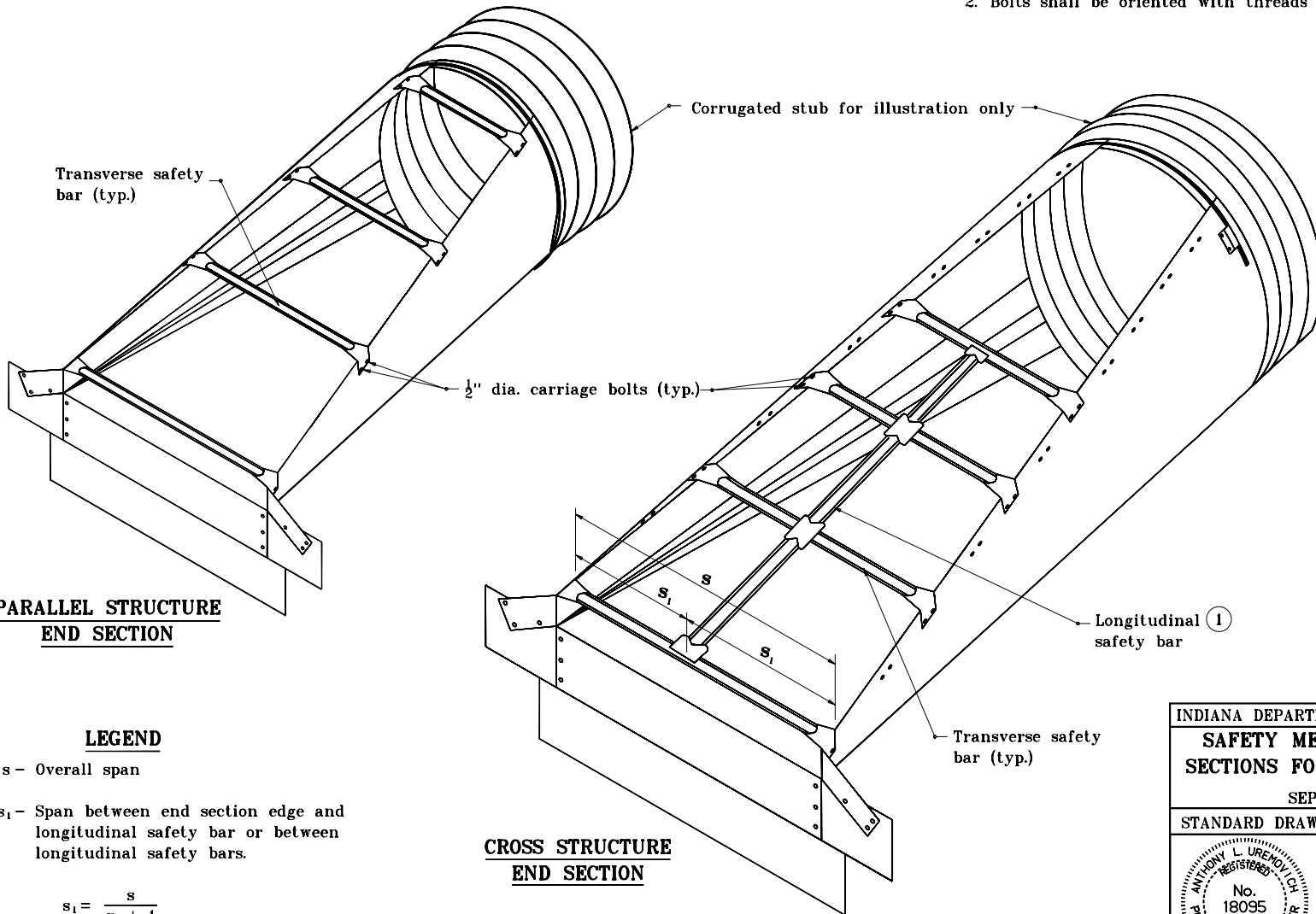


GENERAL NOTES

- ① Longitudinal safety bar shall be welded to transverse bars. For cross structure and section, if $S < 2'-6"$, no longitudinal safety bar is required. If $S > 2'-6"$, longitudinal safety bar(s) shall be provided so $S_1 < 2'-6"$.
2. Bolts shall be oriented with threads to inside of end section.



**PARALLEL STRUCTURE
END SECTION**

**CROSS STRUCTURE
END SECTION**

LEGEND

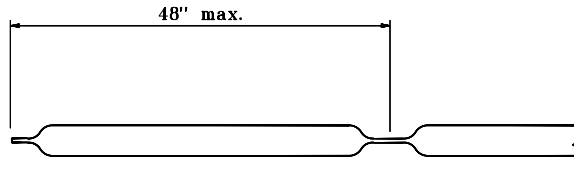
s - Overall span

s_1 - Span between end section edge and longitudinal safety bar or between longitudinal safety bars.

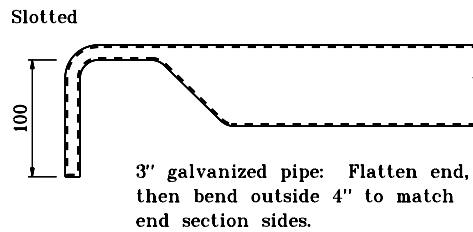
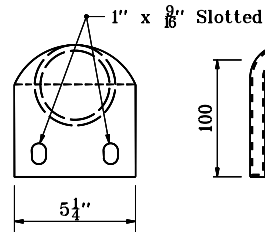
$$s_1 = \frac{s}{n + 1}$$

where n = Number of longitudinal safety bars

INDIANA DEPARTMENT OF TRANSPORTATION	
SAFETY METAL CULVERT END SECTIONS FOR CORRUGATED PIPE	
SEPTEMBER 2000	
STANDARD DRAWING NO. E 715-SMES-01	
	/s/ Anthony L. Uremovich 9-01-00 DESIGN STANDARDS ENGINEER DATE
	/s/ Firooz Zandi 9-01-00 CHIEF HIGHWAY ENGINEER DATE
DESIGN STANDARDS ENGINEER	

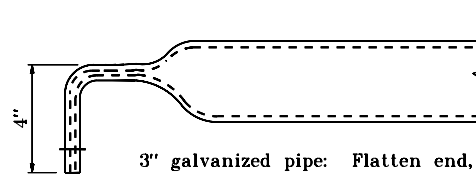
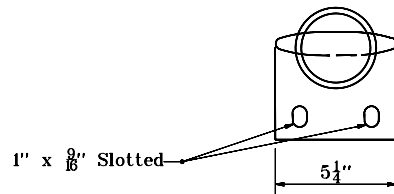


LONGITUDINAL SAFETY BAR DETAIL



3" galvanized pipe: Flatten end, then bend outside 4" to match end section sides.

OR



3" galvanized pipe: Flatten end, then bend outside 4" to match end section sides.

TRANSVERSE SAFETY BAR DETAILS

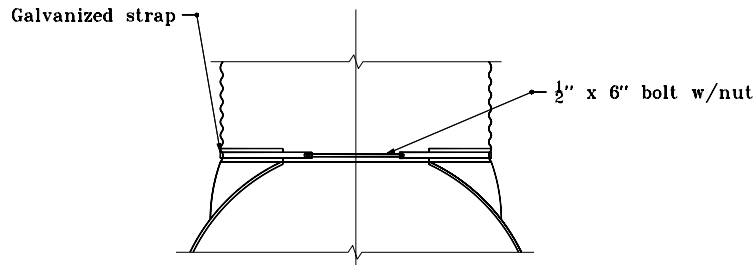
INDIANA DEPARTMENT OF TRANSPORTATION
**SAFETY METAL CULVERT END
 SECTIONS FOR CORRUGATED PIPE**
 JANUARY 1998

STANDARD DRAWING NO. **E 715-SMES-02**

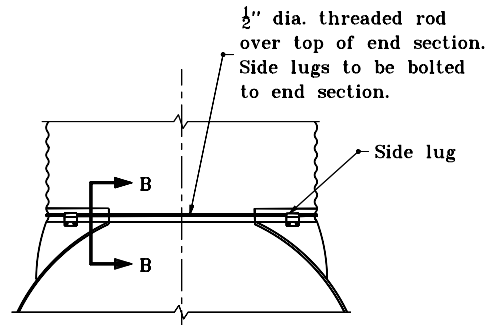
	DETAILS PLACED IN THIS FORMAT 7-27-99
	/s/ Anthony L. Uremovich 7-27-99 DESIGN STANDARDS ENGINEER DATE
	/s/ Firooz Zandi 7-27-99 CHIEF HIGHWAY ENGINEER DATE
DESIGN STANDARDS ENGINEER	ORIGINALLY APPROVED 1-02-98

GENERAL NOTES

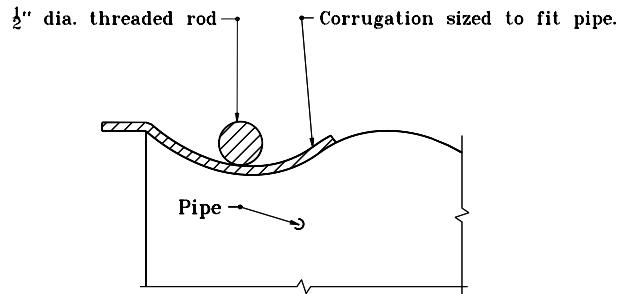
1. For circular pipe diameters through 24", attach end section to pipe with type 1 connector. For all other sizes, attach end section to pipe with type 2 connector.



TYPE 1 CONNECTOR DETAIL
Through 24" dia.



TYPE 2 CONNECTOR DETAIL
For all circular pipes larger than 24"
and all pipe-arches

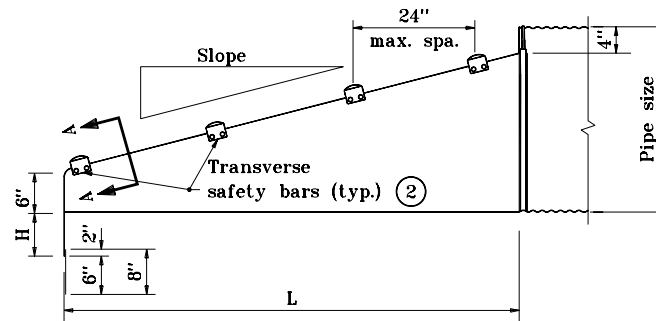


SECTION B-B

INDIANA DEPARTMENT OF TRANSPORTATION	
SAFETY METAL CULVERT END SECTIONS FOR CORRUGATED PIPE	
JANUARY 1998	
STANDARD DRAWING NO. E 715-SMES-03	
DETAILS PLACED IN THIS FORMAT	7-27-99
	/s/ Anthony L. Uremovich 7-27-99 DESIGN STANDARDS ENGINEER DATE
	/s/ Firooz Zandi 7-27-99 CHIEF HIGHWAY ENGINEER DATE
DESIGN STANDARDS ENGINEER	ORIGINALLY APPROVED 1-02-98

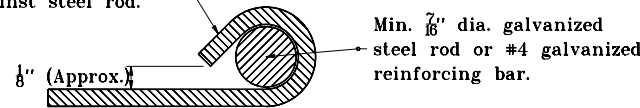
GENERAL NOTES

1. See Standard Drawing E 715-SMES-06 for variable dimensions.
- ② Transverse safety bars shall be schedule 40 galvanized steel pipe. Pipe shall be galvanized after forming. Number of bars required will vary depending on the length of the end sections.
3. The toe plate extension shall be the same thickness as the end section. The dimension shall be the end section overall width less 6".

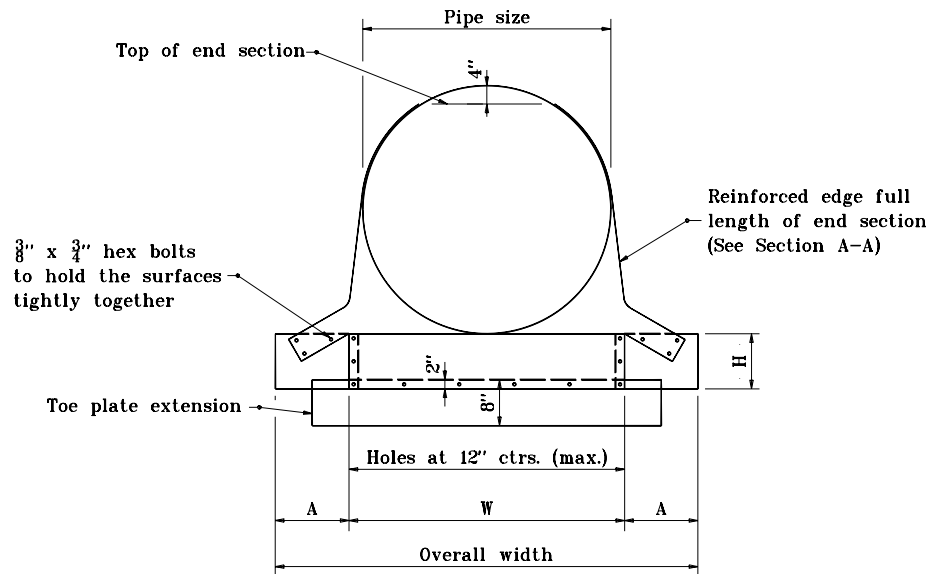


SIDE ELEVATION OF PARALLEL STRUCTURE END SECTION

Edge of sidewall sheet rolled snugly against steel rod.



SECTION A-A

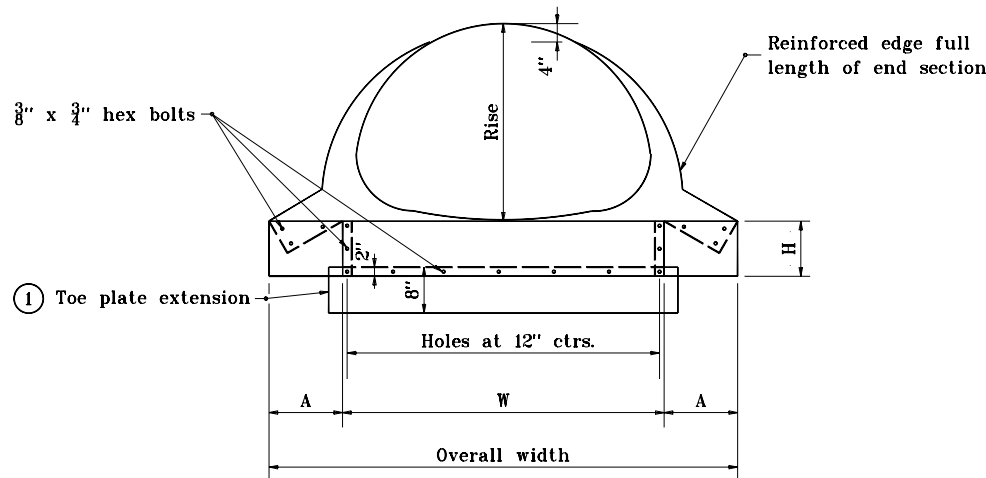


FRONT VIEW

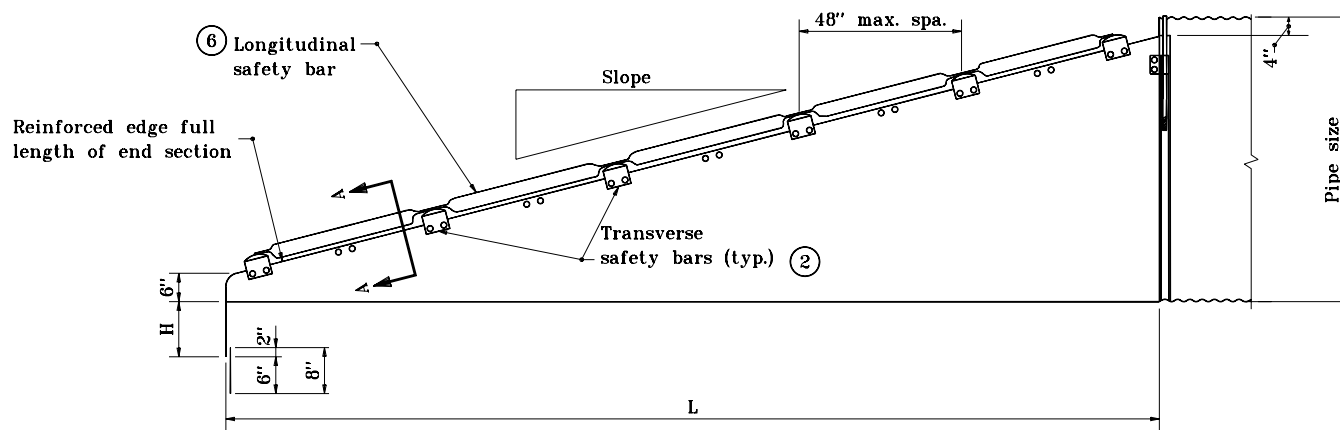
INDIANA DEPARTMENT OF TRANSPORTATION	
SAFETY METAL CULVERT END SECTIONS FOR CORRUGATED PIPE	
JANUARY 1998	
STANDARD DRAWING NO. E 715-SMES-04	
DETAILS PLACED IN THIS FORMAT	7-27-99
	/s/ Anthony L. Uremovich 7-27-99 DESIGN STANDARDS ENGINEER DATE
	/s/ Firooz Zandi 7-27-99 CHIEF HIGHWAY ENGINEER DATE
DESIGN STANDARDS ENGINEER	ORIGINALLY APPROVED 1-02-98

GENERAL NOTES

- ① Toe plate extension shall be the same thickness as the end section. Dimension shall be overall width less 6".
- ② Transverse safety bars shall be Schedule 40 galvanized steel pipe. Pipe shall be galvanized after forming. Number of bars required will vary depending on the length of the end sections.
3. Slotted holes for safety bar attachment shall be provided for all end sections.
4. See Standard Drawing E 715-SMES-04 for Section A-A.
5. See Standard Drawing E 715-SMES-06 for variable dimensions.
- ⑥ See Standard Drawing E 715-SMES-01 for warrant of longitudinal safety bar.



FRONT VIEW

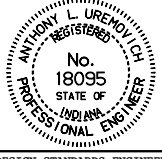


SIDE ELEVATION FOR CROSS STRUCTURE END SECTION

INDIANA DEPARTMENT OF TRANSPORTATION	
SAFETY METAL CULVERT END SECTIONS FOR CORRUGATED PIPE	
JANUARY 1998	
STANDARD DRAWING NO. E 715-SMES-05	
DETAILS PLACED IN THIS FORMAT 7-27-99	
	/s/ Anthony L. Uremovich 7-27-99 DESIGN STANDARDS ENGINEER DATE
	/s/ Firooz Zandi 7-27-99 CHIEF HIGHWAY ENGINEER DATE
	ORIGINALLY APPROVED 1-02-96

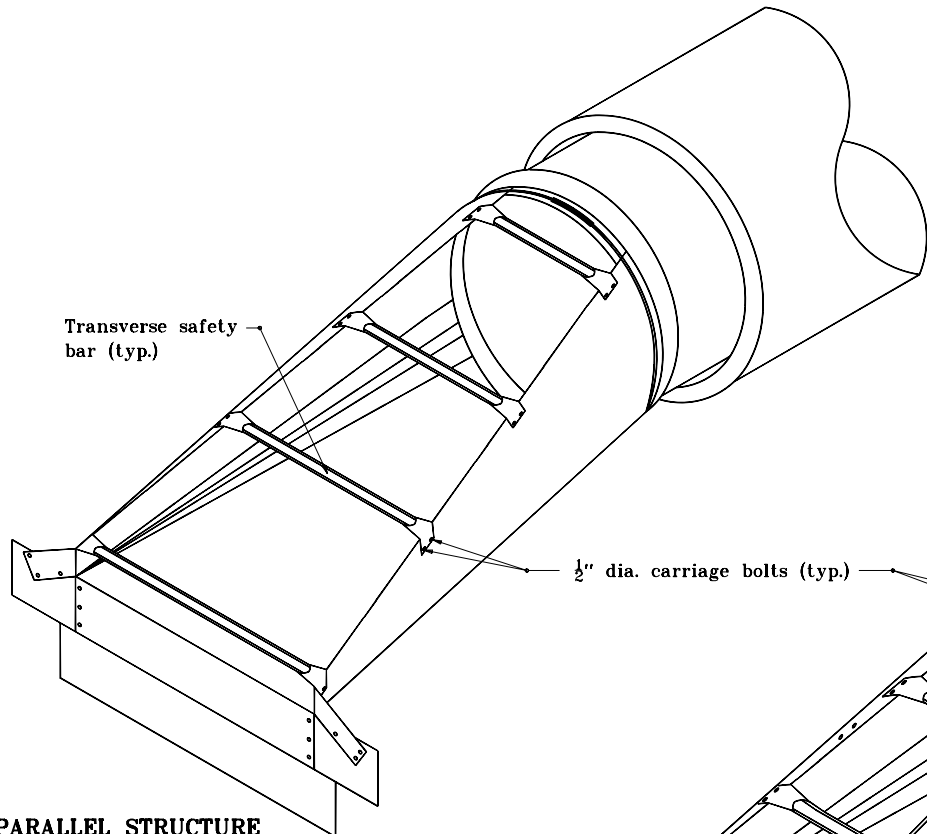
METAL END SECTIONS FOR CIRCULAR PIPES									
Pipe Dia.	Min. Thick.	Dimensions, in.				L Dimensions			
		A	H	W	Overall Width	Slope	Length (in.)	Slope	Length (in.)
15	.064	8	6	37	37	4:1	20	6:1	30
18	.064	8	6	40	40	4:1	32	6:1	48
21	.064	8	6	43	43	4:1	44	6:1	66
24	.064	8	6	46	46	4:1	56	6:1	84
30	.109	12	9	60	60	4:1	80	6:1	120
36	.109	12	9	66	66	4:1	104	6:1	156
42	.109	16	12	80	80	4:1	128	6:1	192
48	.109	16	12	86	86	4:1	152	6:1	228
54	.109	16	12	92	92	4:1	176	6:1	264
60	.109	16	12	66	98	4:1	200	6:1	300

SAFETY METAL END SECTIONS FOR PIPE-ARCHES											
Equiv. Dia. (in.)	(inches)		Min. Thick. in.	Dimensions, in.				L Dimensions			
	Span	Rise		A	H	W	Overall Width	Slope	Length (in.)	Slope	Length (in.)
18	21	15	.064	8	6	27	43	4:1	20	6:1	30
21	24	18	.064	8	6	30	46	4:1	32	6:1	48
24	28	20	.064	8	6	34	50	4:1	40	6:1	60
30	35	24	.079	12	9	41	65	4:1	56	6:1	84
36	42	29	.109	12	9	48	72	4:1	76	6:1	114
42	49	33	.109	16	12	55	87	4:1	92	6:1	138
48	57	38	.109	16	12	63	95	4:1	112	6:1	168
54	64	43	.109	16	12	70	102	4:1	132	6:1	198
60	71	47	.109	16	12	77	109	4:1	148	6:1	222
72	83	57	.109	16	12	89	121	4:1	188	6:1	282

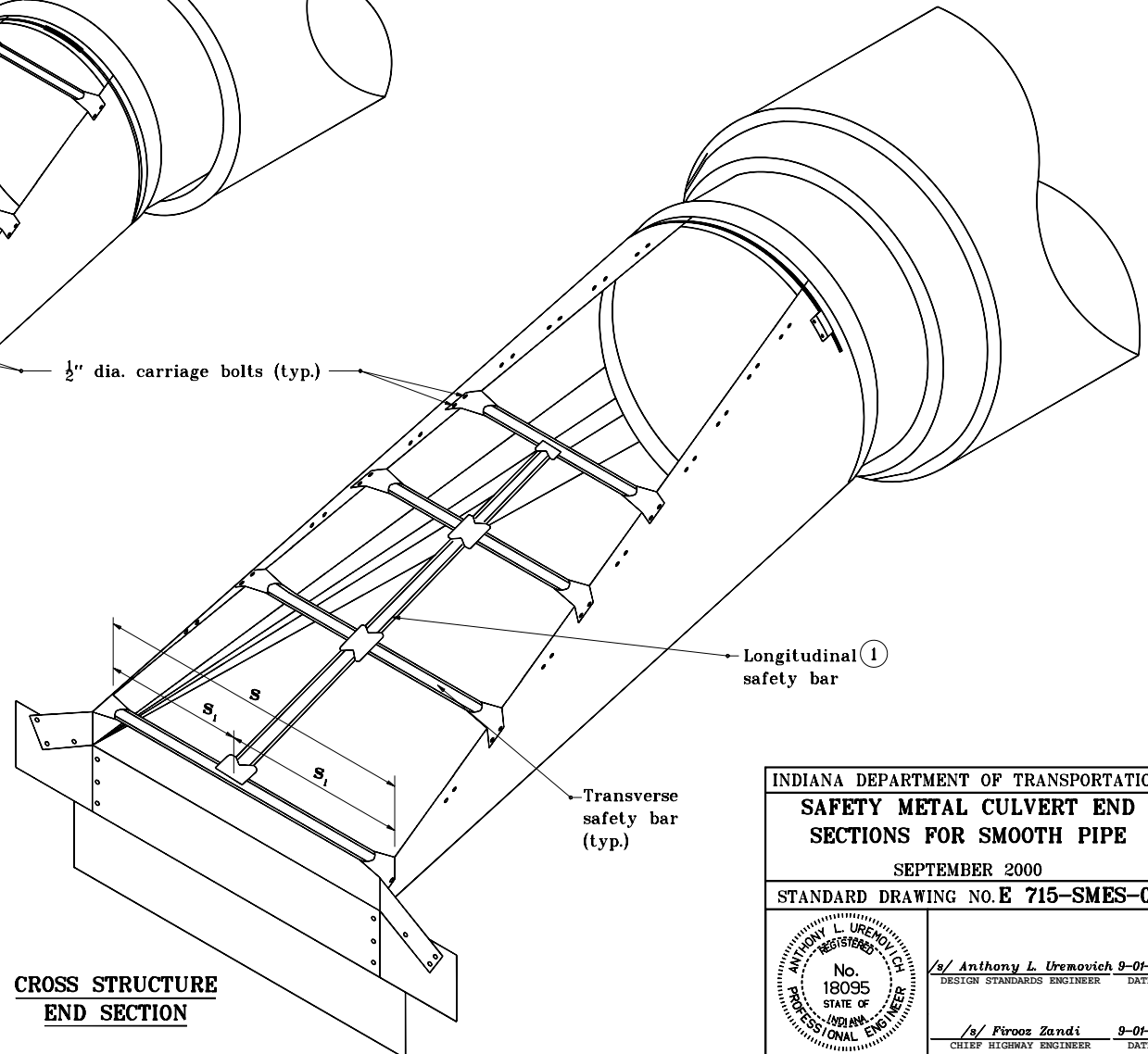
INDIANA DEPARTMENT OF TRANSPORTATION	
SAFETY METAL CULVERT END SECTIONS FOR CORRUGATED PIPE	
JANUARY 1998	
STANDARD DRAWING NO. E 715-SMES-06	
	DETAILS PLACED IN THIS FORMAT 11-15-99 /s/ Anthony L. Uremovich 11-15-99 DESIGN STANDARDS ENGINEER DATE
	/s/ Firooz Zandi 11-15-99 CHIEF HIGHWAY ENGINEER DATE ORIGINALLY APPROVED 1-02-98

GENERAL NOTES

- ① Longitudinal safety bar shall be welded to transverse bars. For cross structure and section, if $S < 2'-6"$, no longitudinal safety bar is required. If $S > 2'-6"$, longitudinal safety bar(s) shall be provided so $S_1 < 2'-6"$.
2. Bolts shall be oriented with threads to inside of end section.



**PARALLEL STRUCTURE
END SECTION**



**CROSS STRUCTURE
END SECTION**

LEGEND

s - Overall span

① Span between end section edge and longitudinal safety bar or between longitudinal safety bars.

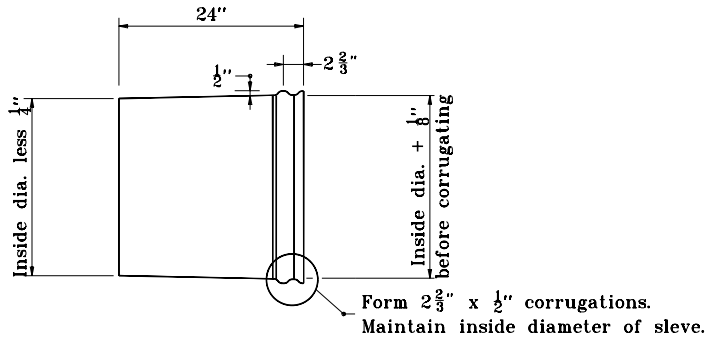
$$s_1 = \frac{s}{n + 1}$$

where n = Number of longitudinal safety bars

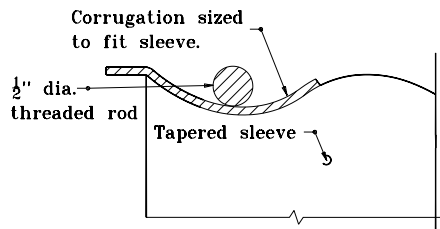
INDIANA DEPARTMENT OF TRANSPORTATION	
SAFETY METAL CULVERT END SECTIONS FOR SMOOTH PIPE	
SEPTEMBER 2000	
STANDARD DRAWING NO. E 715-SMES-07	
	/s/ Anthony L. Uremovich 9-01-00 DESIGN STANDARDS ENGINEER DATE
	/s/ Firooz Zandi 9-01-00 CHIEF HIGHWAY ENGINEER DATE
DESIGN STANDARDS ENGINEER	

GENERAL NOTES

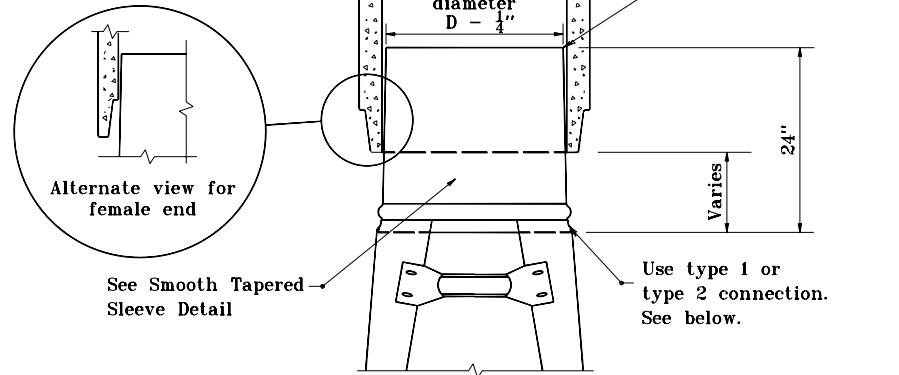
1. For circular pipe diameters through 24", attach end section to pipe with type 1 connector. For all other sizes, attach end section to pipe with type 2 connector.



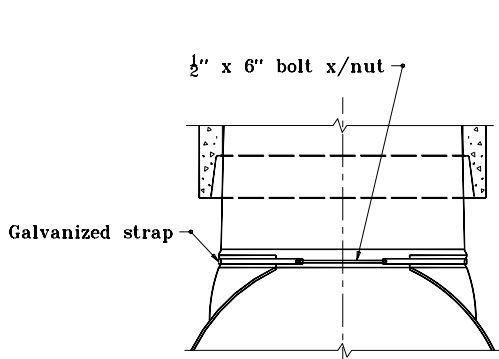
SMOOTH TAPERED SLEEVE DETAIL



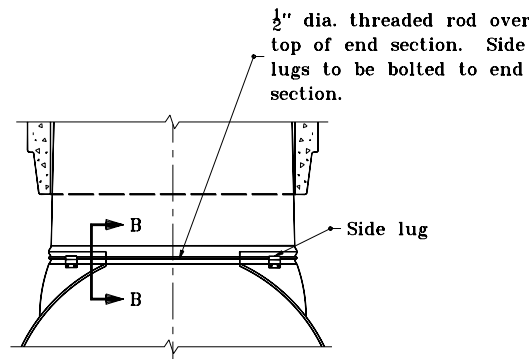
SECTION B-B



TAPERED SLEEVE FOR ATTACHING STEEL END SECTION TO SMOOTH INTERIOR PIPE

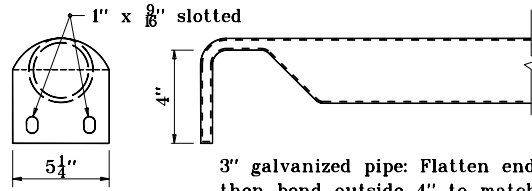


TYPE 1 CONNECTOR DETAIL
for all circular pipes through 24"



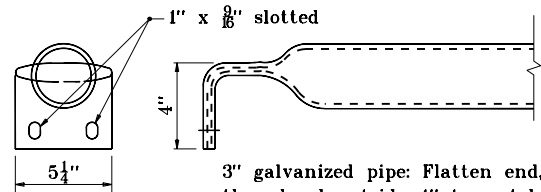
TYPE 2 CONNECTOR DETAIL
all circular pipes larger than 24"
and all horizontal elliptical pipes

INDIANA DEPARTMENT OF TRANSPORTATION	
SAFETY METAL CULVERT END SECTIONS FOR SMOOTH PIPE	
JANUARY 1998	
STANDARD DRAWING NO. E 715-SMES-08	
DETAILS PLACED IN THIS FORMAT 7-27-99	
	/s/ Anthony L. Uremovich 7-27-99 DESIGN STANDARDS ENGINEER DATE
	/s/ Firooz Zandi 7-27-99 CHIEF HIGHWAY ENGINEER DATE
	DESIGN STANDARDS ENGINEER ORIGINALLY APPROVED 1-02-98



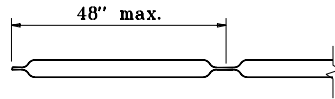
3" galvanized pipe: Flatten end, then bend outside 4" to match end section sides.

OR



3" galvanized pipe: Flatten end, then bend outside 4" to match end section sides.

TRANSVERSE SAFETY BAR DETAILS

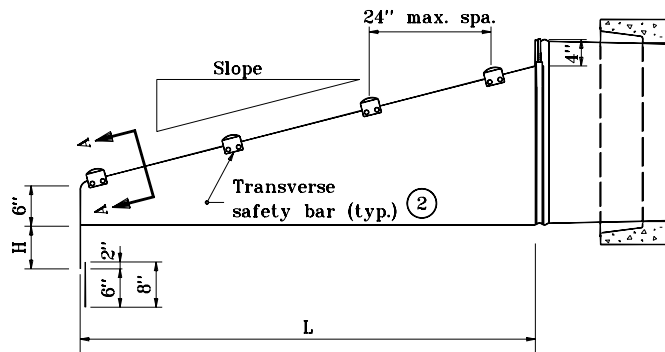


LONGITUDINAL SAFETY BAR DETAIL

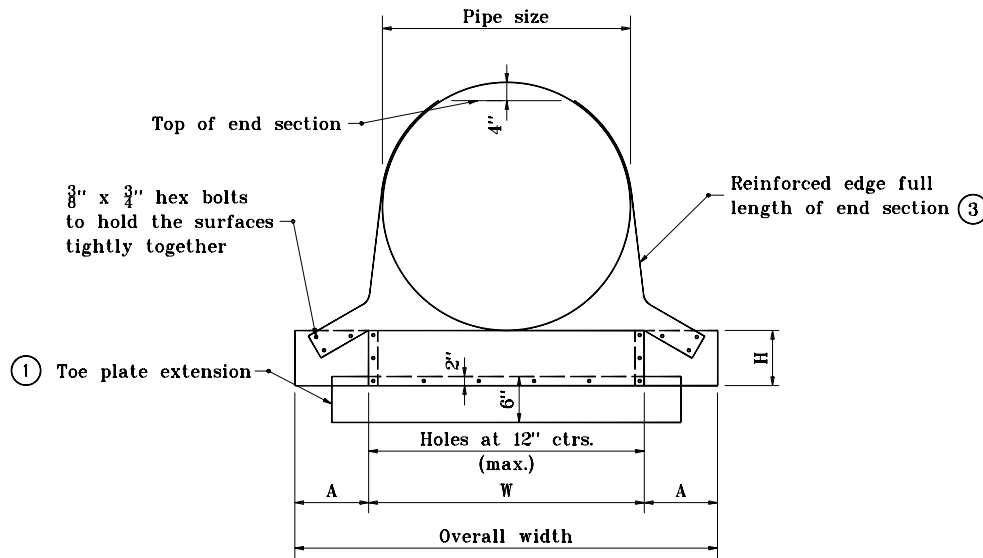
INDIANA DEPARTMENT OF TRANSPORTATION	
SAFETY METAL CULVERT END SECTIONS FOR SMOOTH PIPE	
JANUARY 1998	
STANDARD DRAWING NO. E 715-SMES-09	
	DETAILS PLACED IN THIS FORMAT 7-27-99 /s/ Anthony L. Uremovich 7-27-99 <small>DESIGN STANDARDS ENGINEER DATE</small>
	/s/ Firooz Zandi 7-27-99 <small>CHIEF HIGHWAY ENGINEER DATE</small>
	<small>DESIGN STANDARDS ENGINEER ORIGINALLY APPROVED 1-02-98</small>

GENERAL NOTES

- ① Toe plate extension is to be the same thickness as the end section. Dimension shall be end section overall width less 6".
- ② Transverse safety bars shall be Schedule 40 galvanized steel pipe. Pipe to be galvanized after forming. Number of bars req'd will vary depending on the length of the end section.
- ③ See Standard Drawing E 715-SMES-11 for Section A-A.
- 4. See Standard Drawing E 715-SMES-12 for variable dimensions.



SIDE ELEVATION OF PARALLEL STRUCTURE END SECTION

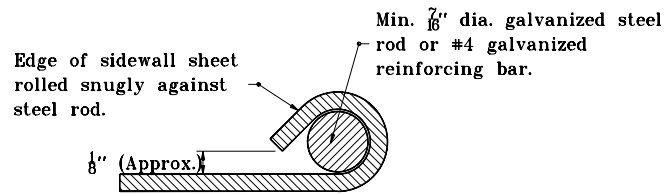


FRONT VIEW

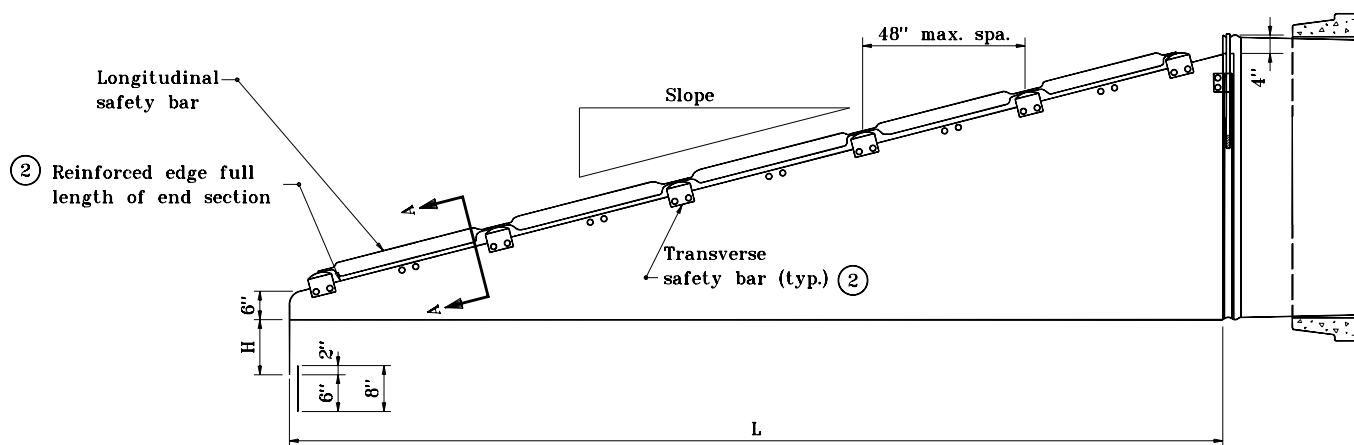
INDIANA DEPARTMENT OF TRANSPORTATION	
SAFETY METAL CULVERT END SECTIONS FOR SMOOTH PIPE	
JANUARY 1998	
STANDARD DRAWING NO. E 715-SMES-10	
	DETAILS PLACED IN THIS FORMAT 7-27-99 /s/ Anthony L. Uremovich 7-27-99 DESIGN STANDARDS ENGINEER DATE
	/s/ Firooz Zandi 7-27-99 CHIEF HIGHWAY ENGINEER DATE ORIGINALLY APPROVED 1-02-98
DESIGN STANDARDS ENGINEER	

GENERAL NOTES

- ① Toe plate extension is to be the same thickness as the end section. Dimensions shall be overall width less 6", by 8" high.
- ② Transverse safety bars shall be Schedule 40 galvanized steel pipe. Pipe to be galvanized after forming. Number of bars req'd. will vary depending on the length of the end section.
3. Slotted holes for safety bar attachment shall be provided for all end sections.
4. See Standard Drawing E 715-SMES-12 for variable dimensions.
- ⑤ See Standard Drawing E 715-SMES-07 for warrant of longitudinal safety bar.



SECTION A-A



SIDE ELEVATION FOR CROSS STRUCTURE END SECTION

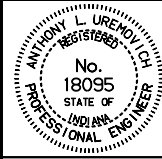
INDIANA DEPARTMENT OF TRANSPORTATION
SAFETY METAL CULVERT END SECTIONS FOR SMOOTH PIPE
 JANUARY 1998

STANDARD DRAWING NO. **E 715-SMES-11**

	DETAILS PLACED IN THIS FORMAT 7-27-99
	/s/ Anthony L. Uremovich 7-27-99 DESIGN STANDARDS ENGINEER DATE
/s/ Firooz Zandi 7-27-99 CHIEF HIGHWAY ENGINEER DATE	ORIGINALLY APPROVED 1-02-98

SAFETY METAL END SECTIONS FOR CIRCULAR PIPES									
Pipe Dia. (in.)	Min. Thick.	Dimensions, in.				L Dimensions			
		A	H	W	Overall Width	Slope	Length (in.)	Slope	Length (in.)
15	.064	8	6	21	37	4:1	20	6:1	30
18	.064	8	6	24	40	4:1	32	6:1	48
21	.064	8	6	27	43	4:1	44	6:1	66
24	.064	8	6	30	46	4:1	56	6:1	84
27	.109	12	9	33	57	4:1	68	6:1	102
30	.109	12	9	36	60	4:1	80	6:1	120
33	.109	12	9	39	63	4:1	92	6:1	138
36	.109	12	9	42	66	4:1	104	6:1	156
42	.109	16	12	48	80	4:1	128	6:1	192
48	.109	16	12	54	86	4:1	152	6:1	228
54	.109	16	12	60	92	4:1	176	6:1	264
60	.109	16	12	66	98	4:1	200	6:1	300

SAFETY METAL END SECTIONS FOR HORIZONTAL ELLIPTICAL PIPE											
Equiv. Dia. (in.)	(inches)		Min. Thick. in.	Dimensions (inches)				L Dimension			
	Span	Rise		A	H	W	Overall Width	Slope	Length (in.)	Slope	Length (in.)
18	23	14	.064	8	6	29	45	4:1	16	6:1	24
24	30	19	.064	8	6	36	52	4:1	36	6:1	54
27	34	22	.079	12	9	40	64	4:1	48	6:1	72
30	38	24	.079	12	9	44	68	4:1	56	6:1	84
33	42	27	.109	12	9	48	72	4:1	68	6:1	102
36	45	29	.109	16	12	51	83	4:1	76	6:1	114
42	53	34	.109	16	12	59	91	4:1	96	6:1	144
48	60	38	.109	16	12	66	98	4:1	112	6:1	168
54	68	43	.109	16	12	74	106	4:1	132	6:1	198
60	76	48	.109	16	12	80	112	4:1	152	6:1	228

INDIANA DEPARTMENT OF TRANSPORTATION	
SAFETY METAL CULVERT END SECTIONS FOR SMOOTH PIPE	
JANUARY 1998	
STANDARD DRAWING NO. E 715-SMES-12	
	DETAILS PLACED IN THIS FORMAT 11-15-99 /s/ Anthony L. Uremovich 11-15-99 DESIGN STANDARDS ENGINEER DATE
DESIGN STANDARDS ENGINEER	/s/ Firooz Zandi 11-15-99 CHIEF HIGHWAY ENGINEER DATE ORIGINALLY APPROVED 1-02-98