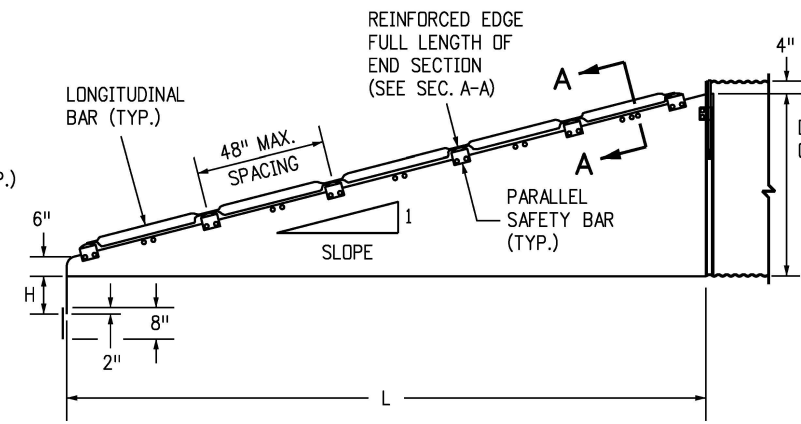
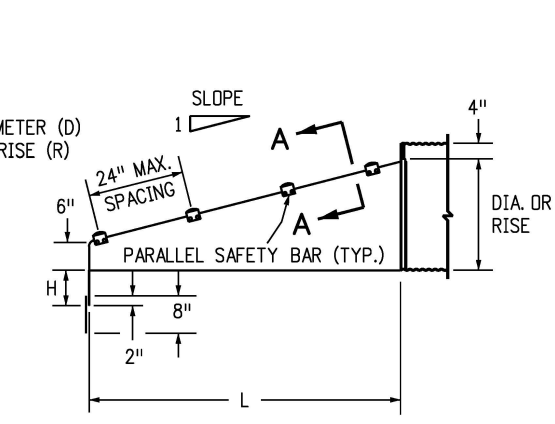


FRONT VIEW  
**ROUND PIPE CULVERT**



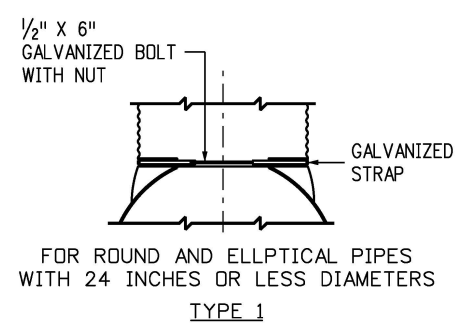
ELEVATION VIEW  
**CROSS DRAINAGE END SECTION**



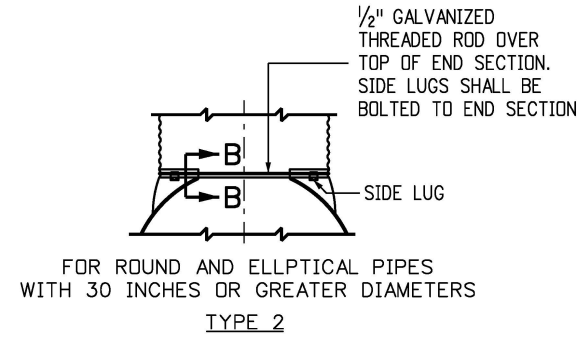
ELEVATION VIEW  
**PARALLEL DRAINAGE END SECTION**

**GENERAL NOTES**

1. USE END SECTIONS ON 1V:4H TO 1V:6H SLOPES ONLY. USE TOE PLATE EXTENSION WHERE SHOWN ON THE PLANS.
2. FABRICATE SAFETY AND LONGITUDINAL BARS FROM STEEL PIPE CONFORMING TO ASTM A53 SCHEDULE 40 SPECIFICATIONS. GALVANIZE BARS HOT DIPPED AFTER FABRICATION.
3. A LONGITUDINAL BAR IS REQUIRED FOR CROSS DRAINAGE END SECTIONS WHEN THE SPAN IS GREATER THAN 30 INCHES. USE ADDITIONAL LONGITUDINAL BARS IF SPACING EXCEEDS 30 INCHES ON LARGER END SECTIONS.
4. SAFETY AND LONGITUDINAL BARS ARE NOT REQUIRED ON 30 INCHES AND SMALLER CROSS DRAINAGE END SECTIONS.
5. SAFETY BARS ARE NOT REQUIRED ON 18 INCHES AND SMALLER PARALLEL DRAINAGE END SECTIONS.
6. WHEN REQUIRED, TOE PLATE EXTENSIONS SHALL BE THE SAME GAGE AS END SECTIONS. DIMENSIONS SHALL BE OVERALL WIDTH LESS 6 INCHES BY 8 INCHES HIGH.



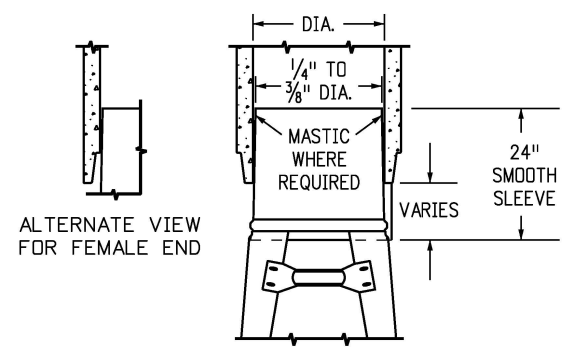
FOR ROUND AND ELLIPTICAL PIPES WITH 24 INCHES OR LESS DIAMETERS  
**TYPE 1**



FOR ROUND AND ELLIPTICAL PIPES WITH 30 INCHES OR GREATER DIAMETERS  
**TYPE 2**

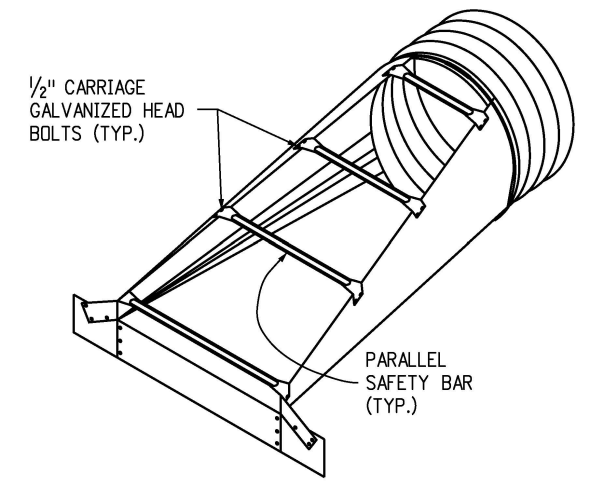
**CONNECTOR DETAILS**

NOTE: SIZES THRU 24" ATTACH TO PIPE WITH TYPE 1 STRAPS. ALL OTHER SIZES ATTACH WITH TYPE 2 RODS AND LUGS.

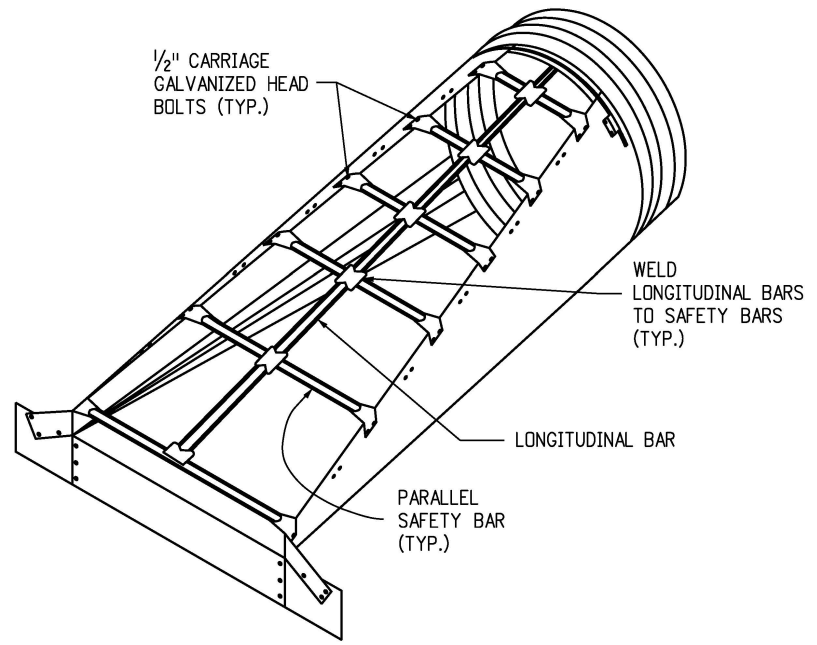


FOR ALL SIZES OF CONCRETE ROUND OR PIPE ARCHES  
**TAPER SLEEVE CONNECTION**

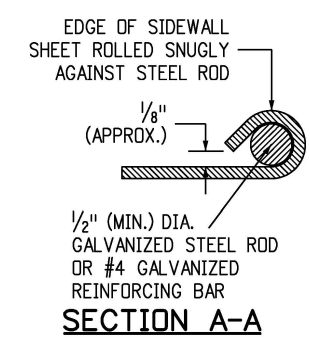
METAL END SECTIONS FOR ROUND PIPE CULVERT							
PIPE DIA. SIZE (INCHES)	METAL THICK MIN. (INCH/GAGE)	DIMENSIONS IN INCHES					
		A	H	W	OVERALL WIDTH	L	
						Slope = 4	Slope = 6
18	0.064/16	8	6	24	40	32	47
24	0.064/16	8	6	30	46	55	83
30	0.109/12	12	9	36	60	79	118
36	0.109/12	12	9	42	66	102	154
42	0.109/12	16	12	48	80	126	189
48	0.109/12	16	12	54	86	150	224
54	0.109/12	16	12	60	92	173	260
60	0.109/12	16	12	66	98	197	295



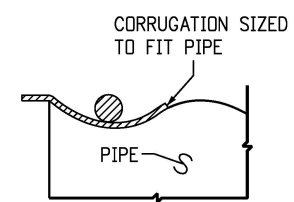
**PARALLEL DRAINAGE END SECTION**



**CROSS DRAINAGE END SECTION**

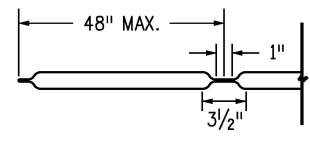


**SECTION A-A**

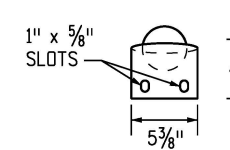


**SECTION B-B**

METAL END SECTIONS FOR PIPE ARCH CULVERT									
PIPE SIZE (INCHES)			METAL THICK MIN. (INCH/GAGE)	DIMENSIONS (INCHES)					
EQUIV. DIA.	SPAN	RISE		A	H	W	OVERALL WIDTH	L	
								Slope = 4	Slope = 6
18	21	15	0.064/16	8	6	27	43	20	30
24	28	20	0.064/16	8	6	33	49	40	60
30	35	24	0.109/12	12	9	40	64	55	83
36	41	29	0.109/12	12	9	47	71	75	112
42	48	32	0.109/12	16	12	54	86	90	136
48	56	37	0.109/12	16	12	62	94	110	165
54	63	42	0.109/12	16	12	69	101	130	195
60	70	46	0.109/12	16	12	76	107	146	218
72	82	56	0.109/12	16	12	88	120	185	278



**LONGITUDINAL DRAINAGE BAR**



**PARALLEL BARS**

**SAFETY BAR DETAILS**

**Computer File Information**

Creation Date: 07/31/19
Designer Initials: JJP
Last Modification Date: 07/31/19
Detailer Initials: LTA
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English

**Sheet Revisions**

Date:	Comments
(R-X)	
(R-X)	
(R-X)	
(R-X)	

**Colorado Department of Transportation**

2829 West Howard Place  
CDDT HQ, 3rd Floor  
Denver, CO 80204  
Phone: 303-757-9021 FAX: 303-757-9868

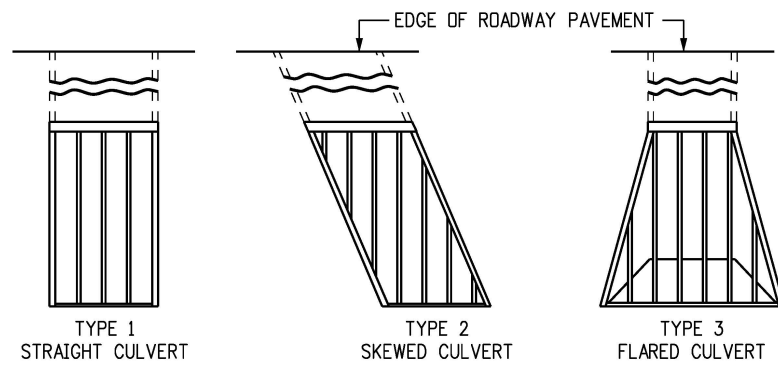
**Project Development Branch** **JBK**

**TRAVERSABLE END SECTIONS AND SAFETY GRATES**

Issued by the Project Development Branch: July 31, 2019

**STANDARD PLAN NO.**

**M-603-12**  
**Standard Sheet No. 1 of 3**  
Project Sheet Number:



TYPE 1  
STRAIGHT CULVERT

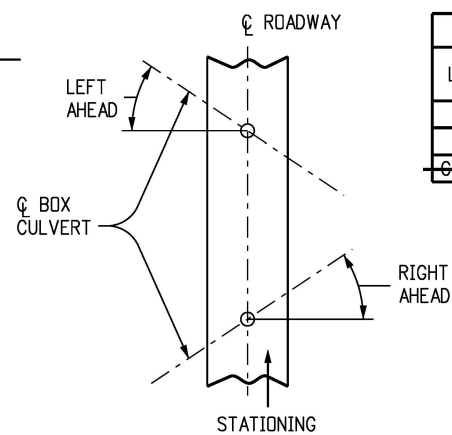
TYPE 2  
SKEWED CULVERT

TYPE 3  
FLARED CULVERT

TYPE 4  
FLARED-SKEWED CULVERT

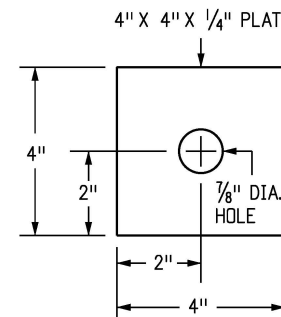
**INSTALLATION TYPES**

GRATE BARS SHALL BE PERPENDICULAR TO DIRECTION OF TRAFFIC FLOW.

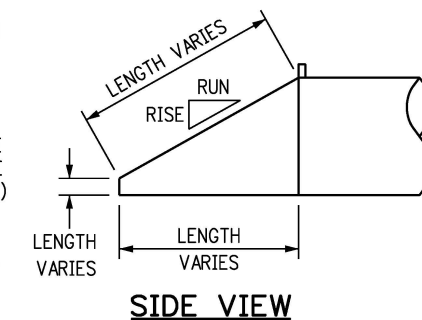


**SKEW ANGLE DETERMINATION**

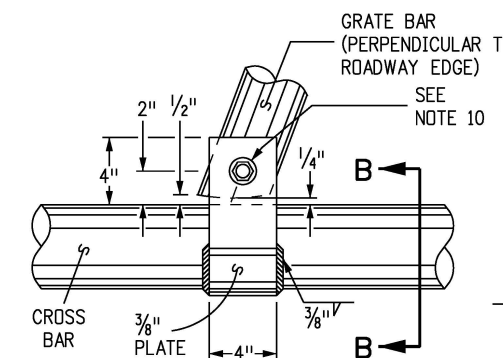
GRATE & CROSS BAR SIZE REQUIREMENTS		
LENGTH OF SPAN	NOMINAL PIPE SIZE (SEE NOTE 7)	O.D. SIZE
LESS THAN 12'	3.0"	3.0"
12' - 16'	3.5"	3.5"
GREATER THAN 16'	4.0"	4.0"



**SHIM DETAIL**

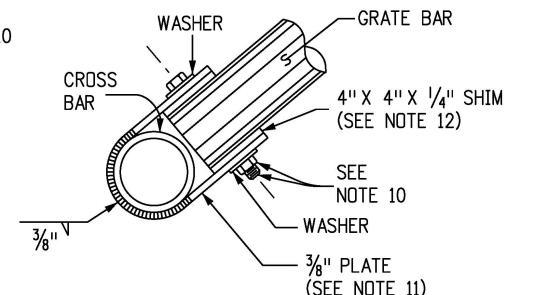


**SIDE VIEW**

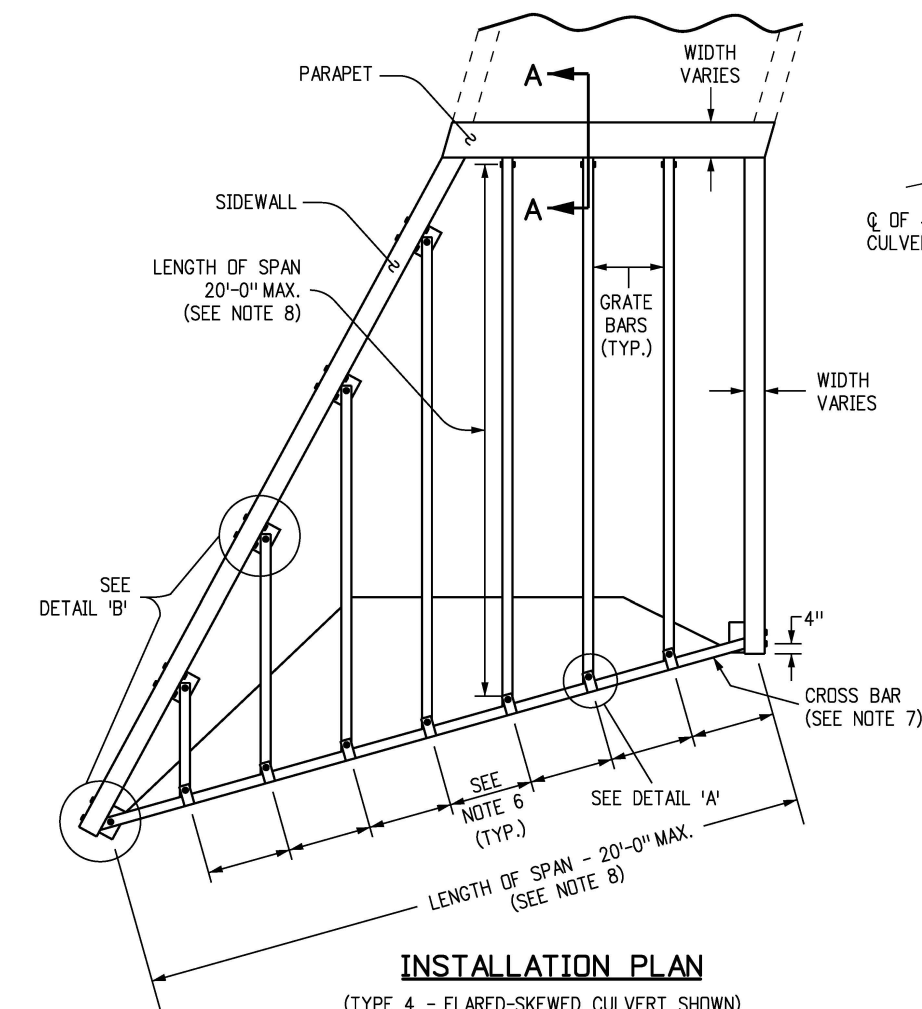


**DETAIL "A"**

TOP VIEW

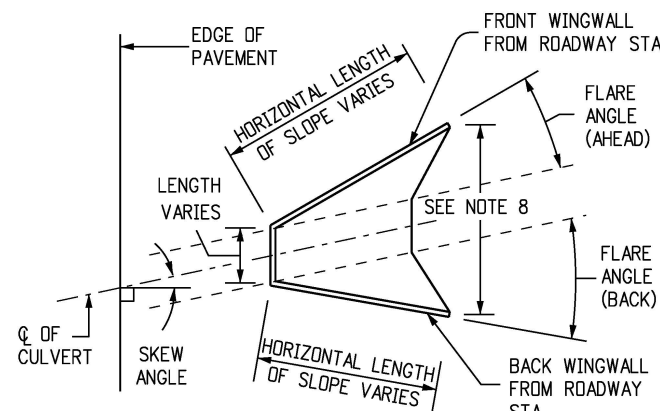


**SECTION B-B**

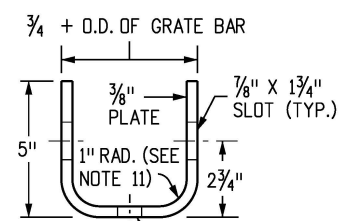


**INSTALLATION PLAN**

(TYPE 4 - FLARED-SKEWED CULVERT SHOWN)

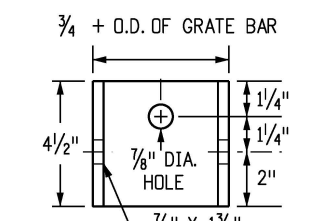


**TOP VIEW**



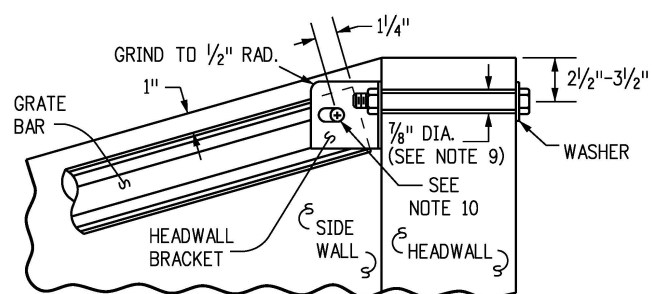
**HEADWALL BRACKET**

TOP VIEW

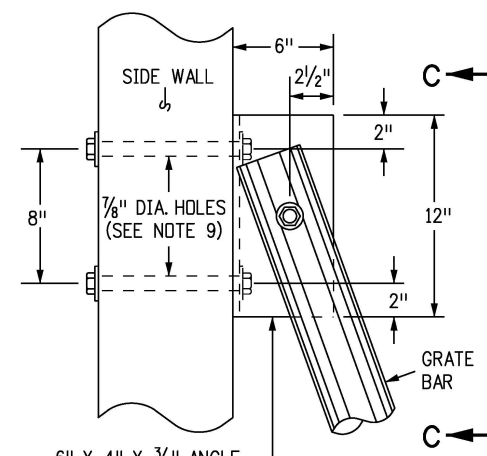


**HEADWALL BRACKET**

FRONT VIEW

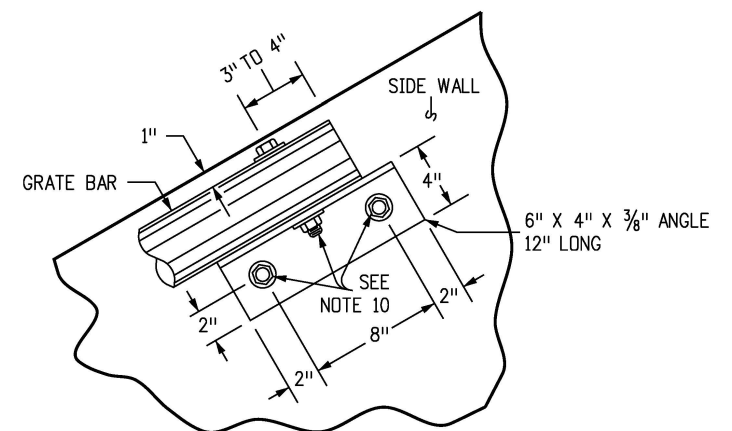


**SECTION A-A**



**DETAIL "B"**

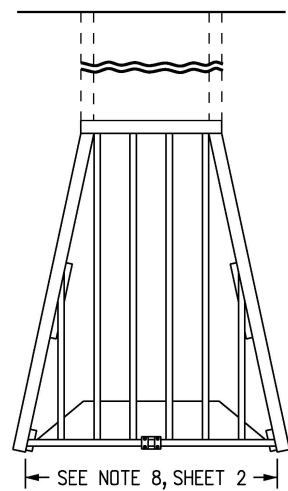
TOP VIEW



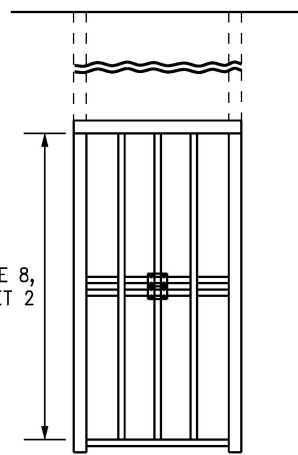
**SECTION C-C**

- NOTES**
- SHOP DRAWINGS SHALL BE SUBMITTED PER 105.02
  - HARDWARE SUCH AS BOLTS, WASHERS, AND LOCK NUTS SHALL BE HOT-DIPPED GALVANIZED PER ASTM A123
  - INTENDED FOR USE ON TERRAIN XX SLOPES WITH A CLEAR ROUNDT FOR ERRANT VEHICLES. GUARDRAIL IS THE PREFERRED OPTION ON STEEPER TERRAIN OR WITH HIGHER TRAFFIC VOLUMES
  - MINIMUM SCHEDULE 40 PIPE SHALL BE UED. GALVANIZE ALL PIPES, FITTINGS AND HARDWARE AFTER ALL CUTTING, WELDING, DRILLING, AND FABRICATION.
  - BOTH ENDS OF CULVERT SHALL BE TREATED TO PREVENT DEBRIS FROM ENTERING
  - EQUALLY SPACED 24 INCHES MIN. TO 30 INCHES MAX. FROM EDGE OF SIDEWALL TO CENTER OF BRACKET, OR FROM CENTER TO CENTER OF BRACKET.
  - THE CROSS BAR DIAMETER SHALL BE EQUAL TO OR GREATER THAN THE GRATE BAR DIAMETER.
  - IF MORE THAN 20 FEET THAN A MIDSPAN SUPPORT SHALL BE REQUIRED. SEE SHEETS 3 AND 4.
  - DRILL HOLES USING EQUIPMENT DESIGNED TO CUT THROUGH CONCRETE AND REINFORCING STEEL.
  - A 3/4 INCH BOLT, LOCK NUT AND WASHERS. ALL HOLES ARE TO BE 7/8 INCH IN DIAMETER.
  - BEND PLATES OR STRIPS WITHOUT CRACKING MATERIAL.
  - SHIM THICKNESS EQUALS THE DIFFERENCE IN DIAMETERS OF THE GRATE BAR AND CROSS BAR.

<b>Computer File Information</b>		<b>Sheet Revisions</b>		<b>Colorado Department of Transportation</b>		<b>TRAVERSABLE END SECTIONS AND SAFETY GRATES</b>		<b>STANDARD PLAN NO.</b>	
Creation Date: 07/31/19		Date: _____		2829 West Howard Place		Issued by the Project Development Branch: July 31, 2019		M-603-12	
Designer Initials: JJP		Comments: _____		CDOT HQ, 3rd Floor				Standard Sheet No. 2 of 3	
Last Modification Date: 07/31/19		(R-X)		Denver, CO 80204		Project Sheet Number: _____		Project Development Branch	
Detailer Initials: LTA		(R-X)		Phone: 303-757-9021 FAX: 303-757-9868					
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English		(R-X)		<b>Project Development Branch</b>		<b>JBK</b>			



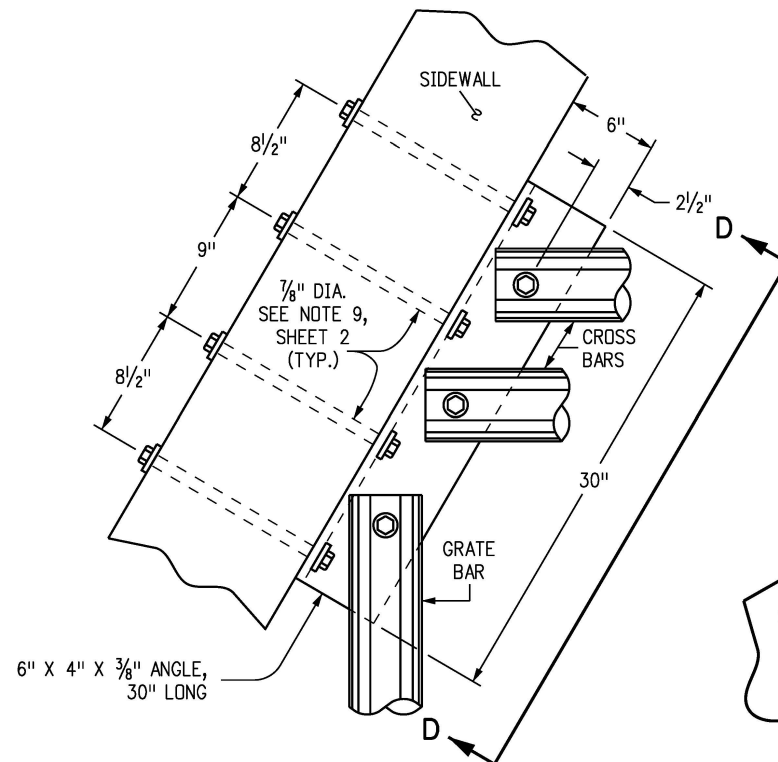
**CASE 1**



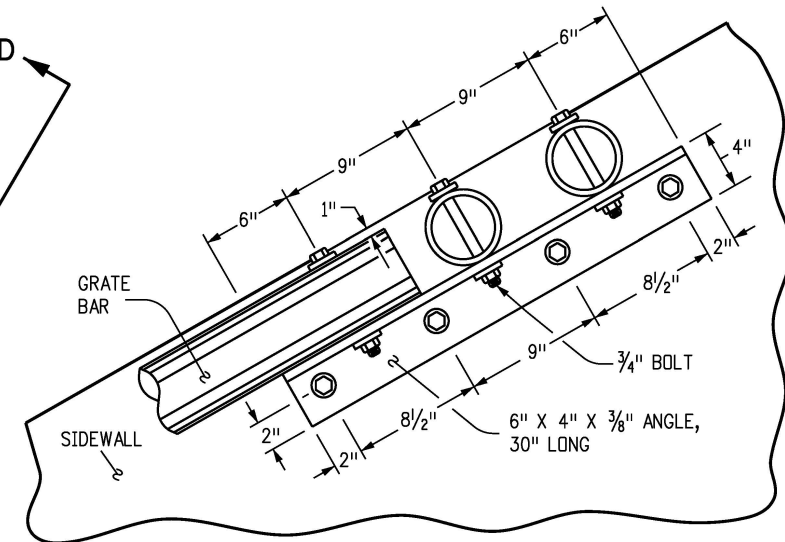
**CASE 2**

SEE NOTE 8, SHEET 2

SEE NOTE 8, SHEET 2

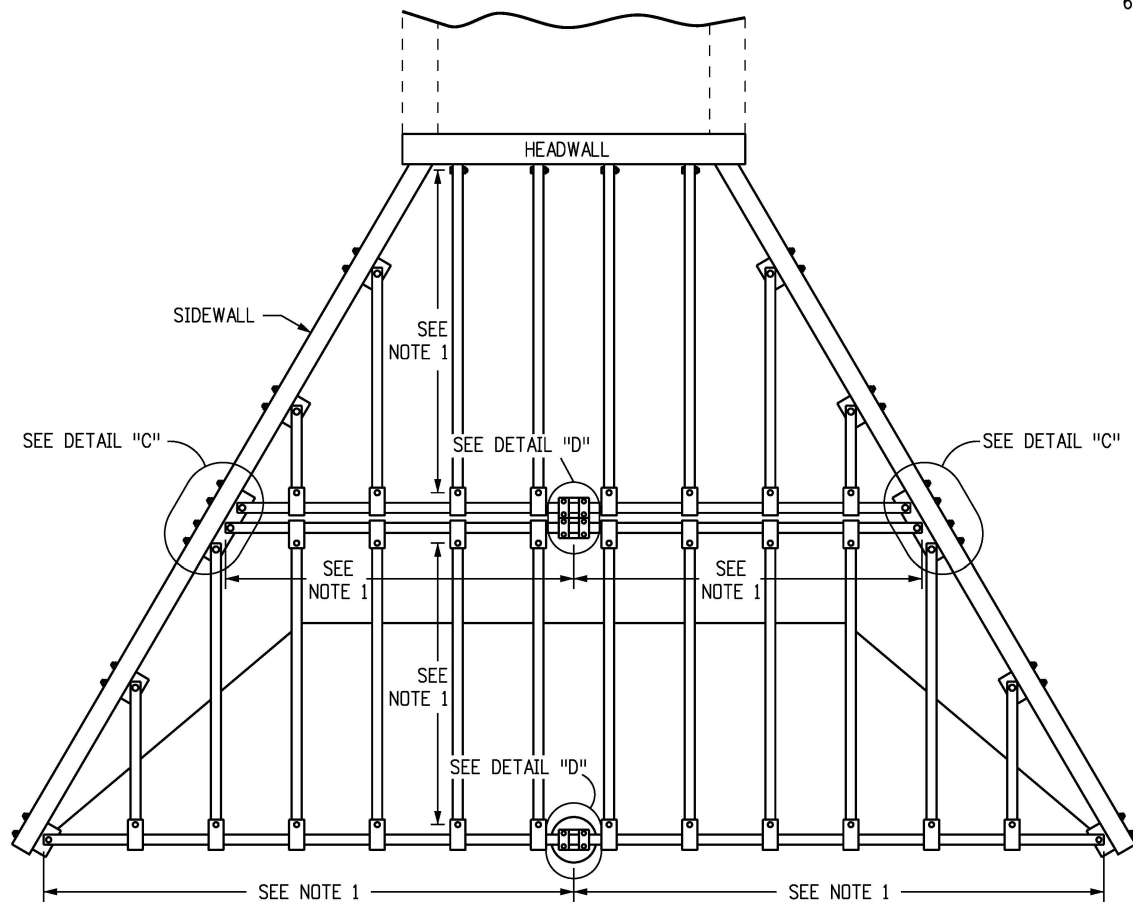


**DETAIL "C"**

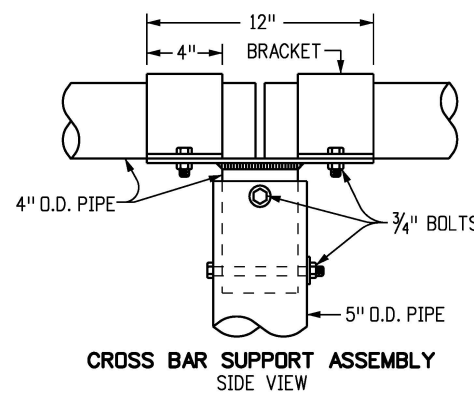


**SECTION D-D**

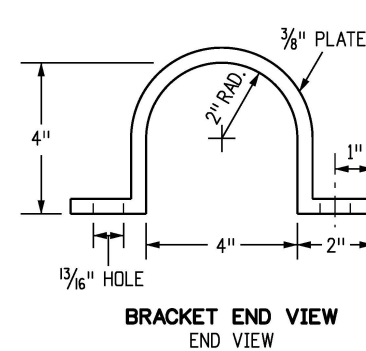
- NOTES**
1. LENGTH OF SPAN (20 FEET MAXIMUM).
  2. ALL ANCHOR BOLTS SHALL BE GROUTED IN PLACE WITH A NONSHRINK OR EPOXY GROUT WHICH SHALL COMPLETELY FILL THE HOLES.



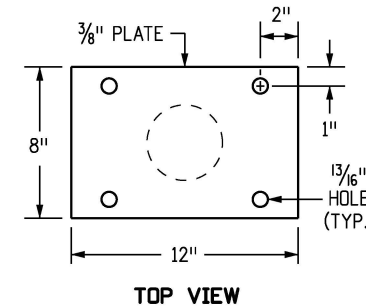
**INSTALLATION PLAN WITH MIDSPAN SUPPORT**



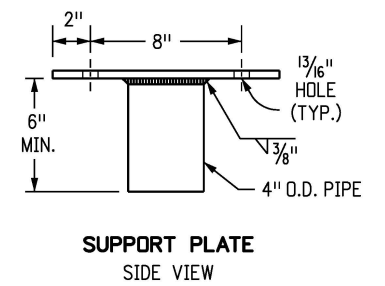
**CROSS BAR SUPPORT ASSEMBLY SIDE VIEW**



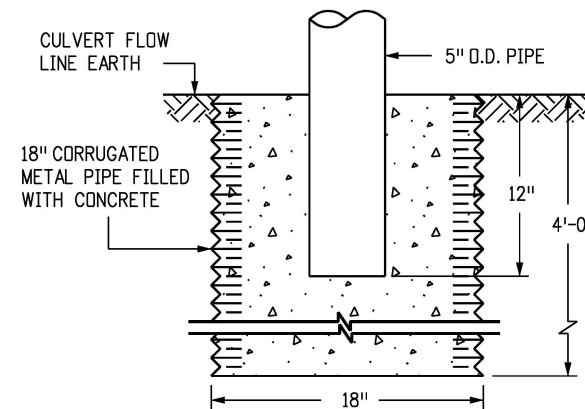
**BRACKET END VIEW END VIEW**



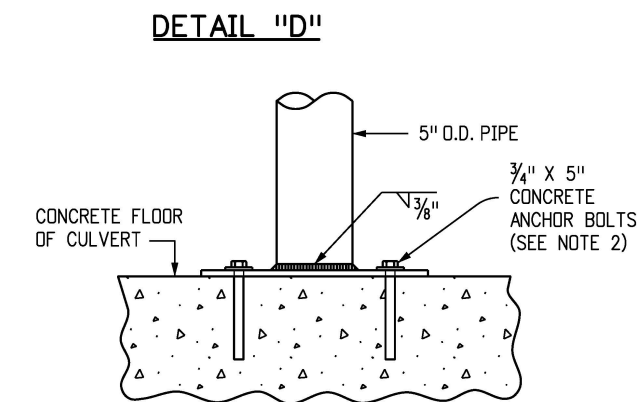
**TOP VIEW**



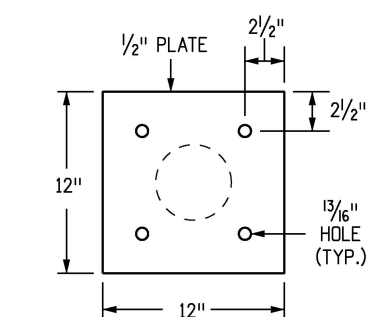
**SUPPORT PLATE SIDE VIEW**



**BOTTOM SUPPORT ON EARTH**



**BOTTOM SUPPORT ON CULVERT FLOOR**



**BOTTOM SUPPORT PLATE**

**Computer File Information**

Creation Date: 07/31/19	(R-X)
Designer Initials: JJP	(R-X)
Last Modification Date: 07/31/19	(R-X)
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**Sheet Revisions**

Date:	Comments

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**Project Development Branch** **JBK**

**TRAVERSABLE END SECTIONS AND SAFETY GRATES**

Issued by the Project Development Branch: July 31, 2019

**STANDARD PLAN NO.**

**M-603-12**

**Standard Sheet No. 3 of 3**

Project Sheet Number: