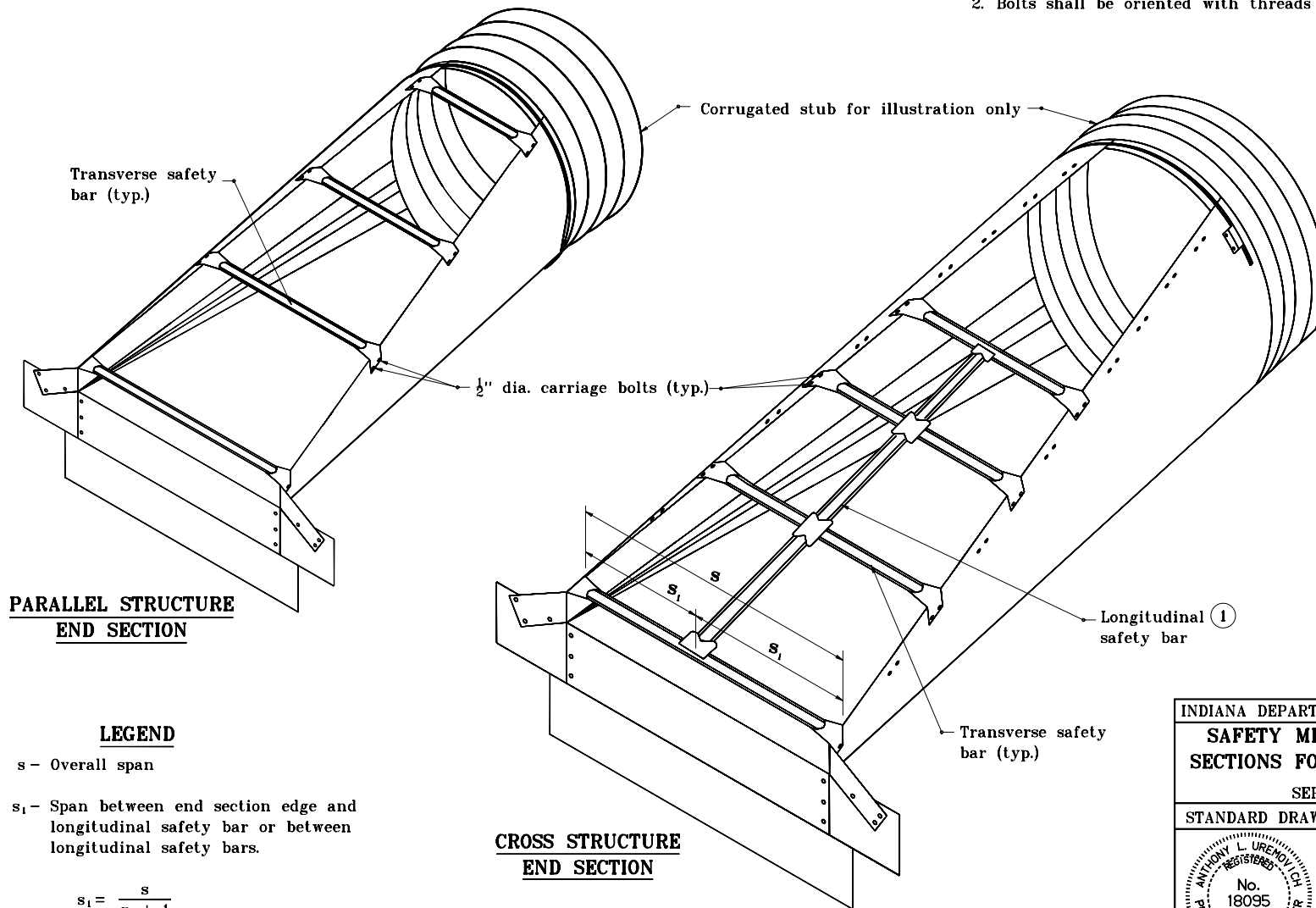
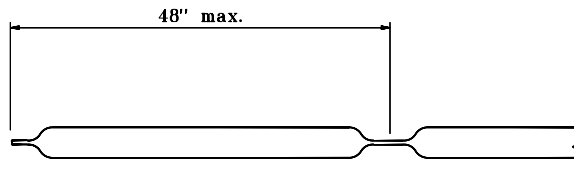


GENERAL NOTES

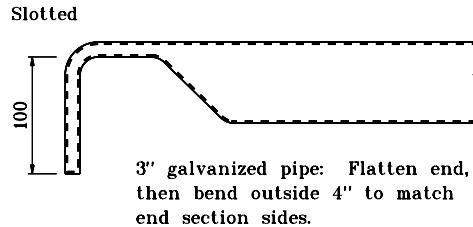
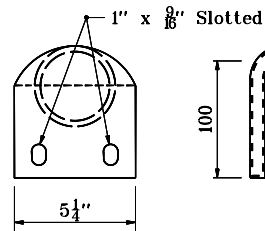
- ① Longitudinal safety bar shall be welded to transverse bars. For cross structure and section, if $S < 2'-6"$, no longitudinal safety bar is required. If $S > 2'-6"$, longitudinal safety bar(s) shall be provided so $S_1 < 2'-6"$.
2. Bolts shall be oriented with threads to inside of end section.



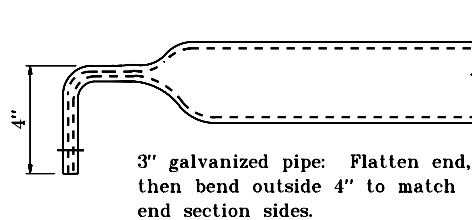
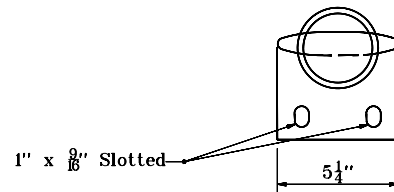
| | |
|--|--|
| INDIANA DEPARTMENT OF TRANSPORTATION | |
| SAFETY METAL CULVERT END SECTIONS FOR CORRUGATED PIPE | |
| SEPTEMBER 2000 | |
| STANDARD DRAWING NO. E 715-SMES-01 | |
| | /s/ Anthony L. Uremovich 9-01-00 DESIGN STANDARDS ENGINEER DATE |
| | /s/ Firooz Zandi 9-01-00 CHIEF HIGHWAY ENGINEER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



LONGITUDINAL SAFETY BAR DETAIL



OR



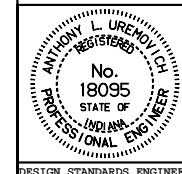
TRANSVERSE SAFETY BAR DETAILS

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

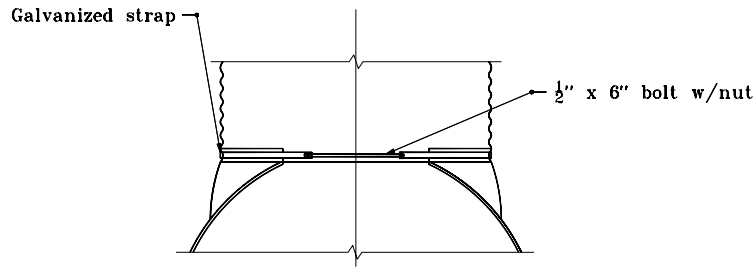
/s/ Firooz Zandi 7-27-99
CHIEF HIGHWAY ENGINEER DATE

DESIGN STANDARDS ENGINEER

ORIGINALLY APPROVED 1-02-98

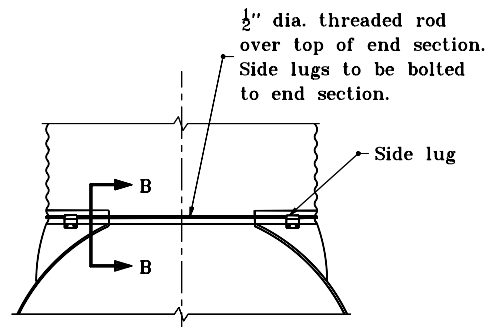
GENERAL NOTES

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.



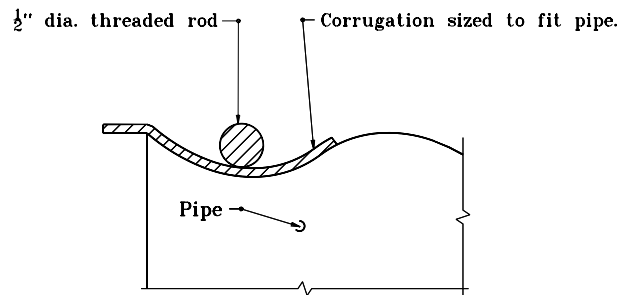
TYPE 1 CONNECTOR DETAIL

Through 24" dia.



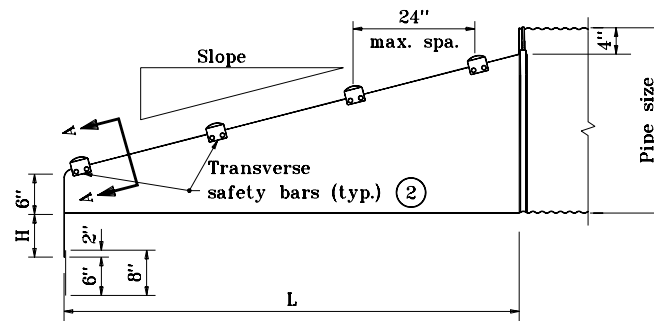
TYPE 2 CONNECTOR DETAIL

For all circular pipes larger than 24"
and all pipe-arches



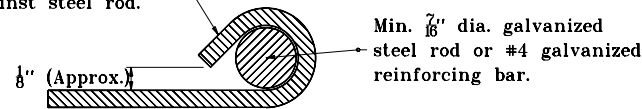
SECTION B-B

| | |
|--|--|
| 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 | ORIGINALLY APPROVED 1-02-98 |

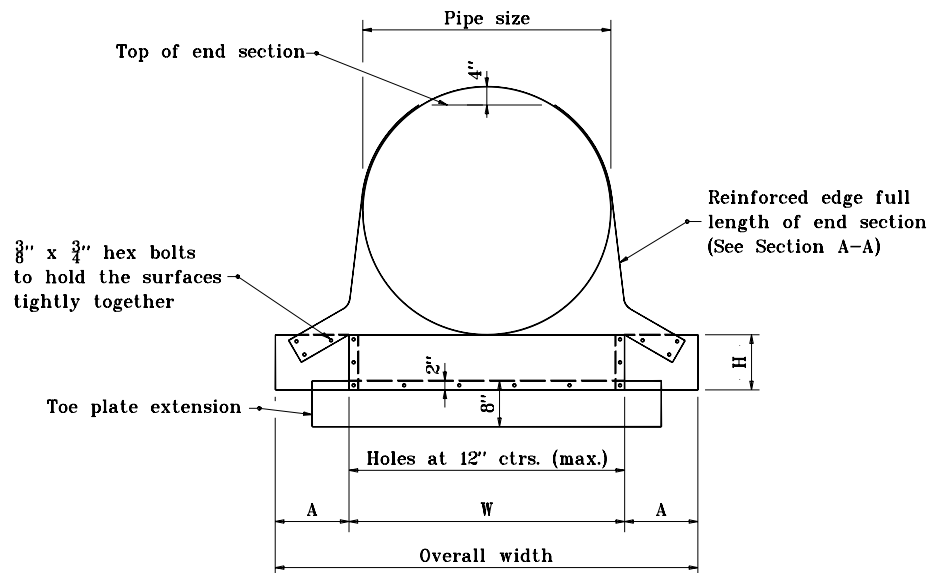


SIDE ELEVATION OF PARALLEL STRUCTURE END SECTION

Edge of sidewall sheet rolled snugly against steel rod.



SECTION A-A



FRONT VIEW

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".

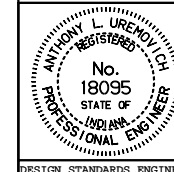
INDIANA DEPARTMENT OF TRANSPORTATION

**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

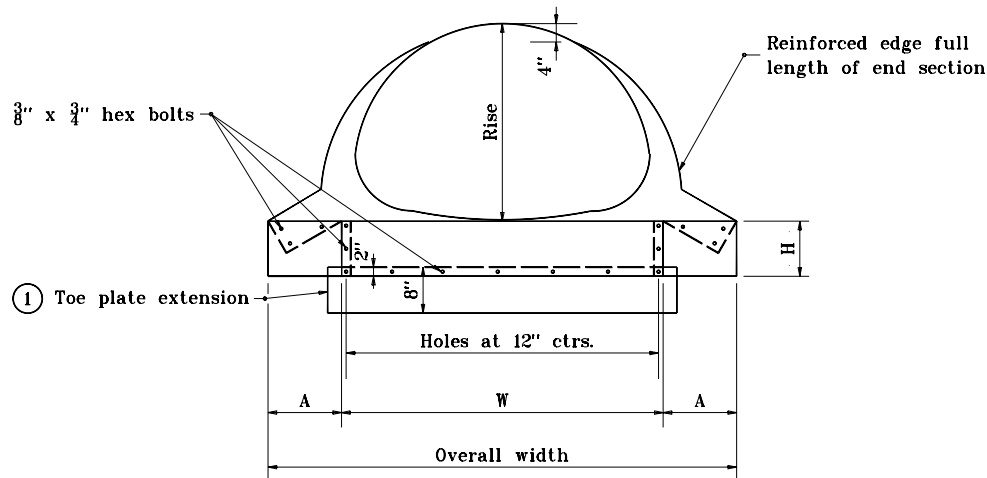
DESIGN STANDARDS ENGINEER

ORIGINALLY APPROVED

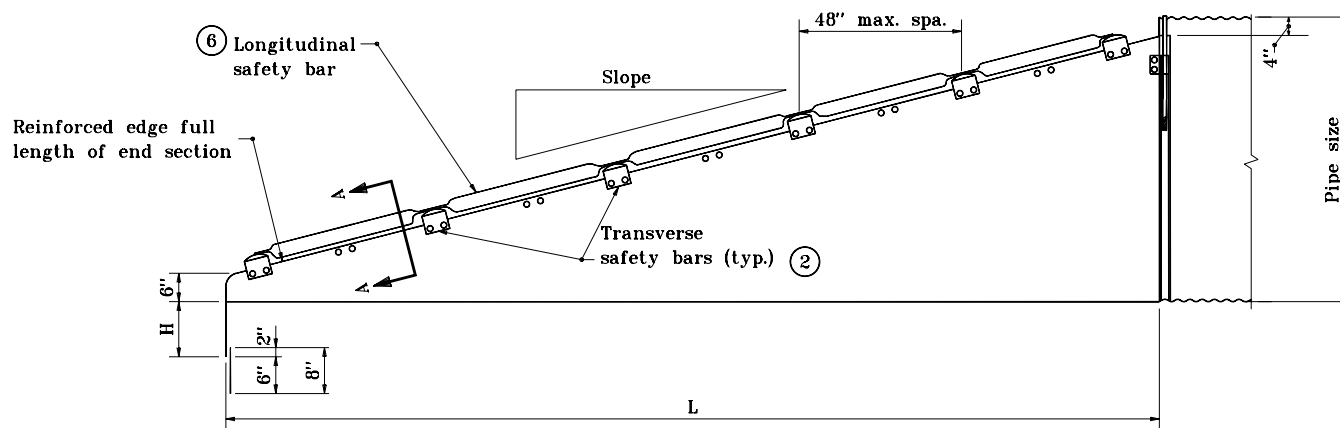
1-02-98

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



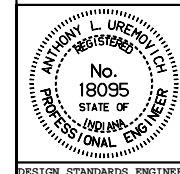
SIDE ELEVATION FOR CROSS STRUCTURE END SECTION

INDIANA DEPARTMENT OF TRANSPORTATION

SAFETY METAL CULVERT END SECTIONS FOR CORRUGATED PIPE

JANUARY 1998

STANDARD DRAWING NO. E 715-SMES-05



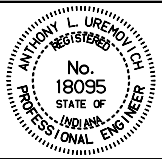
DETAILS PLACED IN THIS FORMAT 7-27-99

/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

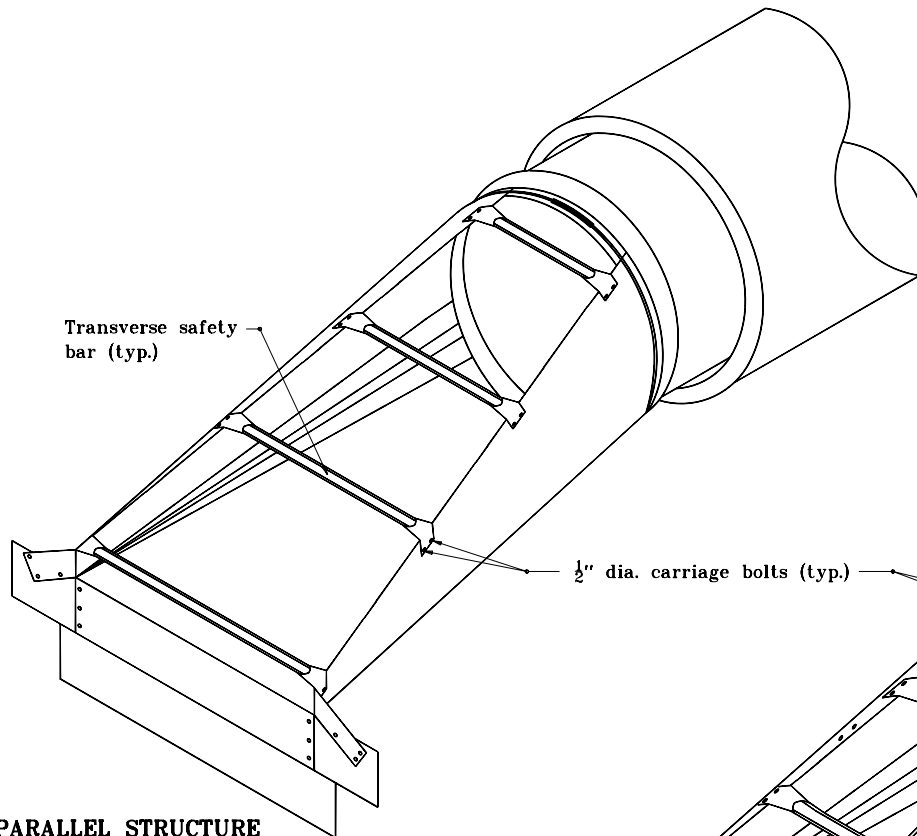
| METAL END SECTIONS FOR CIRCULAR PIPES | | | | | | | | | |
|---------------------------------------|-------------|-----------------|----|----|---------------|--------------|--------------|-------|--------------|
| Pipe Dia. | Min. Thick. | Dimensions, in. | | | | L Dimensions | | | |
| | | A | H | W | Overall Width | Slope | Length (in.) | Slope | Length (in.) |
| 15 | .064 | 8 | 6 | 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 |
| 30 | .109 | 12 | 9 | 36 | 60 | 4:1 | 80 | 6:1 | 120 |
| 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 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 |
| | DESIGN STANDARDS ENGINEER 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**

LEGEND

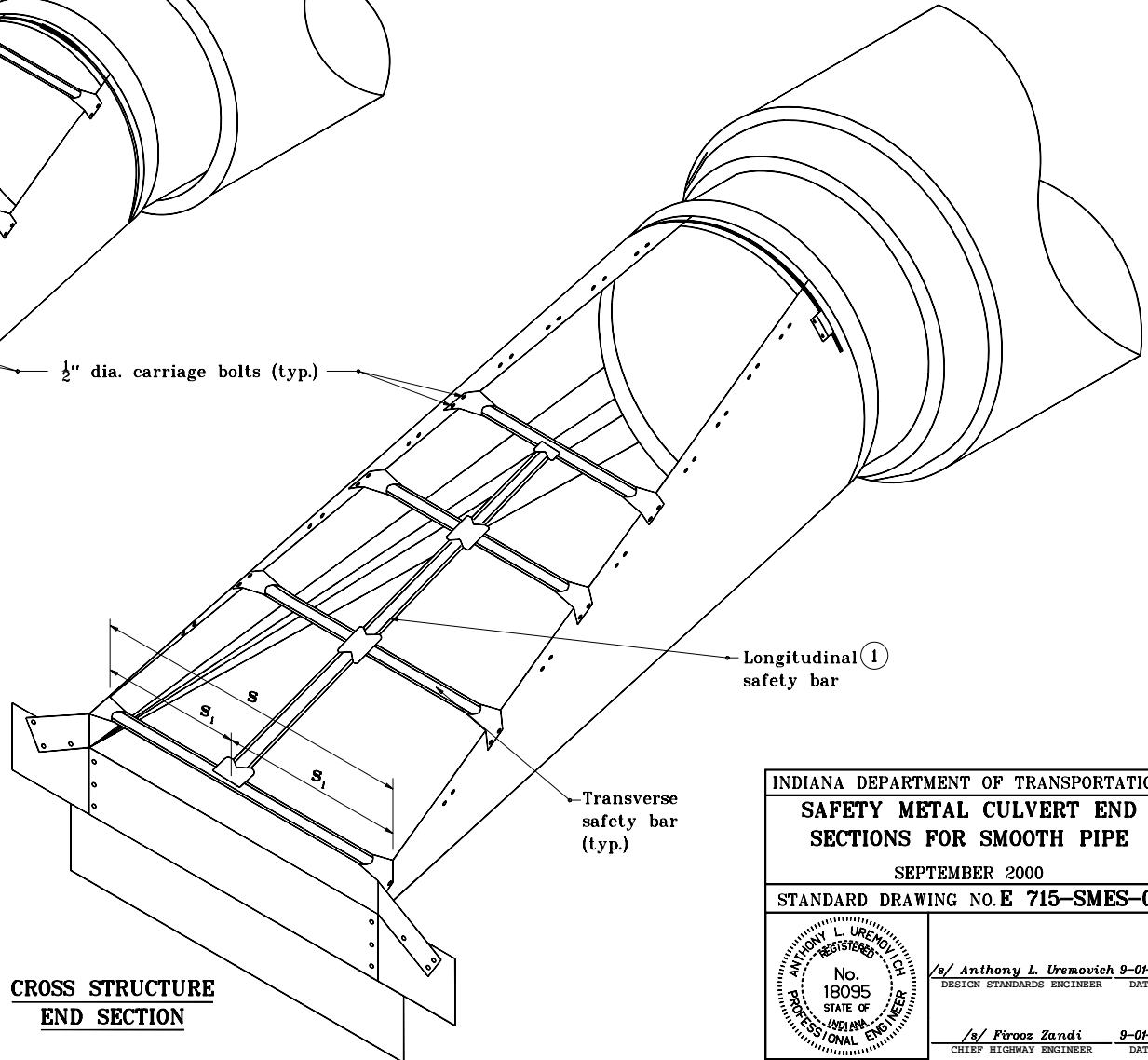
s - Overall span

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

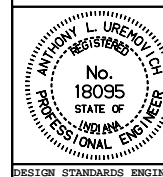
**CROSS STRUCTURE
END SECTION**



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

SEPTEMBER 2000

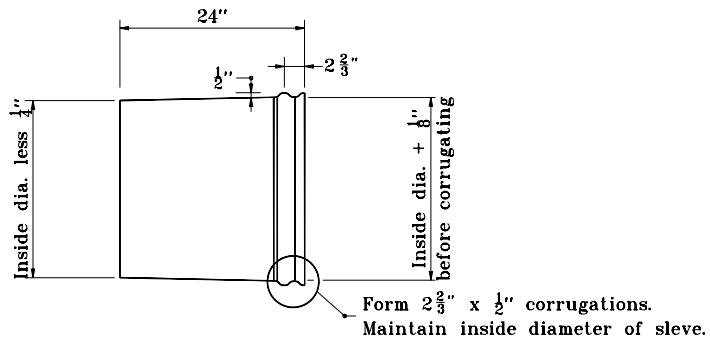
STANDARD DRAWING NO. **E 715-SMES-07**



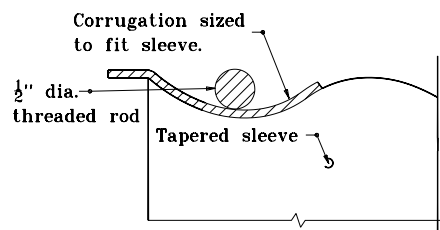
/s/ *Anthony L. Uremovich* 9-01-00
DESIGN STANDARDS ENGINEER DATE

/s/ *Firooz Zandi* 9-01-00
CHIEF HIGHWAY ENGINEER DATE

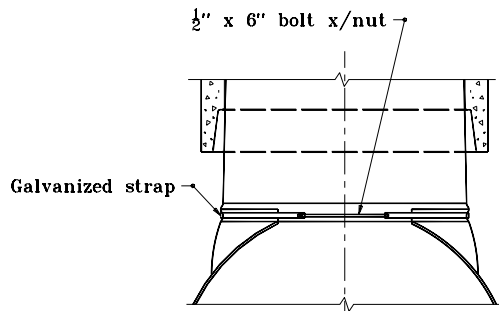
DESIGN STANDARDS ENGINEER



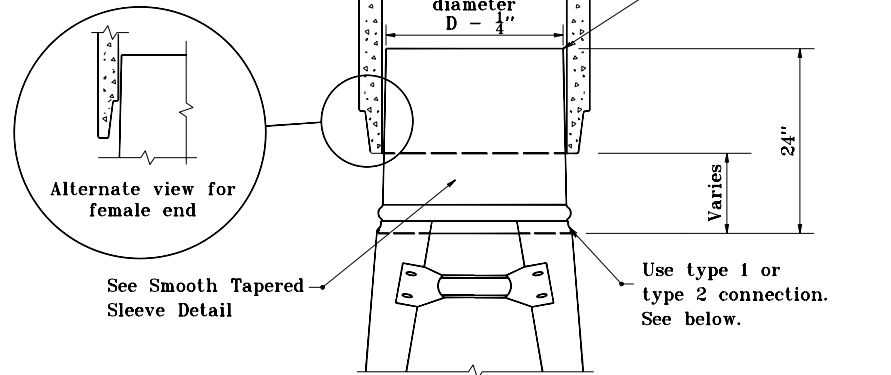
SMOOTH TAPERED SLEEVE DETAIL



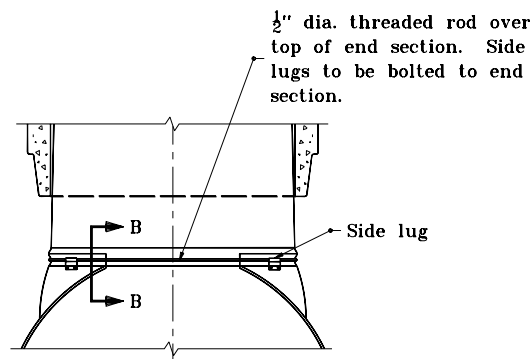
SECTION B-B



TYPE 1 CONNECTOR DETAIL
for all circular pipes through 24"



**TAPERED SLEEVE FOR ATTACHING
STEEL END SECTION TO SMOOTH INTERIOR PIPE**

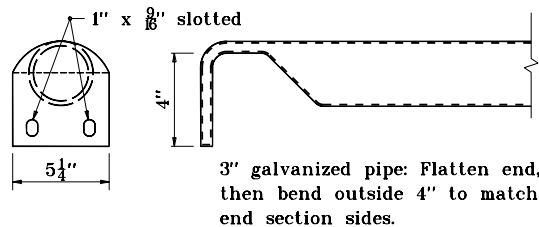


TYPE 2 CONNECTOR DETAIL
all circular pipes larger than 24"
and all horizontal elliptical pipes

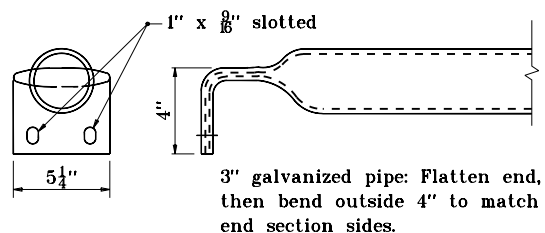
GENERAL NOTES

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.

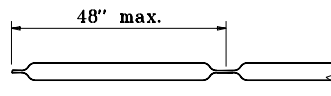
| | |
|---|--|
| INDIANA DEPARTMENT OF TRANSPORTATION | |
| SAFETY METAL CULVERT END SECTIONS FOR SMOOTH PIPE | |
| JANUARY 1998 | |
| STANDARD DRAWING NO. E 715-SMES-08 | |
| DETAILS PLACED IN THIS FORMAT 7-27-99 | |
| | /s/ Anthony L. Uremovich 7-27-99 DESIGN STANDARDS ENGINEER DATE |
| | /s/ Firooz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



OR



TRANSVERSE SAFETY BAR DETAILS



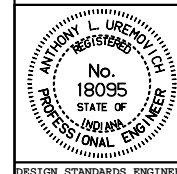
LONGITUDINAL SAFETY BAR DETAIL

INDIANA DEPARTMENT OF TRANSPORTATION

SAFETY METAL CULVERT END SECTIONS FOR SMOOTH PIPE

JANUARY 1998

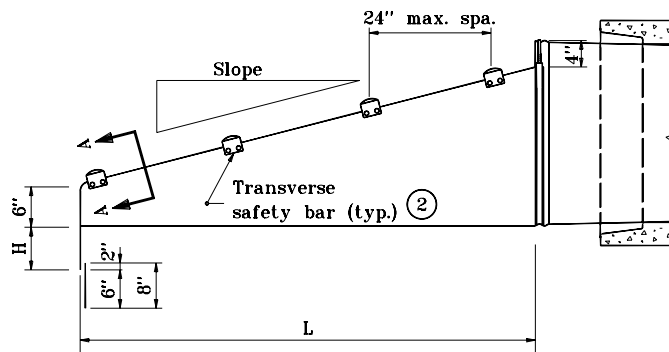
STANDARD DRAWING NO. **E 715-SMES-09**



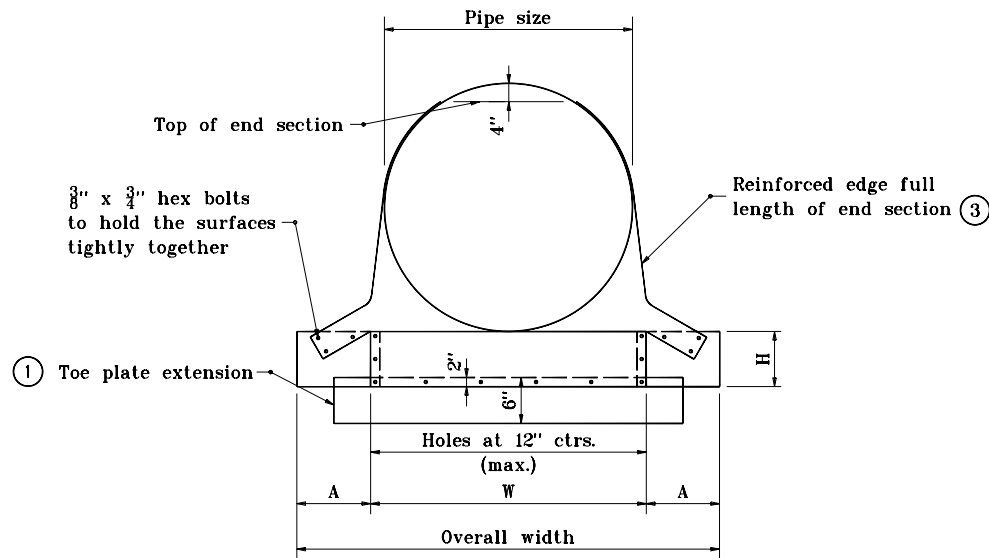
DETAILS PLACED IN THIS FORMAT 7-27-99

/s/ Anthony L. Uremovich 7-27-99
DESIGN STANDARDS ENGINEER DATE

/s/ Firooz Zandi 7-27-99
CHIEF HIGHWAY ENGINEER DATE
ORIGINALLY APPROVED 1-02-98



SIDE ELEVATION OF PARALLEL STRUCTURE END SECTION



FRONT VIEW

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.

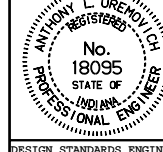
INDIANA DEPARTMENT OF TRANSPORTATION

**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

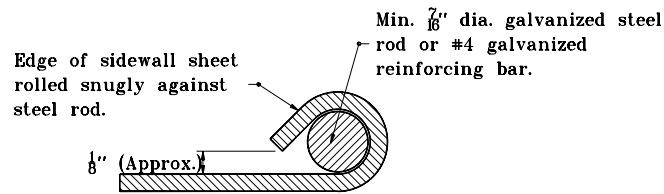


/s/ Anthony L. Uremovich 7-27-99
DESIGN STANDARDS ENGINEER DATE

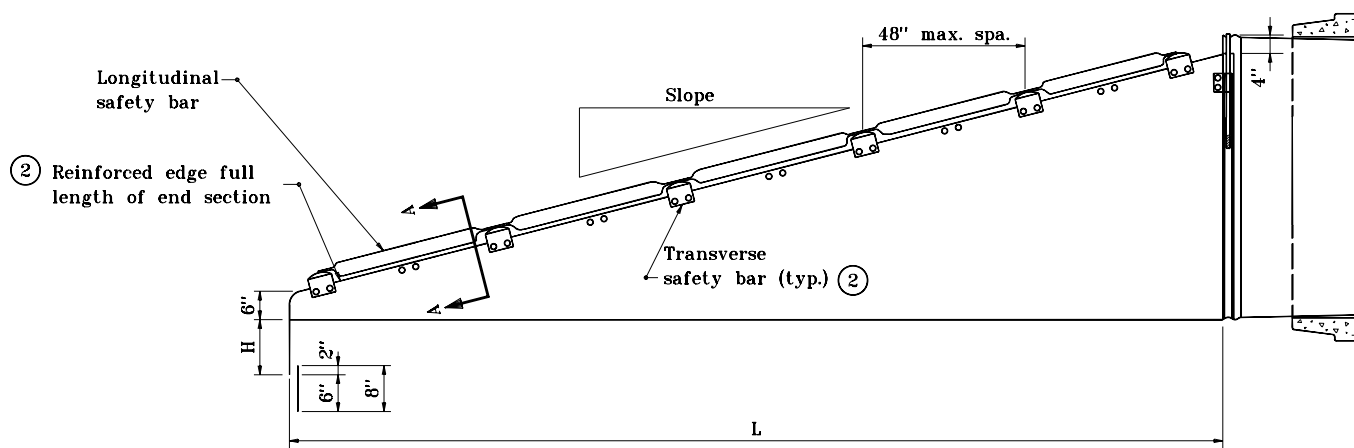
/s/ Firooz Zandi 7-27-99
CHIEF HIGHWAY ENGINEER DATE
ORIGINALLY APPROVED 1-02-98

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



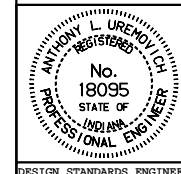
SIDE ELEVATION FOR CROSS STRUCTURE END SECTION

INDIANA DEPARTMENT OF TRANSPORTATION

SAFETY METAL CULVERT END SECTIONS FOR SMOOTH PIPE

JANUARY 1998

STANDARD DRAWING NO. E 715-SMES-11



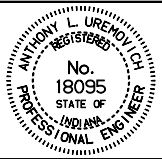
DETAILS PLACED IN THIS FORMAT 7-27-99

/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. | 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 |
| | /s/ Firooz Zandi 11-15-99 CHIEF HIGHWAY ENGINEER DATE |
| | DESIGN STANDARDS ENGINEER ORIGINALLY APPROVED 1-02-98 |