECTIVE: FEBRUARY 2005

MDT serving you with pride

MONTANA DEPARTMENT OF TRANSPORTATION





SECTION A-A

DIAMETER	X (m)	* D	CLEAR RISE (m)	H (m)	W (m)	BACKFILL RETAINER (m^3)
2100	0.525	168	1.944	1.789	1.1	0.03
2250	0.563	257	2.006	1.761	1.4	0.05
2400	0.600	276	2.137	1.873	1.5	0.06

	SURFACING QUANTITIES PER METER FOR DEPTH "D" *				
	FULL DEPTH GRAVEL	60 mm PMS AND REMAINING DEPTH GRAVEL			
	m^3 SURF.	TONS SURF.	m^3 SURF.	TONS BIT. MATERIAL	
DIAMETER	CR. TOP SURF.	PLANT MIX	CR. TOP SURF.	PLANT MIX	PRIME
2100	0.131	0.144	0.068	0.0086	0.0013
2250	0.253	0.188	0.171	0.0113	0.0018
2400	0.291	0.201	0.203	0.0121	0.0020

NOTES:

UNLESS OTHERWISE SPECIFIED, INSTALL STOCKPASSES WITH CUTOFF WALLS AND BACKFILL RETAINERS AT EACH END, GRAVEL FILL AND BEDDING MATERIAL.

WHEN SPECIFIED, INSTALL COMBINATION STOCKPASSES AND DRAINS WITH CUTOFF WALLS, BACKFILL RETAINERS AT BOTH ENDS, CONCRETE EDGE PROTECTION AT THE INLET END, RANDOM RIPRPAP AT THE OUTLET END, BEDDING MATERIAL AND ASPHALT SURFACING; CROSS SLOPE ASPHALT SURFACING TO ALLOW DRAINAGE COURSE ALONG ONE SIDE. (SEE DTL. DWG. NO. 613-14 AND 613-06.)

UNLESS OTHERWISE SPECIFIED, STEP BEVEL PIPE ENDS AT A 1.5:1 SLOPE.

SEE FILL HEIGHT TABLES FOR THICKNESS REQUIREMENTS.

SEE DTL. DWG. NO. 552-00, 603-30 AND 603-18.

ALL DIMENSIONS ARE MILLIMETERS (mm) UNLESS OTHERWISE NOTED.

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 603

DWG. NO. 603-36

CORRUGATED STEEL PIPE STOCKPASS

EFFECTIVE: FEBRUARY 2005

MDT serving you with pride

MONTANA DEPARTMENT OF TRANSPORTATION