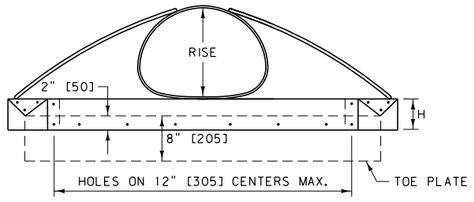
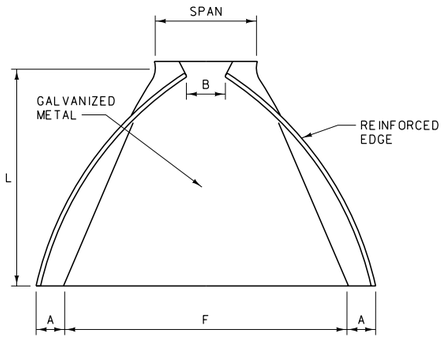
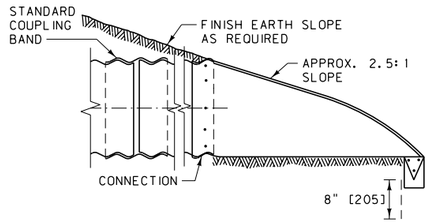
ARCH PIPE



ELEVATION



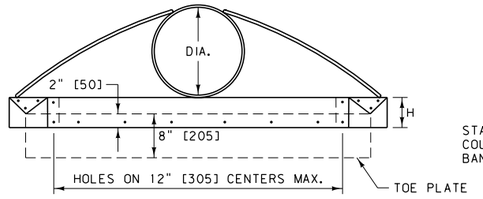
PLAN



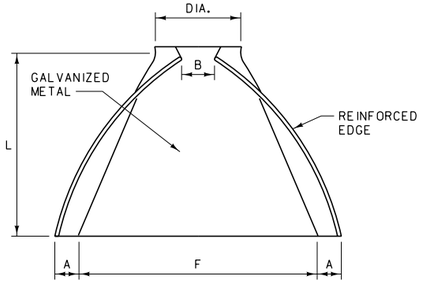
TYPICAL CROSS-SECTION

(ILLUSTRATED WITH TYPE 3 CONNECTION)

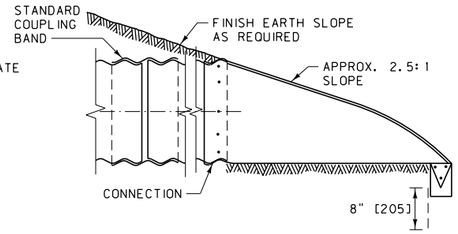
ROUND PIPE



ELEVATION



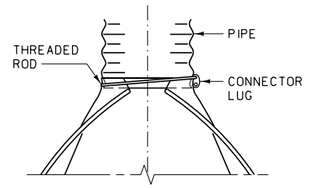
PLAN



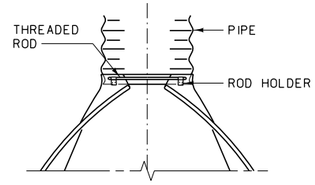
TYPICAL CROSS-SECTION

(ILLUSTRATED WITH TYPE 3 CONNECTION)

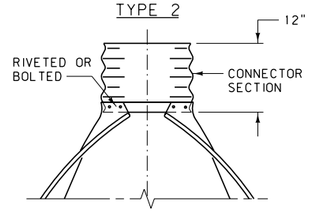
CONNECTIONS



TYPE 1



TYPE 2



TYPE 3

DIMENSION TABLE

3" x 1" CORR. SPAN x RISE	MINIMUM THICKNESS *	2 2/3" x 1/2" CORR. SPAN x RISE	MINIMUM THICKNESS *	DIMENSIONS A 1" TOL.	B MAX.	H 1" TOL.	L 1 1/2" TOL.	F 2" TOL.	TYPE CONNECTOR
		17" x 13"	0.064"	7"	9"	6"	19"	30"	2
		21" x 15"	0.064"	7"	10"	6"	23"	30"	2
		24" x 18"	0.064"	8"	12"	6"	28"	42"	2
		28" x 20"	0.064"	9"	14"	6"	32"	48"	2
		35" x 24"	0.079"	10"	16"	6"	39"	60"	2
40" x 31"	0.079"	42" x 29"	0.079"	12"	18"	8"	46"	75"	3
46" x 36"	0.109"	49" x 33"	0.109"	13"	21"	9"	53"	85"	3
53" x 41"	0.109"	57" x 38"	0.109"	18"	26"	12"	63"	90"	3
60" x 46"	0.109"	64" x 43"	0.109"	18"	30"	12"	70"	102"	3
66" x 51"	0.109"	71" x 47"	0.109"	18"	33"	12"	77"	114"	3
73" x 55"	0.109"	77" x 52"	0.109"	18"	36"	12"	77"	126"	3
81" x 59"	0.109"	83" x 57"	0.109"	18"	36"	12"	77"	138"	3

METRIC DIMENSION TABLE

SPAN x RISE (mm)	MINIMUM THICKNESS (mm) *	DIMENSIONS (mm) A 25 TOL.	B MAX.	H 25 TOL.	L 40 TOL.	F 50 TOL.	APPROX. SLOPE	TYPE CONNECTOR
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

DIMENSION TABLE

PIPE DIA.	MINIMUM THICKNESS *	DIMENSIONS A 1" TOL.	B MAX.	H 1" TOL.	L 1 1/2" TOL.	F 2" TOL.	TYPE CONNECTOR
12"	0.064"	6"	6"	6"	21"	24"	1
15"	0.064"	7"	8"	6"	26"	30"	1
18"	0.064"	8"	10"	6"	31"	36"	1
21"	0.064"	9"	12"	6"	36"	42"	1
24"	0.064"	10"	13"	6"	41"	48"	1
30"	0.079"	12"	16"	8"	51"	60"	2
36"	0.079"	14"	19"	9"	60"	72"	2
42"	0.109"	16"	22"	11"	69"	84"	3
48"	0.109"	18"	27"	12"	78"	90"	3
54"	0.109"	18"	30"	12"	84"	102"	3
60"	0.109"	18"	33"	12"	87"	114"	3
66"	0.109"	18"	36"	12"	87"	120"	3
72"	0.109"	18"	39"	12"	87"	126"	3
78"	0.109"	18"	42"	12"	87"	132"	3
84"	0.109"	18"	45"	12"	87"	138"	3

METRIC DIMENSION TABLE

PIPE DIA. (mm)	MINIMUM THICKNESS (mm) *	DIMENSIONS (mm) A 25 TOL.	B MAX.	H 25 TOL.	L 40 TOL.	F 50 TOL.	APPROX. SLOPE	TYPE CONNECTOR
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

NOTES:

① PROVIDE TOE PLATE WHEN SPECIFIED.

② GALVANIZE ALL PARTS PER SECTION 711.

③ PAINT ANY AREAS WHERE GALVANIZING IS BROKEN OR METAL IS BARE WITH ONE COAT OF ZINC RICH PAINT AND TWO COATS OF ALUMINUM PAINT PER SECTION 710.

④ MINOR VARIATIONS IN DESIGN MAY BE ACCEPTABLE ON APPROVAL OF THE PROJECT MANAGER.

⑤ SEAMS OR JOINTS LENGTHWISE OF THE APRON ARE ACCEPTABLE IF SECURELY BOLTED OR WELDED AND PAINTED AS PROVIDED ABOVE.

* THICKNESSES SHOWN ARE FOR STEEL CULVERTS. FOR THICKNESS OF ALUMINUM, SUBTRACT 0.004" [0.10 mm].

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

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 603, 709, 710, 711

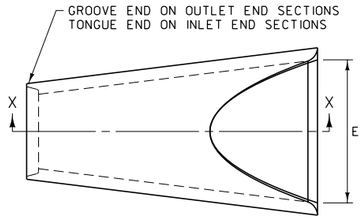
DWG. NO. 603-02

CMP FLARED END TERMINAL SECTION (FETS)

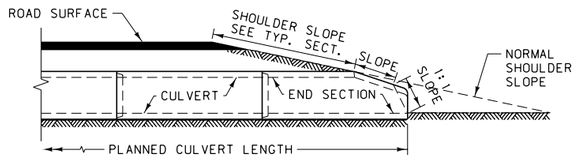
EFFECTIVE: SEPTEMBER 2014

MDT MONTANA DEPARTMENT OF TRANSPORTATION

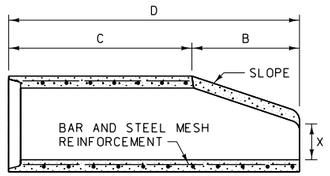
TYPE "A"



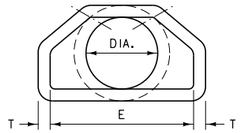
PLAN



SLOPE DETAIL



SECTION X-X



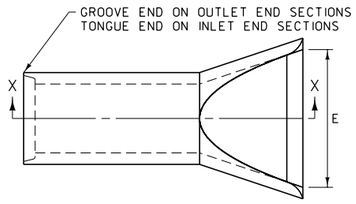
END VIEW

TYPE "A"							
DIA.	SLOPE	X	B	C	D	E	T *
12"	2.4:1	4"	2'-0"	4'-0"	6'-0"	2'-0"	2"
15"	2.4:1	6"	2'-3"	3'-9"	6'-0"	2'-6"	2 1/4"
18"	2.3:1	9"	2'-3"	3'-9"	6'-0"	3'-0"	2 1/2"
24"	2.5:1	9 1/2"	3'-7 1/2"	2'-4 1/2"	6'-0"	4'-0"	3"
30"	2.5:1	1'-0"	4'-6"	1'-6"	6'-0"	5'-0"	3 1/2"
36"	2.5:1	1'-3"	5'-3"	2'-11"	8'-2"	6'-0"	4"
42"	2.5:1	1'-9"	5'-3"	2'-11"	8'-2"	6'-6"	4 1/2"
48"	2.5:1	2'-0"	6'-0"	2'-2"	8'-2"	7'-0"	5"
54"	2.0:1	2'-3"	5'-5"	2'-9 1/2"	8'-2 1/2"	7'-6"	5 1/2"

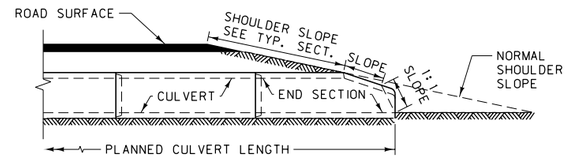
* WALL "B" THICKNESS

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

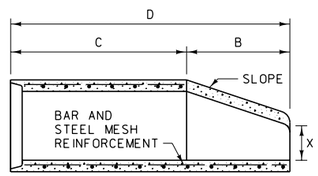
TYPE "B"



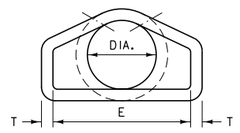
PLAN



SLOPE DETAIL



SECTION X-X

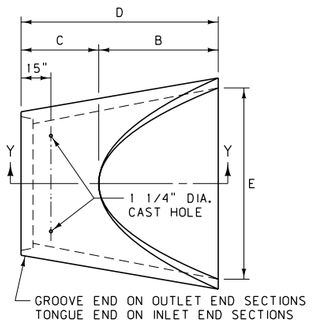


END VIEW

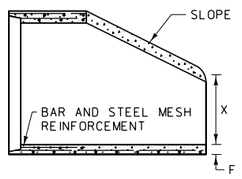
TYPE "B"							
DIA.	SLOPE	X	B	C	D	E	T *
12"	2.4:1	4"	2'-0"	4'-0"	6'-0"	2'-0"	2"
15"	2.4:1	6"	2'-3"	3'-9"	6'-0"	2'-6"	2 1/4"
18"	2.3:1	9"	2'-3"	3'-9"	6'-0"	3'-0"	2 1/2"
24"	2.5:1	9 1/2"	3'-7 1/2"	2'-4 1/2"	6'-0"	4'-0"	3"
30"	2.5:1	1'-0"	4'-6"	1'-6"	6'-0"	5'-0"	3 1/2"
36"	2.5:1	1'-3"	5'-3"	2'-11"	8'-2"	6'-0"	4"
42"	2.5:1	1'-9"	5'-3"	2'-11"	8'-2"	6'-6"	4 1/2"
48"	2.5:1	2'-0"	6'-0"	2'-2"	8'-2"	7'-0"	5"
54"	2.0:1	2'-3"	5'-5"	2'-9 1/2"	8'-2 1/2"	7'-6"	5 1/2"

* WALL "B" THICKNESS

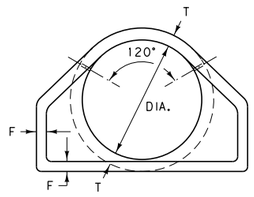
LARGE DIAMETER PIPE



PLAN



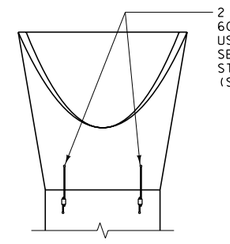
SECTION Y-Y



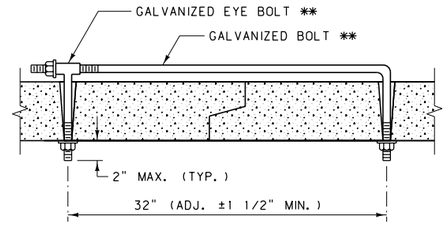
END VIEW

LARGE DIAMETER CULVERT								
DIA.	SLOPE	T *	X	B	C	D	E	F
60"	1.9:1	6"	2'-11"	5'-0"	3'-3"	8'-3"	8'-0"	5"
66"	1.7:1	6 1/2"	2'-6"	6'-0"	2'-3"	8'-3"	8'-6"	5 1/2"
72"	1.9:1	7"	3'-0"	6'-6"	1'-9"	8'-3"	9'-0"	6"
78"	1.8:1	7 1/2"	3'-0"	7'-6"	1'-9"	9'-3"	9'-6"	6 1/2"
84"	1.5:1	8"	3'-0"	7'-6 1/2"	1'-9"	9'-3 1/2"	10'-0"	6 1/2"
90"	1.5:1	8 1/2"	3'-5"	7'-3 1/2"	2'-0"	9'-3 1/2"	11'-0"	6 1/2"

* WALL "B" THICKNESS



TIE BOLT CONNECTION



** 3/4" FOR 12" TO 54" DIA. RCP
1" FOR 60" TO 90" DIA. RCP

TIE BOLT DETAIL
(TWO PER END SECTION)

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 PER SECTION 708.

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 603, 708

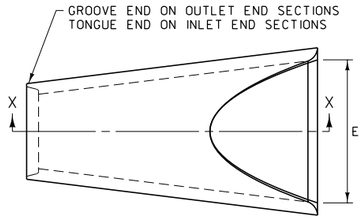
DWG. NO. 603-08

PREFABRICATED RCP FLARED END TERMINAL SECTION (FETS)

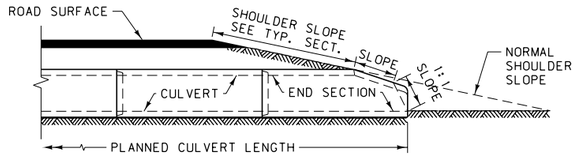
EFFECTIVE: SEPTEMBER 2014

MDT MONTANA DEPARTMENT OF TRANSPORTATION

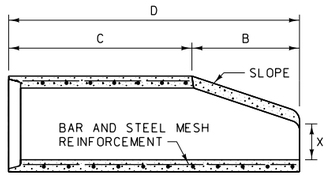
TYPE "A"



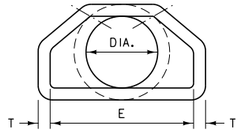
PLAN



SLOPE DETAIL



SECTION X-X



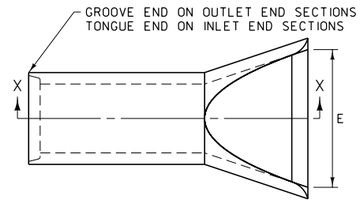
END VIEW

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

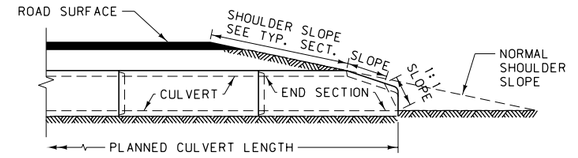
* WALL "B" THICKNESS

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

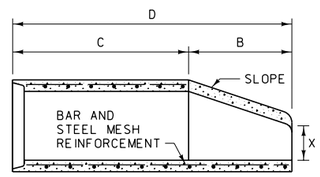
TYPE "B"



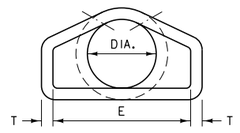
PLAN



SLOPE DETAIL



SECTION X-X

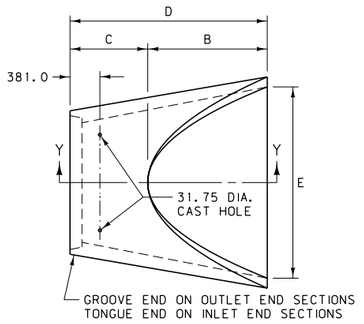


END VIEW

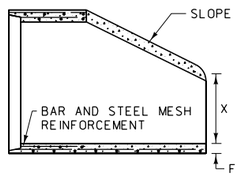
TYPE "B"							
DIA.	SLOPE	X	B	C	D	E	T *
300	2.4:1	101.6	609.6	1219.2	1828.8	609.6	50.8
375	2.4:1	152.4	685.8	1143.0	1828.8	762.0	57.2
450	2.3:1	228.6	685.8	1143.0	1828.8	914.4	63.5
600	2.5:1	241.3	1104.9	723.9	1828.8	1219.2	76.2
750	2.5:1	304.8	1371.6	457.2	1828.8	1524.0	88.9
900	2.5:1	381.0	1600.2	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

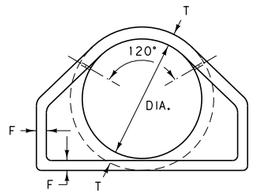
LARGE DIAMETER PIPE



PLAN



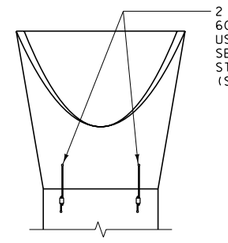
SECTION Y-Y



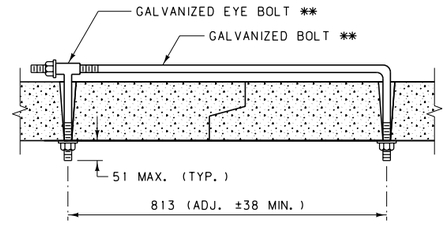
END VIEW

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 2250 DIA. RCP

TIE BOLT DETAIL
(TWO PER END SECTION)

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 PER SECTION 708.

ALL DIMENSIONS ARE MILLIMETERS (mm) UNLESS OTHERWISE NOTED.

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 603, 708

DWG. NO. 603-08

PREFABRICATED RCP FLARED END TERMINAL SECTION (FETS) (METRIC)

EFFECTIVE: SEPTEMBER 2014

MDT MONTANA DEPARTMENT OF TRANSPORTATION

DIMENSION TABLE

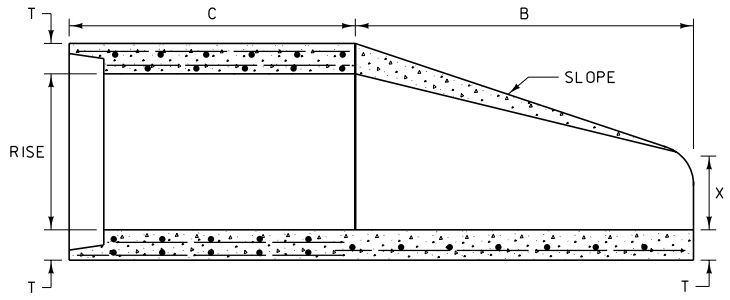
EQUIV. SIZE	SPAN	RISE	T *	X	B	C	D	E	R	SLOPE
18"	22"	13 1/2"	2 1/2"	7"	27"	45"	72"	36"	3"	3:1
24"	28 1/2"	18"	3 1/2"	8 1/2"	39"	33"	72"	48"	3"	3:1
30"	36 1/4"	22 1/2"	4"	9 1/2"	50"	46"	96"	60"	3"	3:1
36"	43 3/4"	26 5/8"	4 1/2"	11 1/8"	60"	36"	96"	72"	6"	3:1
42"	51 1/8"	31 5/16"	4 1/2"	15 13/16"	60"	36"	96"	78"	6"	3:1
48"	58 1/2"	36"	5"	21"	60"	36"	96"	84"	6"	3:1
54"	65"	40"	5 1/2"	25 1/2"	60"	36"	96"	90"	6"	3:1
60"	73"	45"	6"	31"	60"	36"	96"	96"	6"	3:1
72"	88"	54"	7"	31"	60"	36"	96"	120"	6"	2:1
84"	102"	62"	8"	21 1/2"	84"	24"	108"	144"	6"	2:1

* WALL "B" THICKNESS

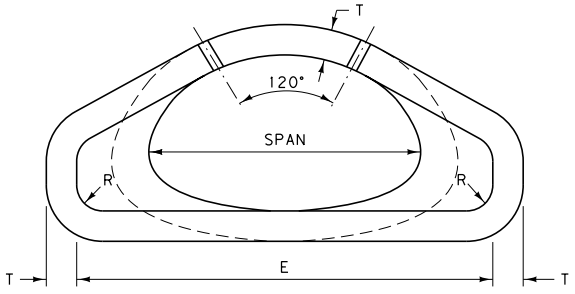
METRIC DIMENSION TABLE

EQUIV. SIZE (mm)	SPAN (mm)	RISE (mm)	T * (mm)	X (mm)	B (mm)	C (mm)	D (mm)	E (mm)	R (mm)	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

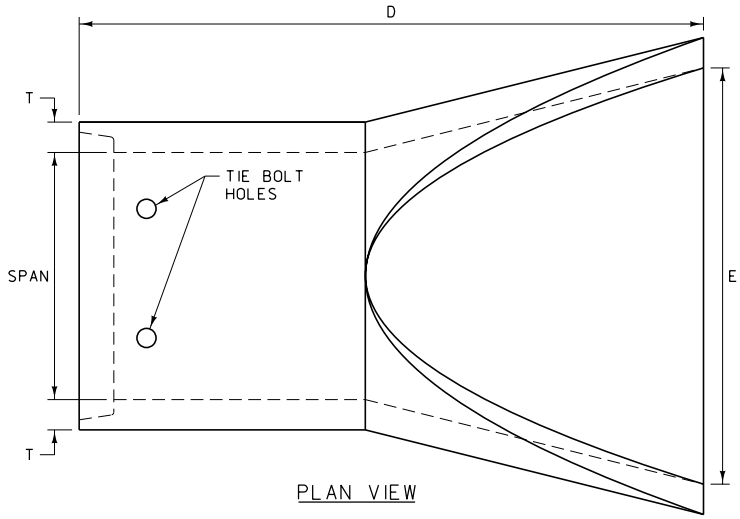
* WALL "B" THICKNESS



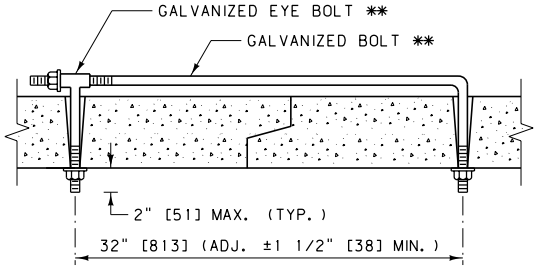
LONGITUDINAL SECTION



END VIEW



PLAN VIEW



** 3/4" [M20] FOR 18" [450] TO 54" [1350] EQUIV. SIZE
1" [M24] FOR 60" [1500] TO 84" [2100] EQUIV. SIZE

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 PER SECTION 711. SEE TIE BOLT DETAIL.

CONSTRUCTION: CONSTRUCT PER SECTION 708.

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

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 603, 708, 711

DWG. NO. 603-10

PREFABRICATED RCP ARCH FLARED END TERMINAL SECTION (FETS)

EFFECTIVE: SEPTEMBER 2014

MDT MONTANA DEPARTMENT OF TRANSPORTATION

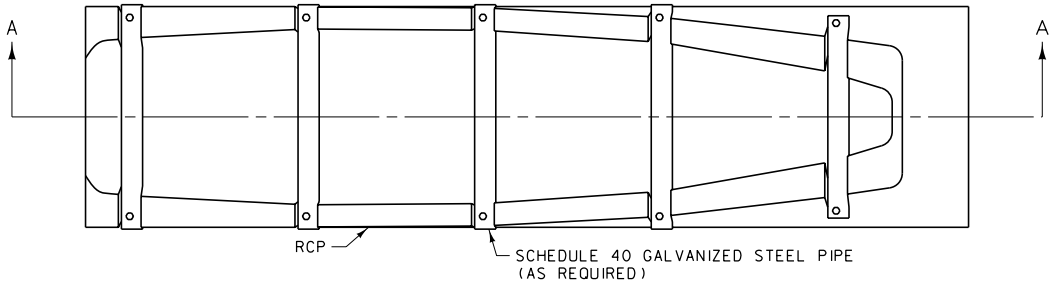
ROAD APPROACH CULVERT END TREATMENT

QUANTITIES (FOR ESTIMATING ONLY)

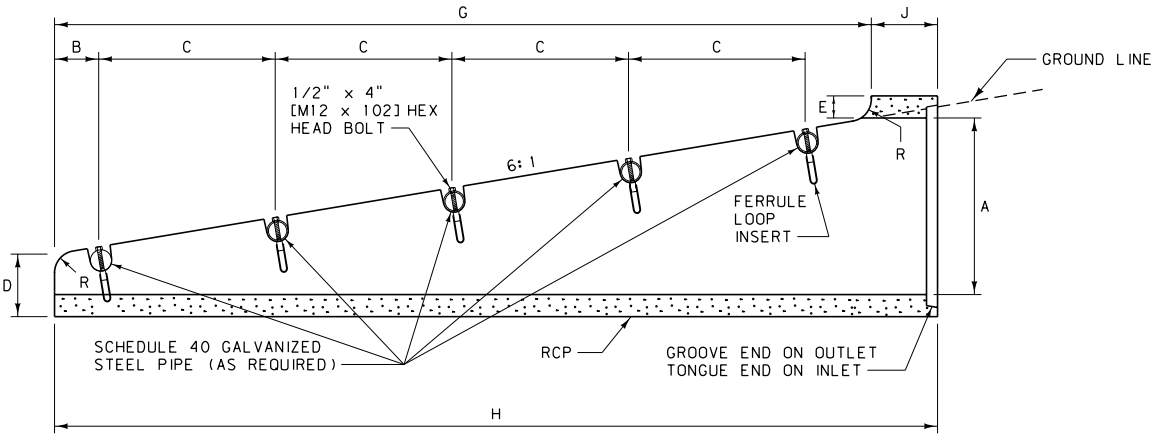
DIA. A RCP	H PIPE LENGTH	F-64 1/2" x 4 1/8" FERRULE LOOP INSERT (EACH)	LENGTH 2 1/2" DIA. SCHEDULE 40 GALV. PIPE	DIMENSIONS (FT.)						
				B	C	D	E	G	R	J
15"	4.75'	~	~	~	~	0.69	0.27	4.0	0.25	0.75
18"	6.5'	~	~	~	~	0.71	0.25	5.75	0.25	0.75
24"	10.0'	10	12.5'	0.5	2.0	0.75	0.21	9.25	0.25	0.75

METRIC QUANTITIES (FOR ESTIMATING ONLY)

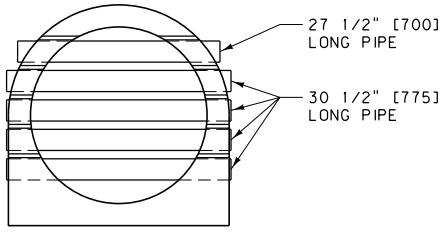
DIA. A RCP	H PIPE LENGTH	M12 x 105 FERRULE LOOP INSERT, EACH	LENGTH 63 DIA. SCHEDULE 40 GALV. PIPE	DIMENSIONS (mm)						
				B	C	D	E	G	R	J
375	1448	~	~	~	~	210	82	1219	76	229
450	1981	~	~	~	~	216	76	1752	76	229
600	3048	10	3800	152	610	229	64	2819	76	229



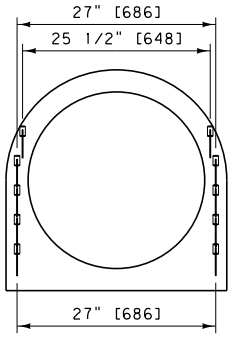
PLAN VIEW



SECTION A-A



END VIEW



VIEW OF INSERTS

NOTE:
PAINT ALL NON-GALVANIZED PARTS.
PER SECTION 710.

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

DETAILED DRAWING

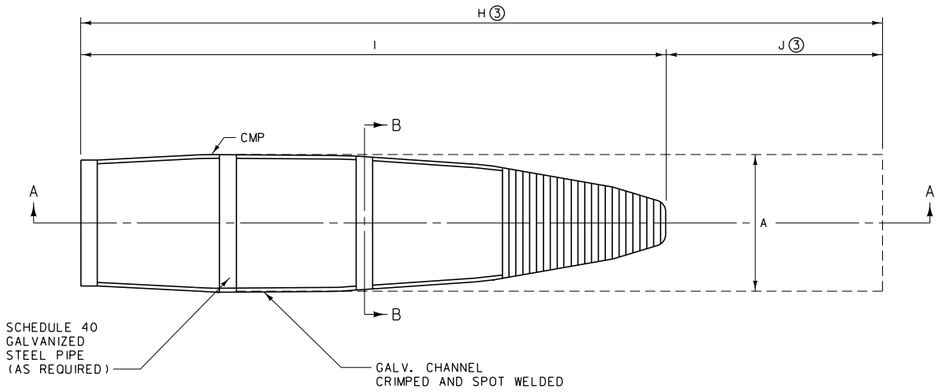
REFERENCE STANDARD SPEC. SECTION 603, 710, 711

DWG. NO. 603-12

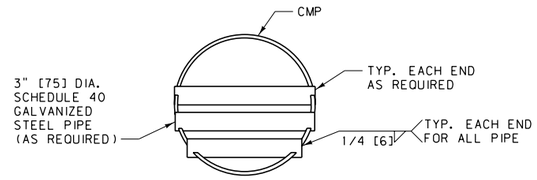
RCP ROAD APPROACH CULVERT END TREATMENT (RACET)

EFFECTIVE: SEPTEMBER 2014

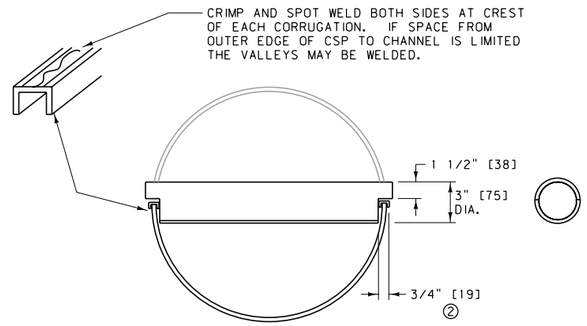
MDT MONTANA DEPARTMENT OF TRANSPORTATION



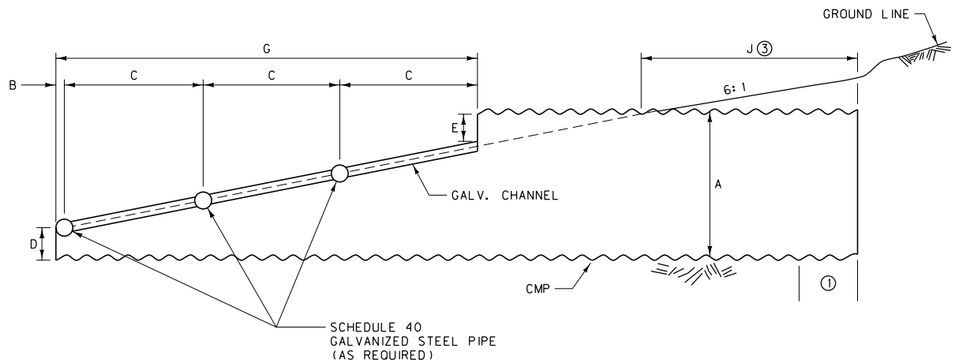
PLAN VIEW



END VIEW



SECTION B-B



SECTION A-A

ILLUSTRATED WITH 24" [600] CMP (30" [750] CMP UTILIZES FOUR GALV. STEEL PIPES)

NOTES:

① PIPE TO HAVE ANNULAR CORRUGATION OR REROLLED ENDS. USE ONLY APPROVED COUPLING BAND PER SECTION 709 FOR CMP. FOR RCP END TREATMENT, SEE DTL. DWG. NO. 603-26 FOR CONNECTION.

② THE TWO 3/4" [19]CHANNELS MAY BE ELIMINATED FROM THE CULVERT END TREATMENT IF:

A. THE CULVERT IS FABRICATED WITH 12 GAUGE (0.109" [2.8]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 PER SECTION 710.

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

ROAD APPROACH CULVERT END TREATMENT

QUANTITIES (FOR ESTIMATING ONLY)

DIA. A CMP	H PIPE LENGTH	3/4" x 3/8" x 1/8" GALV. CHANNEL	LENGTH 3" DIA SCHEDULE 40 GALV. PIPE	DIMENSIONS (FT.)						
				B	C	D	E	G	I	J
15"	7.0'	10'	~	~	~	0.20	0.20	5.0	6.0	1.0
18"	8.0'	10'	~	~	~	0.33	0.33	5.0	7.0	1.0
24"	10.0'	12'	6.0'	0.15	1.95	0.50	0.50	6.0	9.0	1.0
30"	12.5'	16'	10.0'	0.20	1.95	0.60	0.60	8.0	11.5	1.0

METRIC QUANTITIES (FOR ESTIMATING ONLY) (ALL DIMENSIONS IN MILLIMETERS)

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

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

DETAILED DRAWING

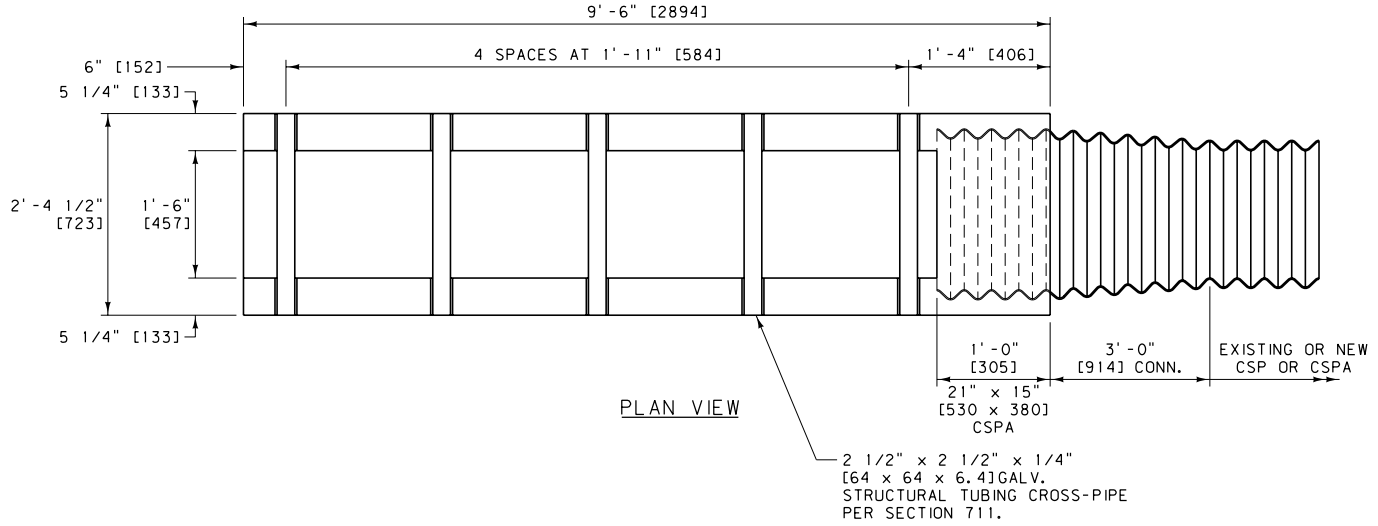
REFERENCE STANDARD SPEC. SECTION 603, 709, 710

DWG. NO. 603-14

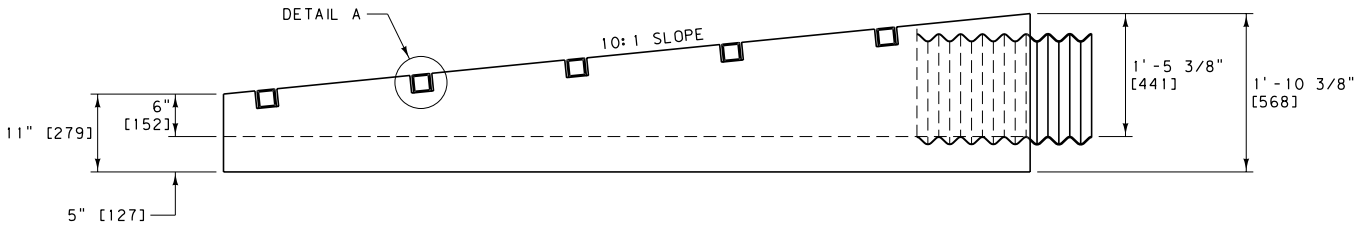
CMP ROAD APPROACH CULVERT END TREATMENT (RACET)

EFFECTIVE: SEPTEMBER 2014

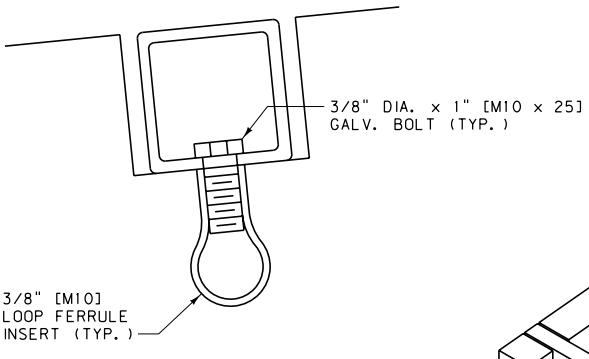
MDT MONTANA DEPARTMENT OF TRANSPORTATION



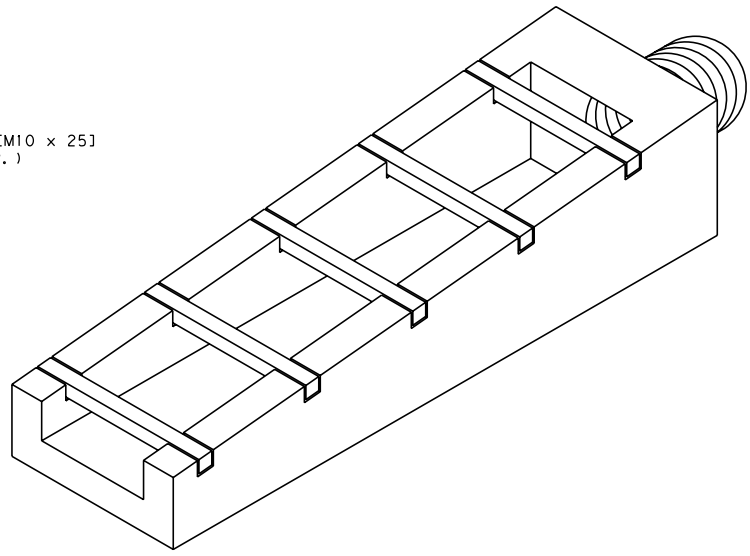
PLAN VIEW



ELEVATION



DETAIL A



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

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

DETAILED DRAWING

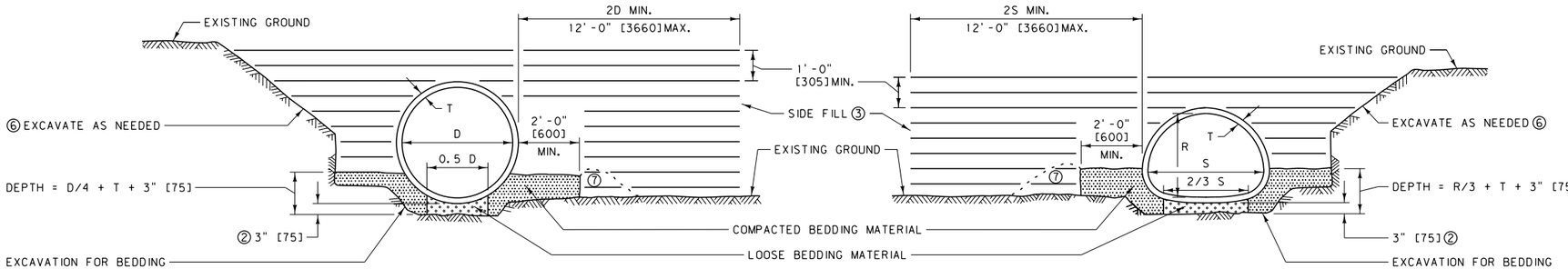
REFERENCE STANDARD SPEC. SECTION 603, 708, 710, 711

DWG. NO. 603-17

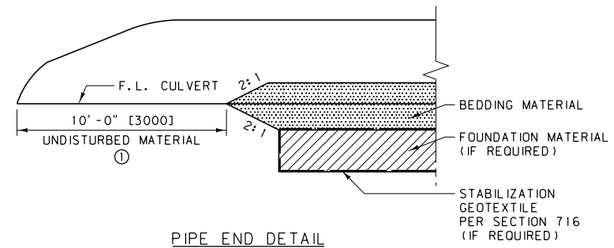
PRECAST MEDIAN U-TURN CROSS DRAIN AND CONC. BEVELED END

EFFECTIVE: SEPTEMBER 2014

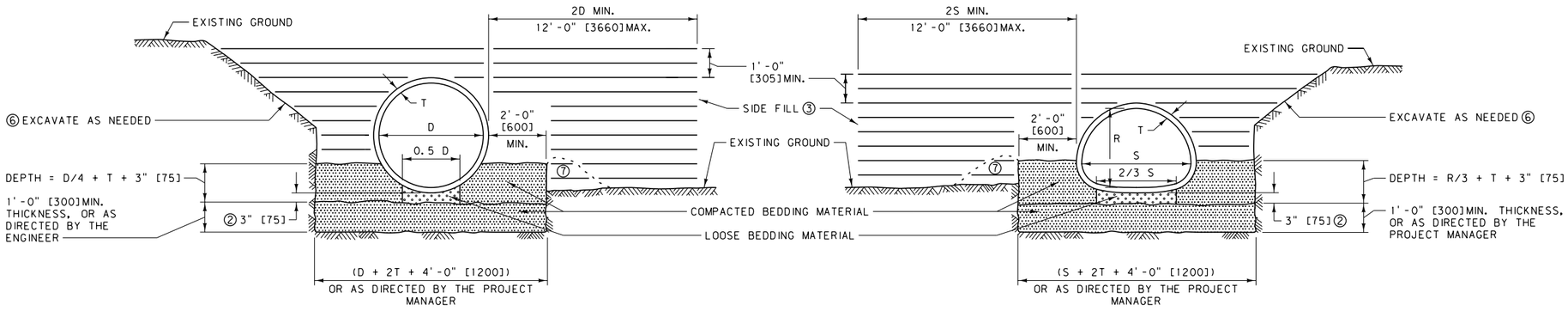
MDT MONTANA DEPARTMENT OF TRANSPORTATION



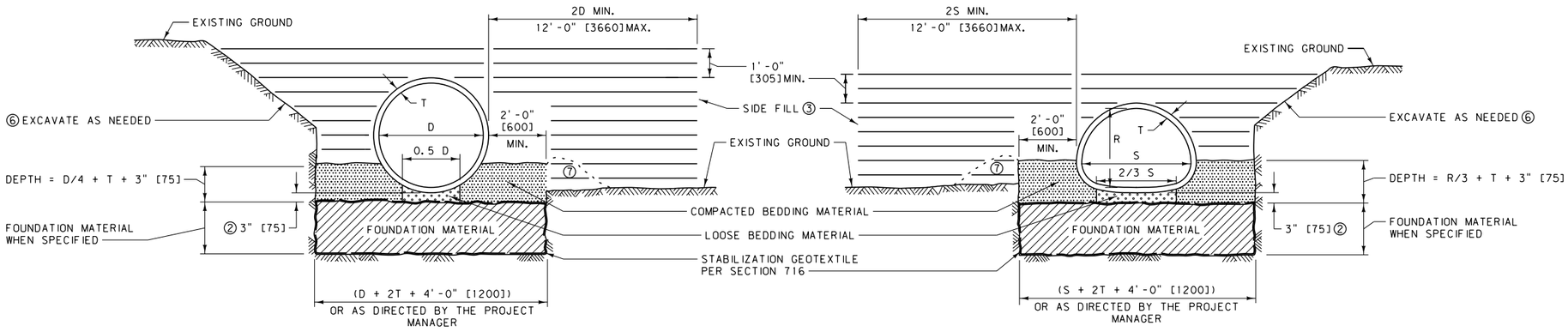
1-STANDARD BEDDING INSTALLATION



PIPE END DETAIL



2-ROCK



3-FOUNDATION STABILIZATION

NOTES:

① DO NOT EXTEND BEDDING MATERIAL TO THE END OF THE PIPE. LEAVE 10' [3000]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 OFPIPE. THE MINIMUM THICKNESS BEFORE PLACING PIPE IS 3" [75]. 42" [1050] AND 48" [1200] RCP IRR. REQUIRE 4" [100] DEPTH OF LOOSE BEDDING MATERIAL TO ACCOMODATE BELL THICKNESS. AFTER LAYING CULVERT, COMPACT BEDDING MATERIAL AT HAUNCHES AND SIDES OF PIPE.

③ COMPACT AND PLACE SIDE FILL PER SECTION 603 AND 203.

④ FURNISH BEDDING AND FOUNDATION MATERIAL PER SECTION 701.

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 1/2" [13] FOR 48" [1200] 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.

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

DETAILED DRAWING

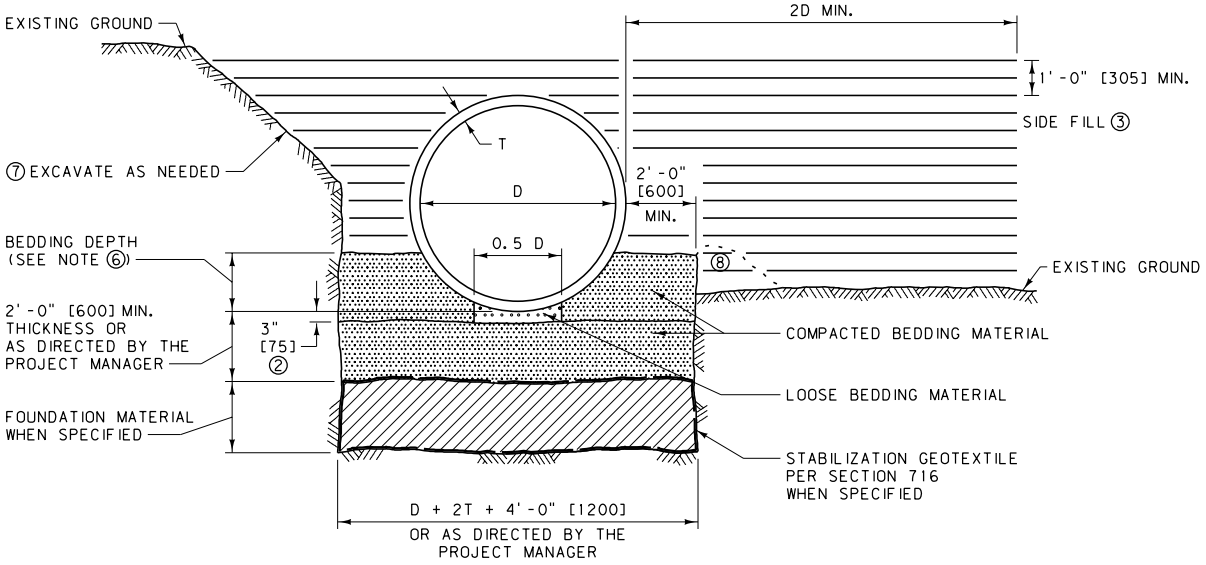
REFERENCE STANDARD SPEC. SECTION 203, 207, 603, 701

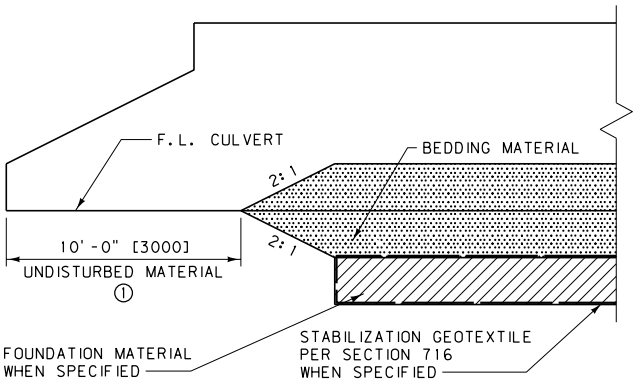
DWG. NO. 603-18

BEDDING FOR MAINLINE & PUBLIC APPROACH CULVERTS 48" [1200 mm]EQUIVALENT & SMALLER

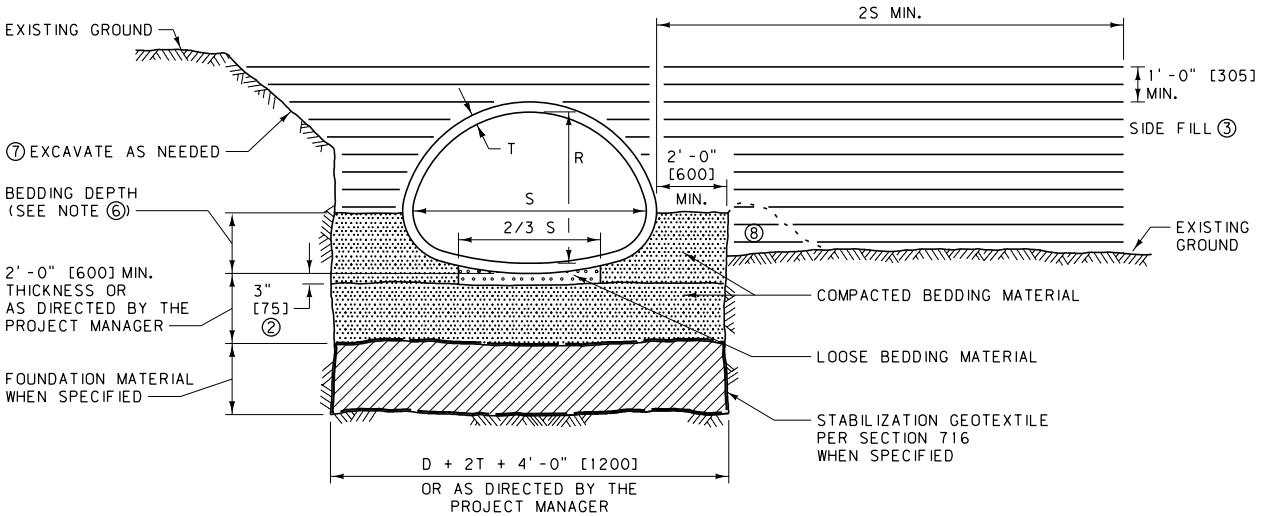
EFFECTIVE: SEPTEMBER 2014

MDT MONTANA DEPARTMENT OF TRANSPORTATION





PIPE END DETAIL



NOTES:

① DO NOT EXTEND BEDDING MATERIAL TO THE END OF THE PIPE. LEAVE 10' [3000] 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 3" [75]. RCP IRR. REQUIRE GREATER THAN 3" [75] OF LOOSE BEDDING MATERIAL TO ACCOMMODATE BELL THICKNESS. AFTER LAYING CULVERT, COMPACT BEDDING MATERIAL AT HAUNCHES AND SIDES OF PIPE.

③ COMPACT AND PLACE SIDE FILL PER SECTION 603 AND 203.

④ FURNISH BEDDING AND FOUNDATION MATERIAL PER SECTION 701.

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.

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

DETAILED DRAWING

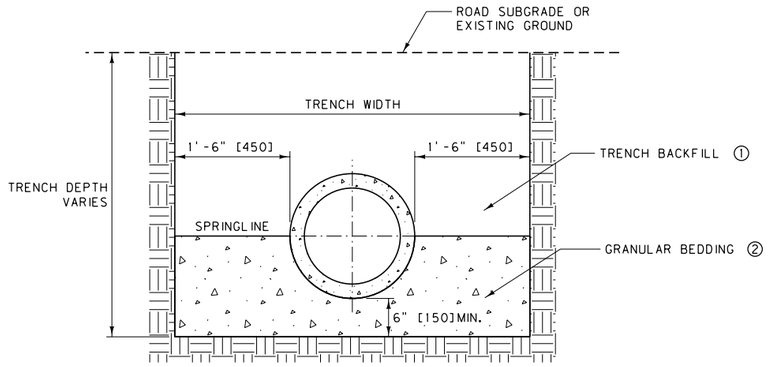
REFERENCE STANDARD SPEC. SECTION 203, 207, 603, 701

DWG. NO. 603-19

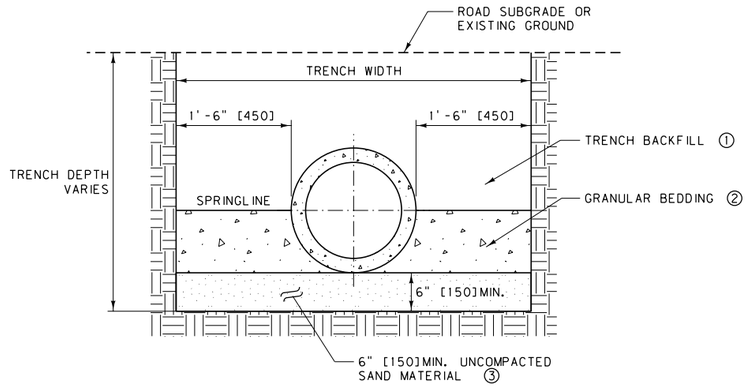
BEDDING FOR CULVERTS 54" [1350 mm] EQUIVALENT & LARGER

EFFECTIVE: SEPTEMBER 2014

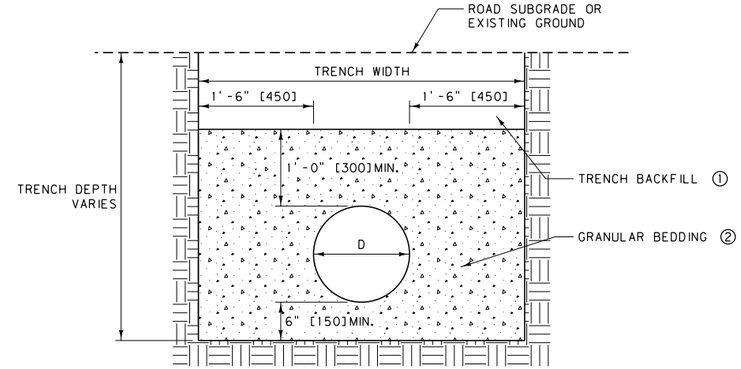
MDT MONTANA DEPARTMENT OF TRANSPORTATION



RIGID PIPE
TRENCH/BEDDING DETAIL
FOR 12" [300]TO 54" [1350]DIA.



RIGID PIPE
TRENCH/BEDDING DETAIL
FOR 60" [1500]TO 84" [2100]DIA.



FLEXIBLE PIPE
TRENCH/BEDDING DETAIL
FOR 12" [300]TO 48" [1200]DIA.

QUANTITIES*		METRIC QUANTITIES	
RIGID PIPE 12" TO 54" DIA.		RIGID PIPE 300 TO 1350 DIA.	
DIAMETER	GRANULAR BEDDING (C.Y. PER Ft.)	DIAMETER (mm)	GRANULAR BEDDING (m^3 PER m)
12"	0.15	300	0.39
18"	0.20	450	0.50
24"	0.25	600	0.63
30"	0.30	750	0.75
36"	0.35	900	0.88
42"	0.41	1050	1.02
48"	0.46	1200	1.16
54"	0.52	1350	1.30

* BASED ON RCP B WALL PIPE.

QUANTITIES*		METRIC QUANTITIES	
RIGID PIPE 60" TO 84" DIA.		RIGID PIPE 1500 TO 2100 DIA.	
DIAMETER	GRANULAR BEDDING (C.Y. PER Ft.)	DIAMETER (mm)	GRANULAR BEDDING (m^3 PER m)
60"	0.48	1500	1.19
66"	0.54	1650	1.35
72"	0.60	1800	1.51
78"	0.67	1950	1.68
84"	0.74	2100	1.85

* BASED ON RCP B WALL PIPE.

QUANTITIES*		METRIC QUANTITIES	
FLEXIBLE PIPE 12" TO 48" DIA.		FLEXIBLE PIPE 300 TO 1200 DIA.	
DIAMETER	GRANULAR BEDDING (C.Y. PER Ft.)	DIAMETER (mm)	GRANULAR BEDDING (m^3 PER m)
12"	0.37	300	0.93
18"	0.47	450	1.17
24"	0.57	600	1.42
30"	0.67	750	1.67
36"	0.77	900	1.94
42"	0.88	1050	2.22
48"	1.00	1200	2.51

* BASED ON 1" [25 mm]NOMINAL WALL THICKNESS.

NOTES

① TRENCH BACKFILL: PLACE PER STANDARD SPECIFICATION 603.03.4. GRANULAR BEDDING MAY BE SUBSTITUTED AT NO ADDITIONAL COST.

② GRANULAR BEDDING: USE COARSE AGGREGATE FOR CONCRETE NO.2 GRADATION PER TABLE 701-4 IN STANDARD SPECIFICATION 701.01.2.

THE BEDDING MATERIAL DIRECTLY UNDERNEATH THE PIPE SHOULD BE LEFT UNCOMPACTED TO FACILITATE THE INSTALLATION OF THE PIPE.

COMPACT GRANULAR BEDDING BY PROOF ROLLING WITH VIBRATORY COMPACTOR IN 8 INCH [200]LIFTS OR BY USING A METHOD APPROVED BY THE PROJECT MANAGER.

③ SAND CUSHION: USE GRADE 5 MATERIAL PER TABLE 701-7 IN STANDARD SPECIFICATION 701.02.3.

THE SAND MATERIAL SHOULD BE LEFT UNCOMPACTED TO FACILITATE THE INSTALLATION OF THE PIPE.

INCLUDE THE SAND MATERIAL IN THE COST OF THE BEDDING.

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

DETAILED DRAWING	
REFERENCE STANDARD SPEC. SECTION 603, 701	DWG. NO. 603-20
TRENCH BEDDING DETAIL	
EFFECTIVE: SEPTEMBER 2014	
MDT MONTANA DEPARTMENT OF TRANSPORTATION	

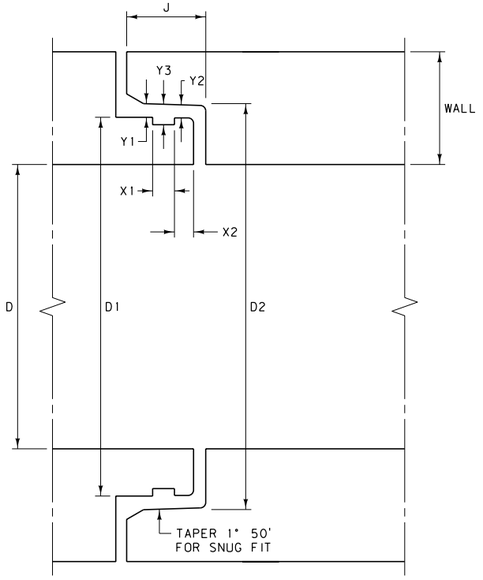
DIMENSION TABLE

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
12"	21/32"	3 5/8"	15.223"	15.331"	5"	2"	~	1"	7/8"	0.062"	0.090"	0.313"
15"	21/32"	3 5/8"	18.723"	18.831"	4 3/4"	2 3/16"	~	1"	7/8"	0.062"	0.090"	0.313"
18"	21/32"	3 5/8"	22.098"	22.206"	5"	2 3/8"	~	1"	7/8"	0.062"	0.090"	0.313"
21"	21/32"	3 7/8"	25.600"	25.724"	5 1/4"	2 9/16"	~	1"	7/8"	0.062"	0.090"	0.313"
24"	21/32"	3 7/8"	28.975"	29.099"	5 1/2"	2 3/4"	2"	1"	7/8"	0.062"	0.090"	0.313"
27"	21/32"	4"	32.476"	32.608"	5 1/2"	2 3/4"	2"	1"	7/8"	0.062"	0.090"	0.313"
30"	21/32"	4"	35.976"	36.108"	5 1/2"	2 3/4"	2"	1"	7/8"	0.062"	0.090"	0.313"
33"	21/32"	4 1/8"	39.476"	39.616"	5 3/4"	2 7/8"	2 1/8"	1"	7/8"	0.062"	0.090"	0.313"
36"	21/32"	4 1/8"	42.976"	43.116"	6"	3 1/8"	2 3/8"	1"	7/8"	0.062"	0.090"	0.313"
42"	3/4"	4 5/8"	50.183"	50.183"	6 3/4"	3 3/4"	3"	1 3/16"	1"	0.067"	0.129"	0.376"
48"	3/4"	4 3/4"	57.023"	57.193"	7 1/4"	4 1/8"	3 3/8"	1 3/16"	1"	0.067"	0.129"	0.376"
54"	3/4"	5"	63.007"	63.192"	7 1/2"	3 5/8"	2 7/8"	1 3/16"	1"	0.067"	0.129"	0.376"
60"	3/4"	5"	69.007"	69.192"	7 1/2"	3 1/8"	2 3/8"	1 3/16"	1"	0.067"	0.129"	0.376"
66"	13/16"	5"	75.007"	75.192"	7 1/2"	2 3/4"	2"	1 3/16"	1"	0.067"	0.129"	0.376"
72"	13/16"	5 1/4"	79.250"	79.400"	~	~	~	1 3/16"	1 1/4"	0.093"	0.190"	0.376"
78"	13/16"	5 1/4"	86.250"	86.400"	~	~	~	1 3/16"	1 1/4"	0.093"	0.190"	0.376"
84"	13/16"	5 1/4"	91.500"	91.650"	~	~	~	1 3/16"	1 1/4"	0.093"	0.190"	0.376"
90"	13/16"	5 1/4"	97.750"	97.900"	~	~	~	1 3/16"	1 1/4"	0.093"	0.190"	0.376"
96"	13/16"	5 1/4"	104.250"	104.400"	~	~	~	1 3/16"	1 1/4"	0.093"	0.190"	0.376"
102"	13/16"	5 1/4"	110.750"	110.900"	~	~	~	1 3/16"	1 1/4"	0.093"	0.190"	0.376"
108"	13/16"	5 1/4"	117.250"	117.400"	~	~	~	1 3/16"	1 1/4"	0.093"	0.190"	0.376"

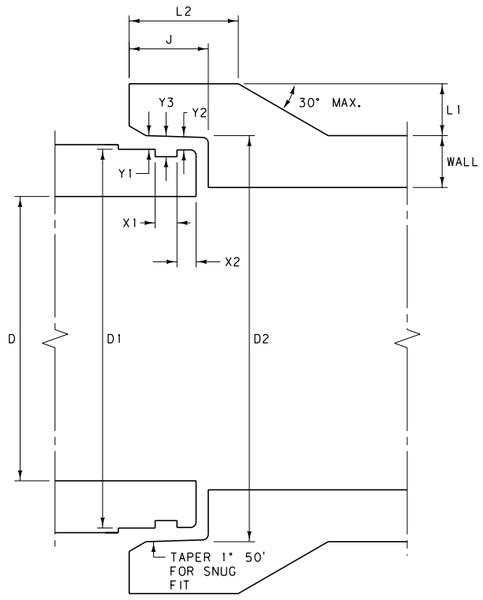
METRIC DIMENSION TABLE (mm)

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

72" [1800] DIA. PIPES AND LARGER



66" [1650] DIA. PIPES AND SMALLER



NOTES:

TYPICAL FOR STORM DRAIN AND IRRIGATION APPLICATIONS (FOR HEADS UP TO 20 FEET [6.1 m]).

USE RUBBER GASKETS THAT MEET THE REQUIREMENTS OF SECTION 707.

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

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 603, 707, 708

DWG. NO. 603-22

WATER TIGHT JOINT FOR REINFORCED CONCRETE PIPE

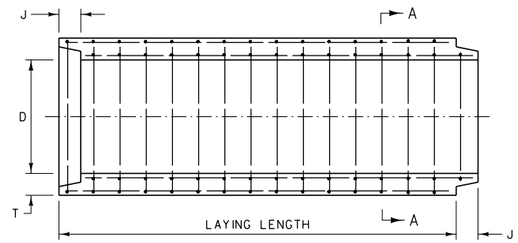
EFFECTIVE: SEPTEMBER 2014

MDT MONTANA DEPARTMENT OF TRANSPORTATION

DIMENSION TABLE

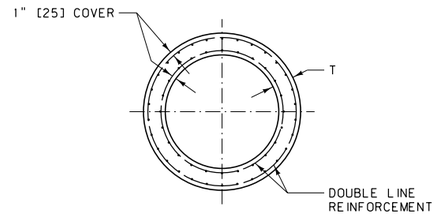
DIA. D	XSEC. WATER AREA (SQ. FT.)	WT. PER FOOT OF PIPE (LB.)	T * MIN. WALL THICKNESS	J LENGTH OF JOINT	A (NOMINAL) = $\frac{D2 - D1}{2}$	D1	D2	D3	D4
12"	0.79	92	2"	1 3/4"	3/16"	13 1/4"	13 5/8"	13 7/8"	14 1/4"
15"	1.23	127	2 1/4"	2"	3/16"	16 1/2"	16 7/8"	17 1/4"	17 5/8"
18"	1.77	168	2 1/2"	2 1/4"	3/16"	19 5/8"	20"	20 3/8"	20 3/4"
21"	2.40	214	2 3/4"	2 1/2"	3/16"	22 7/8"	23 1/4"	23 3/4"	24 1/8"
24"	3.14	265	3"	2 3/4"	3/16"	26"	26 3/8"	27"	27 3/8"
27"	3.98	322	3 1/4"	3"	3/16"	29 1/4"	29 5/8"	30 1/4"	30 5/8"
30"	4.91	384	3 1/2"	3 1/4"	3/16"	32 3/8"	32 3/4"	33 1/2"	33 7/8"
33"	5.94	452	3 3/4"	3 1/2"	1/4"	35 1/2"	36"	36 3/4"	37 1/4"
36"	7.07	524	4"	3 3/4"	1/4"	38 3/4"	39 1/4"	40"	40 1/2"
42"	9.62	685	4 1/2"	4"	1/4"	45 1/8"	45 3/8"	46 1/2"	47"
48"	12.57	867	5"	4 1/4"	1/4"	51 1/2"	52"	53"	53 1/2"
54"	15.90	1070	5 1/2"	4 1/2"	1/4"	57 7/8"	58 3/8"	59 3/8"	59 7/8"
60"	19.63	1296	6"	5"	1/4"	64 1/4"	64 3/4"	66"	66 1/2"
66"	23.76	1542	6 1/2"	5 1/2"	1/4"	70 5/8"	71 1/8"	72 1/2"	73"
72"	28.27	1810	7"	6"	1/4"	77"	77 1/2"	79"	79 1/2"
78"	33.18	2098	7 1/2"	6 1/2"	1/4"	83 3/8"	83 7/8"	85 5/8"	86 1/3"
84"	38.48	2410	8"	7"	1/4"	89 3/4"	90 1/4"	92 1/8"	92 5/8"
90"	44.18	2740	8 1/2"	7"	1/4"	95 3/4"	96 1/4"	98 1/8"	98 5/8"
96"	50.27	2950	9"	7"	1/4"	102 1/8"	102 5/8"	104 1/2"	105"
102"	56.75	3075	9 1/2"	7 1/2"	1/4"	109"	109 1/2"	111 1/2"	112"
108"	63.62	3870	10"	7 1/2"	1/4"	115 1/2"	116"	118"	118 1/2"

* WALL "B" THICKNESS

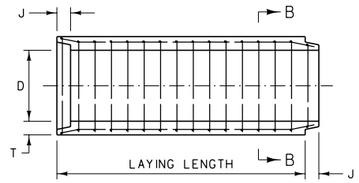


TYPICAL LONGITUDINAL SECTION

36" [900] DIAMETER PIPES AND LARGER

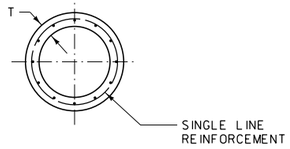


SECTION A-A



TYPICAL LONGITUDINAL SECTION

33" [825] DIAMETER PIPES AND SMALLER



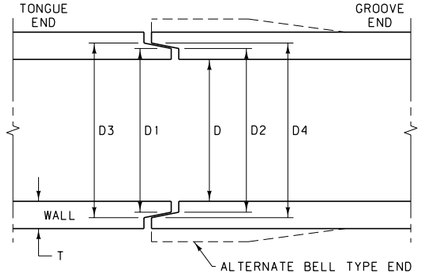
SECTION B-B

METRIC DIMENSION TABLE

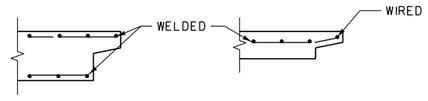
DIA. D	XSEC. WATER AREA (m^2)	WT. PER m OF PIPE (kg)	T * MIN. WALL THICKNESS	J LENGTH OF JOINT	A (NOMINAL) = $\frac{D2 - D1}{2}$	D1	D2	D3	D4
300	0.073	136.9	50.8	44.45	4.76	336.55	346.08	352.43	361.95
375	0.114	189.0	57.2	50.80	4.76	419.10	428.63	438.15	447.68
450	0.164	250.0	63.5	57.15	4.76	498.48	508.00	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

NOTE: ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED

* WALL "B" THICKNESS



JOINT DETAIL



REINFORCING AT ENDS OF PIPE

NOTES:

PROVIDE TOLERANCES IN DIMENSIONS PER SECTION 708.

TYPICAL FOR DRAINAGE APPLICATIONS.

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

DETAILED DRAWING

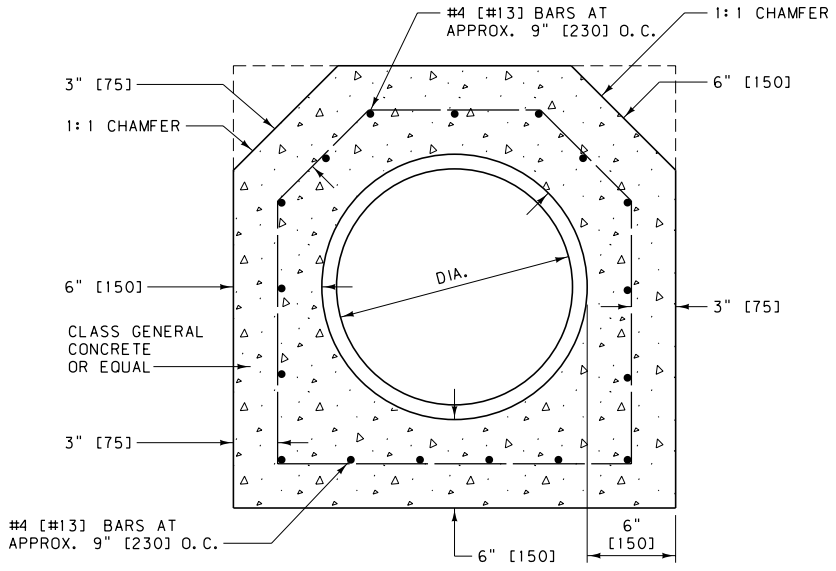
REFERENCE STANDARD SPEC. SECTION 603, 708

DWG. NO. 603-24

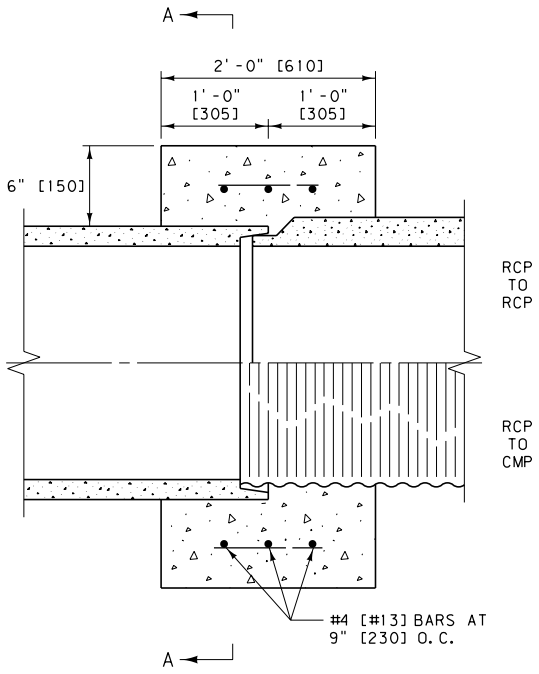
REINFORCED CONCRETE PIPE JOINT

EFFECTIVE: SEPTEMBER 2014

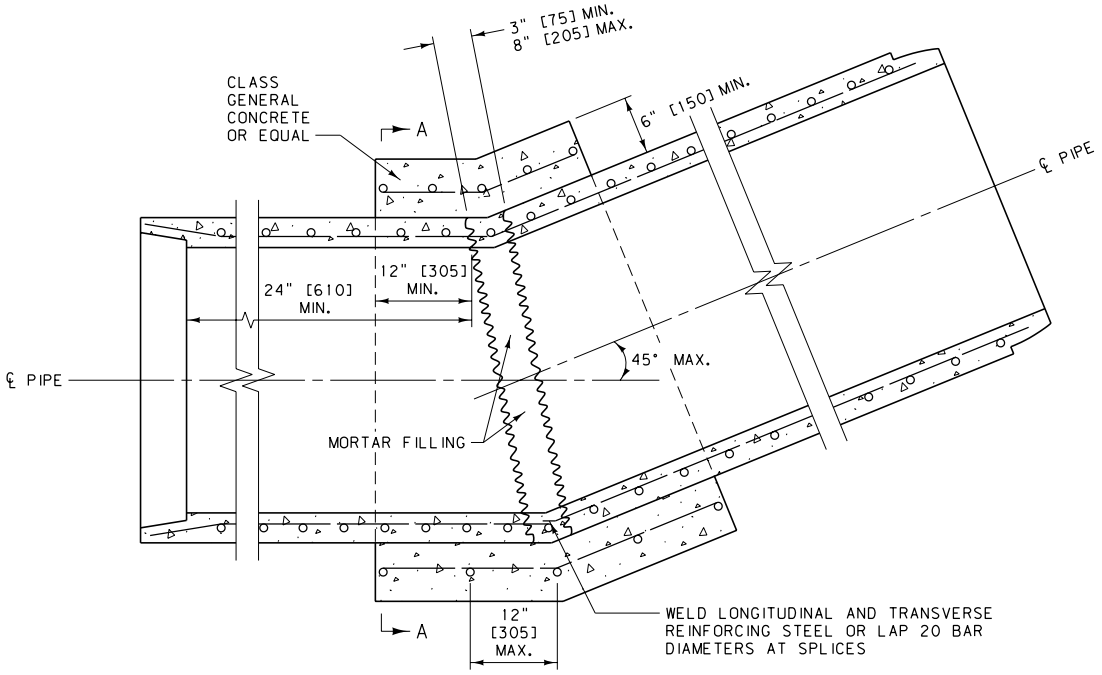
MDT MONTANA DEPARTMENT OF TRANSPORTATION



SECTION A-A



CONNECTION DETAILS

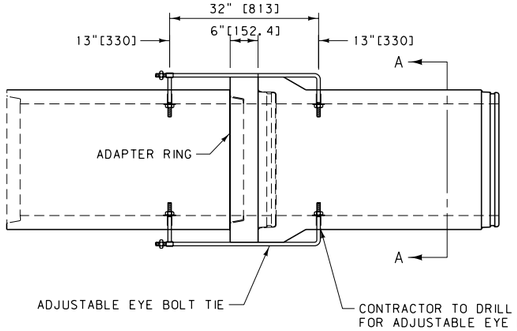


TYPICAL FIELD CAST CONCRETE BEND

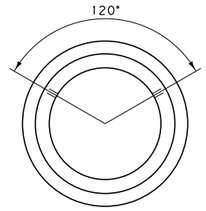
UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.

DETAILED DRAWING	
REFERENCE STANDARD SPEC. SECTION 603, 708	DWG. NO. 603-26
TYPICAL FIELD CAST CONCRETE CONNECTIONS	
EFFECTIVE: SEPTEMBER 2014	
MDT MONTANA DEPARTMENT OF TRANSPORTATION	

ADAPTER RING - TIE BOLT DETAIL



PLAN VIEW



SECTION A-A

NOTES:

① PART NUMBER 11051-A FURNISH WITH ADJUSTING NUT ONLY, ALL OTHERS AS SHOWN

② BOLTS PAINTED WITH ZINC CHROMATE IRON OXIDE

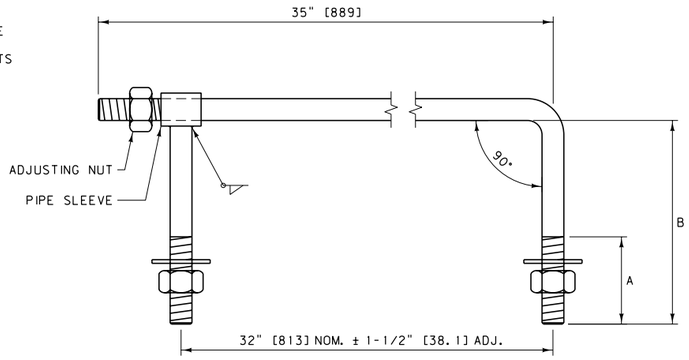
③ PAINT STANDARD ROLLED THREADS ON ALL BOLTS

④ RODS MAY BE HOT BENT

⑤ FOR 18" [457] RCP USE 42-54 EYE BOLT TIE

⑥ FOR 24" [610] RCP USE 60-66 EYE BOLT TIE

ADJUSTABLE EYE BOLT TIE



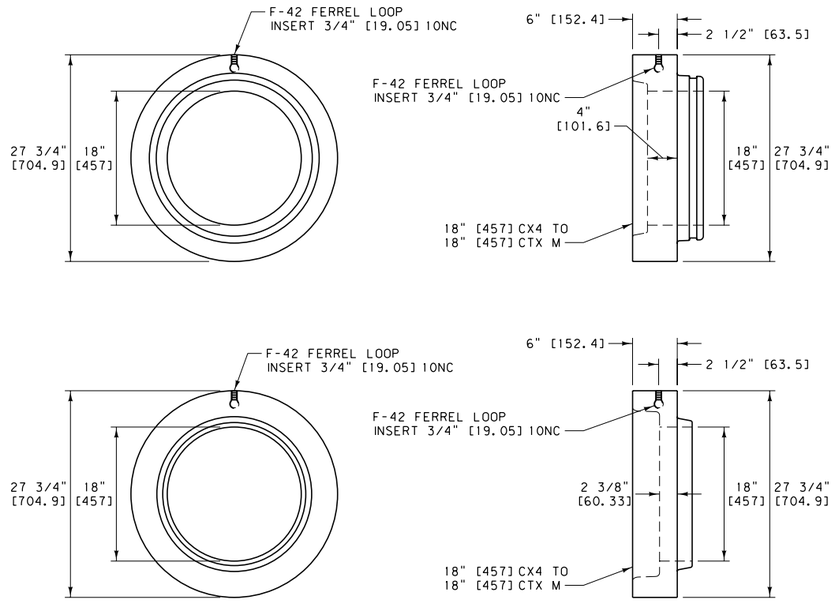
PART NO.	PIPE SIZE *	WALL THK.	P/N	THREAD DIA.	A in	B in	ROD DIA.
11051-A	12"-27"	2"-3.5"	091000	5/8"	0	4	9/16"
11051-D	30"-36"	3.5"-4"	091004	3/4"	3	5.5	11/16"
11051-G	42"-54"	4.5"-5.5"	091008	3/4"	3	7	11/16"
11051-J	60"-66"	6"-6.5"	091012	3/4"	3	8.5	11/16"
11051-M	72"-84"	7"-8"	091016	1"	3	10.5	29/32"
11051-O	90"-102"	8.5"-9.5"	091019	1"	3	12	29/32"
11051-Q	108"-120"	10"	091022	1"	3	13	29/32"

* BASED ON 'B' WALL ROUND PIPE AND EQUIVALENT SIZE ARCH PIPE

PART NO.	PIPE SIZE *	WALL THK.	P/N	THREAD DIA.	A mm	B mm	ROD DIA.
11051-A	300-675	50.8-88.9	091000	15.88	0.0	101.6	14.29
11051-D	750-900	88.9-101.6	091004	19.05	76.2	139.7	17.46
11051-G	1050-1350	114.3-139.7	091008	19.05	76.2	177.8	17.46
11051-J	1500-1650	152.4-165.1	091012	19.05	76.2	215.9	17.46
11051-M	1800-2100	177.8-203.2	091016	25.4	76.2	266.7	23.02
11051-O	2250-2550	215.9-241.3	091019	25.4	76.2	304.8	23.02
11051-Q	2700-3000	254.0	091022	25.4	76.2	330.2	23.02

* BASED ON 'B' WALL ROUND PIPE AND EQUIVALENT SIZE ARCH PIPE

18" [457] CTX ADAPTER RING

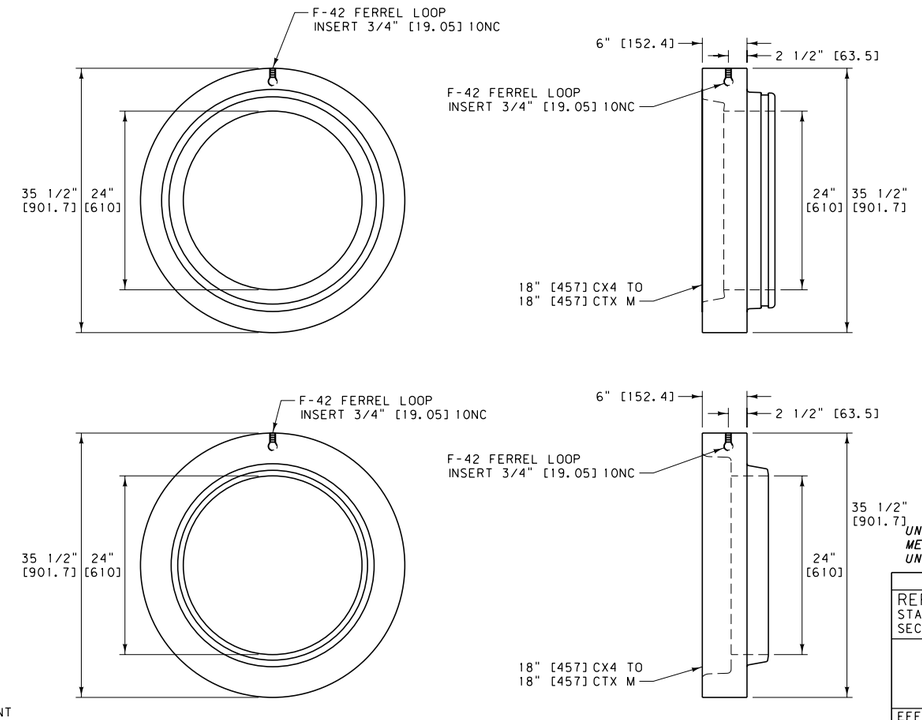


NOTES:

① PRODUCED PER ASTM C76

② CL5 REINFORCING, TYPE 5 CEMENT

24" [610] CTX ADAPTER RING



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

DETAILED DRAWING

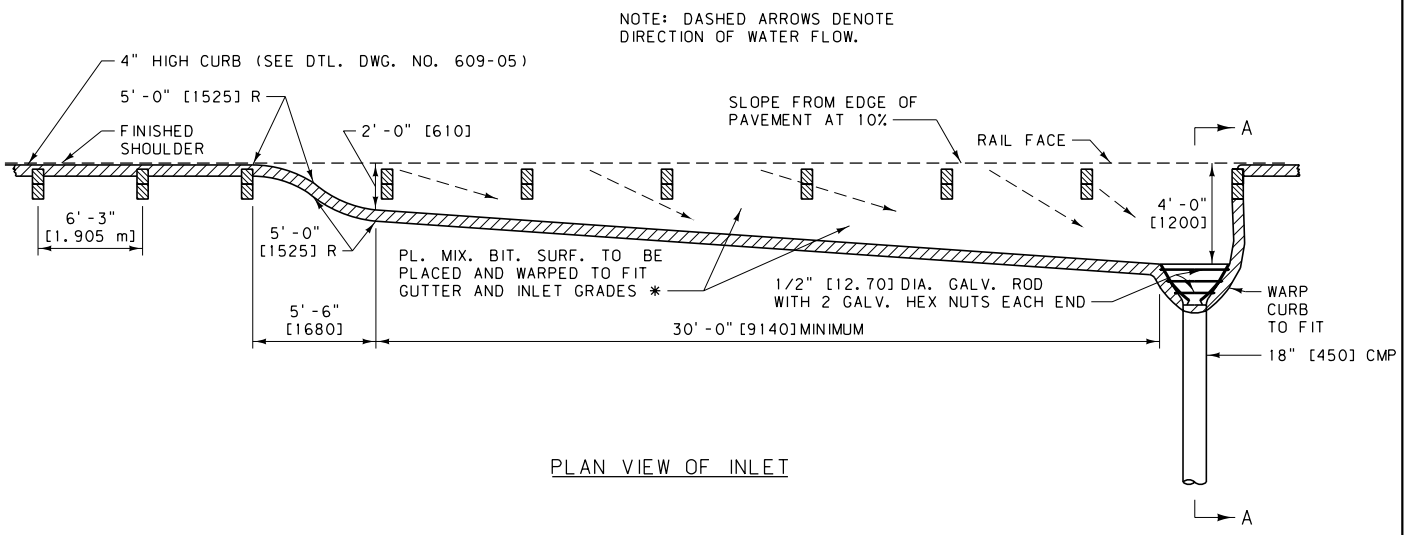
REFERENCE
STANDARD SPEC.
SECTION 603

DWG. NO.
603-27

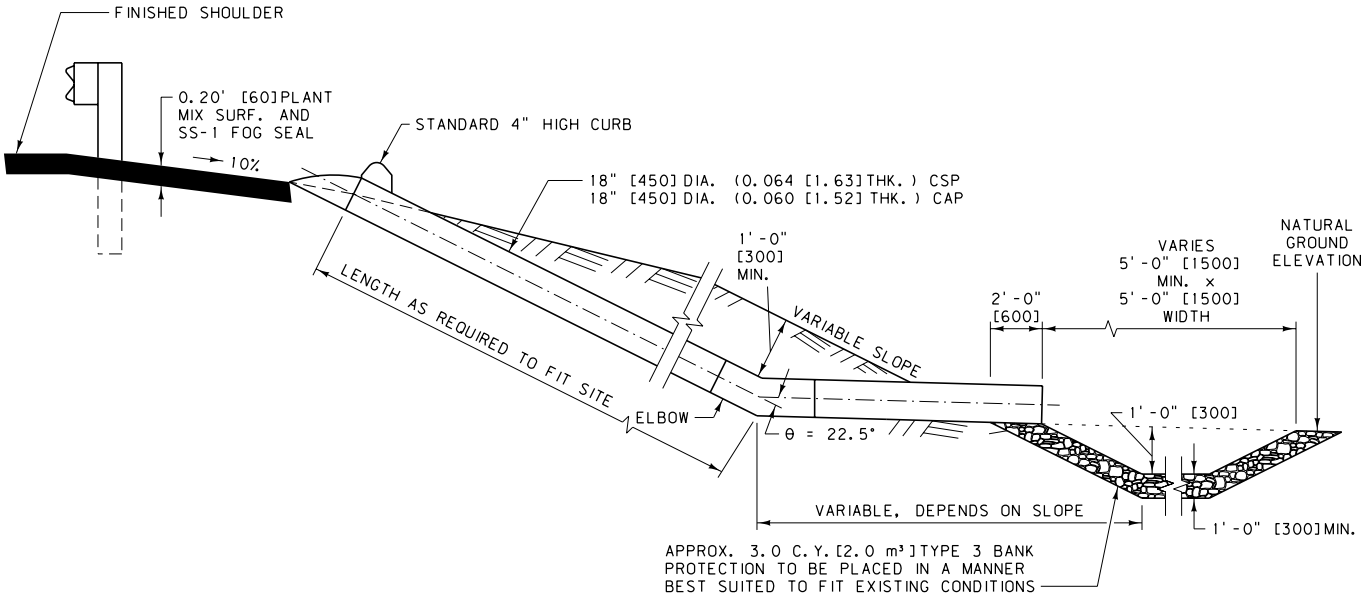
CTX ADAPTER

EFFECTIVE: SEPTEMBER 2014

MDT MONTANA DEPARTMENT OF TRANSPORTATION



PLAN VIEW OF INLET



OUTLET DETAIL

SECTION A-A

NOTES:

① 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.

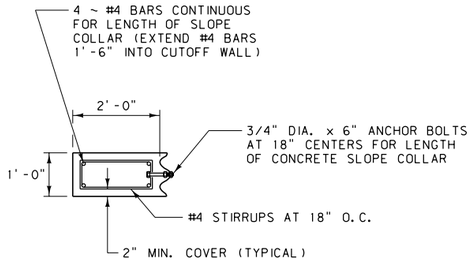
② THE COST OF SS-1 FOG SEAL IS INCLUDED IN THE COST OF PLANT MIX SURFACING.

* INCLUDED WITH ROADWAY QUANTITIES.

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

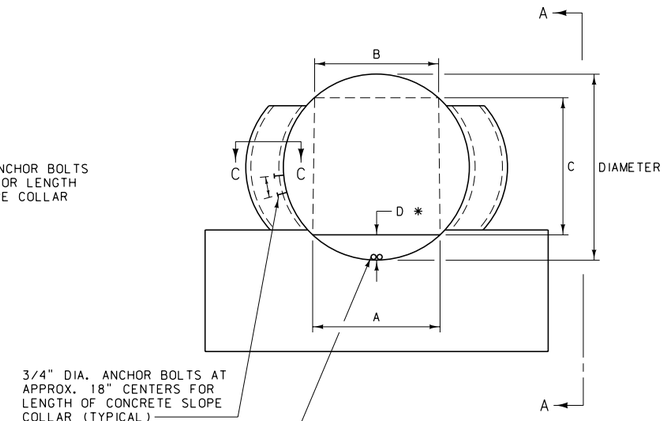
DETAILED DRAWING	
REFERENCE STANDARD SPEC. SECTION 603	DWG. NO. 603-28
EMBANKMENT PROTECTOR	
EFFECTIVE: SEPTEMBER 2014	

MDT MONTANA DEPARTMENT OF TRANSPORTATION

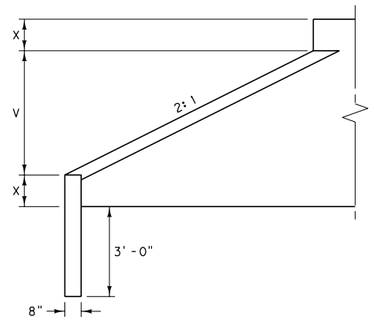


NOTE:
SEE DTL. DWG. NO. 552-00 FOR ANCHOR BOLT DETAILS.

SECTION C-C



ELEVATION



SECTION A-A

NOTES:

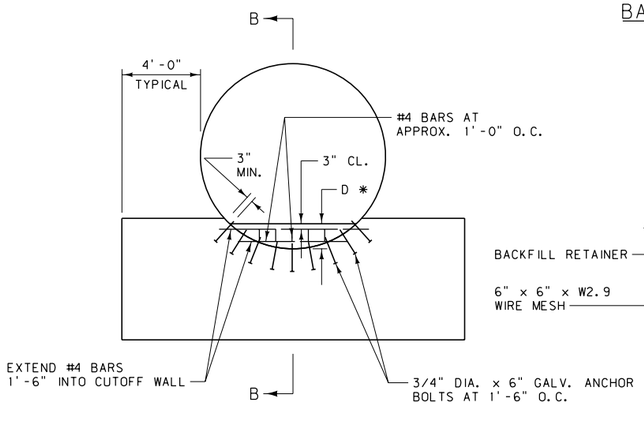
1. DESIGNATE THESE STRUCTURES, IN PLANS AND PROPOSAL, AS "VEHICULAR UNDERPASS." USE THE TERM "VEHICULAR UNDERPASS," REGARDLESS OF THE USE OR PURPOSE OF THE STRUCTURE.
2. PROVIDE END TREATMENT FOR ALL VEHICULAR UNDERPASSES INCLUDING CUTOFF WALLS, BACKFILL RETAINING WALLS AND CONCRETE SLOPE COLLARS.
3. PROVIDE SURFACING FOR THE INSIDE OF THE STRUCTURE, CROSS-SLOPED TO ALLOW A DRAINAGE COURSE DOWN THE CENTERLINE.
4. FOR PLATE THICKNESS SEE ROAD DESIGN MANUAL FILL HEIGHT TABLES.
5. USE CLASS GENERAL CONCRETE OR EQUAL.
6. SEE DTL. DWG. NO. 552-08 FOR QUANTITIES.
7. SEE DTL. DWG. NO. 603-31 FOR ALTERNATIVE "C" PCCP TRANSVERSE JOINT AND BACKFILL RETAINER DETAILS.

DEPTH OF SURFACING *			
MATERIAL	ALTERNATE "A"	ALTERNATE "B"	ALTERNATE "C"
PL. MIX SURF.	—	0.20'	—
PORT. CEM. CONC. PAVE.	—	—	0.67'
CRUSHED AGGREGATE COURSE	BAL.	BAL.	BAL.

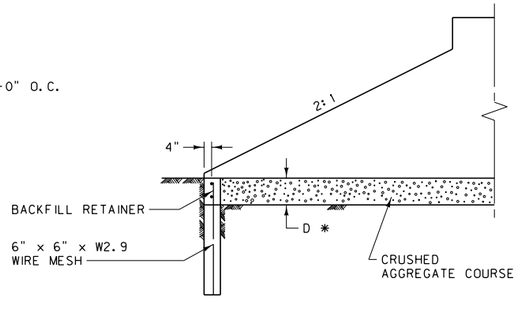
DIAMETER	A	B	C	V	X	D *	BACKFILL RETAINER (C.Y.)	CONCRETE COLLAR (C.Y.)
96"	4'	4'	6.9'	4.0'	2.0'	0.5'	0.04	0.66
120"	7'	7'	7.1'	5.0'	2.5'	1.4'	0.17	0.82
150"	10'	8'	8.6'	6.25'	3.13'	2.5'	0.43	1.08
162"	10'	8'	10.0'	6.75'	3.38'	2.2'	0.38	1.16
186"	12'	10'	10.8'	7.75'	3.88'	2.9'	0.59	1.34
192"	12'	10'	11.5'	8.0'	4.0'	2.7'	0.55	1.38
204"	12'	10'	12.9'	8.5'	4.25'	2.5'	0.51	1.46
216"	12'	10'	14.2'	9.0'	4.50'	2.3'	0.47	1.54
228"	16'	12'	12.5'	9.5'	4.75'	4.4'	1.23	1.72
240"	16'	12'	14.0'	10.0'	5.0'	4.0'	1.10	1.72

SURFACING QUANTITIES PER LINEAR FOOT FOR DEPTH "D" *									
	ALTERNATE "A"	ALTERNATE "B"						ALTERNATE "C"	
	C.Y. SURFACING	TONS SURFACING		C.Y. SURFACING	TONS BIT. MATL.			C.Y. SURFACING	S.Y. SURFACING
DIAMETER	CRUSHED AGGREGATE COURSE	COVER MATERIAL	PLANT MIX	CRUSHED AGGREGATE COURSE	PLANT MIX	PRIME	SEAL	CRUSHED AGGREGATE COURSE	PORT. CEM. CONCRETE PAVEMENT
96"	0.054	0.0056	0.052	0.027	0.0031	0.0005	0.0007	—	0.444
120"	0.255	0.0097	0.097	0.205	0.0058	0.0009	0.0012	0.096	0.778
150"	0.647	0.0139	0.141	0.574	0.0084	0.0014	0.0017	0.413	1.111
162"	0.563	0.0139	0.140	0.489	0.0084	0.0014	0.0017	0.332	1.111
186"	0.882	0.0167	0.169	0.794	0.0102	0.0017	0.0020	0.615	1.333
192"	0.830	0.0167	0.168	0.744	0.0101	0.0016	0.0020	0.550	1.333
204"	0.769	0.0167	0.169	0.680	0.0102	0.0016	0.0020	0.486	1.333
216"	0.702	0.0167	0.168	0.615	0.0101	0.0016	0.0020	0.423	1.333
228"	1.842	0.0222	0.227	1.725	0.0136	0.0022	0.0026	1.453	1.778
240"	1.656	0.0222	0.226	1.539	0.0136	0.0022	0.0026	1.273	1.778

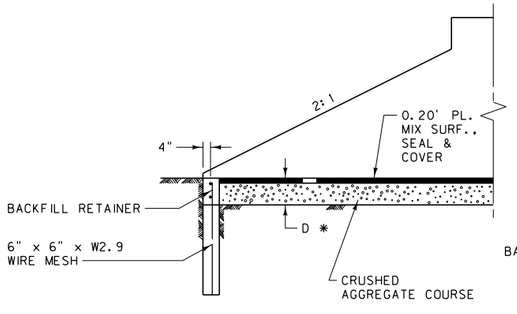
BACKFILL RETAINER & CUTOFF WALL DETAIL



ELEVATION

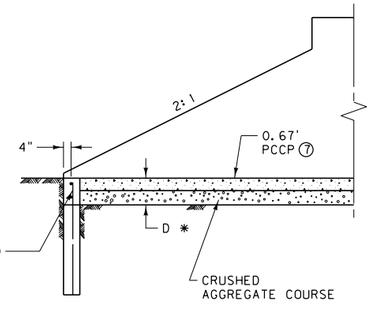


SECTION B-B
(ALTERNATE "A")



SECTION B-B
(ALTERNATE "B")

NOTE:
INCLUDE CONCRETE COLLAR WHEN SPECIFIED.



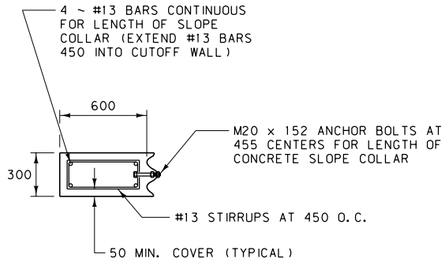
SECTION B-B
(ALTERNATE "C")

DETAILED DRAWING	
REFERENCE STANDARD SPEC. SECTION 552, 603	DWG. NO. 603-30

VEHICULAR UNDERPASS AND BACKFILL RETAINER & CUTOFF WALL DETAIL

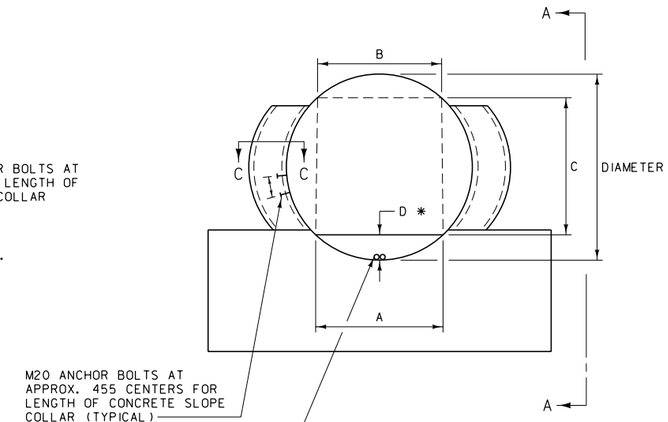
EFFECTIVE: SEPTEMBER 2014

MDT MONTANA DEPARTMENT OF TRANSPORTATION

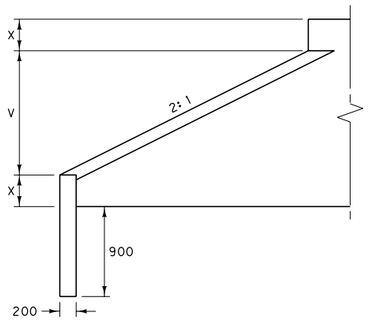


NOTE:
SEE DTL. DWG. NO. 552-00
FOR ANCHOR BOLT DETAILS.

SECTION C-C



ELEVATION



SECTION A-A

NOTES:

① DESIGNATE THESE STRUCTURES, IN PLANS AND PROPOSAL, AS "VEHICULAR UNDERPASS." USE THE TERM "VEHICULAR UNDERPASS," REGARDLESS OF THE USE OR PURPOSE OF THE STRUCTURE.

② PROVIDE END TREATMENT FOR ALL VEHICULAR UNDERPASSES INCLUDING CUTOFF WALLS, BACKFILL RETAINING WALLS AND CONCRETE SLOPE COLLARS.

③ PROVIDE SURFACING FOR THE INSIDE OF THE STRUCTURE, CROSS-SLOPED TO ALLOW A DRAINAGE COURSE DOWN THE CENTERLINE.

④ FOR PLATE THICKNESS SEE ROAD DESIGN MANUAL FILL HEIGHT TABLES.

⑤ USE CLASS GENERAL CONCRETE OR EQUAL.

⑥ SEE DTL. DWG. NO. 552-08 FOR QUANTITIES.

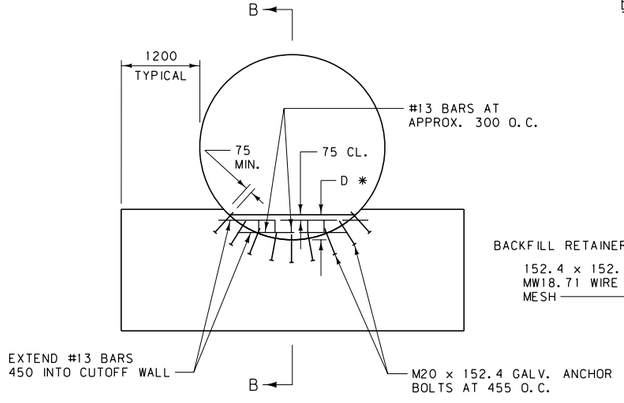
⑦ SEE DTL. DWG. NO. 603-31 FOR ALTERNATIVE "C" PCCP TRANSVERSE JOINT AND BACKFILL RETAINER DETAILS.

DEPTH OF SURFACING *			
MATERIAL	ALTERNATE "A"	ALTERNATE "B"	ALTERNATE "C"
PL. MIX SURF.	—	60	—
PORT. CEM. CONC. PAVE.	—	—	203
CRUSHED AGGREGATE COURSE	BAL.	BAL.	BAL.

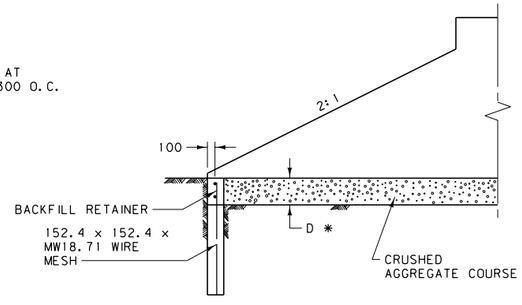
DIAMETER	A (m)	B (m)	C (m)	V (m)	X (m)	D *	BACKFILL RETAINER (m³)	CONCRETE COLLAR (m³)
2400	1.2	1.2	2.078	1.200	0.600	173	0.03	0.50
3000	2.1	2.1	2.142	1.500	0.750	441	0.13	0.63
3.825 m	3.0	2.4	2.683	1.916	0.957	750	0.32	0.80
4.135 m	3.0	2.4	3.114	2.071	1.035	669	0.28	0.87
4.755 m	3.6	3.0	3.407	2.381	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"						ALTERNATE "C"	
	m³ SURFACING	TONS SURFACING		m³ SURFACING	TONS BIT. MATL.			m³ SURFACING	m² SURFACING
DIAMETER	CRUSHED AGGREGATE COURSE	COVER MATERIAL	PLANT MIX	CRUSHED AGGREGATE COURSE	PLANT MIX	PRIME	SEAL	CRUSHED AGGREGATE COURSE	PORT. CEM. CONCRETE PAVEMENT
2400	0.147	0.0175	0.158	0.078	0.0095	0.0015	0.0020	—	1.200
3000	0.649	0.0299	0.284	0.525	0.0170	0.0029	0.0034	0.259	2.100
3.825 m	1.604	0.0429	0.414	1.423	0.0248	0.0042	0.0049	0.998	3.000
4.135 m	1.420	0.0430	0.414	1.239	0.0248	0.0042	0.0049	0.822	3.000
4.755 m	2.159	0.0513	0.496	1.942	0.0298	0.0051	0.0059	1.429	3.600
4.910 m	2.056	0.0514	0.496	1.839	0.0298	0.0051	0.0059	1.327	3.600
5.220 m	1.882	0.0514	0.496	1.665	0.0298	0.0051	0.0059	1.159	3.600
5.530 m	1.741	0.0515	0.496	1.524	0.0298	0.0050	0.0059	1.023	3.600
5.840 m	4.368	0.0681	0.661	4.079	0.0397	0.0068	0.0078	3.372	4.800
6.150 m	3.985	0.0681	0.661	3.696	0.0397	0.0068	0.0078	2.998	4.800

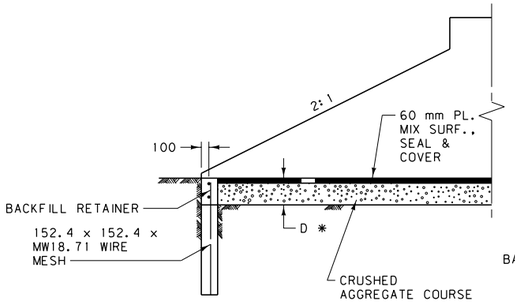
BACKFILL RETAINER & CUTOFF WALL DETAIL



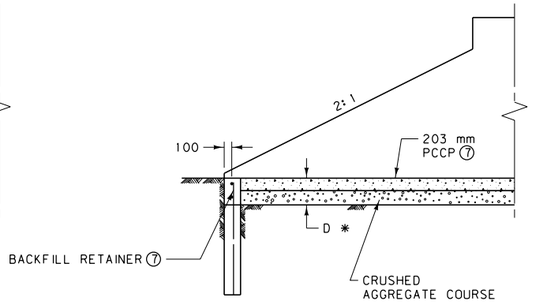
ELEVATION



SECTION B-B
(ALTERNATE "A")



NOTE:
INCLUDE CONCRETE COLLAR
WHEN SPECIFIED.



SECTION B-B
(ALTERNATE "C")

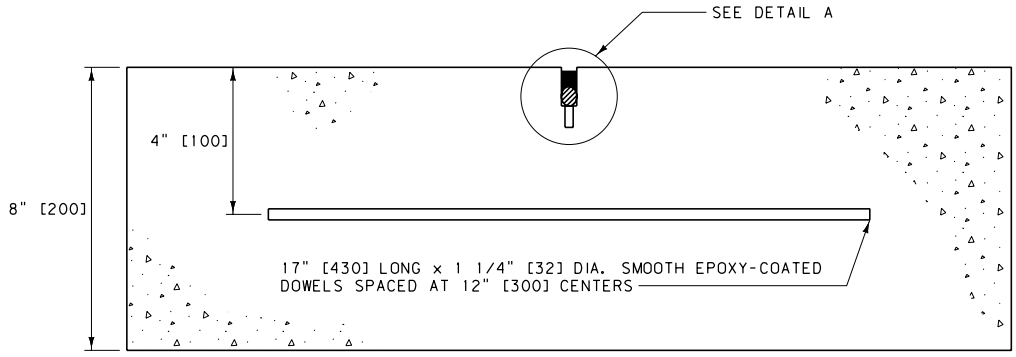
ALL DIMENSIONS ARE MILLIMETERS (mm) UNLESS OTHERWISE NOTED.

DETAILED DRAWING	
REFERENCE STANDARD SPEC. SECTION 552, 603	DWG. NO. 603-30

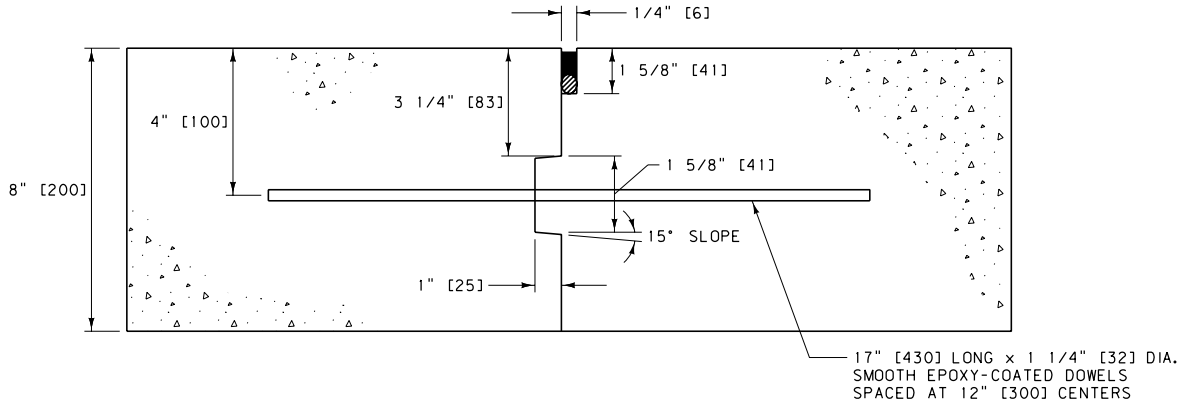
VEHICULAR UNDERPASS AND BACKFILL RETAINER & CUTOFF WALL DETAIL (METRIC)

EFFECTIVE: SEPTEMBER 2014

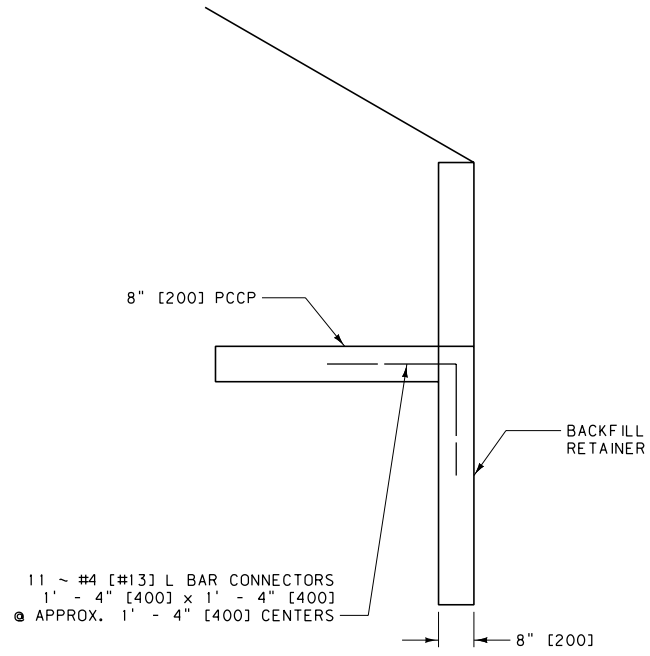
MDT MONTANA DEPARTMENT OF TRANSPORTATION



TRANSVERSE CONTRACTION JOINT (15' [4.5 m] O.C.)

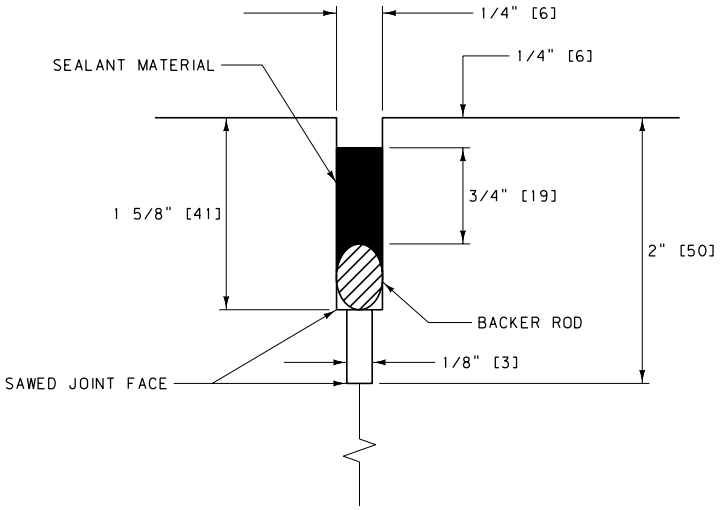


TRANSVERSE CONTRACTION JOINT (AS NEEDED)



TYPICAL BOTH ENDS

REINFORCING STEEL FOR INLET
BACKFILL RETAINER ℄ PCCP SLAB



DETAIL A

SAWED TRANSVERSE OR LONGITUDINAL
JOINT WITH HOT POURED SEALANT

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

DETAILED DRAWING

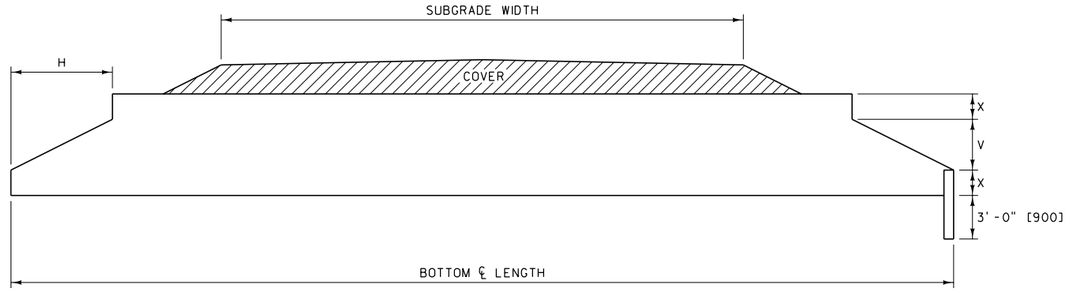
REFERENCE STANDARD SPEC. SECTION 603

DWG. NO. 603-31

VEHICULAR UNDERPASS
PCCP TRANSVERSE JOINT
& BACKFILL RETAINER DETAILS

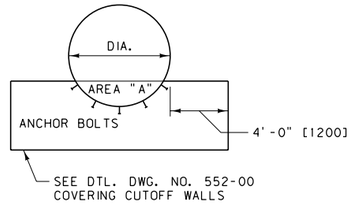
EFFECTIVE: SEPTEMBER 2014

MDT MONTANA DEPARTMENT OF TRANSPORTATION



DIMENSIONS					
DIA.	X (FT.)	V (FT.)	H (FT.) FOR BEVELS: 1.5:1	H (FT.) FOR BEVELS: 2:1	AREA "A" (SQ. FT.) *
CSP 3" x 1" OR 5" x 1" CORRUGATIONS (SEE NOTE ③)					
54"	1.125	2.250	3.375	4.500	3.31
60"	1.250	2.500	3.750	5.000	4.06
66"	1.375	2.750	4.125	5.500	4.89
72"	1.500	3.000	4.500	6.000	5.79
78"	1.625	3.250	4.875	6.500	6.77
84"	1.750	3.500	5.250	7.000	7.83
90"	1.875	3.750	5.625	7.500	8.97
96"	2.000	4.000	6.000	8.000	10.18
102"	2.125	4.250	6.375	8.500	11.47
108"	2.250	4.500	6.750	9.000	12.83
114"	2.375	4.750	7.125	9.500	14.27
120"	2.500	5.000	7.500	10.000	15.79
SSPP 6" x 2" CORRUGATIONS					
10'-6"	2.625	5.250	7.875	10.500	17.39
11'-0"	2.750	5.500	8.250	11.000	19.06
11'-6"	2.875	5.750	8.625	11.500	20.81
12'-0"	3.000	6.000	9.000	12.000	22.64
12'-6"	3.125	6.250	9.375	12.500	24.54
13'-0"	3.250	6.500	9.750	13.000	26.52
13'-6"	3.375	6.750	10.125	13.500	28.58
14'-0"	3.500	7.000	10.500	14.000	30.71
14'-6"	3.625	7.250	10.875	14.500	32.92
15'-0"	3.750	7.500	11.250	15.000	35.21
15'-6"	3.875	7.750	11.625	15.500	37.57
16'-0"	4.000	8.000	12.000	16.000	40.01
16'-6"	4.125	8.250	12.375	16.500	42.53
17'-0"	4.250	8.500	12.750	17.000	45.12
17'-6"	4.375	8.750	13.125	17.500	47.79
18'-0"	4.500	9.000	13.500	18.000	50.54
19'-0"	4.750	9.500	14.250	19.000	56.26
20'-0"	5.000	10.000	15.000	20.000	62.29
21'-0"	5.250	10.500	15.750	21.000	68.63

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



NOTES:

① BEVEL TO TOP OF CORNER PLATE.

② PIPE ENDS ARE SQUARE (PERPENDICULAR TO CENTERLINE OF PIPE) AND FILL SLOPES ARE WARPED TO ACCOMMODATE THE SQUARE ENDS UNLESS SPECIFIED OTHERWISE ON PLANS.

③ TABULATED VALUES BASED ON NOMINAL PIPE DIMENSIONS. IN PLACE DIMENSIONS SUBJECT TO TOLERANCE REQUIREMENTS OF SECTION 709.

METRIC DIMENSIONS					
DIA. #	X (m)	V (m)	H (m) FOR BEVELS: 1.5:1	H (m) FOR BEVELS: 2:1	AREA "A" (m^2) *
CSP 75 x 25 OR 125 x 25 CORRUGATIONS (SEE NOTE ③)					
1350 mm	0.338	0.674	1.011	1.348	0.30
1500 mm	0.375	0.750	1.125	1.500	0.37
1650 mm	0.412	0.826	1.239	1.652	0.44
1800 mm	0.450	0.900	1.350	1.800	0.52
1950 mm	0.488	0.974	1.461	1.948	0.61
2100 mm	0.525	1.050	1.575	2.100	0.70
2250 mm	0.563	1.124	1.686	2.248	0.81
2400 mm	0.600	1.200	1.800	2.400	0.92
2550 mm	0.637	1.276	1.914	2.552	1.03
2700 mm	0.675	1.350	2.025	2.700	1.15
2850 mm	0.712	1.426	2.139	2.852	1.28
3000 mm	0.750	1.500	2.250	3.000	1.42
SSPP 152 x 51 CORRUGATIONS					
3.205 m	0.802	1.605	2.408	3.210	1.67
3.360 m	0.841	1.682	2.523	3.364	1.83
3.515 m	0.880	1.760	2.640	3.520	2.00
3.670 m	0.919	1.837	2.756	3.674	2.17
3.825 m	0.957	1.916	2.874	3.832	2.36
3.980 m	0.996	1.993	2.990	3.986	2.55
4.135 m	1.035	2.071	3.107	4.142	2.74
4.290 m	1.074	2.148	3.222	4.296	2.95
4.445 m	1.113	2.225	3.338	4.450	3.16
4.600 m	1.152	2.302	3.453	4.604	3.38
4.755 m	1.190	2.381	3.572	4.762	3.61
4.910 m	1.229	2.459	3.689	4.918	3.84
5.065 m	1.268	2.536	3.804	5.072	4.09
5.220 m	1.307	2.613	3.920	5.226	4.34
5.375 m	1.346	2.690	4.035	5.380	4.59
5.530 m	1.384	2.770	4.155	5.540	4.86
5.685 m	1.423	2.847	4.271	5.694	5.13
5.840 m	1.462	2.924	4.386	5.848	5.41
5.995 m	1.501	3.001	4.502	6.002	5.69
6.150 m	1.540	3.079	4.619	6.158	5.99
6.305 m	1.578	3.158	4.737	6.316	6.29
6.460 m	1.617	3.235	4.853	6.470	6.60

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

NOMINAL DIAMETER

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

DETAILED DRAWING

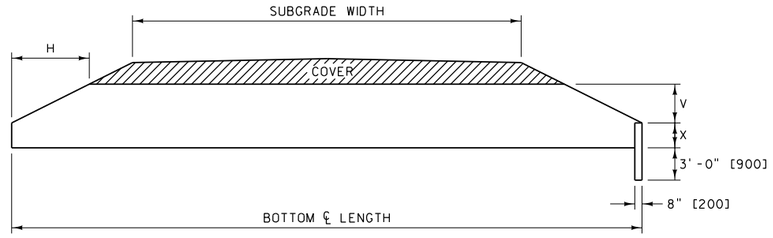
REFERENCE STANDARD SPEC. SECTION 552, 603, 709

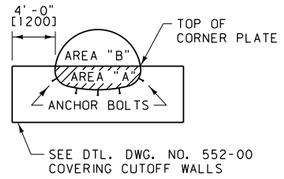
DWG. NO. 603-32

STEP BEVEL FOR CIRCULAR METAL CULVERT

EFFECTIVE: SEPTEMBER 2014

MDT MONTANA DEPARTMENT OF TRANSPORTATION





NOTES:

① BEVEL TO TOP OF CORNER PLATE.

② PIPE ENDS ARE SQUARE (PERPENDICULAR TO CENTERLINE OF PIPE) AND FILL SLOPES ARE WARPED TO ACCOMMODATE THE SQUARE ENDS UNLESS SPECIFIED OTHERWISE ON PLANS.

③ TABULATED VALUES BASED ON NOMINAL PIPE DIMENSIONS. IN PLACE DIMENSIONS SUBJECT TO TOLERANCE REQUIREMENTS OF SECTION 709.

DIMENSIONS									
SPAN	RISE	EQUIV. DIA.	X (FT.)	V (FT.)	H (FT.) FOR BEVELS: 1.5:1	2:1	2.5:1	AREA "A" (SQ. FT.)	AREA "B" (SQ. FT.)
SSPPA 6" x 2" CORRUGATIONS WITH 18" CORNER RADIUS									
6'-1"	4'-7"	66"	2.3	2.3	3.4	4.6	5.7	12	10
6'-9"	4'-11"	72"	2.4	2.5	3.8	5.0	6.3	14	12
7'-3"	5'-3"	78"	2.1	3.2	4.7	6.3	7.9	13	17
7'-11"	5'-7"	84"	2.3	3.3	4.9	6.6	8.2	16	19
8'-7"	5'-11"	90"	2.3	3.6	5.4	7.2	9.0	17	23
9'-4"	6'-3"	96"	2.5	3.8	5.6	7.5	9.4	20	26
9'-9"	6'-7"	102"	2.2	4.4	6.6	8.8	11.0	19	32
10'-8"	6'-11"	108"	2.8	4.1	6.2	8.2	10.3	25	32
11'-5"	7'-3"	114"	2.8	4.5	6.7	8.9	11.1	27	37
11'-10"	7'-7"	120"	2.5	5.1	7.6	10.2	13.6	25	45
12'-6"	7'-11"	126"	2.7	5.2	7.8	10.4	13.0	29	49
12'-10"	8'-4"	132"	2.3	6.0	8.9	11.9	14.9	26	60
SSPPA 6" x 2" CORRUGATIONS WITH 31" CORNER RADIUS									
13'-3"	9'-4"	~	3.9	5.5	8.2	10.9	13.6	44	54
13'-6"	9'-6"	~	3.8	5.7	8.6	11.5	14.3	44	58
14'-0"	9'-8"	144"	4.0	5.7	8.5	11.4	14.2	48	59
14'-2"	9'-10"	~	3.8	6.1	9.1	12.1	15.2	46	64
14'-5"	10'-0"	~	3.7	6.3	9.5	12.7	15.9	46	69
14'-11"	10'-2"	~	4.0	6.2	9.3	12.4	15.5	51	68
15'-4"	10'-4"	156"	4.3	6.0	9.1	12.1	15.1	56	68
15'-7"	10'-6"	~	4.1	6.4	9.6	12.8	16.1	54	74
15'-10"	10'-8"	~	3.9	6.8	10.2	13.6	17.0	53	80
16'-3"	10'-10"	~	4.3	6.5	9.8	13.1	16.4	59	79
16'-6"	11'-0"	168"	4.1	6.9	10.4	13.9	17.3	58	85
17'-0"	11'-2"	~	4.4	6.8	10.2	13.6	17.0	63	85
17'-2"	11'-4"	~	4.3	7.1	10.6	14.1	17.6	63	90
17'-5"	11'-6"	~	4.1	7.4	11.2	14.9	18.6	61	97
17'-11"	11'-8"	180"	4.3	7.4	11.1	14.8	18.5	65	98
18'-1"	11'-10"	~	4.2	7.7	11.5	15.3	19.2	65	103
18'-7"	12'-0"	~	4.5	7.5	11.3	15.0	18.8	70	103
18'-9"	12'-2"	~	4.3	7.9	11.8	15.8	19.7	68	111
19'-3"	12'-4"	192"	4.6	7.7	11.6	15.5	19.4	74	110
19'-6"	12'-6"	~	4.4	8.1	12.2	16.3	20.3	72	118
19'-8"	12'-8"	~	4.3	8.4	12.6	16.8	21.0	72	124
19'-11"	12'-10"	~	4.1	8.8	13.2	17.6	22.0	69	132
20'-5"	13'-0"	204"	4.4	8.6	12.9	17.3	21.6	76	132
20'-7"	13'-2"	~	4.3	8.9	13.4	17.8	22.3	75	137

DIMENSIONS									
SPAN	RISE	EQUIV. DIA.	X (FT.)	V (FT.)	H (FT.) FOR BEVELS: 1.5:1	2:1	2.5:1	AREA "A" (SQ. FT.)	AREA "B" (SQ. FT.)
CSPA 3" x 1" CORRUGATIONS (SEE NOTE ③)									
60"	46"	54"	1.7	2.3	3.5	4.7	5.8	7	9
66"	51"	60"	1.9	2.6	3.9	5.2	6.5	8	11
73"	55"	66"	2.1	2.8	4.1	5.5	6.9	11	13
81"	59"	72"	2.0	3.2	4.8	6.5	8.1	11	16
87"	63"	78"	2.1	3.5	5.2	6.9	8.6	12	20
95"	67"	84"	2.3	3.7	5.5	7.3	9.2	15	22
103"	71"	90"	2.5	3.9	5.8	7.7	9.6	18	25
112"	75"	96"	2.6	4.1	6.1	8.1	10.2	19	29
117"	79"	102"	2.8	4.3	6.4	8.5	10.7	23	32
128"	83"	108"	3.0	4.5	6.7	8.9	11.2	26	35
137"	87"	114"	3.1	4.7	7.0	9.4	11.7	28	39
142"	91"	120"	3.3	4.9	7.3	9.7	12.2	32	43
CSPA 2 2/3" x 1/2" CORRUGATIONS (SEE NOTE ③)									
57"	38"	48"	1.1	2.1	3.1	4.2	5.2	4	7
64"	43"	54"	1.2	2.4	3.5	4.7	5.9	5	10
71"	47"	60"	1.4	2.6	3.8	5.1	6.4	7	11
77"	52"	66"	1.5	2.8	4.3	5.7	7.1	8	14
83"	57"	72"	1.6	3.1	4.7	6.3	7.8	10	17

METRIC DIMENSIONS								
SPAN (mm)	RISE (mm)	X (m)	V (m)	H (m) FOR BEVELS: 1.5:1	2:1	2.5:1	AREA "A" (m²)	AREA "B" (m²)
CSPA 75 x 25 CORRUGATIONS (SEE NOTE ③)								
1520	1170	0.520	0.650	0.975	1.300	~	0.65	0.84
1670	1300	0.580	0.720	1.080	1.440	~	0.74	1.02
1850	1400	0.640	0.760	1.140	1.520	~	1.02	1.21
2050	1500	0.610	0.890	1.335	1.780	~	1.02	1.49
2200	1620	0.640	0.980	1.470	1.960	~	1.11	1.86
2400	1720	0.700	1.020	1.530	2.040	~	1.39	2.04
2600	1820	0.760	1.060	1.590	2.120	~	1.67	2.32
2840	1920	0.790	1.130	1.695	2.260	~	1.77	2.69
2970	2020	0.855	1.165	1.750	2.330	~	2.14	2.97
3240	2120	0.915	1.205	1.810	2.410	~	2.42	3.25
3470	2220	0.945	1.275	1.915	2.550	~	2.60	3.62
3600	2320	1.005	1.315	1.975	2.630	~	2.97	3.99
CSPA 68 x 13 CORRUGATIONS (SEE NOTE ③)								
1440	970	0.335	0.635	0.955	1.270	~	0.37	0.65
1620	1100	0.365	0.735	1.105	1.470	~	0.46	0.93
1800	1200	0.425	0.775	1.165	1.550	~	0.65	1.02
1950	1320	0.455	0.865	1.300	1.730	~	0.74	1.30
2100	1450	0.490	0.960	1.440	1.920	~	0.93	1.58

METRIC DIMENSIONS								
SPAN (m)	RISE (m)	X (m)	V (m)	H (m) FOR BEVELS: 1.5:1	2:1	2.5:1	AREA "A" (m²)	AREA "B" (m²)
SSPPA 150 x 50 CORRUGATIONS WITH 457 CORNER RADIUS								
1.850	1.400	0.701	0.701	1.036	1.402	1.737	1.11	0.93
1.930	1.450	0.640	0.810	1.215	1.620	2.025	1.04	1.14
2.060	1.500	0.732	0.762	1.158	1.524	1.920	1.30	1.11
2.130	1.550	0.700	0.850	1.275	1.700	2.125	1.30	1.30
2.210	1.600	0.640	0.975	1.433	1.920	2.408	1.21	1.58
2.340	1.650	0.700	0.950	1.425	1.900	2.375	1.39	1.67
2.410	1.700	0.701	1.006	1.494	2.012	2.500	1.49	1.77
2.490	1.750	0.610	1.140	1.710	2.280	2.850	1.30	2.14
2.620	1.800	0.701	1.097	1.646	2.195	2.743	1.58	2.14
2.690	1.850	0.670	1.180	1.770	2.360	2.950	1.58	2.42
2.840	1.910	0.762	1.158	1.707	2.286	2.865	1.86	2.42
2.900	1.960	0.700	1.260	1.890	2.520	3.150	1.77	2.79
2.970	2.010	0.671	1.341	2.012	2.682	3.353	1.77	2.97
3.120	2.060	0.730	1.330	1.995	2.660	3.325	1.95	3.07
3.250	2.110	0.853	1.250	1.890	2.500	3.139	2.32	2.97
3.330	2.160	0.790	1.370	2.055	2.740	3.425	2.23	3.34
3.480	2.210	0.853	1.372	2.042	2.713	3.383	2.51	3.44
3.530	2.260	0.820	1.440	2.160	2.880	3.600	2.42	3.81
3.610	2.310	0.762	1.554	2.316	3.109	4.145	2.32	4.18
3.760	2.360	0.850	1.510	2.265	3.020	3.775	2.69	4.18
3.810	2.410	0.823	1.585	2.377	3.170	3.962	2.69	4.55
3.860	2.460	0.760	1.700	2.550	3.400	4250	2.51	5.02
3.910	2.540	0.701	1.829	2.713	3.627	4.542	2.42	5.57
SSPPA 150 x 50 CORRUGATIONS WITH 787 CORNER RADIUS								
4.040	2.840	1.189	1.676	2.499	3.322	4.145	4.09	5.02
4.110	2.900	1.158	1.737	2.621	3.505	4.359	4.09	5.39
4.270	2.950	1.219	1.737	2.591	3.475	4.328	4.46	5.48
4.320	3.000	1.158	1.859	2.774	3.688	4.633	4.27	5.95
4.390	3.050	1.128	1.920	2.896	3.871	4.846	4.27	6.41
4.550	3.100	1.219	1.890	2.835	3.780	4.724	4.74	6.32
4.670	3.150	1.311	1.829	2.774	3.688	4.602	5.20	6.32
4.750	3.200	1.250	1.951	2.926	3.900	4.907	5.02	6.87
4.830	3.250	1.189	2.073	3.109	4.145	5.182	4.92	7.43
4.950	3.300	1.311	1.981	2.987	3.993	4.999	5.48	7.34
5.030	3.350	1.250	2.103	3.170	4.237	5.273	5.39	7.90
5.180	3.400	1.341	2.073	3.109	4.145	5.182	5.85	7.90
5.230	3.450	1.311	2.164	3.231	4.298	5.364	5.85	8.36
5.310	3.510	1.250	2.256	3.414	4.542	5.669	5.67	9.01
5.460	3.560	1.311	2.256	3.383	4.511	5.639	6.04	9.10
5.510	3.610	1.280	2.347	3.505	4.663	5.852	6.04	9.57
5.660	3.660	1.372	2.286	3.444	4.572	5.730	6.50	9.57
5.720	3.710	1.311	2.408	3.597	4.816	6.005	6.32	10.31
5.870	3.760	1.402	2.347	3.537	4.724	5.913	6.87	10.22
5.940	3.810	1.341	2.469	3.719	4.968	6.187	6.69	10.96
5.990	3.860	1.311	2.560	3.840	5.121	6.401	6.69	11.52
6.070	3.910	1.250	2.682	4.023	5.364	6.706	6.41	12.26
6.220	3.960	1.341	2.621	3.932	5.273	6.584	7.06	12.26
6.270	4.010	1.311	2.713	4.084	5.425	6.797	6.97	12.73

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

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 603, 709

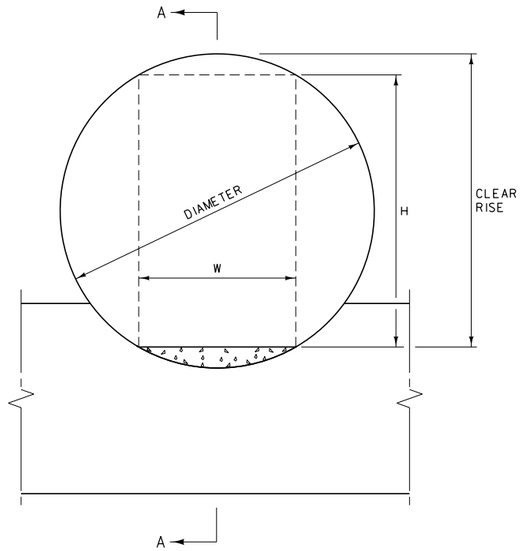
DWG. NO. 603-34

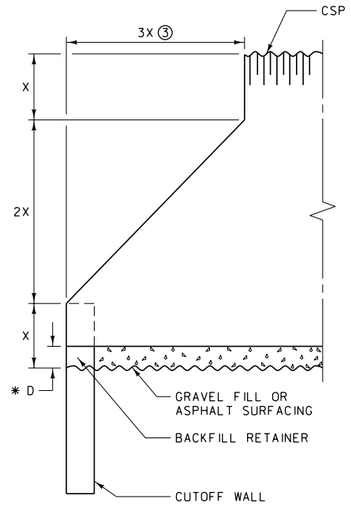
BEVEL ON ARCH METAL CULVERT

--REVISED-- JULY 2016

EFFECTIVE: SEPTEMBER 2014

MDT MONTANA DEPARTMENT OF TRANSPORTATION





SECTION A-A

DIMENSIONS						
DIAMETER	X	* D	CLEAR RISE	H	W	BACKFILL RETAINER (CUBIC YARDS)
84"	21.0"	0.50'	6.5'	6.0'	3.6'	0.1
90"	22.5"	0.75'	6.75'	6.0'	4.5'	0.1
96"	24.0"	0.83'	7.17'	6.34'	4.9'	0.1

METRIC DIMENSIONS						
DIAMETER (mm)	X (m)	* D (mm)	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 LINEAR FOOT FOR DEPTH "D"					
	FULL DEPTH GRAVEL	0.20' PMS AND REMAINING DEPTH GRAVEL			
	C.Y. SURF.	TONS SURF.	C.Y. SURF.	TONS BIT. MATERIAL	
DIAMETER	CR. TOP SURF.	PLANT MIX	CR. TOP SURF.	PLANT MIX	PRIME
84"	0.045	0.046	0.021	0.0028	0.0004
90"	0.085	0.060	0.054	0.0036	0.0006
96"	0.102	0.066	0.068	0.0040	0.0006

NOTES:

① UNLESS OTHERWISE SPECIFIED, INSTALL STOCKPASSES WITH CUTOFF WALLS AND BACKFILL RETAINERS AT EACH END, GRAVEL FILL AND BEDDING MATERIAL.

② WHEN COMBINATION STOCKPASSES AND DRAINS ARE SPECIFIED, INSTALL WITH CUTOFF WALLS, BACKFILL RETAINERS AT BOTH ENDS, CONCRETE EDGE PROTECTION AT THE INLET END, RANDOM RIPRAP 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.)

③ UNLESS OTHERWISE SPECIFIED, STEP BEVEL PIPE ENDS AT A 1.5:1 SLOPE.

④ THE MINIMUM THICKNESS FOR 84" [2100]DIAMETER AND 90" [2250]DIAMETER CORRUGATED STEEL PIPE STOCKPASS IS 0.079" [2.01]. THE MINIMUM THICKNESS FOR 96" [2400]DIAMETER CORRUGATED STEEL PIPE STOCKPASS IS 0.109" [2.77]. (SEE FILL HEIGHT TABLES FOR OTHER THAN THE MINIMUM REQUIREMENTS.)

⑤ SEE DTL. DWG. NO. 552-00, 603-30 AND 603-19.

* METRIC 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 (mm)	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

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. 603-36

CORRUGATED STEEL PIPE STOCKPASS

EFFECTIVE: SEPTEMBER 2014

MDT MONTANA DEPARTMENT OF TRANSPORTATION