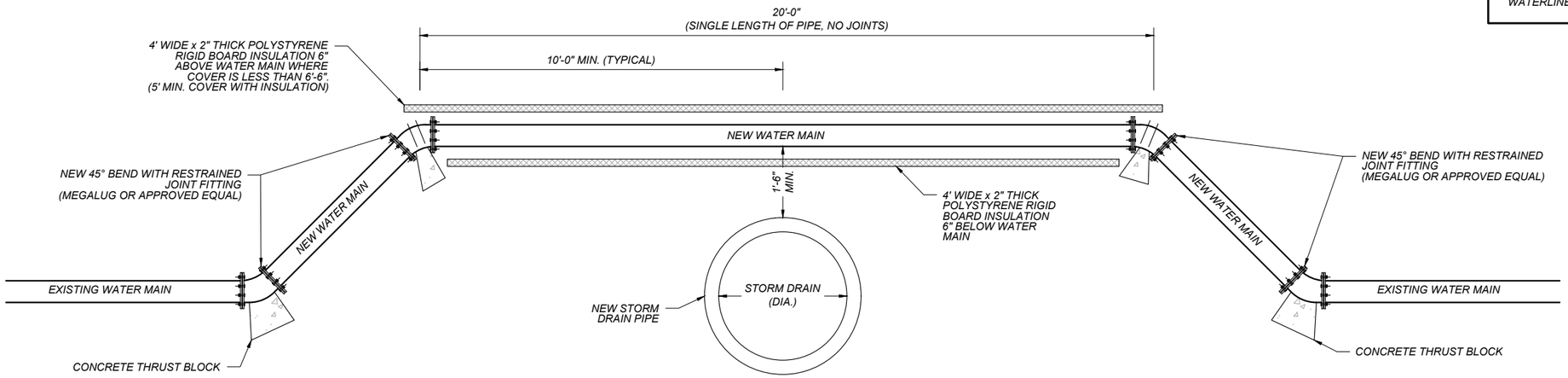
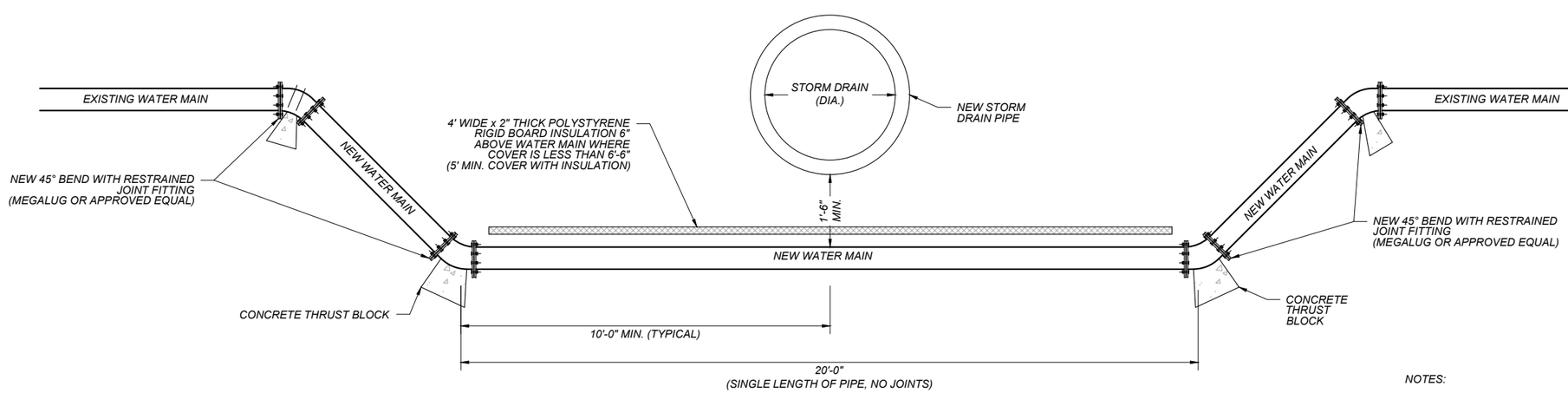
DETAIL

NOTE TO DESIGNER:
MODIFY DETAIL AS NEEDED TO MEET WATERLINE OWNER'S REQUIREMENTS.



WATER MAIN OVER STORM DRAIN



WATER MAIN UNDER STORM DRAIN

ADJUST WATER MAIN						
STATION	OFFSET	# FIELD INVESTIGATION	PIPE TYPE/SIZE (in.)	PIPE LENGTH (ft.)	*GRANULAR BEDDING MATERIAL (yd^3)	*TRENCH EXCAVATION (yd^2)
-	-	-	-	-	-	-
-	-	-	-	-	-	-

* FOR INFORMATIONAL PURPOSES ONLY. COST INCLUDED IN LENGTH OF PIPE.
\# WHEN REQUIRED, FIELD INVESTIGATE TO DETERMINE IF EXISTING WATER MAIN MEETS DEQ CLEARANCE ON NEW STORM DRAIN LINE. WHEN CLEARANCE IS NOT MET, DETERMINE EXISTING LINE SIZE AND ADJUST PER DETAIL.

NOTES:

1. MATCH SIZE OF NEW WATER MAIN TO EXISTING. TO MEET MONTANA PUBLIC WORKS OR MUNICIPALITY STANDARD SPECIFICATION.
2. WHEN REQUIRED, ENCASE NEW D.I. PIPE WITH 2-PLY POLYETHYLENE PIPE WRAPPING PER AWWA C105.
3. WHEN REQUIRED, THRUST BLOCKS TO MEET MONTANA PUBLIC WORKS OR THE MUNICIPALITY STANDARD SPECIFICATION.
4. WHEN REQUIRED, THRUST BLOCKS WILL NOT INTERFERE WITH ACCESS TO CONNECTION JOINT BOLTS.
5. WHEN REQUIRED, POLYSTYRENE RIGID BOARD INSULATION TO MEET ASTM C578, TYPE VI, WITH 60 P.S.I. COMPRESSION STRENGTH.
6. CLEAN, TEST, AND DISINFECT PER MONTANA PUBLIC WORKS.

SHEET NO.
####

ADJUST WATER MAIN DETAIL
NO SCALE

PROJECT NAME ####
COUNTY ####
PROJECT ID ####
UPN ####

DESIGNED BY #### ####
REVIEWED BY #### ####
CHECKED BY #### ####

MONTANA
Department of Transportation

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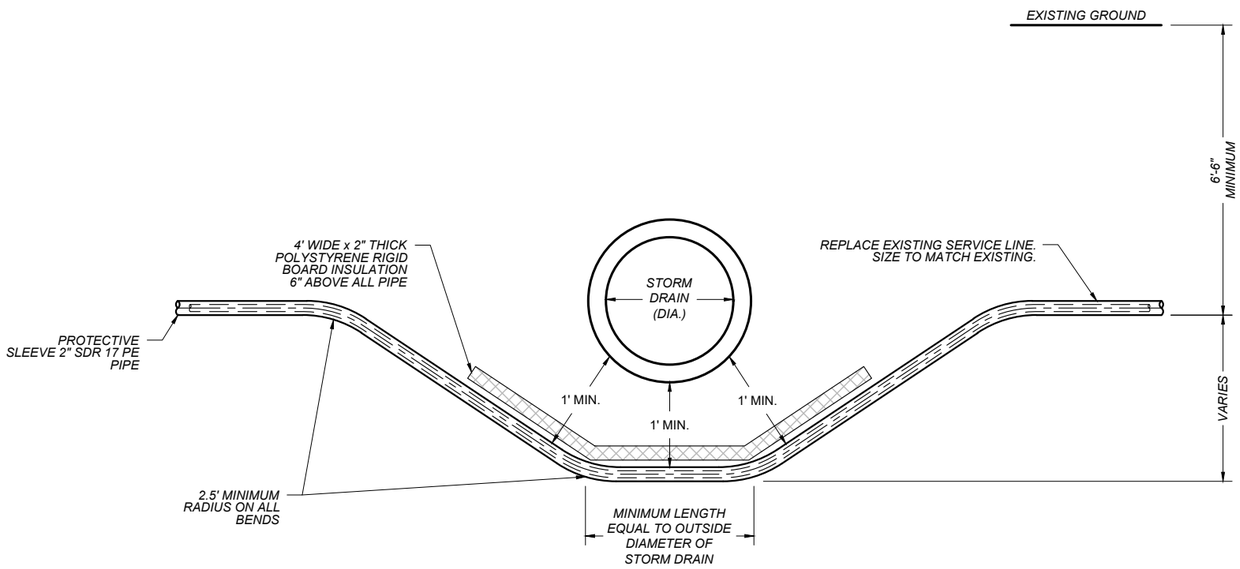
DETAIL

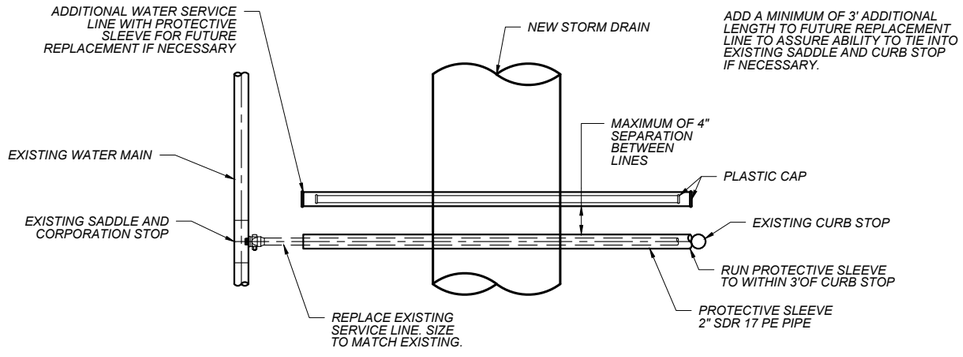
NOTE TO DESIGNER:
MODIFY DETAIL AS NEEDED TO MEET WATERLINE OWNER'S REQUIREMENTS.



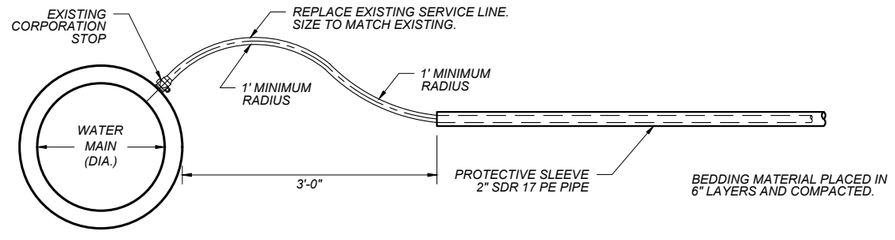
WATER SERVICE ADJUSTMENT DETAIL - PROFILE VIEW

NOTES:

1. MATCH SIZE OF NEW WATER MAIN TO EXISTING. TO MEET MONTANA PUBLIC WORKS OR MUNICIPALITY STANDARD SPECIFICATION.
2. CLEAN, TEST, AND DISINFECT WATER SERVICE AND FITTINGS PER MONTANA PUBLIC WORKS STANDARD SPECIFICATION.
3. WHEN REQUIRED, POLYSTYRENE RIGID BOARD INSULATION TO MEET ASTM C578, TYPE VI, WITH 60 P.S.I. COMPRESSION STRENGTH.



WATER SERVICE ADJUSTMENT DETAIL - PLAN VIEW



WATER SERVICE CONNECTION DETAIL

SHEET NO.
####

WATER SERVICE ADJUSTMENT DETAIL
NO SCALE

PROJECT NAME	###	DESIGNED BY	####
COUNTY	###	REVIEWED BY	####
PROJECT ID	###	CHECKED BY	####
UPN	###	HYDRAULICS_STD_DWG.DWG	

MONTANA
Department of Transportation

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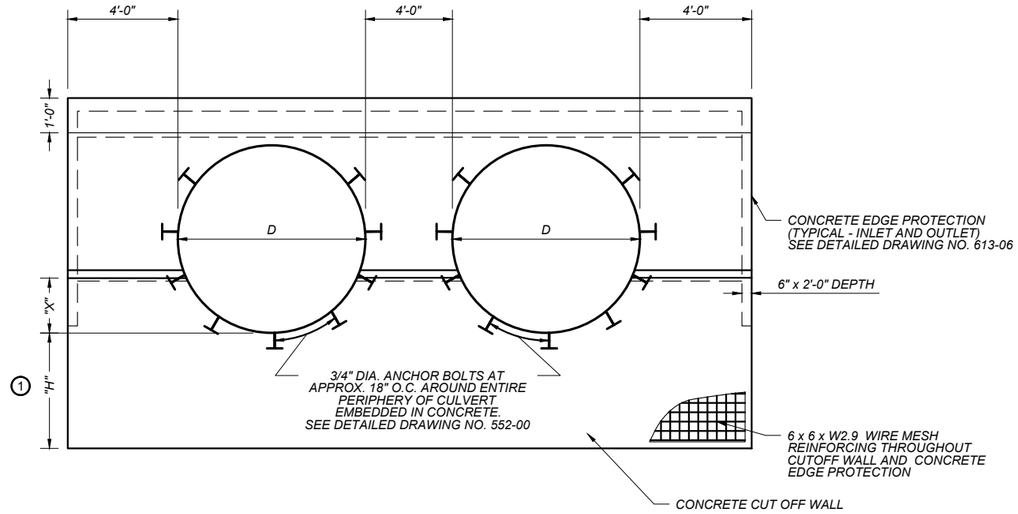
DETAIL



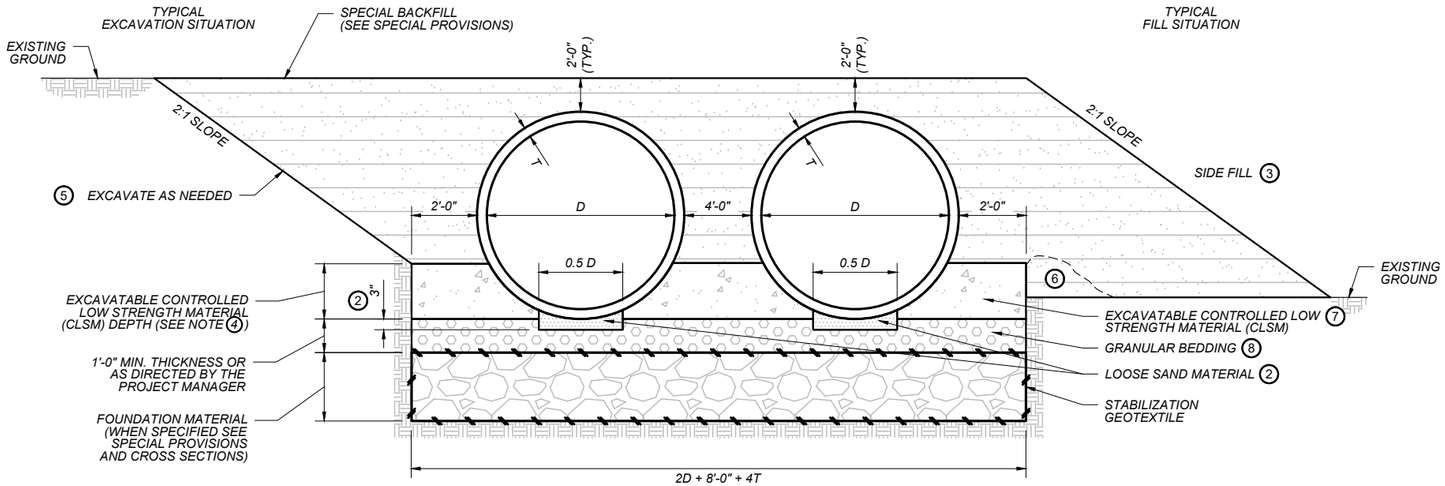
FRONT ELEVATION

KEY NOTES:

1. 3'-0" MIN. OR 1'-0" BELOW BOTTOM OF FOUNDATION MATERIAL IF SPECIFIED.
2. THE CONTRACTOR HAS THE OPTION OF USING A SAND CUSHION AS APPROVED BY THE PROJECT MANAGER TO FACILITATE CULVERT INSTALLATION. IF A SAND CUSHION IS USED, THAT MATERIAL WILL BE MEASURED AND PAID FOR AS GRANULAR BEDDING.
3. COMPACT AND PLACE SIDE FILL PER SECTION 603 AND 203 OF THE STANDARD SPECIFICATIONS.
4. THE EXCAVATABLE CONTROLLED LOW STRENGTH MATERIAL (CLSM) DEPTH FOR METAL PIPE IS "X" + "T". SEE DETAIL DRAWING NO. 603-32 FOR "X" DIMENSIONS OF CIRCULAR METAL PIPES.
5. 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.
6. BUILD BERM WITH FILL MATERIAL AS NEEDED TO CONTAIN THE EXCAVATABLE CONTROLLED LOW STRENGTH MATERIAL (CLSM) BEDDING TO THE PROPER DEPTH.
7. PLACE EXCAVATABLE CONTROLLED LOW STRENGTH MATERIAL (CLSM) MEETING THE REQUIREMENTS OF SECTION 551 OF THE STANDARD SPECIFICATIONS.
8. COMPACT GRANULAR BEDDING BY PROOF ROLLING WITH A VIBRATORY COMPACTOR IN 12" LIFTS OR BY USING A METHOD APPROVED BY THE PROJECT MANAGER.

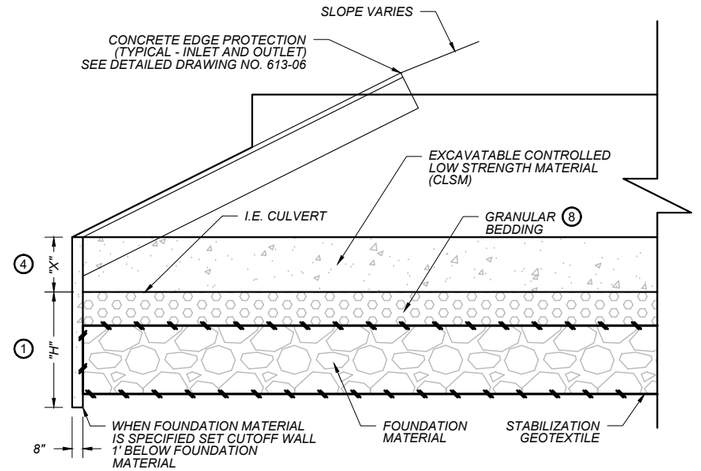
NOTES:

1. FURNISH GRANULAR BEDDING AND FOUNDATION MATERIAL PER SECTION 701 OF THE STANDARD SPECIFICATIONS.
2. DIMENSION D THE INSIDE PIPE DIAMETER. DIMENSION "T" IS THE CORRUGATION DEPTH.



BEDDING DETAILS

(CUTOFF WALLS AND EDGE PROTECTION OMITTED FOR CLARITY)



SIDE ELEVATION

DIMENSIONS					
STATION	D (ft.)	LENGTH (ft.)	"T" (in.)	"X" (ft.)	"H" (ft.)
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-

NOTES:
INCLUDE REINFORCING MATERIAL IN THE UNIT PRICE BID PER CUBIC YARD OF CLASS GENERAL CONCRETE.
INCLUDE ANCHOR BOLTS IN THE UNIT PRICE BID PER LINEAR FOOT OF CULVERT.
QUANTITIES ARE BASED ON THE DIMENSIONS IN THE TABLE.

SHEET NO.
####

BEDDING FOR DOUBLE STRUCTURAL STEEL PLATE PIPE CULVERTS
NO SCALE

PROJECT NAME ####
COUNTY ####
PROJECT ID ####
UPN ####

DESIGNED BY ####
REVIEWED BY ####
CHECKED BY ####
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MONTANA
Department of Transportation

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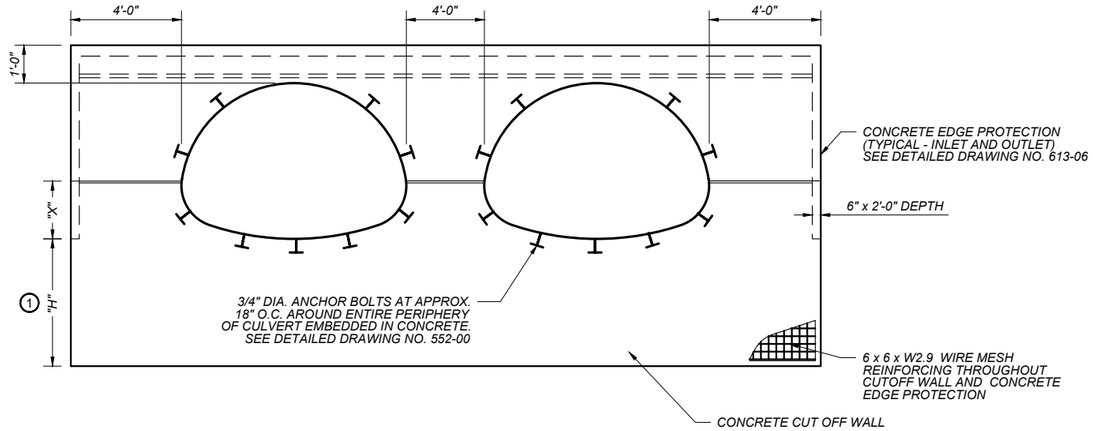
DETAIL



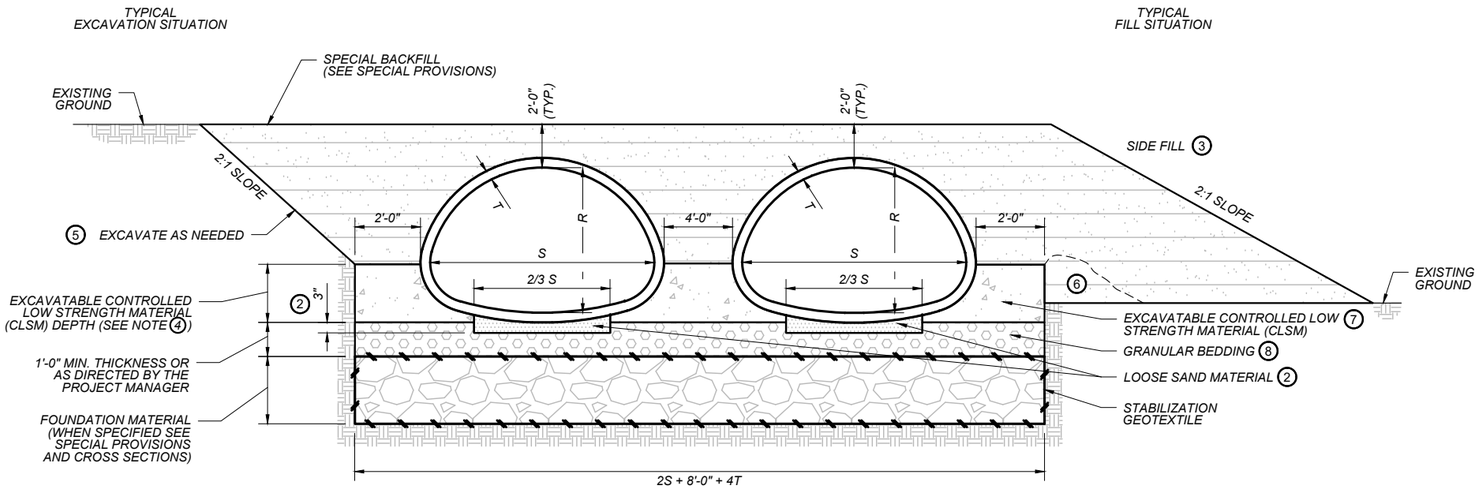
FRONT ELEVATION

KEY NOTES:

1. 3'-0" MIN. OR 1'-0" BELOW BOTTOM OF FOUNDATION MATERIAL IF SPECIFIED.
2. THE CONTRACTOR HAS THE OPTION OF USING A SAND CUSHION AS APPROVED BY THE PROJECT MANAGER TO FACILITATE CULVERT INSTALLATION. IF A SAND CUSHION IS USED, THAT MATERIAL WILL BE MEASURED AND PAID FOR AS GRANULAR BEDDING.
3. COMPACT AND PLACE SIDE FILL PER SECTION 603 AND 203 OF THE STANDARD SPECIFICATIONS.
4. THE EXCAVATABLE CONTROLLED LOW STRENGTH MATERIAL (CLSM) DEPTH FOR METAL PIPE IS "X" + "T". SEE DETAIL DRAWING NO. 603-32 FOR "X" DIMENSIONS OF CIRCULAR METAL PIPES.
5. 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.
6. BUILD BERM WITH FILL MATERIAL AS NEEDED TO CONTAIN THE EXCAVATABLE CONTROLLED LOW STRENGTH MATERIAL (CLSM) BEDDING TO THE PROPER DEPTH.
7. PLACE EXCAVATABLE CONTROLLED LOW STRENGTH MATERIAL (CLSM) MEETING THE REQUIREMENTS OF SECTION 551 OF THE STANDARD SPECIFICATIONS.
8. COMPACT GRANULAR BEDDING BY PROOF ROLLING WITH A VIBRATORY COMPACTOR IN 12" LIFTS OR BY USING A METHOD APPROVED BY THE PROJECT MANAGER.

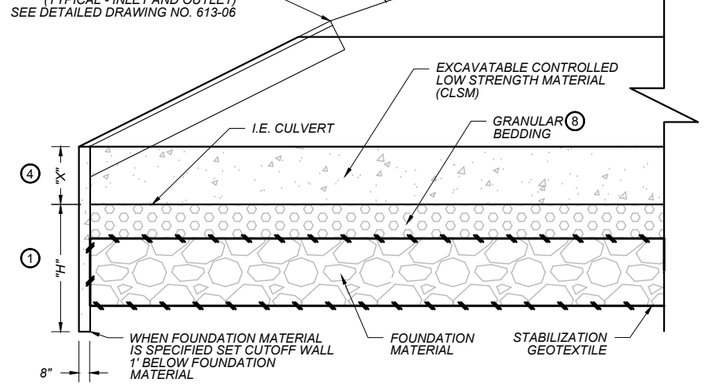
NOTES:

1. FURNISH GRANULAR BEDDING AND FOUNDATION MATERIAL PER SECTION 701 OF THE STANDARD SPECIFICATIONS.
2. DIMENSIONS S AND R ARE THE SPAN AND RISE. DIMENSION "T" IS THE CORRUGATION DEPTH.



BEDDING DETAILS

(CUTOFF WALLS AND EDGE PROTECTION OMITTED FOR CLARITY)



SIDE ELEVATION

DIMENSIONS						
STATION	SPAN (ft.)	RISE (ft.)	LENGTH (ft.)	"T" (in.)	"X" (ft.)	"H" (ft.)
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-

NOTES:
INCLUDE REINFORCING MATERIAL IN THE UNIT PRICE BID PER CUBIC YARD OF CLASS GENERAL CONCRETE.
INCLUDE ANCHOR BOLTS IN THE UNIT PRICE BID PER LINEAR FOOT OF CULVERT.
QUANTITIES ARE BASED ON THE DIMENSIONS IN THE TABLE.

SHEET NO.
####

BEDDING FOR DOUBLE STRUCTURAL STEEL PLATE PIPE ARCH CULVERTS
NO SCALE

PROJECT NAME	COUNTY	PROJECT ID	UPN
#####	#####	#####	#####

DESIGNED BY	REVIEWED BY	CHECKED BY
#####	#####	#####

MONTANA
Department of Transportation

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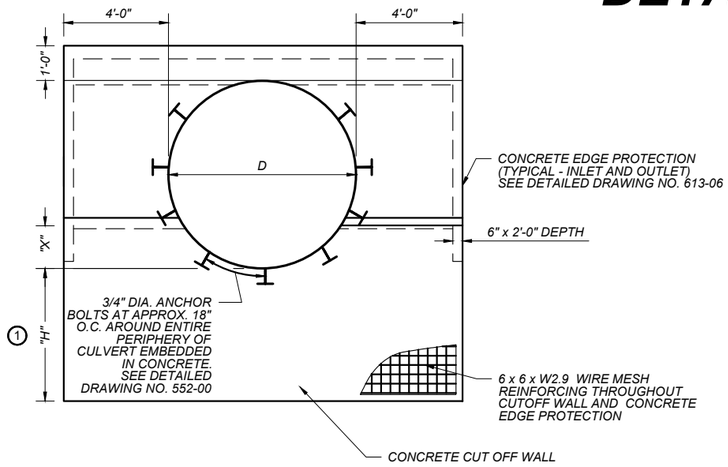
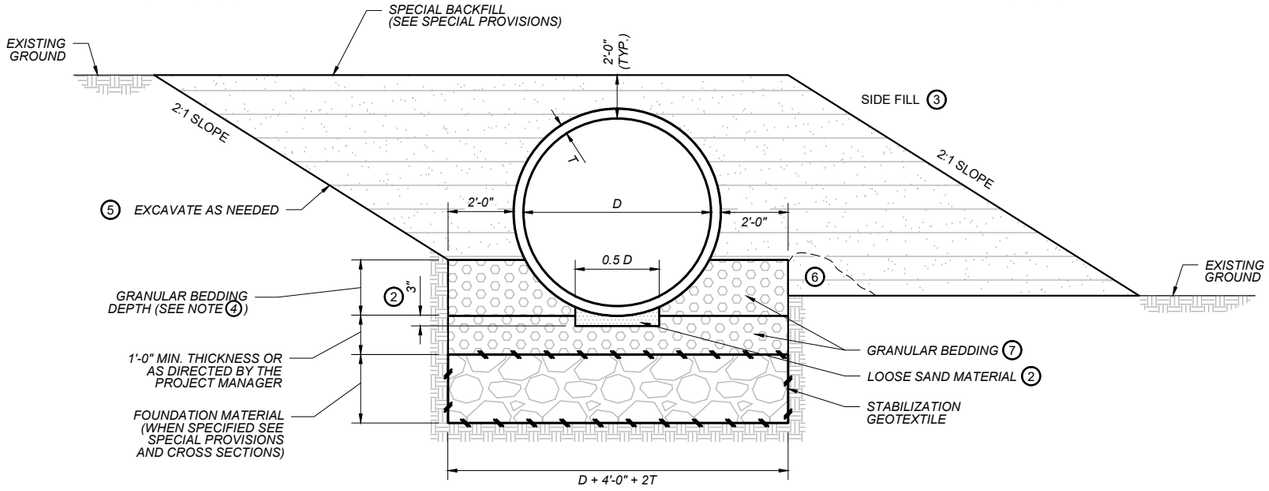
DETAIL



FRONT ELEVATION

TYPICAL EXCAVATION SITUATION

TYPICAL FILL SITUATION



BEDDING DETAILS

(CUTOFF WALLS AND EDGE PROTECTION OMITTED FOR CLARITY)

DIMENSIONS					
STATION	D (ft.)	LENGTH (ft.)	"T" (in.)	"X" (ft.)	"H" (ft.)
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-

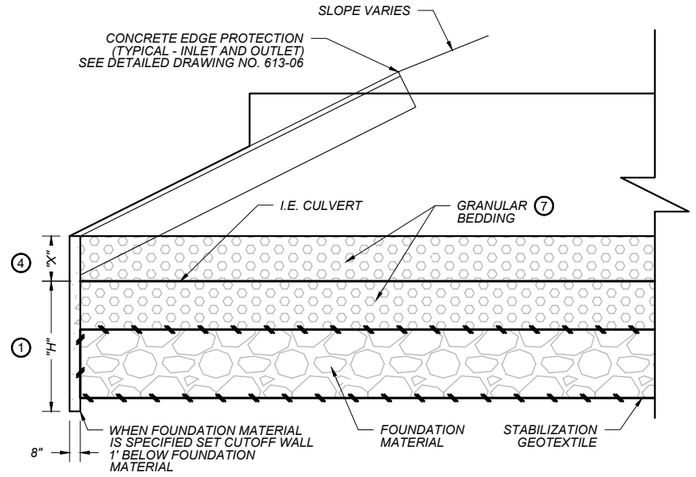
NOTES:
INCLUDE REINFORCING MATERIAL IN THE UNIT PRICE BID PER CUBIC YARD OF CLASS GENERAL CONCRETE.
INCLUDE ANCHOR BOLTS IN THE UNIT PRICE BID PER LINEAR FOOT OF CULVERT.
QUANTITIES ARE BASED ON THE DIMENSIONS IN THE TABLE.

KEY NOTES:

1. 3'-0" MIN. OR 1'-0" BELOW BOTTOM OF FOUNDATION MATERIAL IF SPECIFIED.
2. THE CONTRACTOR HAS THE OPTION OF USING A SAND CUSHION AS APPROVED BY THE PROJECT MANAGER TO FACILITATE CULVERT INSTALLATION. IF A SAND CUSHION IS USED, THAT MATERIAL WILL BE MEASURED AND PAID FOR AS GRANULAR BEDDING.
3. COMPACT AND PLACE SIDE FILL PER SECTION 603 AND 203 OF THE STANDARD SPECIFICATIONS.
4. THE GRANULAR BEDDING DEPTH IS "X" + "T". SEE DETAIL DRAWING. NO. 603-32 FOR "X" DIMENSIONS OF CIRCULAR METAL CULVERTS. AFTER LAYING CULVERT, COMPACT GRANULAR BEDDING AT HAUNCHES AND SIDES.
5. 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.
6. BUILD BERM WITH FILL MATERIAL AS NEEDED TO CONTAIN THE GRANULAR BEDDING TO THE PROPER DEPTH.
7. COMPACT GRANULAR BEDDING BY PROOF ROLLING WITH A VIBRATORY COMPACTOR IN 12" LIFTS OR BY USING A METHOD APPROVED BY THE PROJECT MANAGER.

NOTES:

1. FURNISH GRANULAR BEDDING AND FOUNDATION MATERIAL PER SECTION 701 OF THE STANDARD SPECIFICATIONS.
2. DIMENSION D THE INSIDE PIPE DIAMETER.
   DIMENSION "T" IS THE CORRUGATION DEPTH.



SIDE ELEVATION

SHEET NO.
####

BEDDING FOR STRUCTURAL STEEL PLATE PIPE CULVERT
NO SCALE

PROJECT NAME ####
COUNTY ####
PROJECT ID ####
UPN ####

DESIGNED BY ####
REVIEWED BY ####
CHECKED BY ####

MONTANA
Department of Transportation

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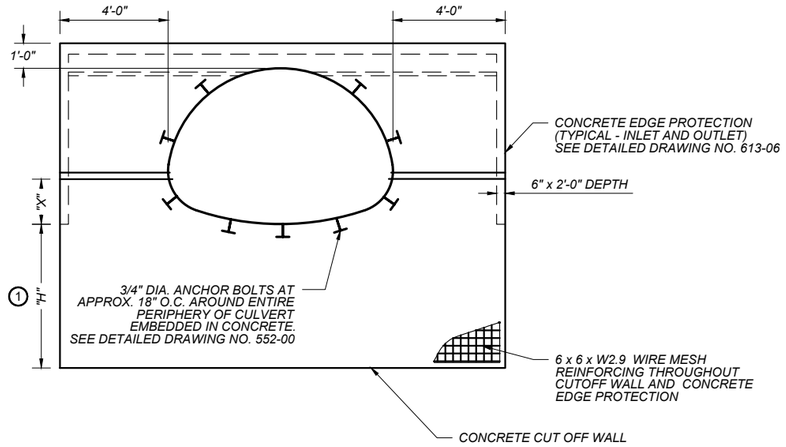
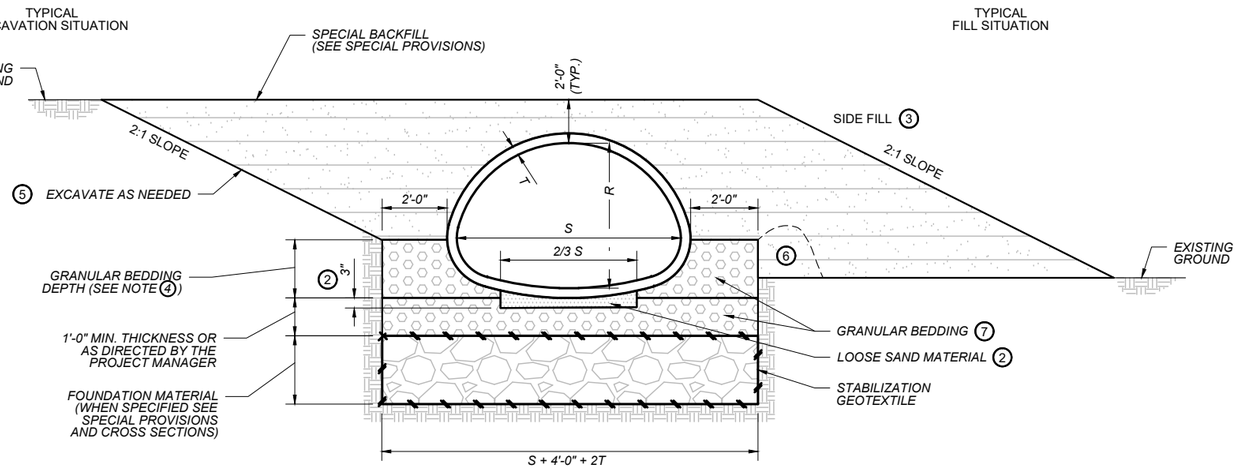
DETAIL



FRONT ELEVATION



BEDDING DETAILS

(CUTOFF WALLS AND EDGE PROTECTION OMITTED FOR CLARITY)

DIMENSIONS						
STATION	SPAN (ft.)	RISE (ft.)	LENGTH (ft.)	"T" (in.)	"X" (ft.)	"H" (ft.)
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-

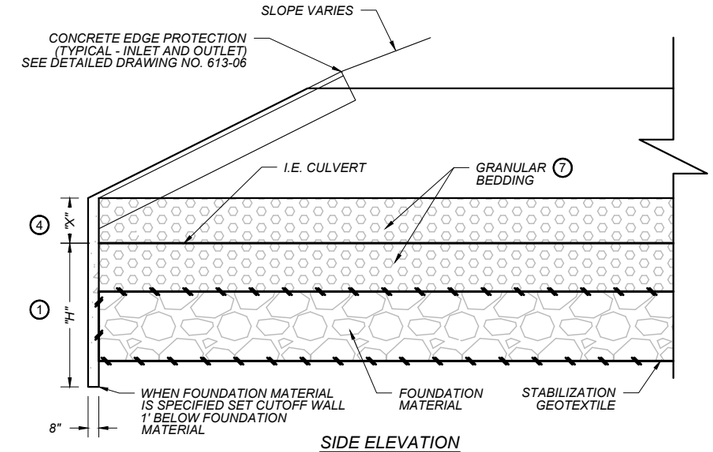
NOTES:
INCLUDE REINFORCING MATERIAL IN THE UNIT PRICE BID PER CUBIC YARD OF CLASS GENERAL CONCRETE.
INCLUDE ANCHOR BOLTS IN THE UNIT PRICE BID PER LINEAR FOOT OF CULVERT.
QUANTITIES ARE BASED ON THE DIMENSIONS IN THE TABLE.

KEY NOTES:

1. 3'-0" MIN. OR 1'-0" BELOW BOTTOM OF FOUNDATION MATERIAL IF SPECIFIED.
2. PLACE LOOSE SAND MATERIAL UNIFORMLY IN THE BOTTOM OF THE TRENCH AND SHAPE TO FIT BOTTOM OF PIPE. THE MINIMUM THICKNESS BEFORE PLACING PIPE IS 3". AFTER LAYING CULVERT, COMPACT GRANULAR BEDDING AT HAUNCHES AND SIDES OF PIPE. COMPACT GRANULAR BEDDING BY PROOF ROLLING WITH A VIBRATORY COMPACTOR IN 12 INCH LIFTS OR BY USING A METHOD APPROVED BY THE PROJECT MANAGER.
3. COMPACT AND PLACE SIDE FILL PER SECTION 603 AND 203 OF THE STANDARD SPECIFICATIONS.
4. THE GRANULAR BEDDING DEPTH IS "X" + "T". SEE DETAIL DRAWING. NO. 603-34 FOR "X" DIMENSIONS OF METAL ARCH CULVERTS.
5. 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.
6. BUILD BERM WITH FILL MATERIAL AS NEEDED TO CONTAIN THE GRANULAR BEDDING TO THE PROPER DEPTH.
7. COMPACT GRANULAR BEDDING BY PROOF ROLLING WITH A VIBRATORY COMPACTOR IN 12" LIFTS OR BY USING A METHOD APPROVED BY THE PROJECT MANAGER.

NOTES:

1. SEE SECTION 701.04 OF THE STANDARD SPECIFICATIONS FOR BEDDING MATERIAL REQUIREMENTS.
2. DIMENSIONS S AND R ARE THE SPAN AND RISE. DIMENSION "T" IS THE CORRUGATION DEPTH.



SIDE ELEVATION

SHEET NO.
####

BEDDING FOR STRUCTURAL STEEL PLATE PIPE ARCH CULVERT
NO SCALE

PROJECT NAME #####
COUNTY #####
PROJECT ID #####
UPN #####

DESIGNED BY ####
REVIEWED BY ####
CHECKED BY ####

MONTANA
Department of Transportation

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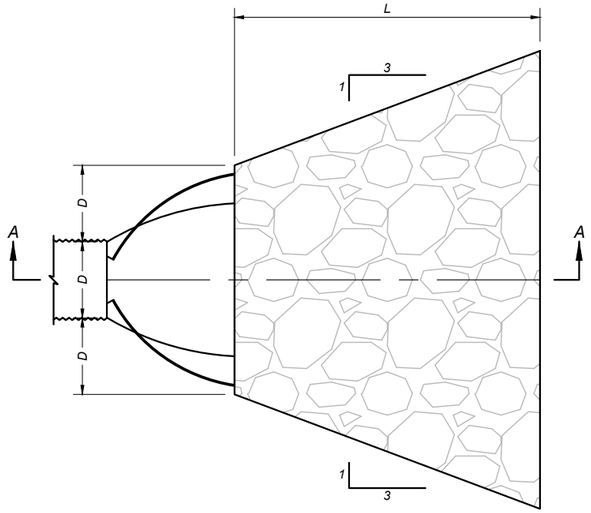
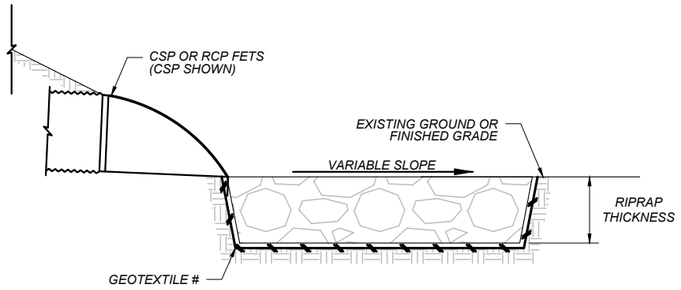
DETAIL



PLAN VIEW



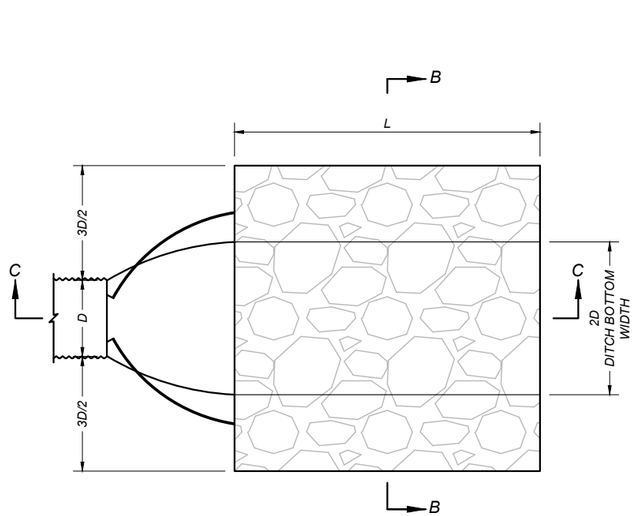
SECTION A-A

CULVERT OUTLET RIPRAP WITHOUT DITCH

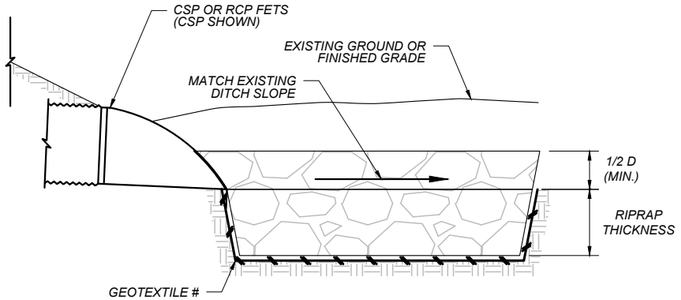
CULVERT OUTLET RIPRAP WITHOUT DITCH - DIMENSIONS AND ESTIMATED QUANTITIES

	CLASS I RIPRAP (2' THICK)			CLASS II RIPRAP (2.5' THICK)		
CULVERT DIA. OR SPAN D (in.)	LENGTH OF APRON L (ft.)	CLASS I RIPRAP (yd^3)	GEOTEXTILE # (yd^2)	LENGTH OF APRON L (ft.)	CLASS II RIPRAP (yd^3)	GEOTEXTILE # (yd^2)
12	4	1.3	2	6	2.8	3
18	6	2.9	4	9	6.3	8
21	7	3.9	6	11	9.1	11
22	8	4.8	7	11	9.3	11
24	8	5.1	8	12	11.1	13
26	9	6.3	10	13	13.0	16
28	10	7.7	11	14	15.1	18
28 1/2	10	7.7	12	15	16.8	20
30	10	8.0	12	15	17.4	21
35	12	11.3	17	18	24.6	30
36	12	11.6	17	18	25.0	30
36 1/4	13	12.9	19	19	27.1	33
42	14	15.7	24	21	34.0	41
43 3/4	15	17.7	27	22	37.2	45
48	16	20.5	31	24	44.4	53
49	17	22.6	34	25	47.6	57
51 1/8	18	25.0	38	26	51.6	62
53	18	25.7	39	27	55.6	67
57	19	29.0	43	29	64.2	77
58 1/2	20	31.5	47	30	68.4	82

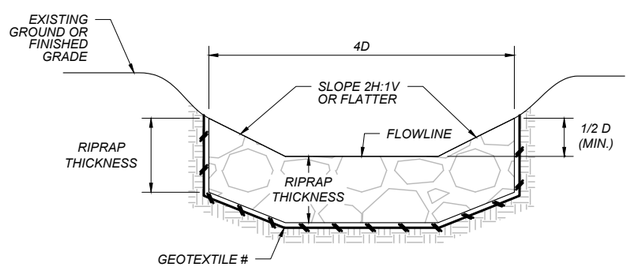
PERMANENT EROSION CONTROL GEOTEXTILE - HIGH SURVIVABILITY



PLAN VIEW



SECTION C-C



SECTION B-B

CULVERT OUTLET RIPRAP WITH DITCH

CULVERT OUTLET RIPRAP WITH DITCH - DIMENSIONS AND ESTIMATED QUANTITIES

	CLASS I RIPRAP (2' THICK)			CLASS II RIPRAP (2.5' THICK)		
CULVERT DIA. OR SPAN D (in.)	LENGTH OF APRON L (ft.)	CLASS I RIPRAP (yd^3)	GEOTEXTILE # (yd^2)	LENGTH OF APRON L (ft.)	CLASS II RIPRAP (yd^3)	GEOTEXTILE # (yd^2)
12	4	1.2	2	6	2.2	3
18	6	2.7	4	9	5.0	6
21	7	3.6	6	11	7.1	9
22	8	4.3	7	11	7.5	9
24	8	4.7	8	12	8.9	11
26	9	5.8	9	13	10.4	13
28	10	6.9	11	14	12.1	15
28 1/2	10	7.0	11	15	13.2	17
30	10	7.4	12	15	13.9	18
35	12	10.4	16	18	19.4	25
36	12	10.7	17	18	20.0	25
36 1/4	13	11.6	18	19	21.3	27
42	14	14.5	23	21	27.2	35
43 3/4	15	16.2	26	22	29.7	38
48	16	19.0	30	24	35.6	45
49	17	20.6	33	25	37.8	48
51 1/8	18	22.7	36	26	41.0	52
53	18	23.6	37	27	44.2	56
57	19	26.7	42	29	51.0	65
58 1/2	20	28.9	46	30	54.2	69

PERMANENT EROSION CONTROL GEOTEXTILE - HIGH SURVIVABILITY

CULVERT STATION	CULVERT DIA. OR SPAN D (in.)	OUTLET RIPRAP LOCATION (lt. or rt.)	WITH DITCH	WITHOUT DITCH
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-

SHEET NO.
####

CULVERT OUTLET RIPRAP FOR CULVERTS WITH FETS (48" EQUIVALENT AND SMALLER) NOT TO SCALE

PROJECT NAME ####
COUNTY ####
PROJECT ID ####
UPN ####

DESIGNED BY ####
REVIEWED BY ####
CHECKED BY ####

MONTANA Department of Transportation

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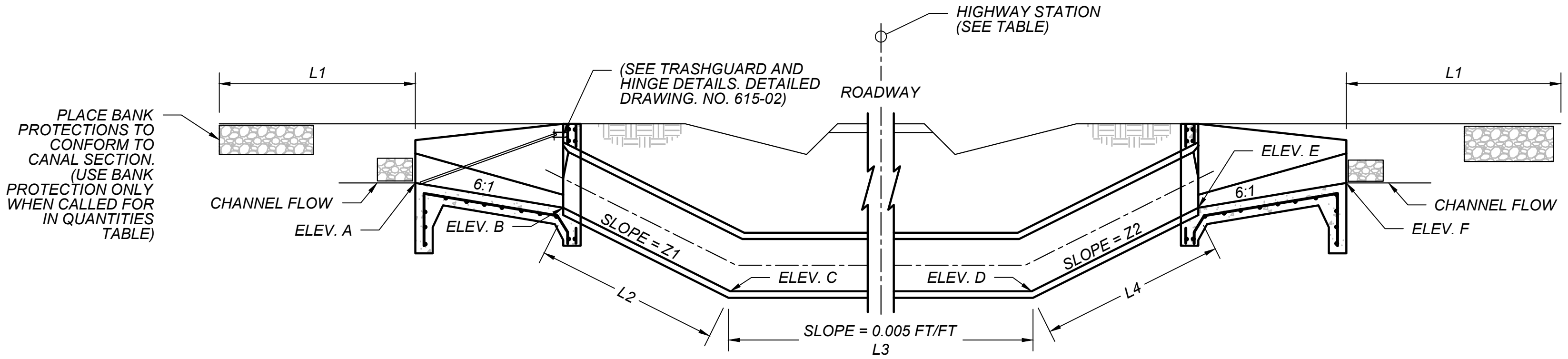
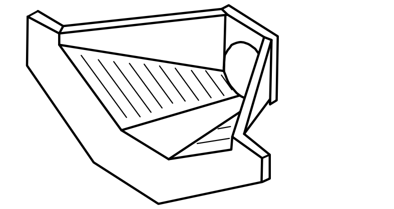
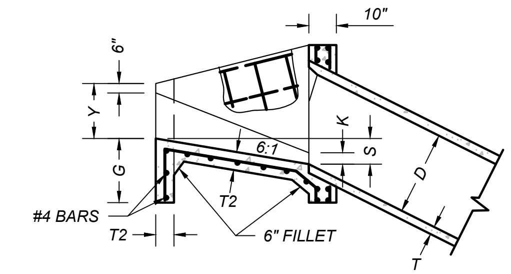
DETAIL



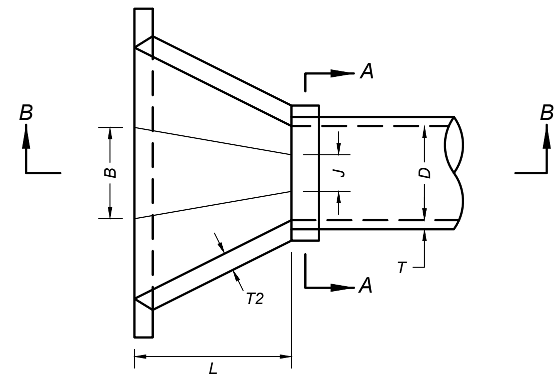


ISO VIEW OF TRANSITION

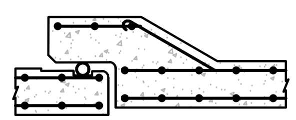


SECTION B-B

NOTES:
1. PROVIDE TRASHGUARDS WHERE REQUIRED. (SEE QUANTITIES TABLE, DETAILED DRAWING NO. 615-02)
2. PRE-CAST OR FIELD CAST BENDS AS SHOWN ON DETAILED DRAWING NO. 603-26. CONSTRUCT WATERTIGHT JOINTS. GASKETS TO MEET THE REQUIREMENTS OF SUB-SECTION 603.03 OF STANDARD SPECIFICATIONS.
3. MAXIMUM SLOPE FOR Z1 AND Z2 IS 2:1.
4. SEE CULVERT SUMMARY FOR ALLOWABLE OPTIONS.

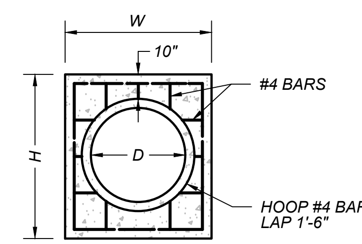


PLAN VIEW

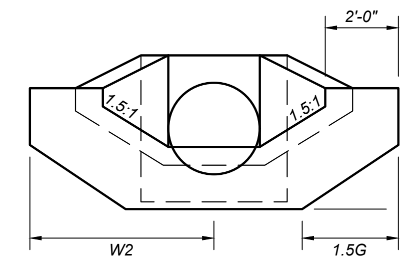


TYPE CX-4

RUBBER GASKET JOINT



SECTION A-A



ELEVATION

NOTE TO DESIGNER:
ASTM 361 - "REINFORCED LOW HEAD CONCRETE PRESSURE PIPE" SHOULD BE USED FOR SIPHONS THAT WILL HAVE A HEAD GREATER THAN 20 FEET.

NOTE:
SPACE REINFORCING BARS ABOUT 12" C-C BOTH WAYS THROUGHOUT STRUCTURE. USE CONTINUOUS BARS IN FLOORS AND WALLS WHEN SPLICES ARE MADE. LAP REINFORCING BARS 1'-6". ALL EXPOSED EDGES TO BE CHAMFERED 1". PLACE REINFORCING BARS IN CENTER OF WALLS AND SLABS UNLESS OTHERWISE NOTED.

HIGHWAY ℄ STATION	DIAMETER & TYPE	DIMENSIONS (ft.in.)					INVERT ELEVATIONS						** QUANTITIES			
		* L5 **	B	L1	Z1	Z2	INLET A	B	C	D	E	OUTLET F	TRASHGUARD		TYPE 4 BANK PROTECTION (cu.yd.)	
													INLET	OUTLET	INLET	OUTLET
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*L5 = TOTAL PIPE LENGTH OR L2+L3+L4
** QUANTITIES INCLUDED IN CULVERT SUMMARY ARE FOR ESTIMATING PURPOSES ONLY.

INLET & OUTLET CONCRETE TRANSITIONS FOR R.C.P.																					
CULVERT		DIMENSIONS (ft.-in.)											QUANTITIES								
													B = d			B = d + 1'-0"			B = d + 2'-0"		
DIA. "d" (in.)	AREA (sq.ft.)	G	H	L	T	T2	W	Y	J	K	S	W2	B	CLASS GEN. CONC. (cu.yd.)	#4 BAR (lbs.)	B	CLASS GEN. CONC. (cu.yd.)	#4 BAR (lbs.)	B	CLASS GEN. CONC. (cu.yd.)	#4 BAR (lbs.)
18"	1.77	2.0	3-8	3-0	0-2 1/2	0-6	3-2	1-3	0-5	0-4	0-6	3-10 1/2	1-6	0.8	74	2-6	0.9	80	3-6	1.0	85
24"	3.14	2.0	4-3	4-0	0-3	0-6	3-9	1-6	0-7	0-5 1/2	0-8	4-6	2-0	1.2	100	3-0	1.3	106	4-0	1.4	112
30"	4.91	2.0	4-10	5-0	0-3 1/2	0-6	4-4	1-9	0-9	0-7	0-10	5-1 1/2	2-6	1.6	127	3-6	1.7	134	4-6	1.8	141
36"	7.07	2.6	5-6	6-0	0-4	0-6	4-11	2-0	0-11	0-8	1-0	5-9	3-0	2.2	174	4-0	2.3	181	5-0	2.4	191
42"	9.62	2.6	6-1	7-0	0-4 1/2	0-6	5-6	2-3	1-0	0-9 1/2	1-2	6-4 1/2	3-6	2.7	212	4-6	2.8	222	5-6	2.9	232
48"	12.57	2.6	6-8	8-0	0-5	0-8	6-1	2-6	1-2	0-11	1-4	7-0	4-0	4.2	267	5-0	4.4	277	6-0	4.6	287
54"	15.60	2.6	7-3	9-0	0-5 1/2	0-8	6-8	2-9	1-4	1-0 1/2	1-6	7-7 1/2	4-6	4.9	316	5-6	5.2	330	6-6	5.4	346
60"	19.63	2.6	7-10	10-0	0-6	0-8	7-3	3-0	1-6	1-2	1-8	8-3	5-0	5.9	366	6-0	6.0	382	7-0	6.3	398

REINFORCING STEEL TO BE INCLUDED IN THE UNIT PRICE BID FOR CLASS GENERAL CONCRETE.

####

####

SHEET NO.
####

IRRIGATION SIPHON DETAIL
NO SCALE

PROJECT NAME ####
COUNTY ####
PROJECT ID ####
UPN ####

DESIGNED BY #### ####
REVIEWED BY #### ####
CHECKED BY #### ####
HYDRAULICS_STD_DWG.DWG ####

MONTANA
Department of Transportation
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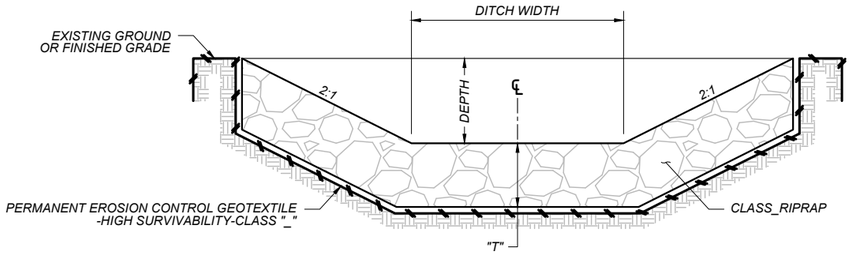
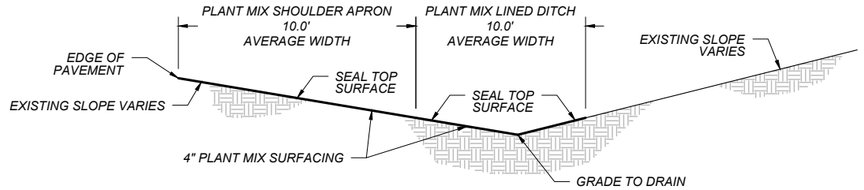
DETAIL



RIPRAP LINED DITCH



PLANT MIX LINED DITCH

RESHAPE AND COMPACT EXISTING SLOPES AS NECESSARY TO PROVIDE SUITABLE PAVING SURFACE. COMPACTION REQUIREMENTS FOR PLANT MIX AND GROUND ARE WAIVED BUT SUBJECT TO ENGINEER'S APPROVAL. RESHAPING PAID FOR WITH GRADER HOURS. COMPACTION TO BE INCLUDED IN COST OF OTHER ITEMS.

SHEET NO.
####

PROJECT NAME
COUNTY
PROJECT ID
UPN

DESIGNED BY ####
REVIEWED BY ####
CHECKED BY ####

MONTANA
Department of Transportation

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2/11/2025 10:20 AM
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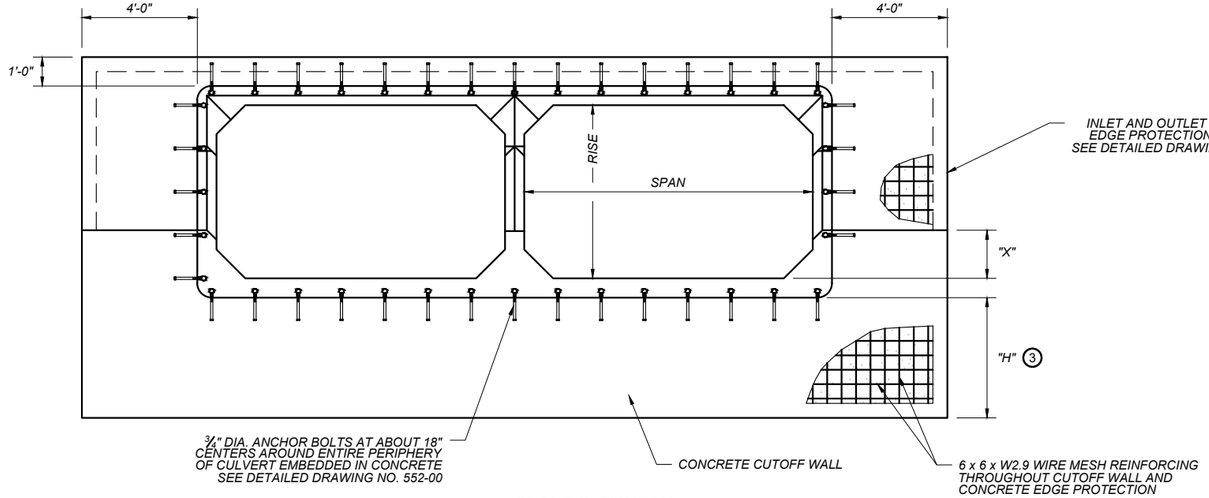
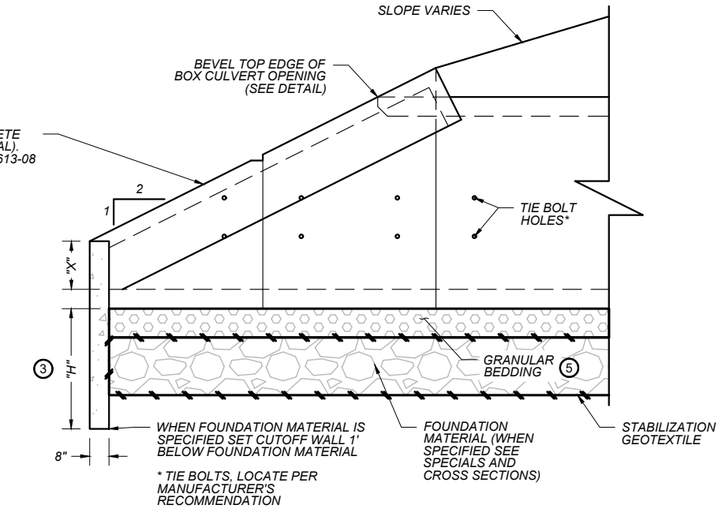
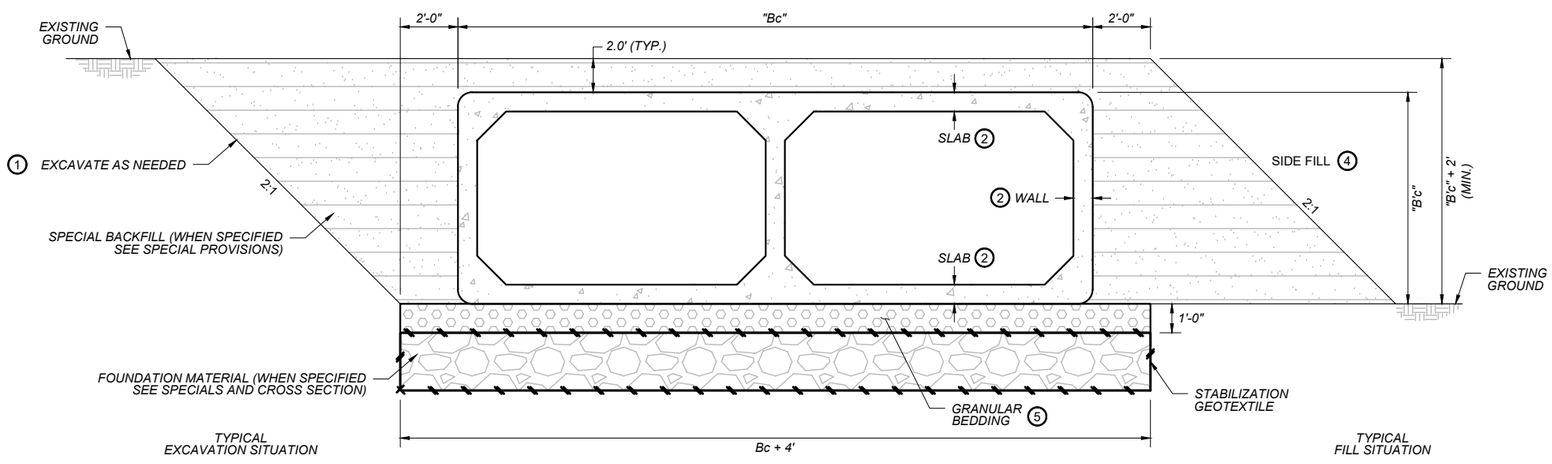
DETAIL



FRONT ELEVATION



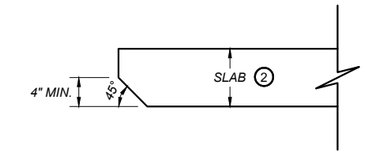
SIDE ELEVATION



BEDDING DETAIL

DIMENSIONS										
STATION	SPAN (ft.)	RISE (ft.)	LENGTH (ft.)	WALL (in.)	SLAB (in.)	"Bc" (ft.)	"x" (ft.)	"B'c" (ft.)	"H" (ft.)	COVER (ft.)
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-

NOTES:
INCLUDE REINFORCING, CUTOFF WALL, AND CONCRETE EDGE PROTECTION IN THE UNIT PRICE BID PER CUBIC YARD OF CLASS GENERAL CONCRETE.
INCLUDE ANCHOR BOLTS IN THE UNIT PRICE BID PER LINEAR FOOT OF CULVERT.
PROVIDE BOX CULVERTS MEETING ASTM C1577.
QUANTITIES ARE BASED ON THE DIMENSIONS IN THE TABLE.



TOP BEVEL DETAIL

NOTES:

1. 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.
2. FOR ESTIMATING QUANTITIES ONLY. ACTUAL DIMENSION TO BE DETERMINED BY PRECAST MANUFACTURER.
3. 3'-0" MIN.OR 1'-0" BELOW BOTTOM OF FOUNDATION MATERIAL IF SPECIFIED.
4. COMPACT AND PLACE SIDE FILL PER SECTION 603 AND 203 OF THE STANDARD SPECIFICATIONS.
5. SEE SECTION 701 OF THE STANDARD SPECIFICATIONS FOR GRANULAR BEDDING REQUIREMENTS. THE CONTRACTOR HAS THE OPTION OF USING A SAND CUSHION ABOVE THE GRANULAR BEDDING TO FACILITATE JOINING OF THE BOX CULVERT SECTIONS.

SHEET NO.
####

SLOPED END DOUBLE RCB DETAIL
NO SCALE

PROJECT NAME ####
COUNTY ####
PROJECT ID ####
UPN ####

DESIGNED BY ####
####
REVIEWED BY ####
####
CHECKED BY ####
####

MONTANA
Department of Transportation

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HYDRAULICS_STD_DWG.DWG
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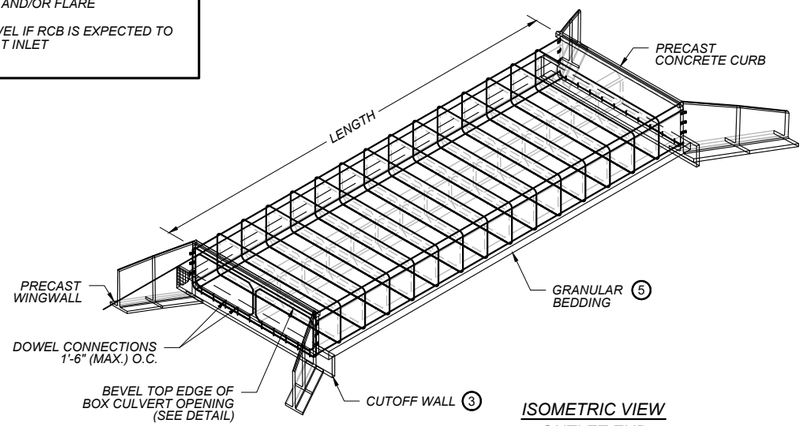
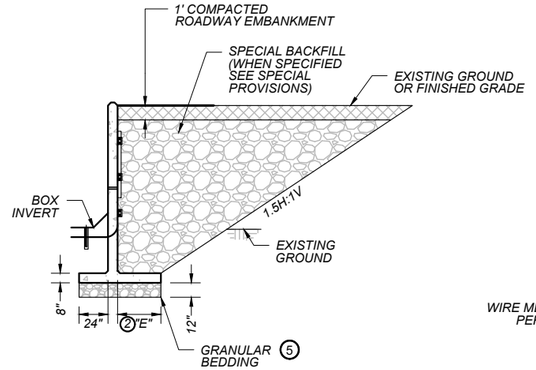
DETAIL

NOTES TO DESIGNER:

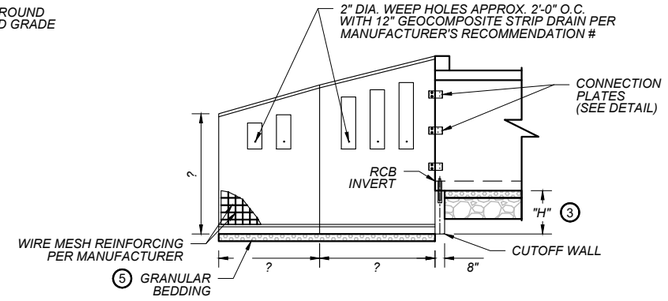
1. ADDITIONAL SHEETS MAY BE REQUIRED IF WINGWALLS ARE DIFFERENT DIMENSIONS AND/OR FLARE
2. ADD TOP BEVEL IF RCB IS EXPECTED TO FLOW FULL AT INLET



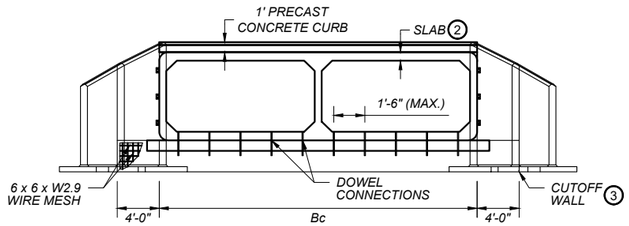
ISOMETRIC VIEW
OUTLET END



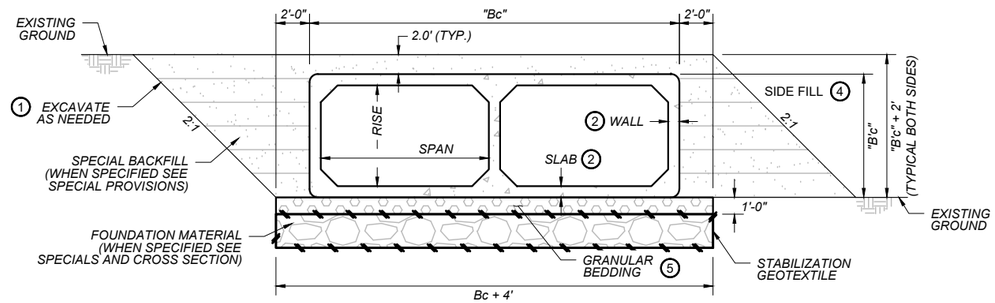
PRECAST TAPERED WINGWALL
BEDDING AND BACKFILL DETAIL



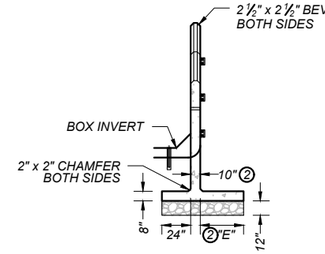
PRECAST TAPERED WINGWALL
DETAIL SIDE VIEW



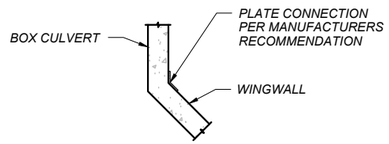
PRECAST TAPERED DOUBLE CELL BOX CULVERT
WITH CUTOFF WALL AND 45° PRECAST WINGWALLS



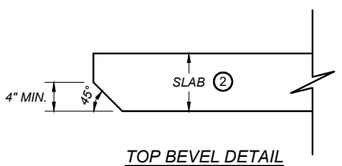
BOX CULVERT BEDDING DETAIL



PRECAST TAPERED WINGWALL
DETAIL END VIEW



CONNECTION
PLATE DETAIL



TOP BEVEL DETAIL

NOTES:

(1) 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.

(2) FOR ESTIMATING QUANTITIES ONLY. ACTUAL DIMENSION TO BE DETERMINED BY PRECAST MANUFACTURER.

(3) 3'-0" MIN.OR 1'-0" BELOW BOTTOM OF FOUNDATION MATERIAL IF SPECIFIED.

(4) COMPACT AND PLACE SIDE FILL PER SECTION 603 AND 203 OF THE STANDARD SPECIFICATIONS.

(5) SEE SECTION 701 OF THE STANDARD SPECIFICATIONS FOR GRANULAR BEDDING REQUIREMENTS. THE CONTRACTOR HAS THE OPTION OF USING A SAND CUSHION ABOVE THE GRANULAR BEDDING TO FACILITATE JOINING OF THE BOX CULVERT SECTIONS.

DIMENSIONS										
STATION	SPAN (ft.)	RISE (ft.)	LENGTH (ft.)	WALL (in.)	SLAB (in.)	"E" (in.)	"Bc" (ft.)	"B'c" (ft.)	"H" (ft.)	COVER (ft.)
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-

NOTE: QUANTITIES ARE BASED ON THE DIMENSIONS IN THE TABLE. PROVIDE BOX CULVERTS MEETING ASTM C1577. INCLUDE PRECAST TAPERED WINGWALLS, PRECAST CONCRETE CURBS, CUTOFF WALLS, SPECIAL BACKFILL BEHIND PRECAST TAPERED WINGWALLS, GEOCOMPOSITE STRIP DRAINS, AND GRANULAR BEDDING BENEATH THE PRECAST TAPERED WINGWALLS IN THE UNIT PRICE BID PER LINEAR FOOT OF RCB.

PROVIDE A GEOCOMPOSITE STRIP DRAIN CONSTRUCTED OF A HDPE DRAINAGE CORE WITH A MINIMUM COMPRESSIVE STRENGTH OF 9000 PSF PER ASTM D 1621 AND A MINIMUM FLOW CAPACITY OF 20 GPM PER ASTM D 4716. THE STRIP DRAIN MUST BE WRAPPED IN A SUBSURFACE DRAINAGE GEOTEXTILE FILTER MEETING THE REQUIREMENTS OF HIGH SURVIVABILITY, CLASS B OF SECTION 716.

SHEET NO.
####

DOUBLE RCB WITH TAPERED WINGWALLS DETAIL
NOT TO SCALE

PROJECT NAME ####
COUNTY ####
PROJECT ID ####
UPN ####

DESIGNED BY ####
REVIEWED BY ####
CHECKED BY ####

HYDRAULICS_STD_DWG.DWG

MONTANA
Department of Transportation

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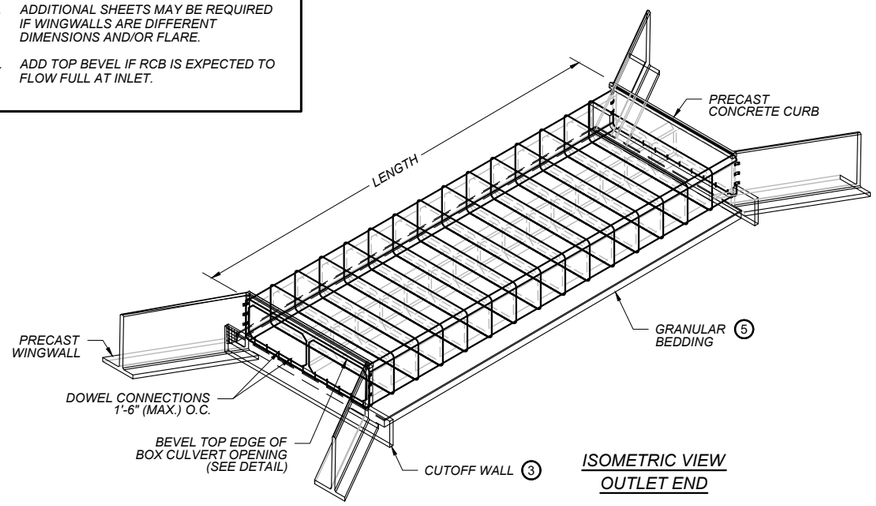
2/11/2025 10:20 AM

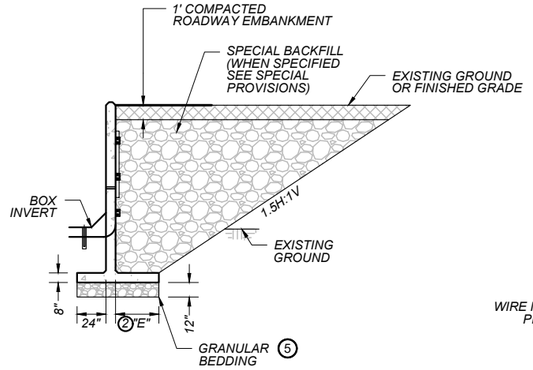
DETAIL

NOTES TO DESIGNER:

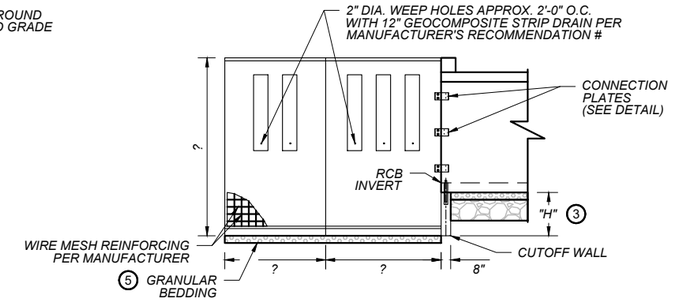
1. ADDITIONAL SHEETS MAY BE REQUIRED IF WINGWALLS ARE DIFFERENT DIMENSIONS AND/OR FLARE.
2. ADD TOP BEVEL IF RCB IS EXPECTED TO FLOW FULL AT INLET.



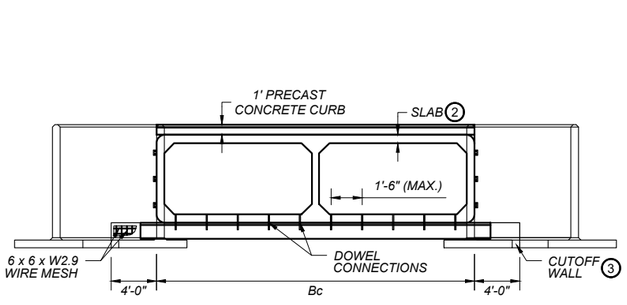
ISOMETRIC VIEW
OUTLET END



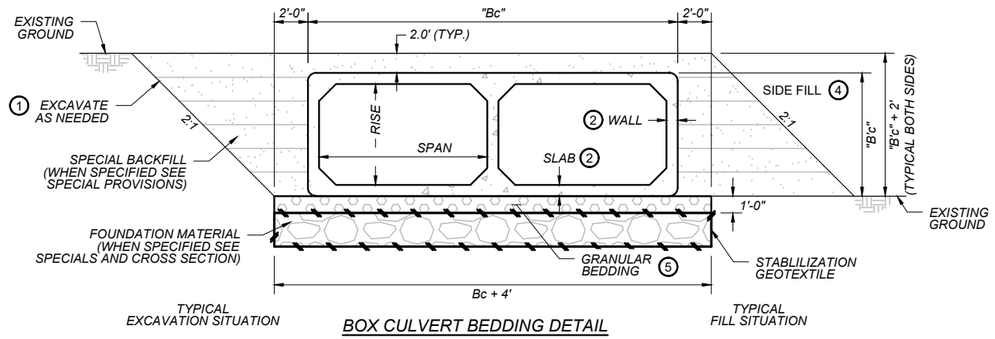
PRECAST WINGWALL
BEDDING AND BACKFILL DETAIL



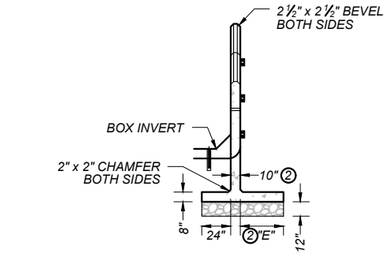
PRECAST WINGWALL
DETAIL SIDE VIEW



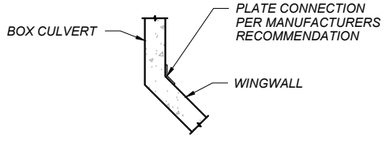
PRECAST DOUBLE CELL BOX CULVERT
WITH CUTOFF WALL AND 45° PRECAST WINGWALLS



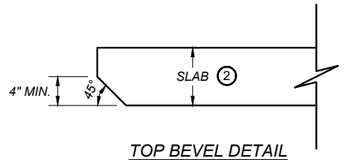
BOX CULVERT BEDDING DETAIL



PRECAST WINGWALL
DETAIL END VIEW



CONNECTION
PLATE DETAIL



TOP BEVEL DETAIL

NOTES:

1. 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.
2. FOR ESTIMATING QUANTITIES ONLY. ACTUAL DIMENSION TO BE DETERMINED BY PRECAST MANUFACTURER.
3. 3'-0" MIN.OR 1'-0" BELOW BOTTOM OF FOUNDATION MATERIAL IF SPECIFIED.
4. COMPACT AND PLACE SIDE FILL PER SECTION 603 AND 203 OF THE STANDARD SPECIFICATIONS.
5. SEE SECTION 701 OF THE STANDARD SPECIFICATIONS FOR GRANULAR BEDDING REQUIREMENTS. THE CONTRACTOR HAS THE OPTION OF USING A SAND CUSHION ABOVE THE GRANULAR BEDDING TO FACILITATE JOINING OF THE BOX CULVERT SECTIONS.

DIMENSIONS										
STATION	SPAN (ft.)	RISE (ft.)	LENGTH (ft.)	WALL (in.)	SLAB (in.)	"E" (in.)	"Bc" (ft.)	"B'c" (ft.)	"H" (ft.)	COVER (ft.)
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-

NOTE: QUANTITIES ARE BASED ON THE DIMENSIONS IN THE TABLE. PROVIDE BOX CULVERTS MEETING ASTM C1577. INCLUDE PRECAST WINGWALLS, PRECAST CONCRETE CURBS, CUTOFF WALLS, SPECIAL BACKFILL BEHIND PRECAST WINGWALLS, GEOCOMPOSITE STRIP DRAINS, AND GRANULAR BEDDING BENEATH THE PRECAST WINGWALLS IN THE UNIT PRICE BID PER LINEAR FOOT OF RCB.

PROVIDE A GEOCOMPOSITE STRIP DRAIN CONSTRUCTED OF A HDPE DRAINAGE CORE WITH A MINIMUM COMPRESSIVE STRENGTH OF 9000 PSF PER ASTM D 1621 AND A MINIMUM FLOW CAPACITY OF 20 GPM PER ASTM D 4716. THE STRIP DRAIN MUST BE WRAPPED IN A SUBSURFACE DRAINAGE GEOTEXTILE FILTER MEETING THE REQUIREMENTS OF HIGH SURVIVABILITY, CLASS B OF SECTION 716.

SHEET NO.
####

DOUBLE RCB WITH WINGWALLS DETAIL
NOT TO SCALE

PROJECT NAME ####
COUNTY ####
PROJECT ID ####
UPN ####

DESIGNED BY ####
REVIEWED BY ####
CHECKED BY ####
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MONTANA
Department of Transportation

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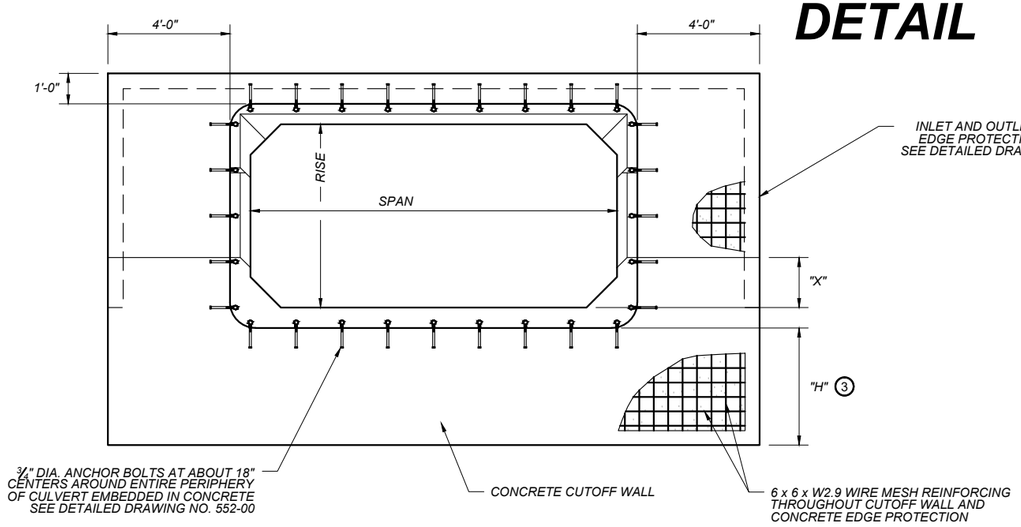
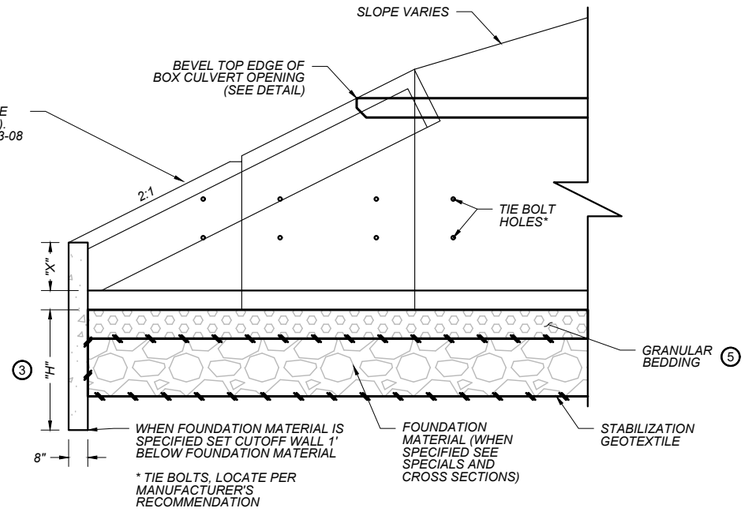
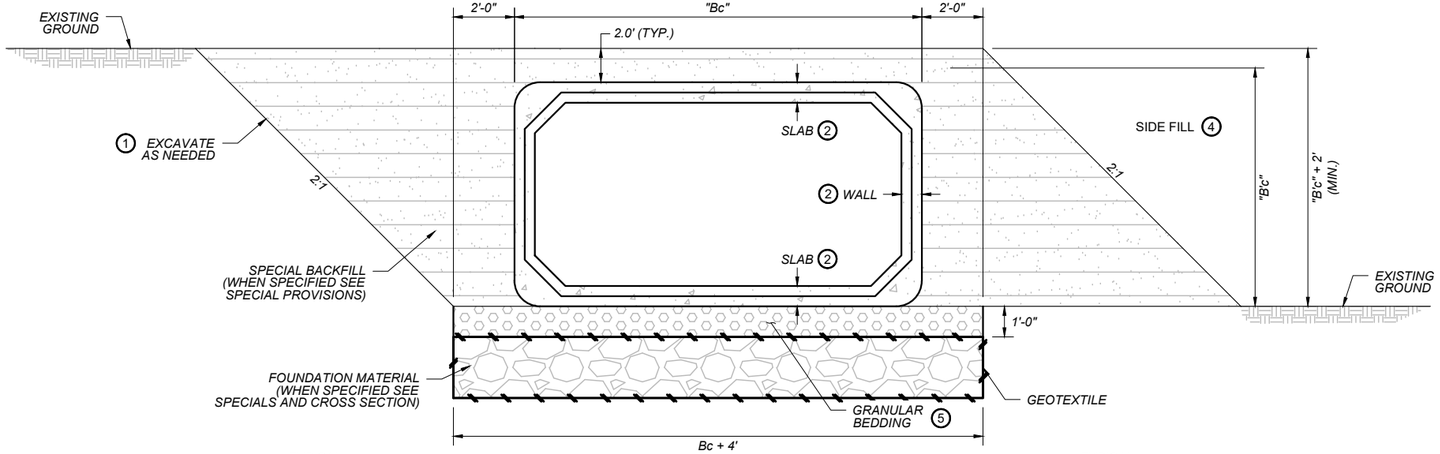
DETAIL



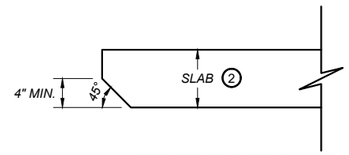
FRONT ELEVATION



SIDE ELEVATION



BEDDING DETAIL



TOP BEVEL DETAIL

DIMENSIONS										
STATION	SPAN (ft.)	RISE (ft.)	LENGTH (ft.)	WALL (in.)	SLAB (in.)	"E" (in.)	"Bc" (ft.)	"B'c" (ft.)	"H" (ft.)	COVER (ft.)
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-

NOTES:
INCLUDE REINFORCING, CUTOFF WALL, AND CONCRETE EDGE PROTECTION IN THE UNIT PRICE BID PER CUBIC YARD OF CLASS GENERAL CONCRETE.
INCLUDE ANCHOR BOLTS IN THE UNIT PRICE BID PER LINEAR FOOT OF CULVERT.
PROVIDE BOX CULVERTS MEETING ASTM C1577.
QUANTITIES ARE BASED ON THE DIMENSIONS IN THE TABLE.

NOTES:

1. 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.
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SHEET NO.
####

SLOPED END
RCB DETAIL
NO SCALE

PROJECT NAME ####
COUNTY ####
PROJECT ID ####
UPN ####

DESIGNED BY ####
####
REVIEWED BY ####
####
CHECKED BY ####
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MONTANA
Department of Transportation

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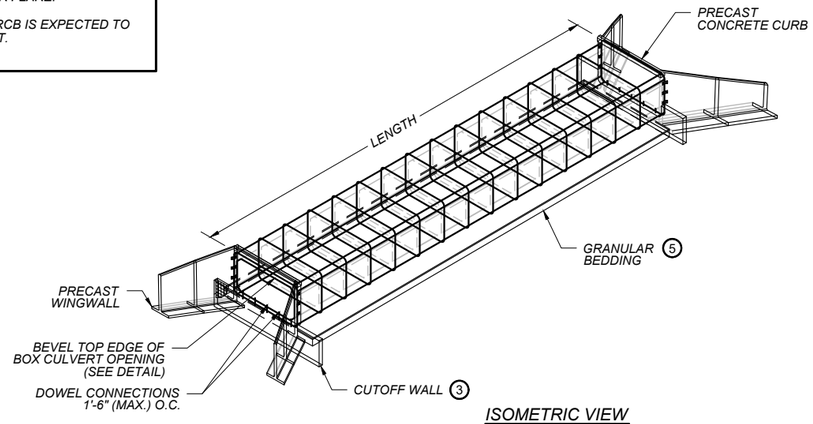
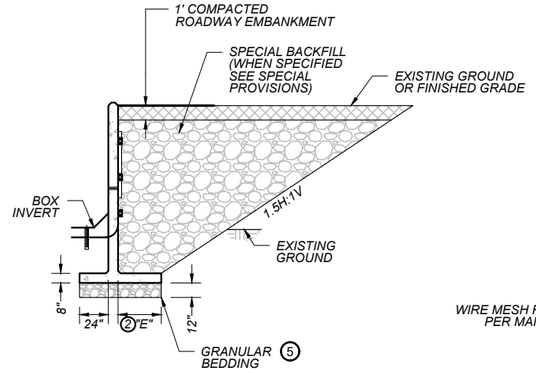
DETAIL

NOTES TO DESIGNER:

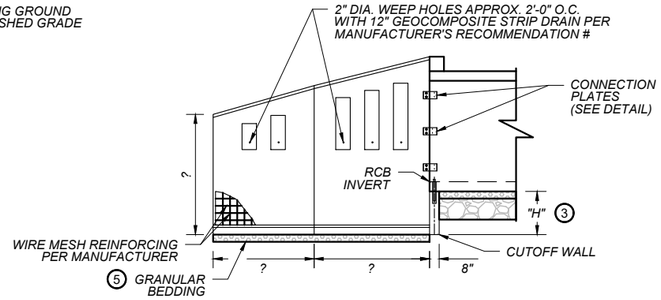
1. ADDITIONAL SHEETS MAY BE REQUIRED IF WINGWALLS ARE DIFFERENT DIMENSIONS AND/OR FLARE.
2. ADD TOP BEVEL IF RCB IS EXPECTED TO FLOW FULL AT INLET.



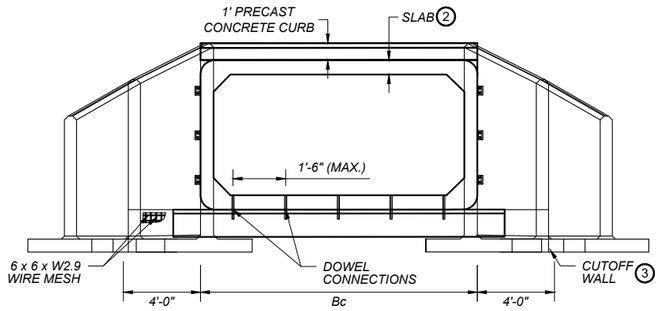
ISOMETRIC VIEW
OUTLET END



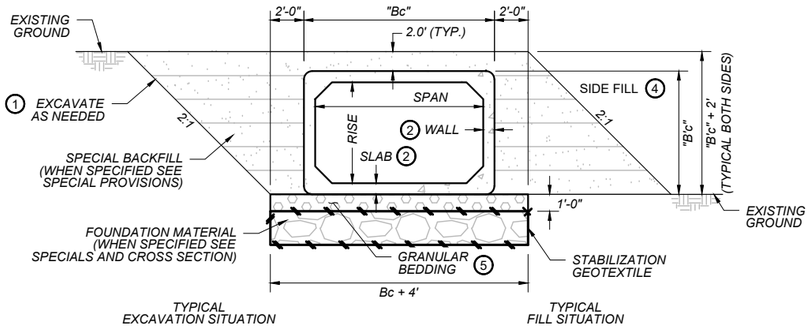
PRECAST TAPERED WINGWALL
BEDDING AND BACKFILL DETAIL



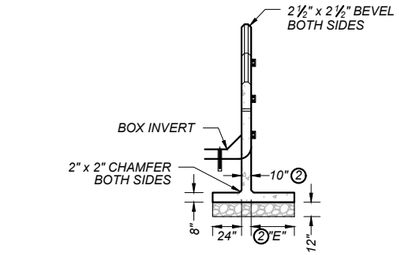
PRECAST TAPERED WINGWALL
DETAIL SIDE VIEW



PRECAST TAPERED SINGLE CELL BOX CULVERT
WITH CUTOFF WALL AND 45° PRECAST WINGWALLS



BOX CULVERT BEDDING DETAIL



PRECAST TAPERED WINGWALL
DETAIL END VIEW

NOTES:

(1) 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.

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DIMENSIONS										
STATION	SPAN (ft.)	RISE (ft.)	LENGTH (ft.)	WALL (in.)	SLAB (in.)	"E" (in.)	"Bc" (ft.)	"B'c" (ft.)	"H" (ft.)	COVER (ft.)
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-

NOTE: QUANTITIES ARE BASED ON THE DIMENSIONS IN THE TABLE. PROVIDE BOX CULVERTS MEETING ASTM C1577. INCLUDE PRECAST TAPERED WINGWALLS, PRECAST CONCRETE CURBS, CUTOFF WALLS, SPECIAL BACKFILL BEHIND PRECAST TAPERED WINGWALLS, GEOCOMPOSITE STRIP DRAINS, AND GRANULAR BEDDING BENEATH THE PRECAST TAPERED WINGWALLS IN THE UNIT PRICE BID PER LINEAR FOOT OF RCB.

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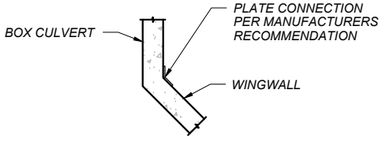
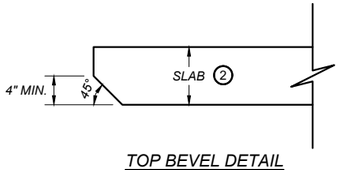


CONNECTION
PLATE DETAIL



TOP BEVEL DETAIL

SHEET NO.
####

RCB WITH TAPERED WING WALLS DETAIL
NOT TO SCALE

PROJECT NAME ####
COUNTY ####
PROJECT ID ####
UPN ####

DESIGNED BY ####
REVIEWED BY ####
CHECKED BY ####
HYDRAULICS_STD_DWG.DWG

MONTANA
Department of Transportation

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2/11/2025 10:20 AM

DETAIL

NOTES TO DESIGNER:

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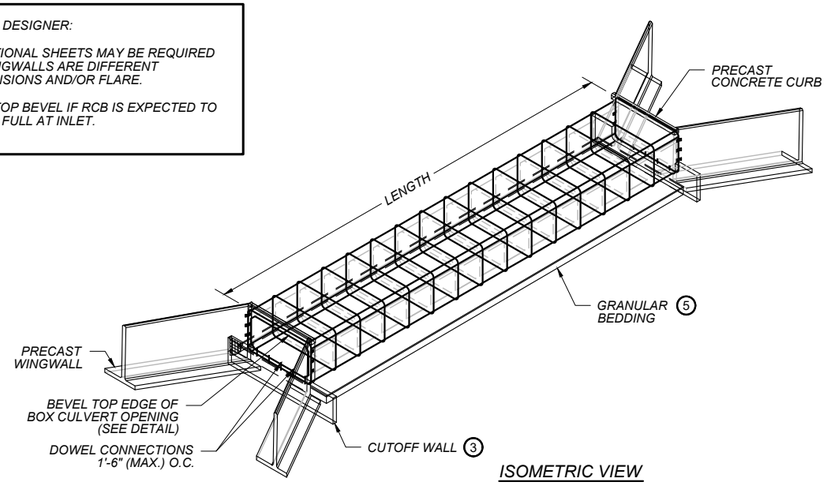
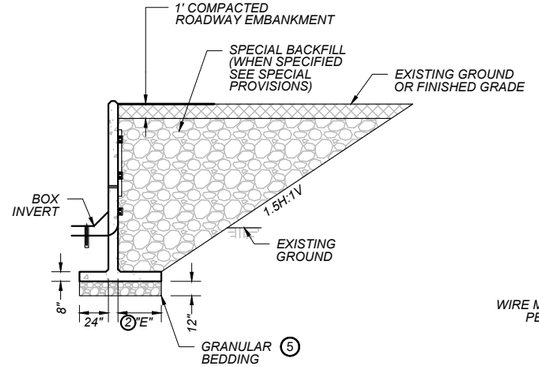
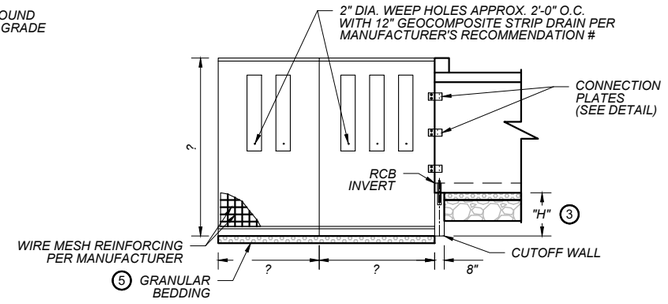
2. ADD TOP BEVEL IF RCB IS EXPECTED TO FLOW FULL AT INLET.



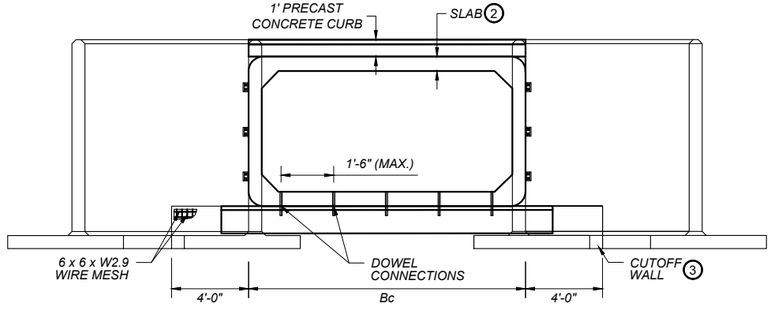
ISOMETRIC VIEW
OUTLET END



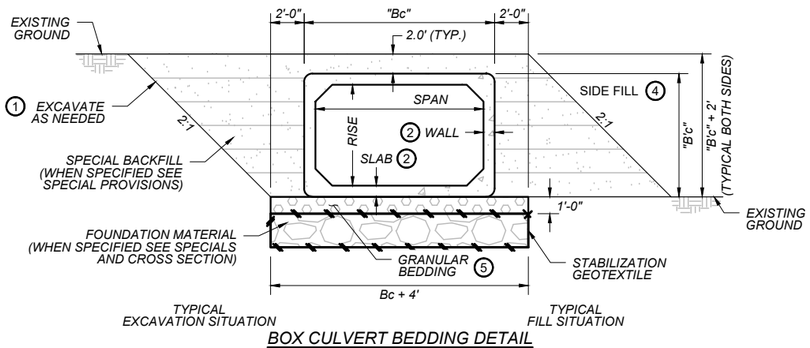
PRECAST WINGWALL
BEDDING AND BACKFILL DETAIL



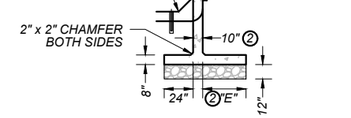
PRECAST WINGWALL
DETAIL SIDE VIEW



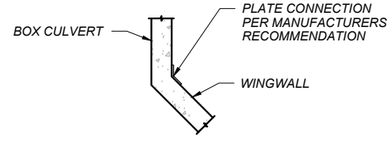
PRECAST SINGLE CELL BOX CULVERT
WITH CUTOFF WALL AND 45° PRECAST WINGWALLS



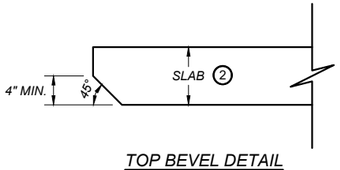
BOX CULVERT BEDDING DETAIL



PRECAST WINGWALL
DETAIL END VIEW



CONNECTION
PLATE DETAIL



TOP BEVEL DETAIL

NOTES:

1. 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.
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DIMENSIONS										
STATION	SPAN (ft.)	RISE (ft.)	LENGTH (ft.)	WALL (in.)	SLAB (in.)	"E" (in.)	"Bc" (ft.)	"B'c" (ft.)	"H" (ft.)	COVER (ft.)
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-

NOTE: QUANTITIES ARE BASED ON THE DIMENSIONS IN THE TABLE. PROVIDE BOX CULVERTS MEETING ASTM C1577. INCLUDE PRECAST WINGWALLS, PRECAST CONCRETE CURBS, CUTOFF WALLS, SPECIAL BACKFILL BEHIND PRECAST WINGWALLS, GEOCOMPOSITE STRIP DRAINS, AND GRANULAR BEDDING BENEATH THE PRECAST WINGWALLS IN THE UNIT PRICE BID PER LINEAR FOOT OF RCB.

PROVIDE A GEOCOMPOSITE STRIP DRAIN CONSTRUCTED OF A HDPE DRAINAGE CORE WITH A MINIMUM COMPRESSIVE STRENGTH OF 9000 PSF PER ASTM D 1621 AND A MINIMUM FLOW CAPACITY OF 20 GPM PER ASTM D 4716. THE STRIP DRAIN MUST BE WRAPPED IN A SUBSURFACE DRAINAGE GEOTEXTILE FILTER MEETING THE REQUIREMENTS OF HIGH SURVIVABILITY, CLASS B OF SECTION 716.

SHEET NO.
####

RCB WITH WING WALLS
DETAIL
NOT TO SCALE

PROJECT NAME ####
COUNTY ####
PROJECT ID ####
UPN ####

DESIGNED BY ####
REVIEWED BY ####
CHECKED BY ####

MONTANA
Department of Transportation

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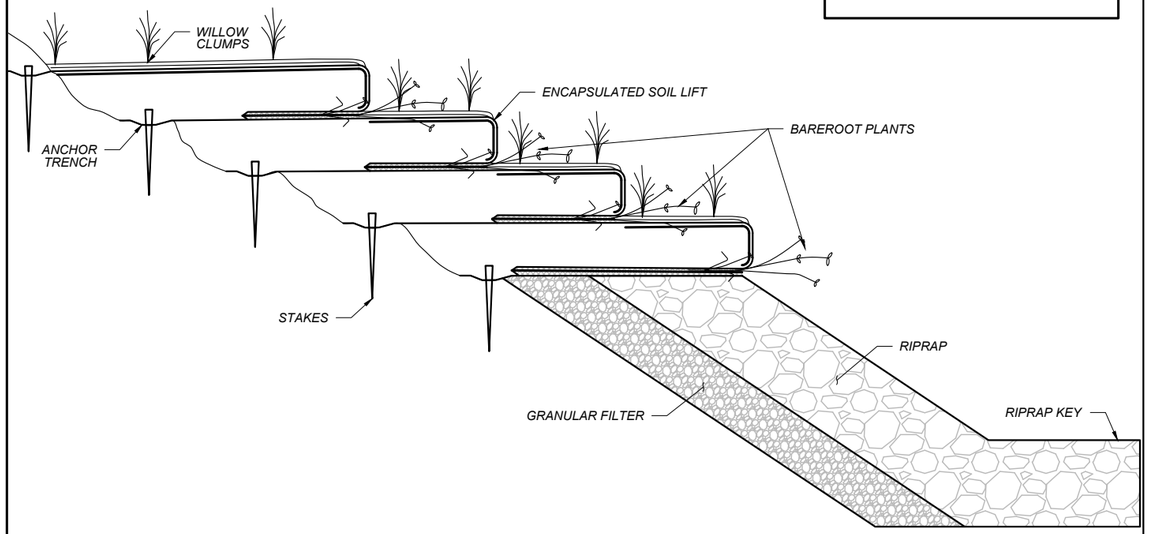
HYDRAULICS_STD_DWG.DWG
2/11/2025 10:20 AM

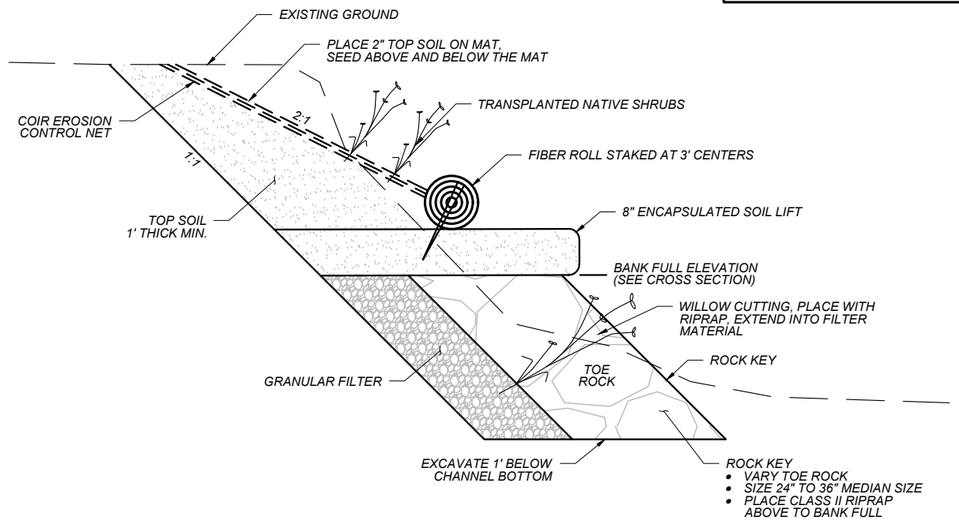
DETAIL

NOTE TO DESIGNER:
FINAL DESIGN BASED ON SITE CONDITIONS

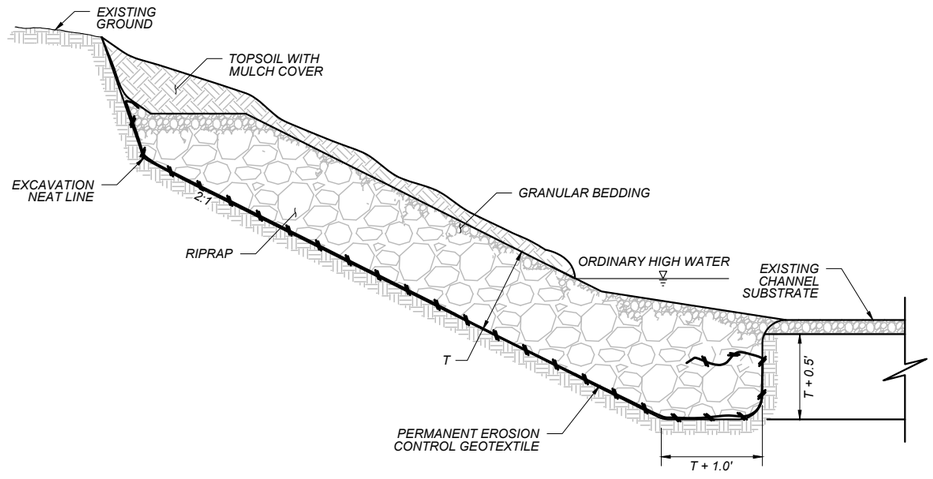


ENCAPSULATED SOIL WITH RIPRAP KEY

NOTE TO DESIGNER:
FINAL DESIGN BASED ON SITE CONDITIONS



REVEGETATION/SLOPE WITH ROCK TOE DETAIL



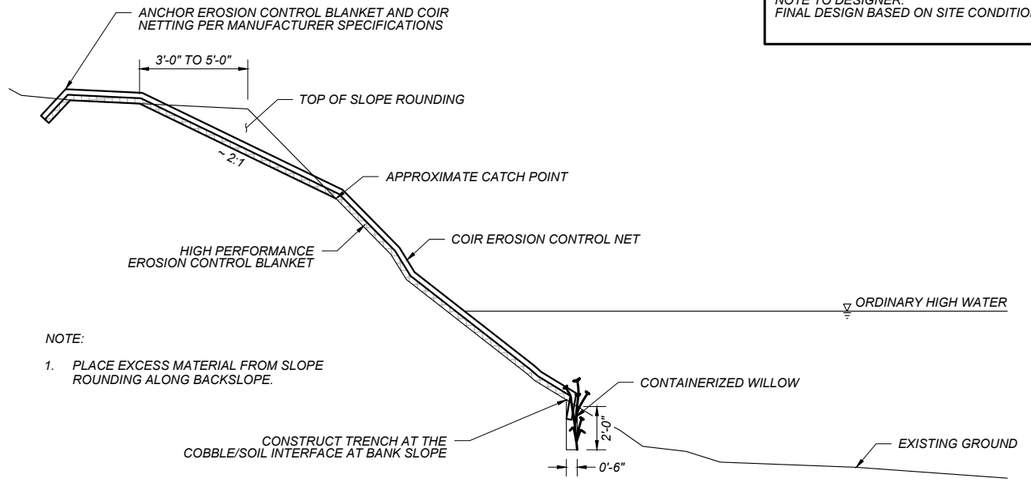
REVEGETATED RIPRAP EMBANKMENT PROTECTION

NOTES:

1. FILL RIPRAP VOIDS WITH GRANULAR BEDDING OR A MATERIAL OF SIMILAR GRADATION OBTAINED ON SITE TO PROVIDE A UNIFORM SURFACE FOR THE PLACEMENT OF TOPSOIL, AS APPROVED BY THE PROJECT MANAGER.
2. PLACE TOPSOIL WITH A MINIMUM THICKNESS OF 8".

MINIMUM T FOR:
CLASS I RIPRAP = 1'-6"
CLASS II RIPRAP = 2'-6"
CLASS III RIPRAP = 3'-0"

NOTE TO DESIGNER:
FINAL DESIGN BASED ON SITE CONDITIONS



NOTE:

1. PLACE EXCESS MATERIAL FROM SLOPE ROUNDING ALONG BACKSLOPE.

BANK STABILIZATION AND REVEGETATION DETAIL

SHEET NO.
####

PROJECT NAME ####
COUNTY ####
PROJECT ID ####
UPN ####

DESIGNED BY #### ####
REVIEWED BY #### ####
CHECKED BY #### ####

MONTANA
Department of Transportation

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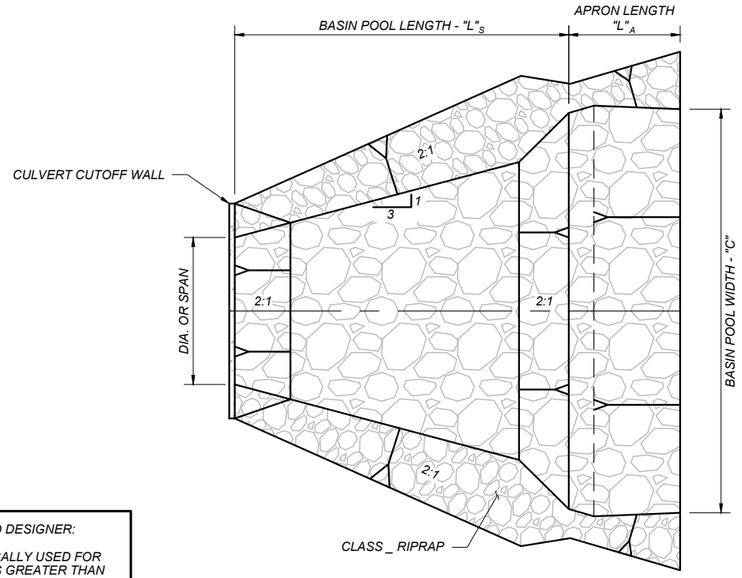
2/11/2025 10:20 AM

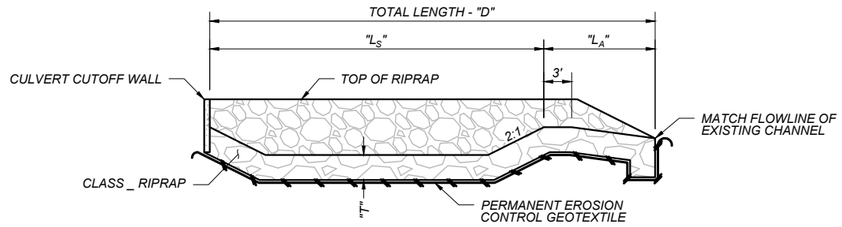
DETAIL



PLAN VIEW - RIPRAP BASIN

NOTES TO DESIGNER:

1. TYPICALLY USED FOR PIPES GREATER THAN 48" EQUIVALENT.
2. CONSIDER FILLING RIPRAP VOIDS WITH GRANULAR BEDDING.



PROFILE VIEW

STATION	"L_S" (ft.)	"L_A" (ft.)	"C" (ft.)	"T" (ft.)	CLASS_RIPRAP $(yd.)^3$	PERMANENT EROSION CONTROL GEOTEXTILE $(yd.)^2$
-	-	-	-	-	-	-

SHEET NO.
####

RIPRAP BASIN
NO SCALE

PROJECT NAME ####
COUNTY ####
PROJECT ID ####
UPN ####

DESIGNED BY ####
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REVIEWED BY ####
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CHECKED BY ####
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MONTANA
Department of Transportation

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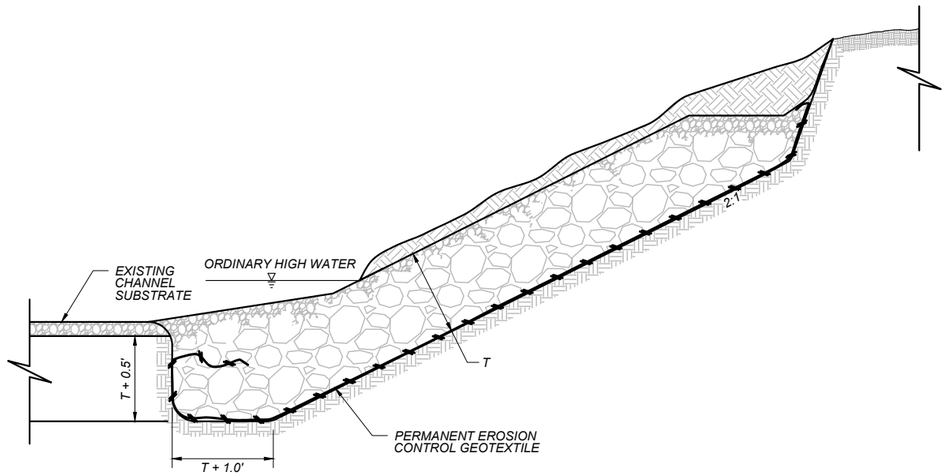
DETAIL



RIPRAP REVEGETATION TYPICAL

NOTES:

1. FILL RIPRAP VOIDS WITH GRANULAR BEDDING OR A MATERIAL OF SIMILAR. GRADATION OBTAINED ON SITE TO PROVIDE A UNIFORM SURFACE FOR THE PLACEMENT OF TOPSOIL, AS APPROVED BY THE PROJECT MANAGER.
2. PLACE TOPSOIL WITH A MINIMUM THICKNESS OF 6".
3. THIS DETAIL IS TO BE USED AS A VISUAL GUIDE FOR RIPRAP REVEGETATION. REFER TO THE PLAN SHEETS AND CROSS SECTIONS FOR SPECIFIC ELEVATIONS AND GEOMETRIC CONFIGURATION OF THE RIPRAP LAYOUT.
4. REFER TO THE SPECIAL PROVISIONS FOR PLANTING AND SEEDING SPECIFICATIONS.

EMBANKMENT PROTECTION
MINIMUM T FOR:
CLASS I RIPRAP = 1'-6"
CLASS II RIPRAP = 2'-6"
CLASS III RIPRAP = 3'-0"

LEGEND

- TOPSOIL WITH EROSION CONTROL BLANKET/MULCH COVER
- RANDOM RIPRAP
- GRANULAR BEDDING
- EXISTING GROUND
- PERMANENT EROSION CONTROL GEOTEXTILE
- EXCAVATION

SHEET NO.
####

RIPRAP REVEGETATION DETAIL NO SCALE

####	####	####	####

PROJECT NAME ####
COUNTY ####
PROJECT ID ####
UPN ####

DESIGNED BY	REVIEWED BY	CHECKED BY
####	####	####
####	####	####

MONTANA
Department of Transportation

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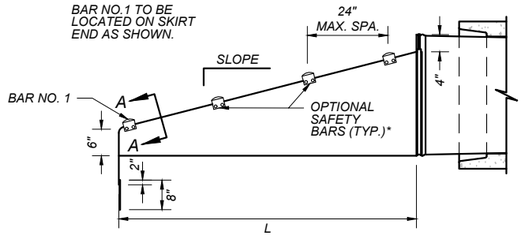
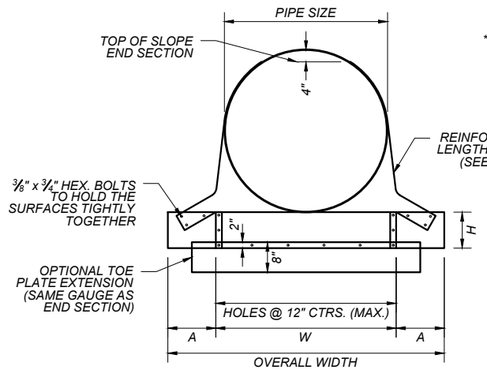
DETAIL

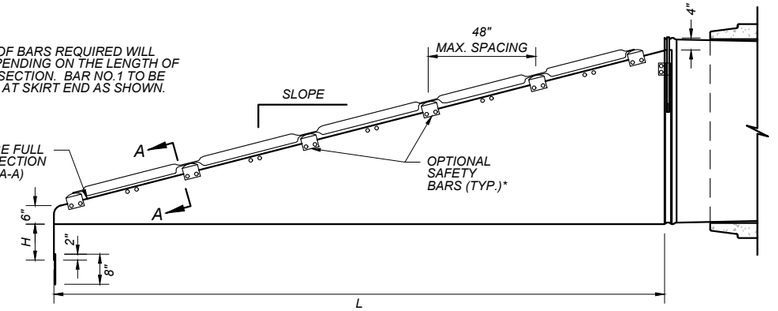


SIDE ELEVATION
OF PARALLEL DRAINAGE STRUCTURE

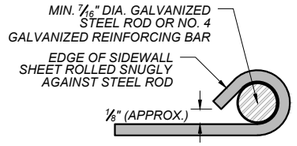


FRONT VIEW

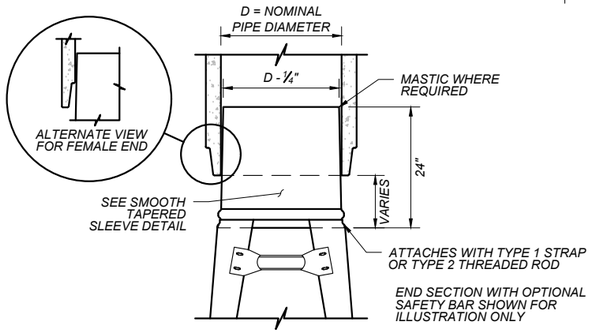
* NUMBER OF BARS REQUIRED WILL VARY DEPENDING ON THE LENGTH OF THE END SECTION. BAR NO.1 TO BE LOCATED AT SKIRT END AS SHOWN.



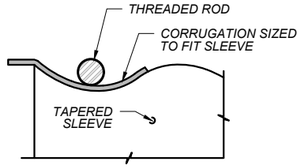
SIDE ELEVATION FOR CROSS DRAINAGE STRUCTURE



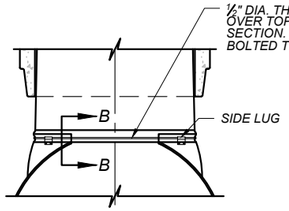
SECTION A-A



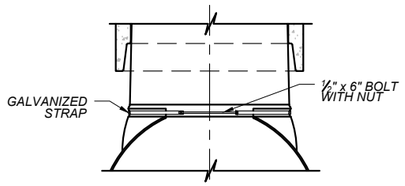
TAPERED SLEEVE FOR ATTACHING STEEL
END SECTIONS TO CONCRETE PIPE



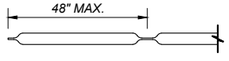
SECTION B-B



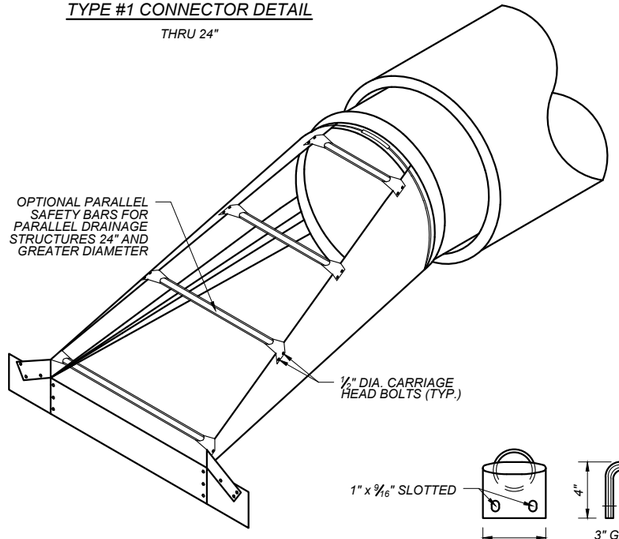
TYPE #2 CONNECTOR DETAILS
FOR 30" AND LARGER



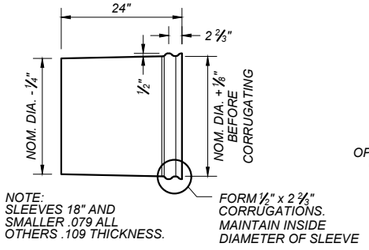
TYPE #1 CONNECTOR DETAIL
THRU 24"



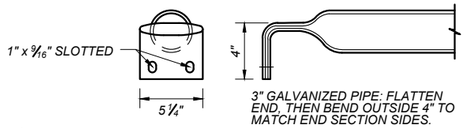
CROSS DRAINAGE BAR
DETAIL OF OPTIONAL SAFETY BARS



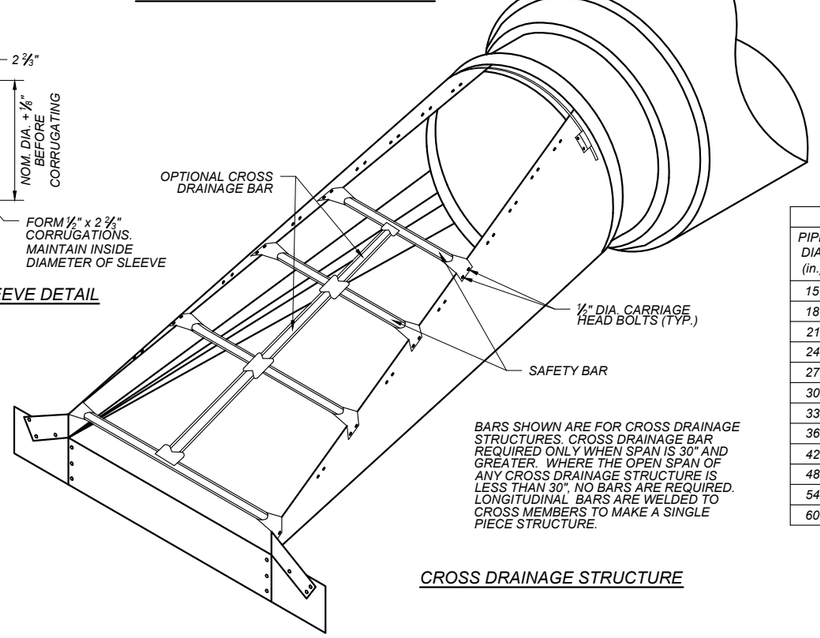
PARALLEL DRAINAGE STRUCTURE



SMOOTH TAPERED SLEEVE DETAIL



PARALLEL BARS
DETAIL OF OPTIONAL SAFETY BARS



BARS SHOWN ARE FOR CROSS DRAINAGE STRUCTURES. CROSS DRAINAGE BAR REQUIRED ONLY WHEN SPAN IS 30" AND GREATER. WHERE THE OPEN SPAN OF ANY CROSS DRAINAGE STRUCTURE IS LESS THAN 30", NO BARS ARE REQUIRED. LONGITUDINAL BARS ARE WELDED TO CROSS MEMBERS TO MAKE A SINGLE PIECE STRUCTURE.

CROSS DRAINAGE STRUCTURE

NOTES:

STEEL
GALVANIZED STEEL PER SECTION 711 OF THE STANDARD SPECIFICATIONS.

CONNECTORS
ROUND SIZES THRU 24" ATTACH TO PIPE WITH TYPE #1 STRAPS. ALL OTHER SIZES ATTACH WITH TYPE #2 RODS AND LUGS.

TOE PLATE EXTENSIONS
WHEN REQUIRED,TOE PLATE EXTENSIONS ARE THE SAME GAUGE AS END SECTION. TOE PLATE EXTENSIONS DIMENSIONS ARE OVERALL WIDTH LESS 6 INCHES BY 8 INCHES HIGH.

OPTIONAL SAFETY BARS
SCHEDULED 40 GALVANIZED STEEL PIPE, WHEN SPECIFIED.

MISCELLANEOUS DETAILS
PROVIDE SLOTTED HOLES FOR SAFETY BAR ATTACHMENT FOR ALL END SECTIONS.

METAL END SECTIONS FOR ROUND PIPES

PIPE DIA. (in.)	MIN. THICK. IN.	MIN. THICK. GAUGE	DIMENSIONS (INCHES) A	H	W	OVERALL WIDTH	L DIMENSIONS SLOPE	LENGTH (in.)	SLOPE	LENGTH (in.)
15	.064	16	8	6	21	37	4:1	20	6:1	30
18	.064	16	8	6	24	40	4:1	32	6:1	48
21	.064	16	8	6	27	43	4:1	44	6:1	66
24	.064	16	8	6	30	46	4:1	56	6:1	84
27	.109	12	12	9	33	57	4:1	68	6:1	102
30	.109	12	12	9	36	60	4:1	80	6:1	120
33	.109	12	12	9	39	63	4:1	92	6:1	138
36	.109	12	12	9	42	66	4:1	104	6:1	156
42	.109	12	16	12	48	80	4:1	128	6:1	192
48	.109	12	16	12	54	86	4:1	152	6:1	228
54	.109	12	16	12	60	92	4:1	176	6:1	264
60	.109	12	16	12	66	98	4:1	200	6:1	300

SHEET NO.
####

SAFETY SLOPE END SECTION
FOR ROUND RCP PIPE
NO SCALE

PROJECT NAME ####
COUNTY ####
PROJECT ID ####
UPN ####

DESIGNED BY ####
REVIEWED BY ####
CHECKED BY ####

MONTANA
Department of Transportation

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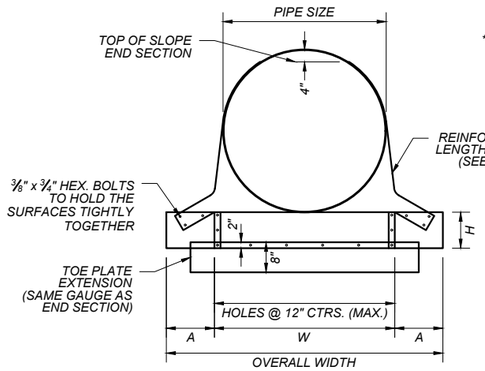
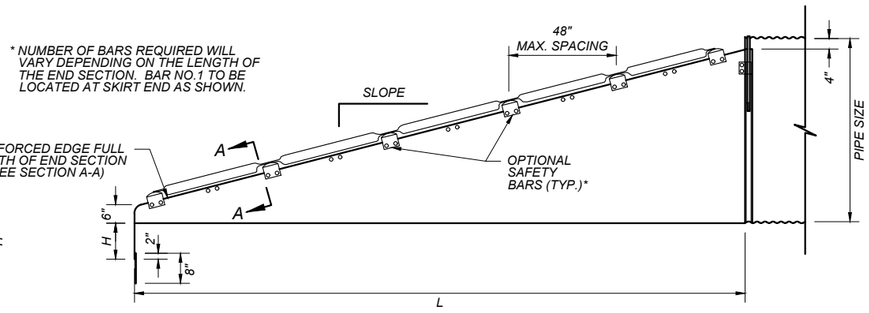
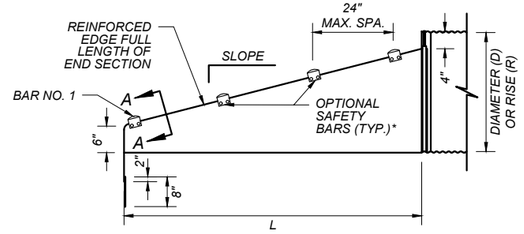
DETAIL



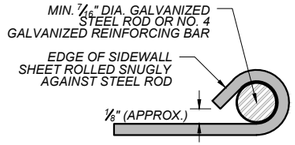
FRONT VIEW



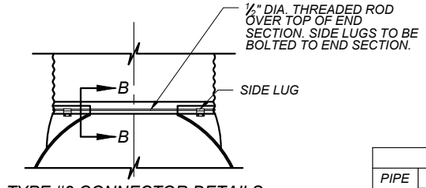
SIDE ELEVATION FOR CROSS DRAINAGE STRUCTURE



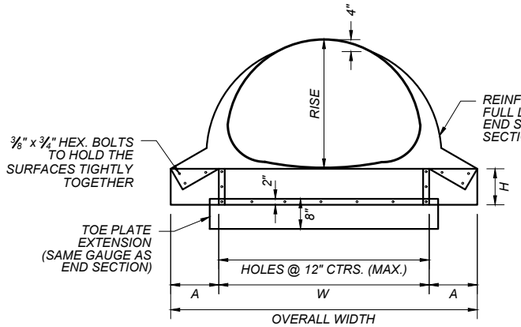
SIDE ELEVATION
OF PARALLEL DRAINAGE STRUCTURE



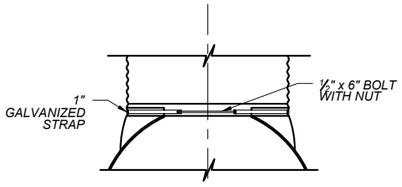
SECTION A-A



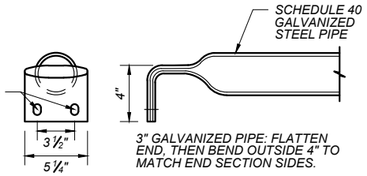
TYPE #2 CONNECTOR DETAILS
FOR 30" AND LARGER
21" x 15" AND LARGER



FRONT VIEW

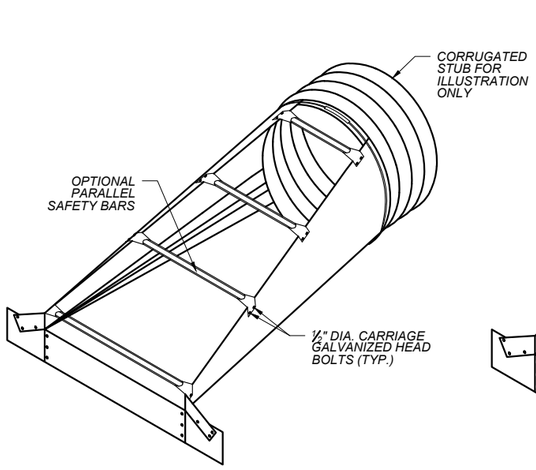


TYPE #1 CONNECTOR DETAIL
THRU 24"

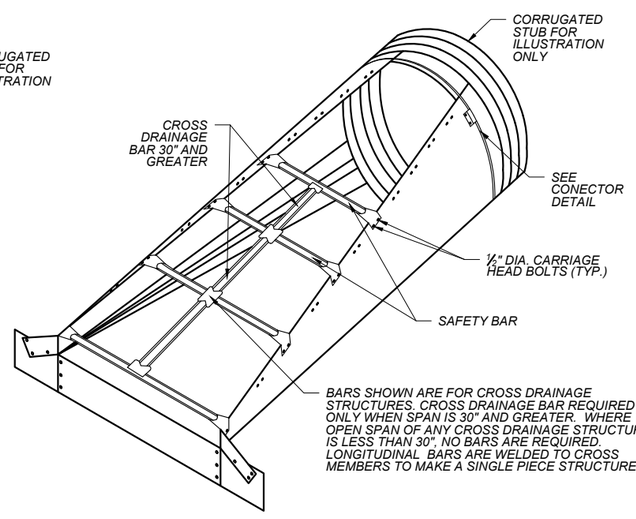


SAFETY BAR DETAIL

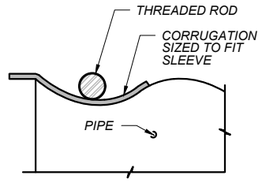
METAL END SECTIONS FOR CIRCULAR PIPES												
PIPE DIA. (in.)	MIN. THICK.		DIMENSIONS (INCHES)				L DIMENSIONS					
	IN.	GAUGE	A	H	W	OVERALL WIDTH	SLOPE	LENGTH (in.)	SLOPE	LENGTH (in.)	SLOPE	LENGTH (in.)
15	.064	16	8	6	21	37	4:1	20	6:1	30	10:1*	70
18	.064	16	8	6	24	40	4:1	32	6:1	48	10:1*	100
21	.064	16	8	6	27	43	4:1	44	6:1	66	10:1*	130
24	.064	16	8	6	30	46	4:1	56	6:1	84	10:1*	160
30	.109	12	12	9	36	60	4:1	80	6:1	120	10:1*	220
36	.109	12	12	9	42	66	4:1	104	6:1	156	10:1*	280
42	.109	12	16	12	48	80	4:1	128	6:1	192	-	-
48	.109	12	16	12	54	86	4:1	152	6:1	228	-	-
54	.109	12	16	12	60	92	4:1	176	6:1	264	-	-
60	.109	12	16	12	66	98	4:1	200	6:1	300	-	-



PARALLEL DRAINAGE STRUCTURE



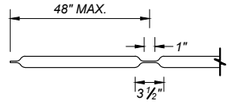
CROSS DRAINAGE STRUCTURE



SECTION B-B

METAL END SECTIONS FOR ARCHED PIPES														
PIPE DIA. (in.)	(INCHES)		MIN. THICK.		DIMENSIONS (INCHES)				L DIMENSIONS					
	SPAN	RISE	IN.	GAUGE	A	H	W	OVERALL WIDTH	SLOPE	LENGTH (in.)	SLOPE	LENGTH (in.)	SLOPE	LENGTH (in.)
18	21	15	.064	16	8	6	27	43	4:1	20	6:1	30	10:1*	70
21	24	18	.064	16	8	6	30	46	4:1	32	6:1	48	10:1*	70
24	28	20	.064	16	8	6	34	50	4:1	40	6:1	60	10:1*	100
30	35	24	.079	14	12	9	41	65	4:1	56	6:1	84	10:1*	120
36	42	29	.109	12	12	9	48	72	4:1	76	6:1	114	10:1*	160
42	49	33	.109	12	16	12	55	87	4:1	92	6:1	138	10:1*	210
48	57	38	.109	12	16	12	63	95	4:1	112	6:1	168	-	-
54	64	43	.109	12	16	12	70	102	4:1	132	6:1	198	-	-
60	71	47	.109	12	16	12	77	109	4:1	148	6:1	222	-	-

* MINIMUM THICKNESS OF ALL 10:1 SLOPE END SECTIONS IS .109" - 12 GAUGE



CROSS DRAINAGE BAR DETAIL

NOTES:

STEEL
GALVANIZED STEEL PER SECTION 711 OF THE STANDARD SPECIFICATIONS.

TOE PLATE EXTENSIONS
WHEN REQUIRED,TOE PLATE EXTENSIONS ARE THE SAME GAUGE AS END SECTION. TOE PLATE EXTENSIONS DIMENSIONS ARE OVERALL WIDTH LESS 6 INCHES BY 8 INCHES HIGH.

SHEET NO.
####

SAFETY SLOPE END SECTION FOR CSP & CSPA
NO SCALE

####

PROJECT NAME
COUNTY
PROJECT ID
UPN

DESIGNED BY ####
REVIEWED BY ####
CHECKED BY ####

MONTANA
Department of Transportation

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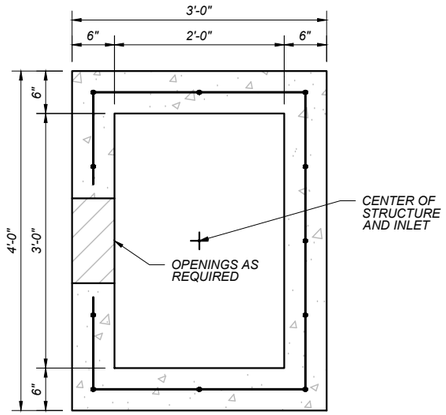
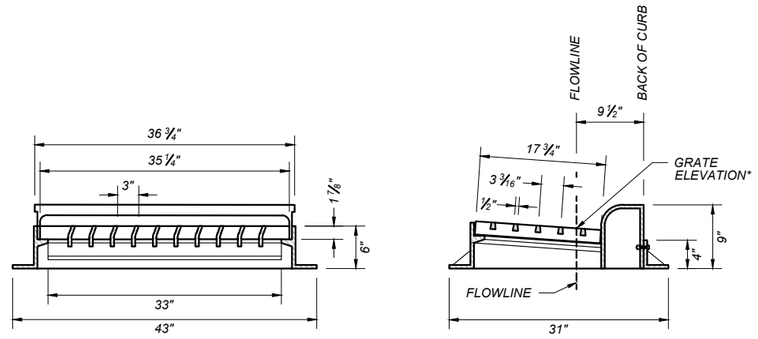
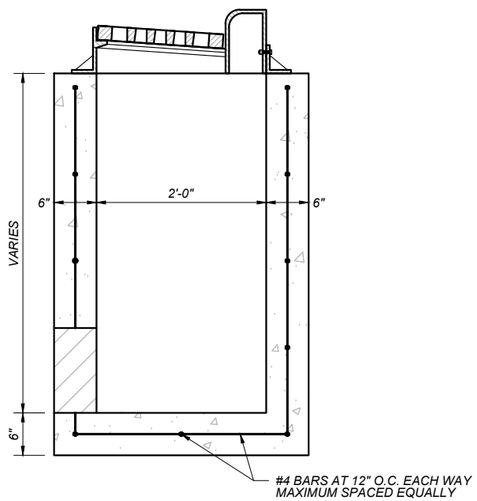
DETAIL



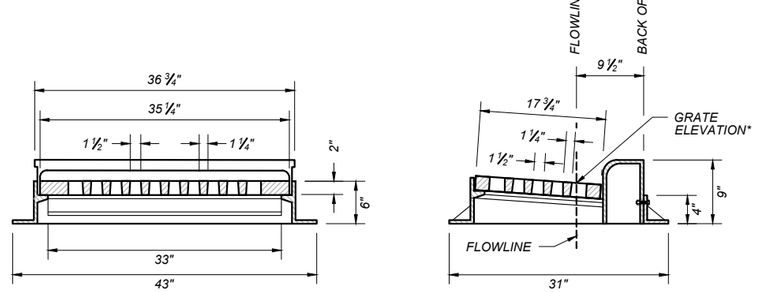
SPECIAL DESIGN CURB INLET - PLAN VIEW



CURVED VANE STYLE #



SPECIAL DESIGN CURB INLET - SECTION VIEW



STRAIGHT BAR STYLE #

PROVIDE SPECIAL DESIGN CURB INLETS WITH CURVED VANE UNLESS OTHERWISE NOTED IN THE PLANS.

* GRATE ELEVATIONS FOR SPECIAL DESIGN CURB INLETS SHOWN IN PLANS ARE 1" LESS THAN GUTTER FLOW LINE ELEVATION.

NOTES:

1. SEE PLANS FOR LOCATIONS AND QUANTITIES.
2. PLAN STATION AND OFFSET FOR SPECIAL DESIGN CURB INLET IS CENTER OF STRUCTURE.
3. STANDARD UNLESS OTHERWISE NOTED ON PLANS.
4. SET ALL FINAL INLET GRATE ELEVATIONS TO ENSURE THAT POSITIVE DRAINAGE IS PROVIDED.

SHEET NO.
####

SPECIAL DESIGN CURB INLET DETAIL NO SCALE

PROJECT NAME ####
COUNTY ####
PROJECT ID ####
UPN ####

DESIGNED BY #### ####
REVIEWED BY #### ####
CHECKED BY #### ####

MONTANA Department of Transportation

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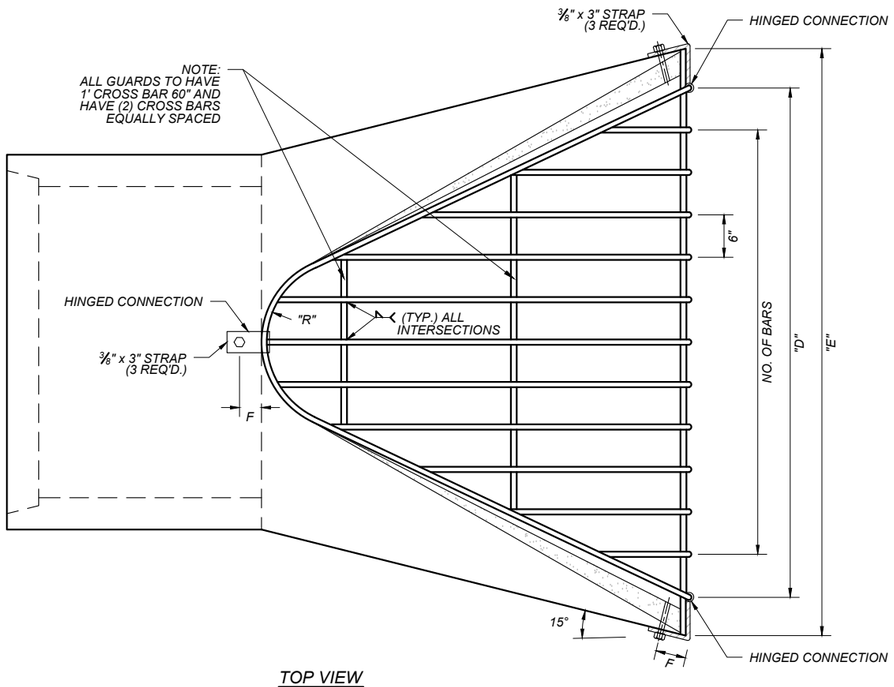
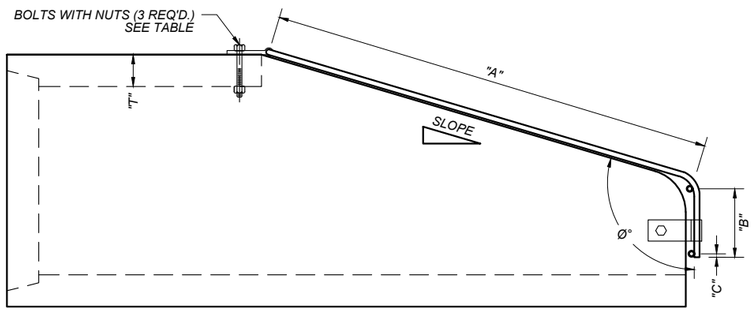
DETAIL



TOP VIEW



SIDE VIEW

REINFORCED CONCRETE ROUND PIPE													
PIPE SIZE	T	BAR SIZE (dia.)	NO. OF BARS	BOLT SIZE & LENGTH	SLOPE	RADIUS "R"	"A"	"B"	"C"	"D"	"E"	"F"	Ø°
12"	2"	#5	3	#5 x 4 1/2"	2.4:1	3 1/4"	27"	3"	1"	24"	30"	4"	113°
15"	2 1/4"	#5	4	#5 x 4 1/2""	2.4:1	4 1/8"	29"	5"	1"	30"	36"	4"	113°
18"	2 1/2"	#5	5	#5 x 5"	2.3:1	5"	31"	8"	1"	36"	42"	4"	113°
21"	2 3/4"	#5	6	#5 x 5"	2.4:1	5 5/8"	40"	8"	2"	42"	48"	4"	113°
24"	3"	#5	7	#5 x 5 1/2"	2.5:1	6 1/2"	48"	8 1/2"	2"	48"	56"	4"	112°
27"	3 1/4"	#5	8	#5 x 5 1/2"	2.5:1	7 3/8"	55"	9 1/2"	2"	54"	62"	4"	112°
30"	3 1/2"	#6	9	#6 x 6"	2.5:1	8 1/4"	58"	11"	2"	60"	69"	6"	112°
36"	4"	#6	11	#6 x 6 1/2"	2.5:1	10"	68"	14"	2"	72"	82"	6"	112°
42"	4 1/2"	#6	12	#6 x 7"	2.5:1	11 3/4"	68"	20"	2"	78"	90"	6"	112°
48"	5"	#6	13	#6 x 7 1/2"	2.5:1	13 1/2"	74"	23"	2"	84"	96"	6"	112°
54"	5 1/2"	1"	14	1" x 8"	2.0:1	15"	72"	25"	4"	90"	103"	6"	116°
60"	6"	1"	15	1" x 8 1/2"	1.9:1	16 3/4"	69"	33"	4"	96"	108"	8"	118°
66"	6 1/2"	1"	16	1" x 9"	1.7:1	18 1/2"	83"	28"	4"	102"	115"	8"	121°
72"	7"	1"	17	1" x 9 1/2"	1.8:1	20 1/4"	91"	34"	4"	108"	122"	8"	119°
78"	7 1/2"	1"	18	1" x 10"	1.8:1	22"	105"	34"	4"	114"	129"	8"	119°
84"	8"	1"	19	1" x 10 1/2"	1.6:1	23 3/4"	109"	34"	4"	120"	135"	8"	122°
90"	8 1/2"	1"	21	1" x 11"	1.5:1	25 1/2"	107"	39"	4"	132"	147"	8"	124°

REINFORCED CONCRETE ARCH PIPE													
SPAN	RISE	T	BAR SIZE (dia.)	NO. OF BARS	BOLT SIZE & LENGTH	SLOPE	RADIUS "R"	"A"	"B"	"C"	"D"	"E"	"F"	Ø°
22"	14"	2 1/2"	#5	5	#5 x 5 1/2"	3:1	5 3/4"	30"	6"	1"	36"	41"	4"	108°
29"	18"	3 1/2"	#6	7	#6 x 6"	3:1	7 7/8"	43"	7 1/2"	1"	48"	58"	4"	108°
36"	23"	4"	3/4"	9	3/4" x 6 1/2"	3:1	10 1/16"	54"	8 1/2"	1"	60"	70"	6"	108°
44"	27"	4 1/2"	3/4"	11	3/4" x 7"	3:1	12 9/16"	62"	10 1/8"	1"	72"	83"	6"	108°
51"	32"	4 1/2"	3/4"	12	3/4" x 7"	3:1	14"	62"	14 3/4"	1"	78"	89"	6"	108°
58"	36"	5"	3/4"	13	1" x 7 1/2"	3:1	16 1/8"	62"	20"	1"	84"	96"	6"	108°
65"	40"	5 1/2"	1"	14	1" x 8"	3:1	17 3/4"	62"	23 1/2"	2"	90"	103"	8"	108°
73"	45"	6"	1"	15	1" x 8 1/2"	3:1	20"	65"	29"	2"	96"	110"	8"	108°
88"	54"	7"	1"	19	1" x 9 1/2"	3:1	24 1/4"	65"	29"	2"	120"	135"	8"	108°

NOTES:

1. ALL STRUCTURAL STEEL FOR TRASHGUARDS MUST CONFORM TO THE REQUIREMENTS FOR ASTM A-36 STRUCTURAL CARBON STEEL.
2. PAINT ONE COAT OF RED OXIDE PRIMER AND TWO COATS OF ALUMINUM PAINT.
3. BECAUSE OF VARIABLE FORMS BEING USED, TAKE FIELD MEASUREMENT OF FLARED ENDS BEFORE FABRICATING TRASHGUARD.

SHEET NO.
####

TRASHGUARD FOR PRECAST
RCP FLARED ENDS
NO SCALE

PROJECT NAME ####
COUNTY ####
PROJECT ID ####
UPN ####

DESIGNED BY ####
REVIEWED BY ####
CHECKED BY ####

MONTANA
Department of Transportation

####

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