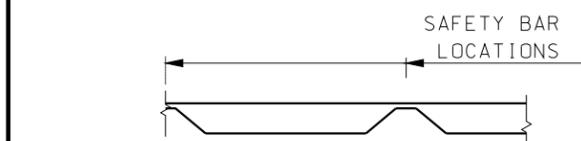
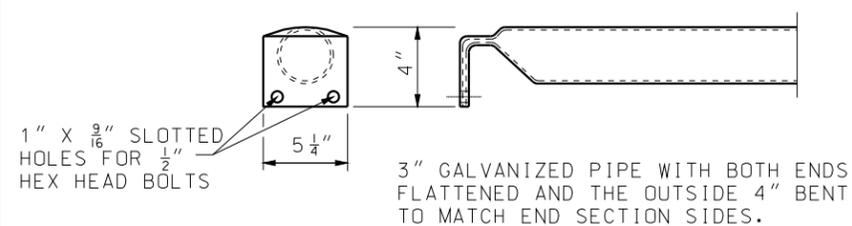


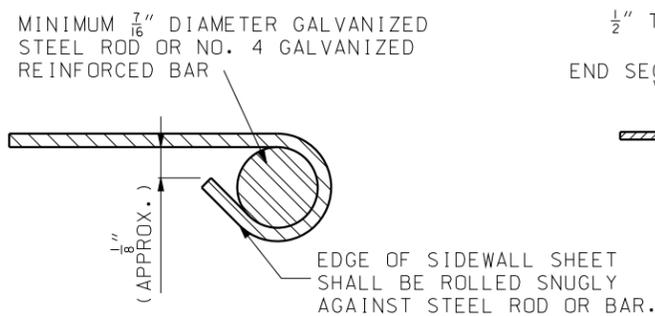
FRONT VIEW CIRCULAR PIPE



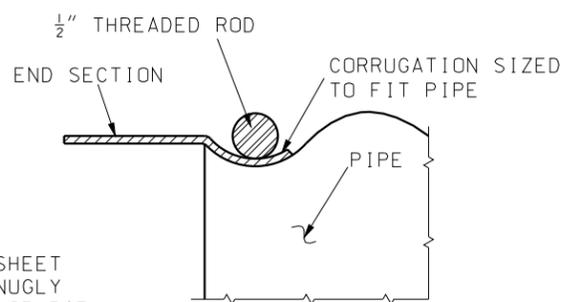
LONGITUDINAL BAR DETAIL



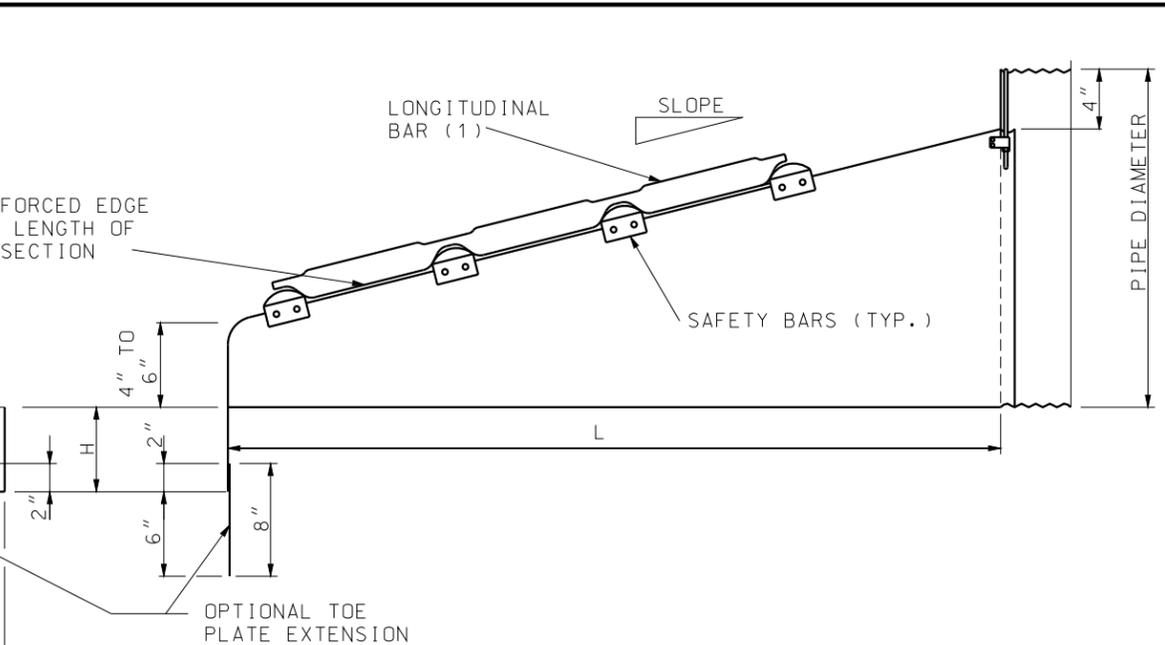
DETAIL OF SAFETY BAR



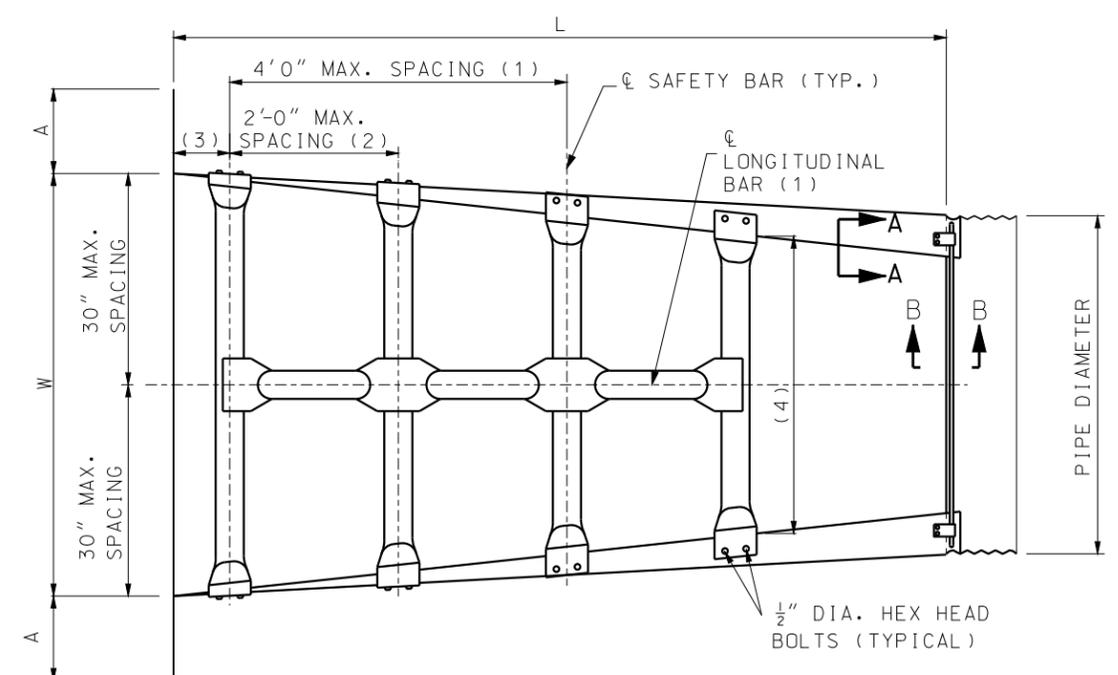
SECTION A-A



SECTION B-B



SIDE ELEVATION CIRCULAR SECTION



TOP VIEW CIRCULAR SECTION

LONGITUDINAL BAR, WHEN REQUIRED, SHALL BE WELDED TO SAFETY BARS TO FORM SINGLE GRATE STRUCTURE. LONGITUDINAL BAR IS NOT TO BE USED FOR PARALLEL DRAINAGE STRUCTURES.

- NOTES:
- (1) FOR CROSSROAD DRAINAGE STRUCTURES ONLY.
  - (2) FOR PARALLEL DRAINAGE STRUCTURES ONLY.
  - (3) 4" TO 6" MINIMUM
  - (4) SAFETY BARS SHALL BE PROVIDED UNTIL THE LATERAL SPAN OF THE OPENING IS LESS THAN OR EQUAL TO 30".

GENERAL NOTES:

END SECTIONS, INCLUDING ALL BOLTS, NUTS, RODS AND STRAPS, SHALL BE FABRICATED FROM GALVANIZED STEEL MEETING THE REQUIREMENTS OF SECTION 1020.

ALL BOLTS UNLESS OTHERWISE SHOWN SHALL BE A307 BOLTS.

WHEN REQUIRED, OPTIONAL TOE PLATE EXTENSION SHALL BE PUNCHED OR DRILLED AND BOLTED TO END SECTION TOE PLATE. STEEL FOR TOE PLATE EXTENSION SHALL BE SAME GAUGE AS END SECTION. DIMENSIONS SHALL BE OVERALL WIDTH LESS 6" BY 8" HIGH.

ATTACHMENT TO CIRCULAR PIPES 15" THROUGH 24" DIAMETER SHALL BE MADE WITH TYPE #1 STRAPS. ALL OTHER SIZES SHALL BE ATTACHED WITH TYPE #2 CONNECTORS.

SAFETY BARS AND LONGITUDINAL BARS SHALL BE FABRICATED FROM STEEL PIPE MEETING THE REQUIREMENTS OF ASTM A-53 SCHEDULE 40 SPECIFICATIONS. SAFETY BARS AND LONGITUDINAL BARS SHALL BE HOT DIPPED GALVANIZED AFTER FABRICATION IN ACCORDANCE WITH SECTION 1020 OF STANDARD SPECIFICATIONS.

INSTALLATION SHALL BE PERFORMED IN ACCORDANCE WITH SECTION 725 AND 732 OF THE STANDARD SPECIFICATIONS.

SLOTTED HOLES FOR SAFETY BAR ATTACHMENT SHALL BE PROVIDED FOR ALL END SECTIONS.

MINOR VARIATIONS OF DETAIL WILL BE ACCEPTED TO PERMIT THE USE OF A MANUFACTURER'S STANDARD METHODS OF FABRICATION.

END SECTIONS FABRICATED FROM THICKER METAL THAN INDICATED WILL BE ACCEPTED.

ALL BOLTS SHALL BE 3/8" DIAMETER AND GALVANIZED, UNLESS OTHERWISE SHOWN.

SKIRT SECTION IS DEFINED AS THE FLARED PORTION OF THE END SECTION INCLUDING SIDE AND BOTTOM (CENTER) PANELS AND APRON.

SKIRT SECTION FOR 12" TROUGH 24" PIPES SHALL BE MADE IN ONE PIECE.

SKIRT SECTIONS FOR 30" AND LARGER PIPES MAY BE MADE FROM UP TO 2 SHEETS JOINED BY RIVETING OR BOLTING ON CENTERLINE.

SKIRT SECTIONS FROM 48" AND LARGER PIPES MAY BE MADE FROM UP TO 3 SHEETS JOINED BY RIVETING OR BOLTING EQUAL DISTANCE FROM CENTERLINE.

ALL 3 PIECE SKIRTS FOR 60" PIPES SHALL HAVE 0.109" THICK SIDES AND 0.138" THICK BOTTOM (CENTER) PANELS. WIDTH OF BOTTOM PANELS SHALL BE GREATER THAN 20% OF THE PIPE PERIPHERY CONNECTOR SECTION. CORNER PLATES AND TOE PLATES SHALL BE GALVANIZED AND OF THE SAME OR GREATER THICKNESS AS THE SKIRT.

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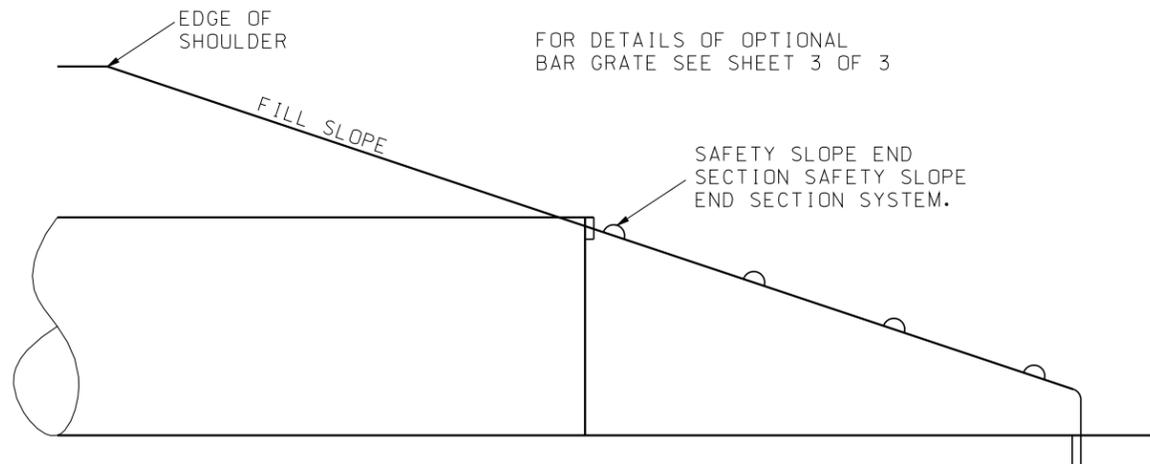
STATE OF MISSOURI  
KATHRYN PHILLIPS HARVEY  
NUMBER PE-23751  
PROFESSIONAL ENGINEER

THIS SHEET HAS BEEN SIGNED, SEALED AND DATED ELECTRONICALLY.

**SAFETY SLOPE END SECTION**

DATE EFFECTIVE: 08/01/2009	<b>732.10G</b>	SHEET NO. 1 OF 3
DATE PREPARED: 6/15/2009		

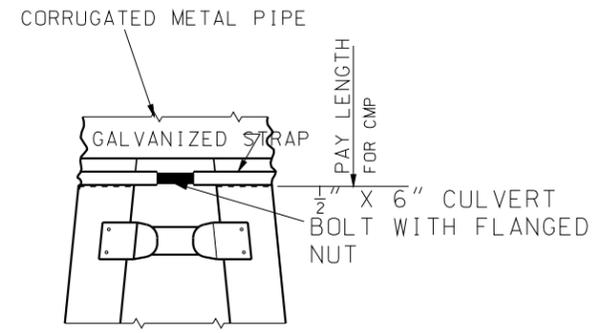
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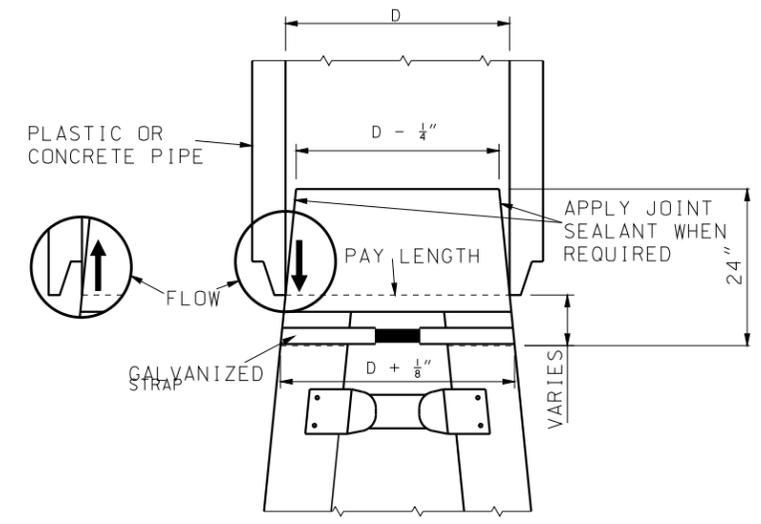
FOR DETAILS OF OPTIONAL BAR GRATE SEE SHEET 3 OF 3

**PIPE END DETAILS FOR DRAINAGE STRUCTURES**

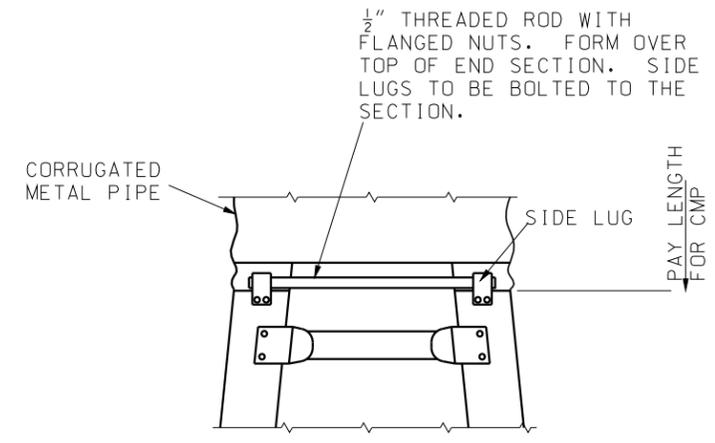
(SINGLE PIPE INSTALLATION)



FOR 15" THRU 24" PIPE  
**TYPE #1 CONNECTOR**  
DETAIL



NOTE:  
SEE DRIVEWAY STANDARD PLANS FOR BEVELED END SECTION REQUIREMENT.



FOR 30" AND LARGER ROUND PIPES  
**TYPE #2 CONNECTOR**  
DETAIL

TAPERED SLEEVE SHALL BE FABRICATED FROM SMOOTH COATED STEEL IN ACCORDANCE WITH AASHTO M-218.  
TAPERED SLEEVE SHALL BE 12 GAUGE.

**TAPERED SLEEVE FOR CONNECTION FOR CONCRETE, OR CORRUGATED POLYETHELENE PIPE**

NOTE:  
TAPERED SLEEVE SHALL BE FIRMLY WEDGED INTO PIPE END BEFORE BACKFILLING PIPE PAY LENGTH.

METAL END SECTIONS FOR CIRCULAR PIPES												
PIPE DIA. (IN.)	MIN. GAUGE ENDS (IN.) 4:1 & 6:1	MIN. GAUGE ENDS (IN.) 10:1	DIMENSIONS IN INCHES				L DIMENSIONS					
			A 1" TOL.	H 1" TOL.	W 2" TOL.	OVERALL WIDTH	SLOPE	LENGTH (IN.)	SLOPE	LENGTH (IN.)	SLOPE	LENGTH (IN.)
15	16	12	8	6	21	37	4:1	20	6:1	30	10:1	70
18	16	12	8	6	24	40	4:1	32	6:1	48	10:1	100
21	16	12	8	6	27	43	4:1	44	6:1	66	10:1	130
24	16	12	8	6	30	46	4:1	56	6:1	84	10:1	160
30	12	12	12	9	36	60	4:1	80	6:1	120	10:1	220
36	12		12	9	42	66	4:1	104	6:1	156	10:1	280
42	12		16	12	48	80	4:1	128	6:1	192		
48	12		16	12	54	86	4:1	152	6:1	228		
54	12		16	12	60	92	4:1	176	6:1	264		
60	12		16	12	66	98	4:1	200	6:1	300		

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STATE OF MISSOURI  
KATHRYN PHILLIPS HARVEY  
NUMBER PE-23751  
PROFESSIONAL ENGINEER  
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**SAFETY SLOPE END SECTION**

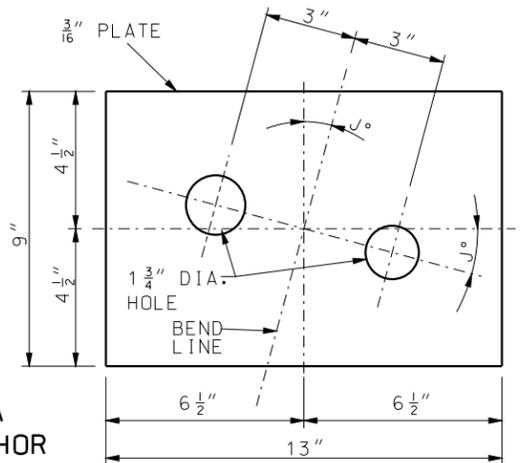
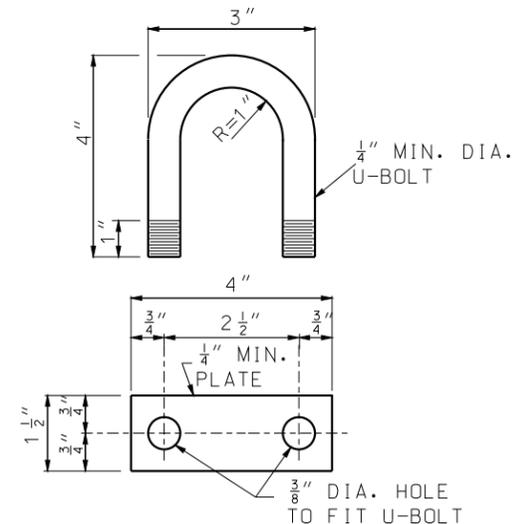
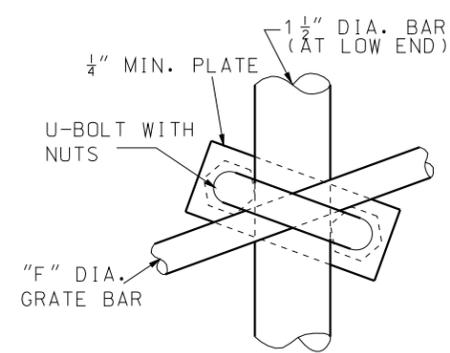
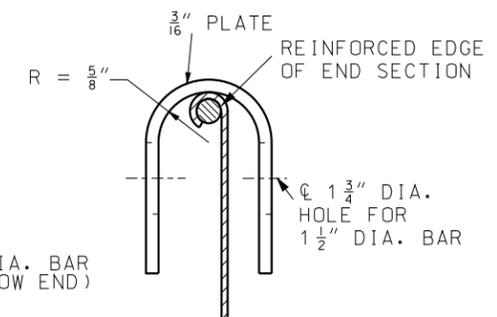
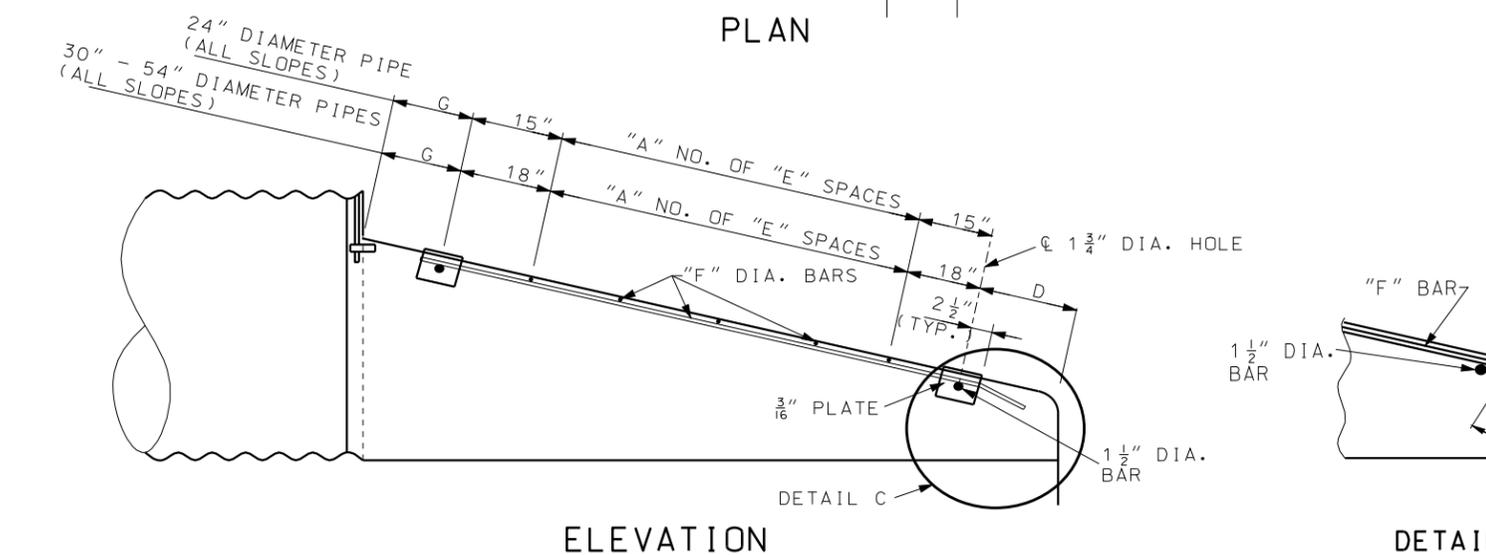
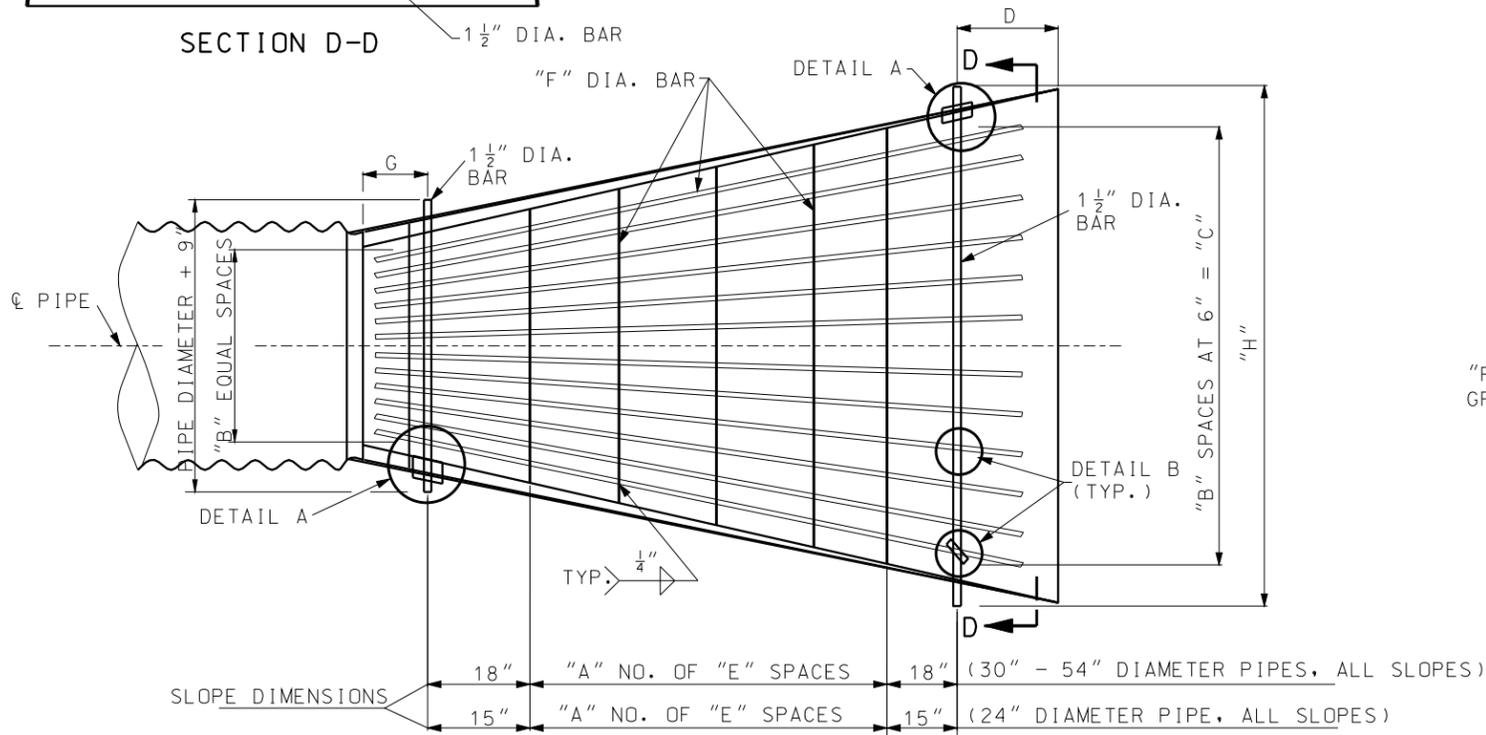
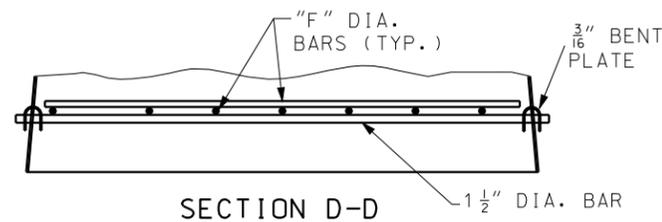
DATE EFFECTIVE: 08/01/2009  
DATE PREPARED: 6/15/2009  
**732.10G**  
SHEET NO. 2 OF 3

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**BAR GRATE SYSTEM DATA**

DRAIN PIPE SIZE	3:1 SLOPE									4:1 SLOPE									6:1 SLOPE								
	A	B	C	D	E	"F" BARS	G	H	J	A	B	C	D	E	"F" BARS	G	H	J	A	B	C	D	E	"F" BARS	G	H	J
15" **																											
18" **																											
21" **																											
24"	0	4	2'-0"	6"	15"	5/8"	8 1/4"	3'-3"	18.4°	0	4	2'-0"	15 3/4"	15"	5/8"	12"	3'-3"	14°	2	4	2'-0"	13 1/8"	15"	5/8"	12"	3'-3"	9.5°
30"	0	5	2'-6"	15 1/4"	18"	5/8"	12"	3'-9"	18.4°	1	5	2'-6"	16 1/2"	18"	5/8"	12"	3'-9"	14°	3	5	2'-6"	19 5/8"	18"	5/8"	12"	3'-9"	9.5°
36"	1	6	3'-0"	16 1/4"	18"	3/4"	12"	4'-3"	18.4°	2	6	3'-0"	18"	18"	3/4"	17 1/4"	4'-3"	14°	5	6	3'-0"	20 5/8"	18"	3/4"	12"	4'-3"	9.5°
42"	2	7	3'-6"	17 1/4"	18"	1"	12"	4'-9"	18.4°	4	7	3'-6"	12"	18"	1"	12"	4'-9"	14°	7	7	3'-6"	11 7/8"	18"	1"	9"	4'-9"	10.1°
48"	3	8	4'-0"	18"	18"	1"	12 5/8"	5'-3"	18.4°	5	8	4'-0"	18"	18"	1"	12 5/8"	5'-3"	14°	7	8	4'-0"	13"	18"	1"	9"	5'-3"	11.9°
54"	4	9	4'-6"	18"	18"	1 1/8"	13 3/8"	5'-9"	18.4°	6	9	4'-6"	18"	18"	1 1/8"	19 3/8"	5'-9"	14°	7	9	4'-6"	14 1/4"	18"	1 1/8"	9"	5'-9"	13.7°

\*\* BAR GRATE SYSTEM IS NOT REQUIRED FOR DRAIN PIPE DIAMETER OF 21" OR LESS, FOR SINGLE PIPE INSTALLATIONS.



**GENERAL NOTES:**

- ALL STEEL MATERIAL FOR BAR GRATE SYSTEM SHALL BE IN ACCORDANCE WITH ASTM A575 GRADE 1020 STEEL.
- ALL MATERIAL IN GRATE SYSTEM SHALL BE GALVANIZED.
- GALVANIZING SHALL BE DONE IN ACCORDANCE WITH ASTM A123.
- ALL MATERIALS, FABRICATION AND INSTALLATION OF OPTIONAL BAR GRATE SYSTEM USED IN LIEU OF SAFETY BAR SYSTEM SHALL BE INCLUDED IN CONTRACT UNIT PRICE BID FOR END SECTION (SAFETY SLOPE).


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 KATHRYN PHILLIPS HARVEY  
 NUMBER PE-23751  
 PROFESSIONAL ENGINEER  
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**OPTIONAL BAR GRATE SYSTEM FOR SAFETY SLOPE END SECTION**

DATE EFFECTIVE: 08/01/2009	<b>732.10G</b>	SHEET NO. 3 OF 3
DATE PREPARED: 6/15/2009		

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