



**STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION
NASHVILLE, TENNESSEE 37243-0350**

INSTRUCTIONAL BULLETIN NO. 04-11

Regarding Guardrail Drawings
To Be Printed With The Plans

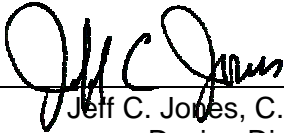
Effective for the July 16, 2004 bid letting, the various guardrail drawings attached to this instructional bulletin are to be printed with the plans. They shall be identified on the lower left hand corner of the index sheet-**“To be printed with the plans”**.

Copies of these drawings are attached to this instructional bulletin.

SAFETY APPURTENANCES AND FENCE

<u>Drawing Number</u>	<u>Current Revision Date</u>	<u>Drawing Title</u>
S-GR-11 SM-GR-11	9-05-03	W-BEAM & THRIE BEAM BARRIER RAIL AND RUB RAIL ALTERNATES
S-GR-12 SM-GR-12	5-27-03	W-BEAM BARRIER POST DETAILS AND SPECIFICATIONS
S-GR-13 SM-GR-13	5-27-03	BARRIER RAIL MOUNTING POST BLOCK-OUTS WITH VERTICAL ADJUSTMENT HOLES
S-GR-13A SM-GR-13A		BARRIER RAIL MOUNTING POST FOR PLASTIC BLOCK-OUTS WITH HORIZONTAL ADJUSTMENT HOLES

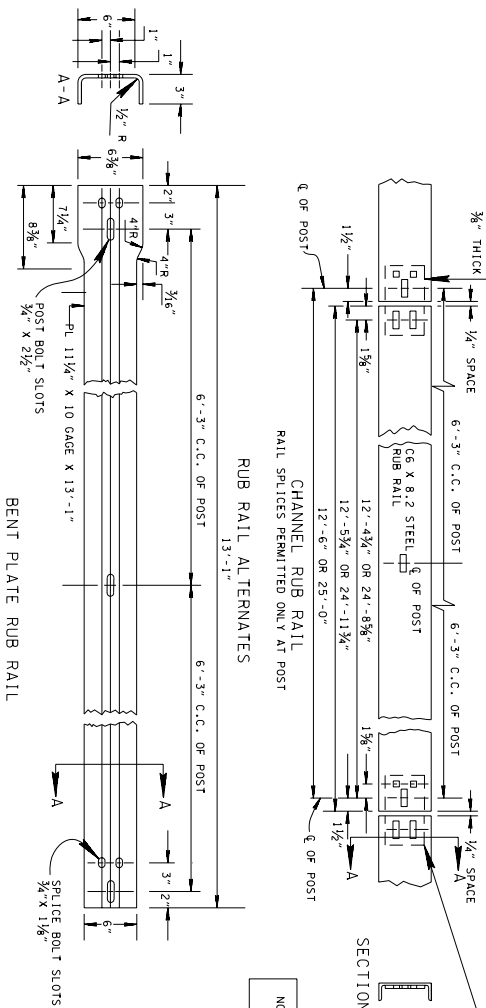
S-GR-15 SM-GR-15	9-05-04	W-BEAM BARRIER TERMINAL ELEMENT DETAILS
S-GR-19 SM-GR-19	10-26-03	GUARDRAIL TERMINAL ANCHORS, TYPE 12 AND TYPE 13
S-GR-21 SM-GR-21	4-15-04	LENGTH OF NEED AND TERMINAL REQUIREMENTS IN FILLS
S-GR-27 SM-GR-27	5-27-03	GUARDRAIL TERMINAL ANCHOR (TYPE 21) ELEMENT ASSEMBLY DETAILS
S-GR-32 SM-GR-32	5-27-03	ET-2000 GUARDRAIL TERMINAL ANCHOR (TYPE 38) POST LAYOUT AND ERECTION DETAILS
S-GR-34 SM-GR-34	5-27-03	ET-2000 (2 TUBE) POST AND ASSEMBLY DETAILS
S-GR-35 SM-GR-35	5-01-03	SKT-350 GUARDRAIL TERMINAL ANCHOR (TYPE 38) POST LAYOUT AND ERECTION DETAILS
S-GR-36 SM-GR-36	5-01-03	SKT-350 (2 TUBE) GUARDRAIL ELEMENT ASSEMBLY DETAILS



Jeff C. Jones, C. E. Director
Design Division

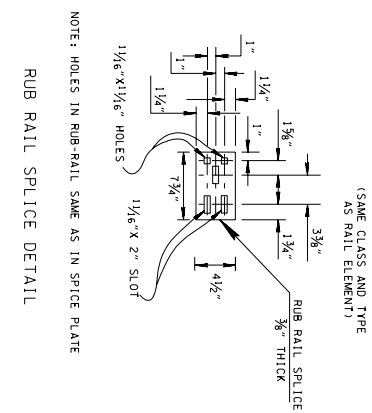
JW:mbd
Attachment
April 2, 2004 Page 2

RUB RAIL SPLICE DETAIL

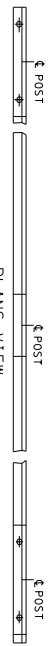


SEE RUB RAIL SPLICE DETAIL

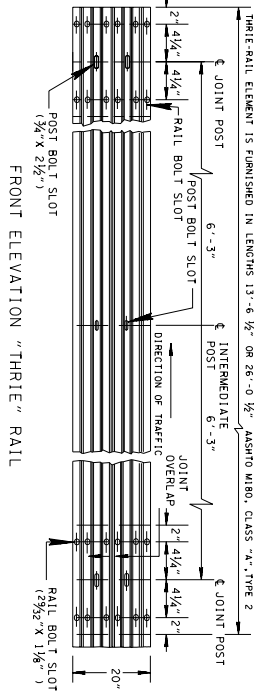
NOTE: HOLES IN RUB-RAIL SAME AS IN SPLICE PLATE



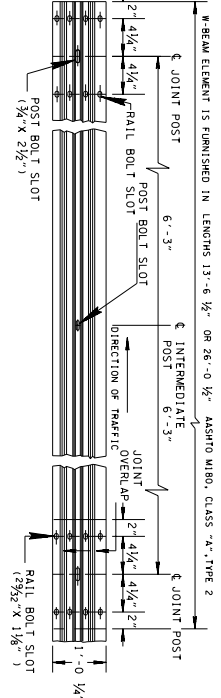
NOTE: HOLES IN RUB-RAIL SAME AS IN SPLICE PLATE



PLANS VIEW
W-BEAM OR THRIE RAIL



FRONT ELEVATION "THRIE" RAIL



FRONT ELEVATION "W"-BEAM

GENERAL NOTES

- Ⓐ CORRUGATED SHEET STEEL BEAMS SHALL CONFORM TO THE CURRENT REQUIREMENTS OF ASHTO M180, CLASS A, TYPE 2. RAIL MATERIAL SHALL HAVE A YIELD STRENGTH OF 50 KIPS PER SQUARE INCH AND A TENSILE STRENGTH OF TO KIPS PER SQUARE INCH.
 - Ⓑ RUB RAILS AND RUB RAIL SPLICE PLATES SHALL CONFORM TO ASTM A36 AND SHALL BE GALVANIZED IN ACCORDANCE WITH ASTM A123.
 - Ⓒ WHERE GUARDRAIL IS TO BE PLACED ON A CURVE WITH A RADIUS LESS THAN 150 FEET, THE RAIL SECTION SHALL BE SHAP-FORMED TO THE REQUIRED RADIUS.
 - Ⓓ SEE THE "RD-TS" STANDARD SERIES FOR GUARDRAIL PLACEMENT.
 - Ⓔ ITEM NUMBERS FOR PAYMENT AS DETAILED ON THESE "S-GR" SERIES OF DRAWINGS ARE AS FOLLOWS:
- | ITEM NO. | DESCRIPTION | ON DWG. NO. |
|-----------|--|-------------------|
| 705-01-01 | GUARDRAIL AT BRIDGE ENDS | S-GR-17 & S-GR-23 |
| 705-01-04 | METAL BEAM GUARD FENCE | S-GR-22 & D-CE-3 |
| 705-02-01 | SINGLE GUARDRAIL WITH RUB-RAIL (TYPE 2) | S-GR-13 & S-GR-18 |
| 705-02-02 | MEDIAN DIVIDER GUARDRAIL W/ RUB-RAIL (TYPE 2) | S-GR-13 & S-GR-18 |
| 705-03-01 | MEDIAN DIVIDER GUARDRAIL (TYPE 2) | S-GR-13 & S-GR-18 |
| 705-03-02 | MEDIAN DIVIDER GUARDRAIL AT CONCRETE BARRIER | S-GR-13 & S-GR-18 |
| 705-03-03 | MEDIAN DIVIDER GUARDRAIL (TYPE 2) 127" MT. HT. | S-GR-13 & S-GR-18 |
| 705-03-04 | GUARDRAIL TERMINAL (TYPE 13) | S-GR-20 |
| 705-04-01 | GUARDRAIL TERMINAL (TYPE 13) | S-GR-20 |
| 705-04-02 | GUARDRAIL TERMINAL (TYPE 13) | S-GR-26 |
| 705-04-03 | GUARDRAIL TERMINAL (TYPE 13) | S-GR-19 |
| 705-04-04 | GUARDRAIL TERMINAL (TYPE 13) | S-GR-26 |
| 705-04-05 | GUARDRAIL TERMINAL (TYPE 13) | S-GR-26 |
| 705-04-06 | GUARDRAIL TERMINAL (TYPE 13) | S-GR-26 |
| 705-04-07 | GUARDRAIL TERMINAL (TYPE 13) | S-GR-26 |
| 705-04-08 | GUARDRAIL TERMINAL (TYPE 13) | S-GR-26 |
| 705-04-09 | GUARDRAIL TERMINAL (TYPE 13) | S-GR-26 |
| 705-04-10 | GUARDRAIL TERMINAL (TYPE 13) | S-GR-26 |
| 705-04-11 | GUARDRAIL TERMINAL (TYPE 13) | S-GR-26 |
| 705-04-12 | GUARDRAIL TERMINAL (TYPE 13) | S-GR-26 |
| 705-04-13 | GUARDRAIL TERMINAL (TYPE 13) | S-GR-26 |
| 705-04-14 | GUARDRAIL TERMINAL (TYPE 13) | S-GR-26 |
| 705-04-15 | GUARDRAIL TERMINAL (TYPE 13) | S-GR-26 |
| 705-04-16 | GUARDRAIL TERMINAL (TYPE 13) | S-GR-26 |
| 705-04-17 | GUARDRAIL TERMINAL (TYPE 13) | S-GR-26 |
| 705-04-18 | GUARDRAIL TERMINAL (TYPE 13) | S-GR-26 |
| 705-04-19 | GUARDRAIL TERMINAL (TYPE 13) | S-GR-26 |
| 705-04-20 | GUARDRAIL TERMINAL (TYPE 13) | S-GR-26 |
| 705-04-21 | GUARDRAIL TERMINAL (TYPE 13) | S-GR-26 |
| 705-04-22 | GUARDRAIL TERMINAL (TYPE 13) | S-GR-26 |
| 705-04-23 | GUARDRAIL TERMINAL (TYPE 13) | S-GR-26 |
| 705-04-24 | GUARDRAIL TERMINAL (TYPE 13) | S-GR-26 |
| 705-04-25 | GUARDRAIL TERMINAL (TYPE 13) | S-GR-26 |
| 705-04-26 | GUARDRAIL TERMINAL (TYPE 13) | S-GR-26 |
| 705-04-27 | GUARDRAIL TERMINAL (TYPE 13) | S-GR-26 |
| 705-04-28 | GUARDRAIL TERMINAL (TYPE 13) | S-GR-26 |
| 705-04-29 | GUARDRAIL TERMINAL (TYPE 13) | S-GR-26 |
| 705-04-30 | GUARDRAIL TERMINAL (TYPE 13) | S-GR-26 |
| 705-04-31 | GUARDRAIL TERMINAL (TYPE 13) | S-GR-26 |
| 705-04-32 | GUARDRAIL TERMINAL (TYPE 13) | S-GR-26 |
| 705-04-33 | GUARDRAIL TERMINAL (TYPE 13) | S-GR-26 |
| 705-04-34 | GUARDRAIL TERMINAL (TYPE 13) | S-GR-26 |
| 705-04-35 | GUARDRAIL TERMINAL (TYPE 13) | S-GR-26 |

REV. 9-11-82, CHANGED S-GR-1 TO S-GR-17 AND S-GR-23 TO S-GR-22 AND S-GR-18 TO S-GR-13 AS REFERRED DWG. DETAIL DIMENSION TO W-BEAM RAIL.

REV. 9-11-86, CHANGED ITEM DESCRIPTIONS AND ADDED NOTE 7.

REV. 9-11-87, CHANGED ITEM NOS. 705-01-01, 705-01-04, 705-01-05, AND 705-02-05 TO ITEM NOS. 705-02-01, 705-02-02, 705-02-03, AND 705-02-05.

REV. 11-4-87, ADDED ITEM NOS. 705-02-07 AND 705-06-CORRECTED REV. 105-01-15, 15-A.

REV. 12-6-90, ADDED RUB RAIL TO BEAM AND ADDED ITEM NOS. 705-01-01, 705-01-07 AND 705-01-08.

REV. 10-26-91, REWER AND CHANGED DRAWING NUMBER TO DRAWING 1501991 STANDARDS.

REV. 10-26-94, IN GENERAL NOTES CHANGED DRAWING NUMBER.

REV. 1-19-95, IN GENERAL NOTE CHANGED DRAWING NUMBER.

REV. 1-29-95, IN GENERAL NOTE ADDED ITEM NOS. 705-04-20 AND 705-04-21.

REV. 5-27-96, IN GENERAL NOTE ADDED ITEM NO. 105-04-06.

REV. 6-10-96, ADDED DIMENSION FOR WIDTH TO RUB RAIL SPLICE DETAIL.

REV. 7-29-98, MODIFIED GENERAL NOTE.

REV. 9-5-98, MODIFIED GENERAL NOTE.

REV. 10-26-99, DELETED BACK UP PLATE DETAIL.

REV. 9-5-00, IN GENERAL NOTES CORRECTED NOTE.

REV. 5-27-01, IN GENERAL NOTE CHANGED ITEM NUMBERS OF GUARDRAIL TO CONCUR WITH NEW PAV. ITEM SYSTEM.

REV. 9-5-01, CORRECTED DESCRIPTION FOR ITEM NO. 705-04-07.

REV. 9-11-02, DELETED ITEM NO. 705-01-02.

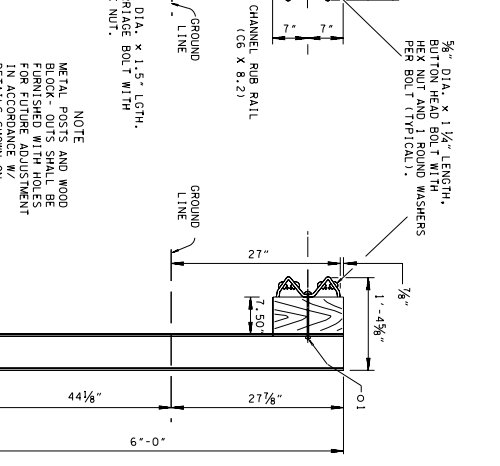
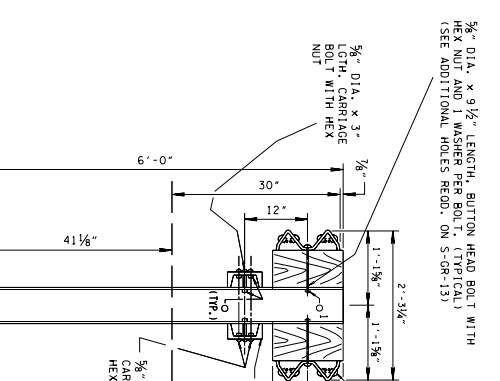
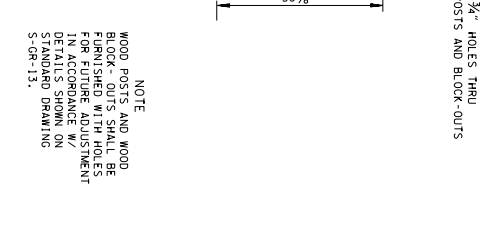
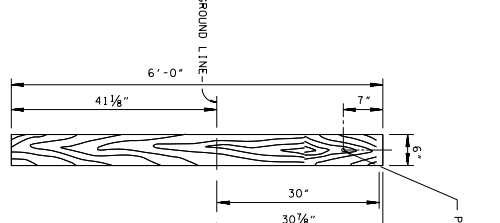
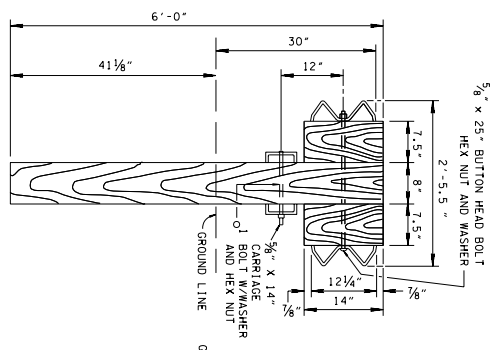
REV. 9-5-03, CHANGED GENERAL NOTE TO REFER TO THE CORRECTED RENUMBERED REMAINING GENERAL NOTES.

MINOR REVISION - FINA APPROVAL NOT REQUIRED.

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

W-BEAM & THRIE BEAM
BARRIER RAIL
AND RUB RAIL
ALTERNATES

S-GR-11



REV. 9-15-82: CHANGED S-CR-2 TO S-CR-13; CONCRETE FOSI DELETED.

REV. 7-1-84: CORRECTED DIMENSIONS FOR WOOD POSTS IN TRANSITION FROM S&M RIGID TO RIGID RAIL.

REV. 9-5-87: REPLACED W6 x 16 OR W6 x 20 WITH W6 x 15.5 FOR ALTERNATE WELDED PLATE, ELIMINATED USE OF WOOD POSTS IN TRANSITION FROM S&M RIGID TO RIGID RAIL.

REV. 1-14-87: CHANGED POST SIZE FOR USE ON BRIDGES.

REV. 7-29-93: REFORM AND REORIENTED SHEET, CORRECTED DIMENSIONS FOR WELDED PLATE W6 x 8.5 AND W6 x 9.0.

REV. 6-10-96: CHANGED LENGTH OF WOOD POSTS TO CORRECTED DIMENSIONS FOR WOOD POST BLOCKS.

REV. 7-29-96: CHANGED DIMENSIONS FOR WOOD POST BLOCKS TO CONFORM WITH DIMENSIONS OF W6 x 8.5 SHAPES.

REV. 7-29-95: CHANGED HEIGHT OF DETAILS CONNECTED VARIOUS MOUNTING HEIGHTS.

REV. 5-27-96: CHANGED DIMENSIONS FOR FRONT VIEW OF MODERN MEDIAN DIVIDER GUARDRAIL.

REV. 6-10-96: CHANGED LENGTH OF TO 18" IN SIDE VIEW SINGLE GUARDRAIL DETAIL.

REV. 7-29-96: ADDED DIMENSION TO SIDE VIEW FOR SINGLE GUARDRAIL.

REV. 7-29-96: DERIVED DETAILS FOR WELDED STEEL SHAPES USING THREE-PART, CHANGED STEEL BLOCK-OUT TO WOOD BLOCK-OUT TO CORRECT DIMENSIONS TO 18" IN SIDE VIEW SINGLE GUARDRAIL DETAIL.

REV. 7-29-96: ADDED DIMENSION TO SIDE VIEW FOR SINGLE GUARDRAIL.

REV. 7-29-96: DERIVED DETAILS FOR WELDED STEEL SHAPES USING THREE-PART, CHANGED STEEL BLOCK-OUT TO WOOD BLOCK-OUT TO CORRECT DIMENSIONS TO 18" IN SIDE VIEW SINGLE GUARDRAIL DETAIL.

REV. 7-29-96: ADDED DIMENSION TO SIDE VIEW FOR SINGLE GUARDRAIL.

NOTE: WOOD POSTS AND WOOD BLOCK-OUTS SHALL BE FURNISHED WITH HOLES FOR FUTURE ADJUSTMENT IN ACCORDANCE WITH DETAILS SHOWN ON S-CR-13.

NOTE: METAL POSTS AND WOOD BLOCK-OUTS SHALL BE FURNISHED WITH HOLES FOR FUTURE ADJUSTMENT IN ACCORDANCE WITH DETAILS SHOWN ON S-CR-13.

SIDE VIEW
MEDIAN DIVIDER GUARDRAIL
(W-BEAM/RIGID RAIL ALT.)

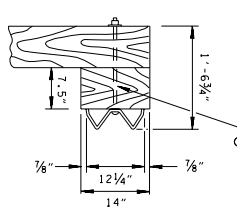
FRONT VIEW
MEDIAN DIVIDER GUARDRAIL
(SHOWING BOLT HOLES FOR W-BEAM RAIL)

DETAILS FOR WOOD POSTS AND BLOCK-OUTS

SIDE VIEW
MEDIAN DIVIDER GUARDRAIL

SIDE VIEW DIMENSIONS BASED ON W6 x 8.5. OTHER DETAILS APPLY TO W6 x 9.0 AND W6 x 15.0 POSTS AND BLOCK-OUTS.

SIDE VIEW
SINGLE GUARDRAIL

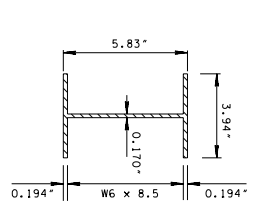


SINGLE GUARDRAIL

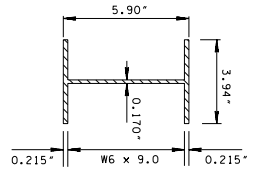
LEGEND FOR WASHER REQUIREMENTS
1 OR 2 ROUND WASHERS — 0102

WOOD SPECIFICATIONS

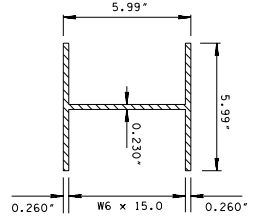
- 21 POSTS AND BLOCK-OUTS SHALL BE OF TIMBER WITH A STRESS GRADE OF 1200 P. S. 1. OR MORE. POSTS WILL HAVE NOMINAL SIZE OF 6" x 8". BLOCK-OUTS WILL HAVE NOMINAL SIZE OF 6" x 8". ALL DIMENSIONS SHALL BE TO THE OUTSIDE UNLESS OTHERWISE INDICATED. TIMBER SHALL BE INSPECTED BY THE INSPECTION BUREAU, OR OTHER APPROPRIATE TIMBER ASSOCIATIONS. TIMBER FOR POSTS SHALL BE ROUGH SAW (UNPLANED) WITH NOMINAL DIMENSIONS INDICATED. TIMBER FOR BLOCK-OUTS SHALL BE S4S WITH THE TYPICAL DIMENSIONS INDICATED.
- 22 ALL WOOD POSTS AND BLOCK-OUTS SHALL BE TREATED WITH TIMBER PRESERVATIVE AS REQUIRED BY SUBSECTION 911.02(4) OF THE TENNESSEE STANDARD SPECIFICATION. WOOD POSTS AND BLOCK-OUTS SHALL BE FURNISHED WITH HOLES FOR FUTURE RAIL ADJUSTMENT IN ACCORDANCE WITH DETAILS SHOWN ON STANDARD DRAWINGS S-CR-13.



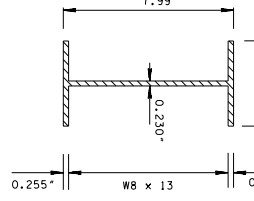
WELDED STEEL SHAPE



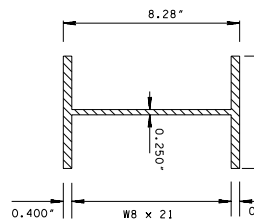
WELDED STEEL SHAPE



WELDED STEEL SHAPE



WELDED STEEL SHAPE



WELDED STEEL SHAPE

GENERAL NOTES

- A MATERIALS AND SPECIFICATIONS NOT SHOWN IN THESE S-CR SERIES OF DRAWINGS SHALL BE IN ACCORDANCE WITH STANDARD PROVISIONS REGARDING SECTION 703.
- B THE CONTRACTOR MAY HAVE OPTIONAL CHOICE OF EITHER THE STEEL W6 x 8.5 OR W6 x 9.0 HOT ROLLED OR WELDED STEEL SHAPE, OR THE WOOD POSTS WITH THEIR COMBINATION BLOCK-OUTS AS SHOWN ABOVE, WITHIN THE FOLLOWING LIMITATIONS:
 - (1) THE MIXING OF ANY OF THE ABOVE POSTS TYPES ON A GIVEN PRO-JECT WILL BE AVOIDED IF POSSIBLE.
 - (2) SHOULD IT BECOME NECESSARY TO CHANGE THE TYPE OF POSTS ON A PROJECT, THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING APPROVAL FROM THE RUN OF GUARDRAIL, WITH THE EXCEPTION, WOOD POSTS ON GUARDRAIL TERMINALS.
- C ON EXISTING STRUCTURES NOT HAVING A VERTICAL FACE FOR THE ATTACHMENT OF TWO RAIL ELEMENTS, USE OF W6 x 15.0 POSTS IS REQUIRED ON THE SEAM-RIGID S-CR-20. THE BOLT HOLES WILL BE ORIENTED TO THE CENTER LINE OF THE FLANGE OF THE STEEL POST AND WILL BE THE SAME SIZE AND DIMENSION AS THOSE SHOWN ON STANDARD DRAWING S-CR-13.
- D METAL POSTS AND ALL BLOCK-OUTS SHALL BE FURNISHED WITH HOLES FOR FUTURE RAIL ADJUSTMENT IN ACCORDANCE WITH DETAILS SHOWN ON STANDARD DRAWINGS S-CR-13 AND S-CR-22.
- E W6 x 9.0 OR W6 x 8.5 POST SHALL BE USED FOR INSTALLATIONS ON BRIDGES AS SHOWN ON STANDARD DRAWING S-CR-22.
- F WELDED STEEL POSTS MAY BE USED AS ALTERNATES TO THE HOT ROLLED STEEL SHAPE. THEY MUST CONFORM TO ASTM A-789 AND BE GALVANIZED ACCORDING TO ASTM A-123.

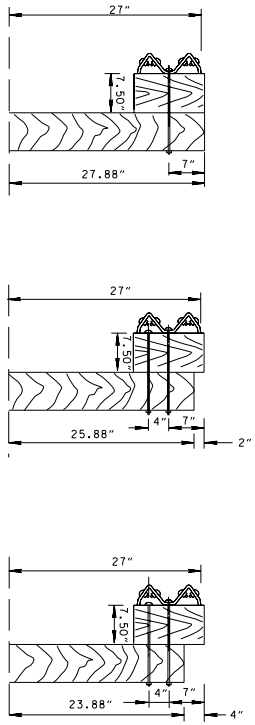
MINOR REVISION ... FMM APPROVAL NOT REQUIRED

STATE OF TENNESSEE DEPARTMENT OF TRANSPORTATION

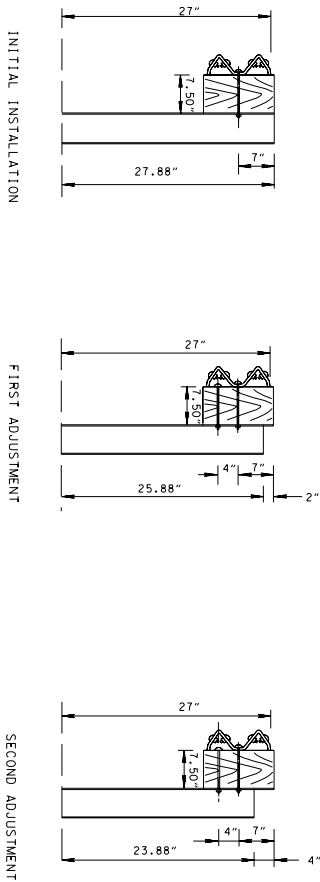
W-BEAM BARRIER POST DETAILS AND SPECIFICATIONS

S-CR-12

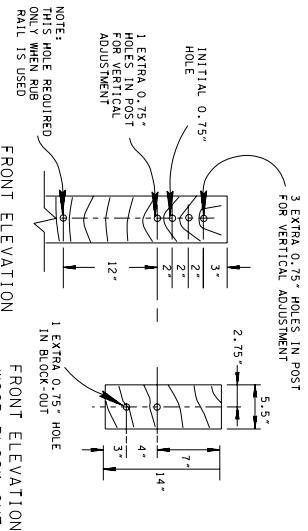
DETAILS SHOWING HOLES REQUIRED IN POSTS AND BLOCK-OUTS
(FOR USE IN FUTURE RAIL ADJUSTMENT)



ADJUSTABLE WOOD POSTS AND BLOCK-OUTS AT VARIOUS ADJUSTMENTS

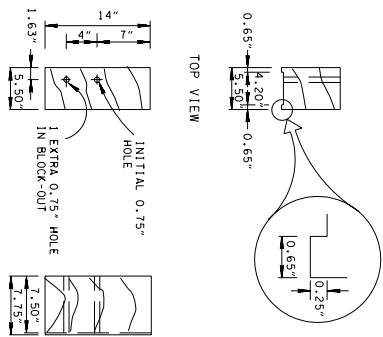


ADJUSTABLE STEEL POSTS AND BLOCK-OUTS AT VARIOUS ADJUSTMENTS



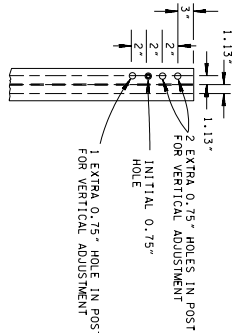
FRONT ELEVATION WOOD POST
FRONT ELEVATION WOOD BLOCK-OUT

WOOD BLOCK-OUT FOR WOOD POST INSTALLATION NOTES	
(B1)	THE INITIAL INSTALLATION WILL REQUIRE ONE 5/8" DIAMETER X 18" LONG BUTTON HEAD BOLT WITH ROUND STEEL WASHER.
(B2)	THE FIRST ADJUSTMENT AND THE SECOND ADJUSTMENT WILL REQUIRE ONE 3/8" DIAMETER X 18" LONG BUTTON HEAD BOLT AND ONE 5/8" DIAMETER X 9 1/2" LONG HEX HEAD BOLT. EACH WILL HAVE ONE ROUND STEEL WASHER.



TOP VIEW FRONT VIEW SIDE VIEW

WOOD BLOCK-OUT DETAIL FOR STEEL POST WITH VERTICAL ADJUSTMENT HOLES



FRONT ELEVATION STEEL POST

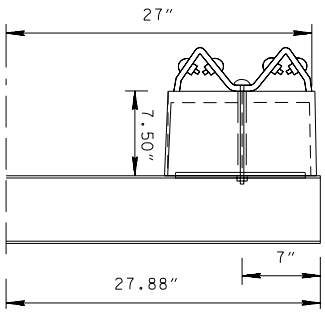
INSTALLATION NOTES FOR BLOCK-OUTS WITH VERTICAL ADJUSTMENT HOLES	
(B1)	THE INITIAL INSTALLATION WILL REQUIRE ONE 5/8" DIAMETER X 9 1/2" LONG BUTTON HEAD BOLT WITH ROUND STEEL WASHER.
(B2)	THE FIRST ADJUSTMENT AND THE SECOND ADJUSTMENT WILL REQUIRE ONE 3/8" DIAMETER X 18" LONG BUTTON HEAD BOLT AND ONE 5/8" DIAMETER X 9 1/2" LONG HEX HEAD BOLT. EACH WILL HAVE ONE ROUND STEEL WASHER.

GENERAL NOTES	
(A)	SEE STANDARD DRAWING S-OR-12 FOR ADDITIONAL POST DETAILS AND SPECIFICATIONS.
(B)	SEE STANDARD DRAWING S-OR-14 FOR ADDITIONAL BOLT, WASHER AND NUT DETAILS AND SPECIFICATIONS.
(C)	SEE STANDARD DRAWING S-OR-13A FOR BLOCK-OUTS WITH HORIZONTAL ADJUSTMENT HOLES AND MOUNTING DETAILS.
(D)	RECYCLED PLASTIC GUARDRAIL BLOCKOUTS LISTED ON THE TENNESSEE DEPARTMENT OF TRANSPORTATION'S WEBSITE SHOULD BE USED FOR WOOD BLOCKOUTS. THE USE OF RECYCLED PLASTIC GUARDRAIL BLOCKOUTS AND SHIELD TO THE FOLLOWING SPECIFICATIONS: (1) THE MIXING OF BLOCKOUTS ON A GIVEN PROJECT WILL BE AVOIDED IF POSSIBLE. (2) SHOULD IT BECOME NECESSARY TO CHANGE THE BLOCKOUT TYPE ON A GIVEN PROJECT, THE BLOCKOUTS SHOULD NOT BE MIXED ON A GIVEN RUN OF GUARDRAIL. (3) BLOCKOUTS SHALL MEET NCHRP-350 GUIDELINES.

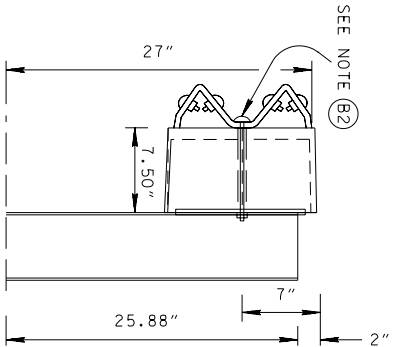
<input type="checkbox"/> MINOR REVISION -- FINAL APPROVAL NOT REQUIRED.
STATE OF TENNESSEE DEPARTMENT OF TRANSPORTATION
BARRIER RAIL MOUNTING POST BLOCK-OUTS WITH VERTICAL ADJUSTMENT HOLES
7-29-98 S-OR-13

REV. 9-15-82: NEW DIM. WITH DETAILS FROM OTHER OLD 5-OR-SERIES DIMS.
 REV. 7-1-84: ADDED ANCHOR DETAILS, ADDED OR CORRECTED DIMENSIONS ON WOOD POST & BLOCK-OUT.
 REV. 9-1-86: CHANGED ITEM DESCRIPTION.
 REV. 9-5-87: REPLACED W6X16 OR W6X15.5 WITH W6X15, 17E AND CONCRETE BASE OPTIONS. REVISED GUARDRAIL DETAILS AND NOTES.
 REV. 11-4-87: DELETED AND CORRECTED NOTES.
 REV. 7-5-89: DELETED ANCHOR DETAIL.
 REV. 7-29-93: REOPEN SHEET, MODIFIED GENERAL NOTES.
 REV. 5-27-96: ADDED NOTE TO W-BEAM WITH RUB-RAIL DETAIL.
 REV. 6-10-96: CHANGED HEIGHT OF WOOD BLOCK-OUT FROM 15" TO 14".
 REV. 7-29-98: ADDED WOOD BLOCK-OUT DETAILS FOR STEEL POST, MODIFIED WOOD BLOCK-OUT DETAIL ELEMENT JOINT DETAILS, IRREGULAR SHOULDER NOTES, (D), AND (E) TO STANDARD DRAWING S-OR-18.
 REV. 9-15-98: GENERAL REVISION THROUGHOUT DRAWING. 5-OR-12 TO S-OR-13 FROM 5-OR-12 TO S-OR-13.
 REV. 5-27-03: ADDED GENERAL NAME (A) AND (D) CHANGED SHEET

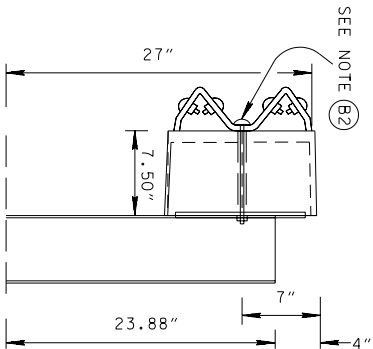
DETAILS SHOWING HOLES REQUIRED IN POSTS AND BLOCK-OUTS
(FOR USE IN FUTURE RAIL ADJUSTMENT)



INITIAL INSTALLATION

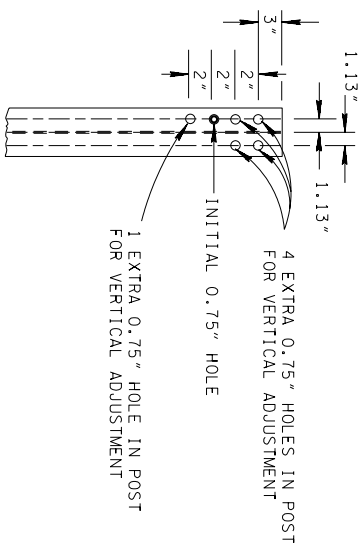


FIRST ADJUSTMENT



SECOND ADJUSTMENT

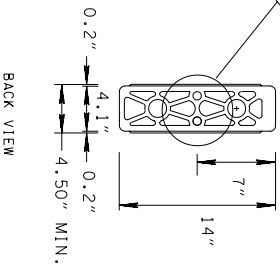
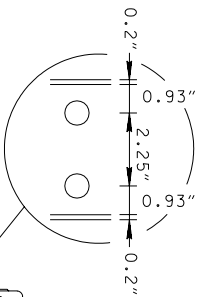
FRONT ELEVATION
STEEL POST



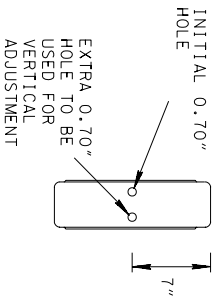
ADJUSTABLE STEEL POSTS AND BLOCK-OUTS AT VARIOUS ADJUSTMENTS

- INSTALLATION NOTES FOR BLOCK-OUTS WITH HORIZONTAL ADJUSTMENT HOLES**
- (B1) THE INITIAL INSTALLATION WILL REQUIRE ONE $\frac{3}{8}$ " DIAMETER X 9 $\frac{1}{2}$ " LONG BUTTON HEAD BOLT WITH ROUND STEEL WASHER.
 - (B2) THE FIRST ADJUSTMENT AND THE SECOND ADJUSTMENT WILL REQUIRE TWO $\frac{3}{8}$ " DIAMETER X 9 $\frac{1}{2}$ " LONG BUTTON HEAD BOLTS. EACH BOLT WILL REQUIRE ONE ROUND STEEL WASHER.

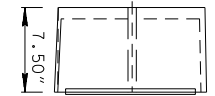
- GENERAL NOTES**
- (A) SEE STANDARD DRAWING S-GR-12 FOR ADDITIONAL POST DETAILS AND SPECIFICATIONS.
 - (B) SEE STANDARD DRAWING S-GR-14 FOR ADDITIONAL BOLT, WASHER AND NUT DETAILS AND SPECIFICATIONS.
 - (C) SEE STANDARD DRAWING S-GR-13 FOR BLOCK-OUTS WITH VERTICAL ADJUSTMENT HOLES AND MOUNTING DETAILS. THE METAL POST SHOWN ON THIS SHEET MAY BE USED WITH WOOD BLOCK-OUTS.
 - (D) RECYCLED PLASTIC GUARDRAIL BLOCK-OUTS LISTED ON THE TENNESSEE DEPARTMENT OF TRANSPORTATION QUALIFIED PRODUCTS LIST MAY BE SUBSTITUTED FOR WOOD BLOCK-OUTS. RECYCLED PLASTIC GUARDRAIL BLOCK-OUTS ARE SUBJECT TO THE FOLLOWING STIPULATIONS:
 - (1) THE MIXING OF BLOCK-OUTS ON A GIVEN PROJECT WILL BE AVOIDED IF POSSIBLE.
 - (2) SHOULD IT BECOME NECESSARY TO CHANGE THE BLOCK-OUT TYPE ON A GIVEN PROJECT, THE BLOCK-OUTS SHOULD NOT BE MIXED ON A GIVEN RAIL OR GUARDRAIL.
 - (3) BLOCK-OUTS SHALL MEET NCHRP-350 GUIDELINES.



BACK VIEW



FRONT VIEW



SIDE VIEW

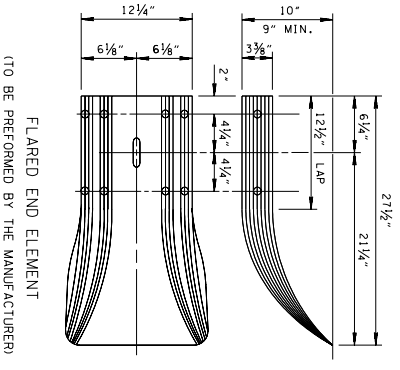
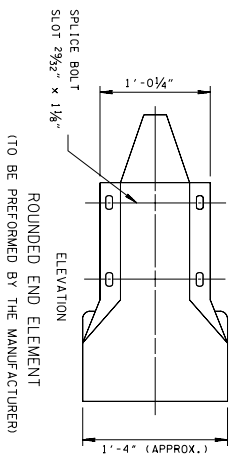
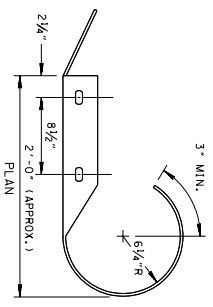
PLASTIC BLOCK-OUT DETAIL FOR STEEL POST

MINOR REVISION -- FINAL APPROVAL NOT REQUIRED.

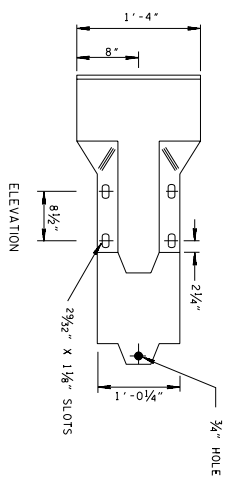
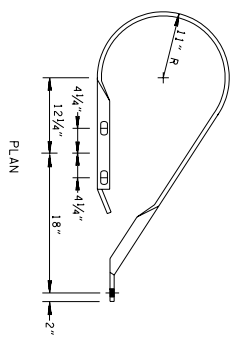
STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

BARRIER RAIL MOUNTING
POST FOR PLASTIC
BLOCK-OUTS
WITH HORIZONTAL
ADJUSTMENT HOLES

5-27-03 S-GR-13A

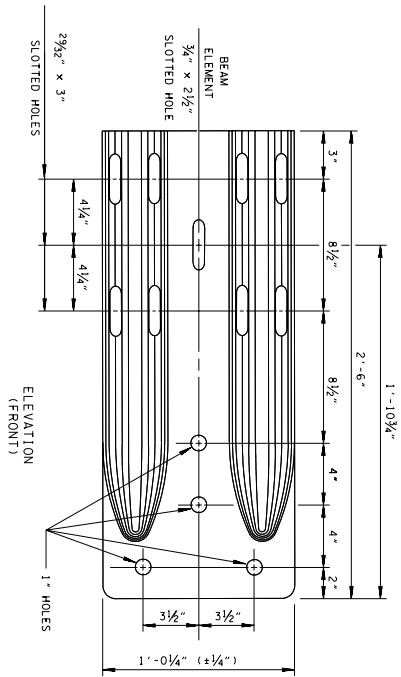
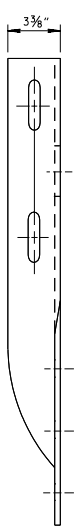


FLARED END ELEMENT
(TO BE PERFORMED BY THE MANUFACTURER)



END ELEMENT FOR GUARDRAIL TERMINAL ANCHOR TYPE 21
(TO BE PERFORMED BY THE MANUFACTURER)

NOTES REGARDING END TERMINALS (EXCEPT MICHIGAN SHOE)
HOLE SPACING IS THE SAME AS FOR ELEMENT DETAILS. OTHER DIMENSIONS SHOWN MAY VARY SLIGHTLY ACCORDING TO MANUFACTURER'S DETAILS. ALL END ELEMENT MATERIAL SHALL MAKE A YIELD STRENGTH OF 50 KIPS PER SQUARE INCH AND A TENSILE STRENGTH OF 70 KIPS PER SQUARE INCH. ALL TYPE 2 GUARDRAIL MATERIAL SHALL HAVE A YIELD STRENGTH OF 50 KIPS PER SQUARE INCH AND A TENSILE STRENGTH OF 70 KIPS PER SQUARE INCH.

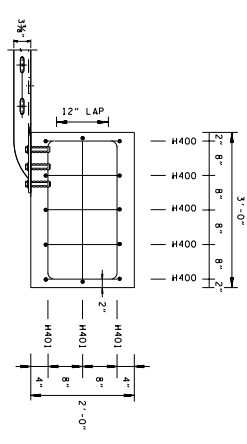


THIS TERMINAL IS COMMONLY KNOWN AS "MICHIGAN END SHOE"

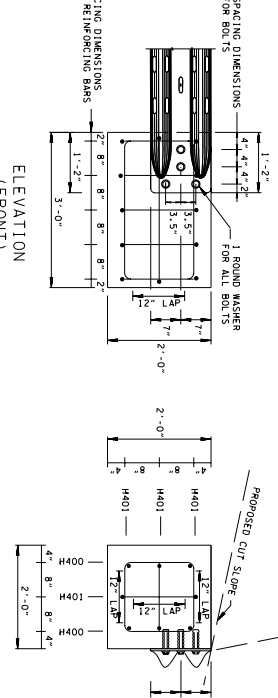
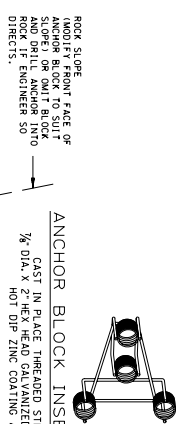
"MICHIGAN END SHOE" TERMINALS END ELEMENT SHALL BE 10 GAUGE STEEL, MATERIAL AND GALVANIZING CONFORMING TO THE REQUIREMENTS OF ASTM A-307, CLASS B (0.135" NOMINAL) THICKNESS. TERMINAL END ELEMENT MATERIAL SHALL MAKE A YIELD STRENGTH OF 50 KIPS PER SQUARE INCH AND A TENSILE STRENGTH OF 70 KIPS PER SQUARE INCH.
BOLTS USED FOR ATTACHMENT OF TERMINAL ELEMENT TO BRIDGE RAIL OR GUARDRAIL TERMINAL ANCHOR, TYPE 12 OR CONCRETE MEDIAN BARRIER SHALL BE 3/4" DIAMETER HEX HEAD, CONFORMING TO THE REQUIREMENTS OF ASTM A-307, WITH ROUND FLAT WASHER, 2" OUTSIDE DIAMETER X 0.165" THICK, PLACED UNDER BOLT HEAD. BOLTS AND WASHERS TO BE GALVANIZED CONFORMING TO THE REQUIREMENTS OF ASTM A153.
SEE THE STRUCTURE PLANS AND BR-2 SERIES BRIDGE REPAIR STANDARD DRAWINGS FOR ATTACHMENT TO BRIDGE RAIL.
SEE STANDARD DRAWING S-CR-19 FOR ATTACHMENT TO GUARDRAIL TERMINAL ANCHOR TYPE 12 AND STEEL INSERT SPECIFICATIONS
SEE STANDARD DRAWINGS S-MB-1 AND S-MB-2 FOR ATTACHMENT TO CONCRETE MEDIAN BARRIER WALLS. ALL TERMINAL ELEMENT JOINTS SHALL BE OVERLAPPED SO THAT THE OUTSIDE TERMINAL EDGE OF JOINT WILL BE FACED AWAY FROM APPROACHING TRAFFIC.

- REV. 3-95-82 CHANGED S-CR-4 TO S-CR-5.
- REV. 11-81-82 CHANGED S-CR-4 TO S-CR-5.
- VARIOUS ELEMENTS TO BE PERFORMED BY THE MANUFACTURER.
- REV. 11-4-81 CORRECTED DIMENSION ON MICHIGAN END SHOE.
- REV. 12-29-89 CHANGED SLOTTED HOLE DIMENSIONS TO 2 3/8" X 3" AND NOTE FOR REVISION NUMBERING AND NOTE FOR RENOVATION SHEET.
- REV. 10-26-91, REORDER AND RENOVATION SHEET, UPDATED DRAWING TO 1991 STANDARDS.
- REV. 7-29-93 IN NOTES CHANGED NUMBERING REFERENCE FOR BRIDGE GUARDRAIL TERMINALS TO BR-2 SERIES.
- REV. 2-29-95 ADDED END TERMINAL FOR TERMINAL ANCHOR TYPE 20 AND TYPE 21.
- REV. 7-29-98 SLOTTED TYPE 11 GUARDRAIL TERMINAL ANCHOR DETAIL AND MEDIAN DIVIDER END ELEMENT DETAIL.
- REV. 9-5-98 CHANGED LABELING FOR END ELEMENT FOR TYPE 21 GUARDRAIL TERMINAL.
- REV. 5-27-01 CORRECTED.
- REV. 9-5-03 CHANGED SPECIFICATION REQUIREMENTS FOR TERMINAL END ELEMENTS.

MINOR REVISION -- FINAL APPROVAL NOT REQUIRED



4"	4"	4"	4"	4"	4"	4"	4"	16"	4"	H400	14"	4"	H401	32"	4"	H401
----	----	----	----	----	----	----	----	-----	----	------	-----	----	------	-----	----	------



GUARDRAIL TERMINAL ANCHOR (TYPE 12) GENERAL NOTES

REQUIREMENTS FOR ANCHOR INSERT BOLTS SHALL BE 1/2" HEX HEAD INSTALLED IN 1 1/2" MASONRY ANCHOR. THE INSERTS ARE TO BE FRAGLED A MINIMUM OF 1 1/2" INTO THE MASONRY ANCHOR. THE MASONRY ANCHOR SHALL BE MADE OF AN INDEPENDENT TESTING LABORATORY USING CLASS "A" CONCRETE IN ACCORDANCE WITH THE STATE OF TENNESSEE STANDARD SPECIFICATIONS FOR ROADS AND BRIDGE CONSTRUCTION. THE ULTIMATE LOAD FOR 1/2" ANCHOR SHALL BE 19,000 POUNDS. BOLTS SHALL CONFORM TO ASTM A307.

THE MASONRY ANCHORS SHALL BE SUB-SET IN THE CONCRETE AT A DEPTH OF BETWEEN 1/2" TO 3/4" AND TORQUED WITH THE END TERMINAL IN THE PLACE TO AN EQUIVALENT DIRECT PULL-OUT LOAD OF 12,000 POUNDS. SLIPPAGE SHALL NOT EXCEED 1/4".

THE CONTRACTOR WILL PERFORM ON-SITE TESTING OF EACH BOLT IN THE PRESENCE OF DOT PERSONNEL TO INSURE THESE REQUIREMENTS. ANY INSTALLATION NOT MEETING THESE REQUIREMENTS SHALL BE CORRECTED AT THE CONTRACTOR'S EXPENSE.

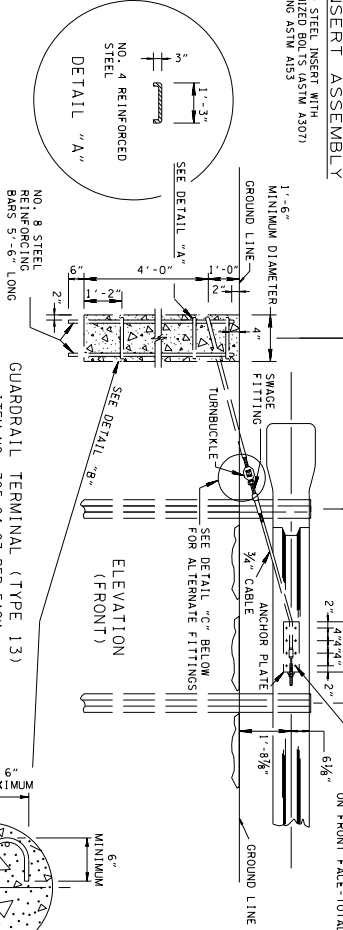
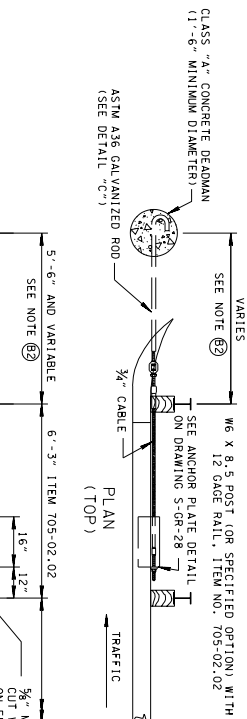
THE CONTRACTOR MAY ELECT TO USE 7/8" INCH DIAMETER GALVANIZED IN ANCHORS WITH 50 KLIPS PER SQUARE INCH OR GREATER YIELD STRENGTH WHEN ATTACHING THE TERMINAL END ELEMENTS INTO ROCK. SEE ABOVE GENERAL NOTE (12) FOR PULL OUT REQUIREMENTS. IF THE CONTRACTOR DRILLS THESE ANCHOR BOLTS IN ROCK, THE SAME FLARE RATE MUST BE USED THAT WOULD BE USED WITH THE CRASH TESTED CONCRETE ANCHOR BLOCK.

UNIT PRICE FOR ITEM NO. 705-04-02, GUARDRAIL TERMINAL (TYPE 12) PER EACH CLASS "A" CONCRETE 0.44 CUBIC YARD.

CLASS "A" CONCRETE 0.44 CUBIC YARD

NO. 4 STEEL REINFORCING BARS= 52 POUNDS

- (1) REQUIREMENTS FOR ANCHOR INSERT BOLTS SHALL BE 1/2" HEX HEAD INSTALLED IN 1 1/2" MASONRY ANCHOR. THE INSERTS ARE TO BE FRAGLED A MINIMUM OF 1 1/2" INTO THE MASONRY ANCHOR. THE MASONRY ANCHOR SHALL BE MADE OF AN INDEPENDENT TESTING LABORATORY USING CLASS "A" CONCRETE IN ACCORDANCE WITH THE STATE OF TENNESSEE STANDARD SPECIFICATIONS FOR ROADS AND BRIDGE CONSTRUCTION. THE ULTIMATE LOAD FOR 1/2" ANCHOR SHALL BE 19,000 POUNDS. BOLTS SHALL CONFORM TO ASTM A307.
- (2) THE MASONRY ANCHORS SHALL BE SUB-SET IN THE CONCRETE AT A DEPTH OF BETWEEN 1/2" TO 3/4" AND TORQUED WITH THE END TERMINAL IN THE PLACE TO AN EQUIVALENT DIRECT PULL-OUT LOAD OF 12,000 POUNDS. SLIPPAGE SHALL NOT EXCEED 1/4".
- (3) THE CONTRACTOR WILL PERFORM ON-SITE TESTING OF EACH BOLT IN THE PRESENCE OF DOT PERSONNEL TO INSURE THESE REQUIREMENTS. ANY INSTALLATION NOT MEETING THESE REQUIREMENTS SHALL BE CORRECTED AT THE CONTRACTOR'S EXPENSE.
- (4) THE CONTRACTOR MAY ELECT TO USE 7/8" INCH DIAMETER GALVANIZED IN ANCHORS WITH 50 KLIPS PER SQUARE INCH OR GREATER YIELD STRENGTH WHEN ATTACHING THE TERMINAL END ELEMENTS INTO ROCK. SEE ABOVE GENERAL NOTE (12) FOR PULL OUT REQUIREMENTS. IF THE CONTRACTOR DRILLS THESE ANCHOR BOLTS IN ROCK, THE SAME FLARE RATE MUST BE USED THAT WOULD BE USED WITH THE CRASH TESTED CONCRETE ANCHOR BLOCK.
- (5) UNIT PRICE FOR ITEM NO. 705-04-02, GUARDRAIL TERMINAL (TYPE 12) PER EACH CLASS "A" CONCRETE 0.44 CUBIC YARD.
- (6) CLASS "A" CONCRETE 0.44 CUBIC YARD
- (7) NO. 4 STEEL REINFORCING BARS= 52 POUNDS



GUARDRAIL TERMINAL ANCHOR (TYPE 13) GENERAL NOTES

UNIT PRICE FOR ITEM NO. 705-04-03, GUARDRAIL TERMINAL (TYPE 13) PER EACH SHALL INCLUDE COSTS OF FURNISHING AND INSTALLING CABLE ANCHOR AND ALL COMPONENTS AS DETAILED. CONCRETE DEADMAN, AND TERMINAL END ELEMENT, COMPLETE, IN PLACE. SEE STANDARD DRAWING NO S-GR-28 FOR DETAILS AND SPECIFICATIONS ON CABLE AND ANCHOR PLATE.

CABLE TO BE PARALLEL TO GUARDRAIL FOR STRAIGHT RUNS OF RAIL. CABLE MAY HAVE ANGLE POINT AT ANCHOR PLATE IF GUARDRAIL IS CURVED.

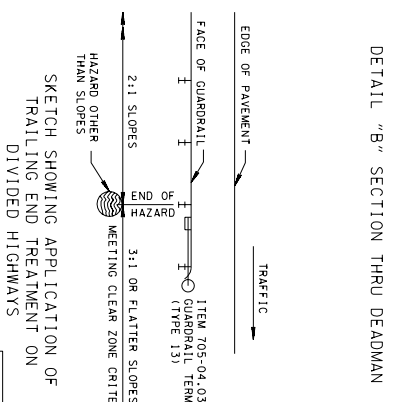
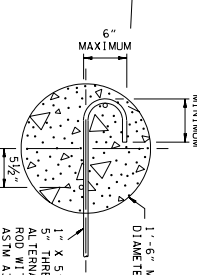
ESTIMATED QUANTITIES OF CONCRETE AND STEEL FOR GUARDRAIL TERMINAL (TYPE 13) ARE:

CLASS "A" CONCRETE= 0.33 CUBIC YARD

NO. 8 STEEL REINFORCING BARS= 77 POUNDS

THIS TERMINAL SHALL NOT BE USED ON THE APPROACH END OF A SECTION OF GUARDRAIL.

- (1) UNIT PRICE FOR ITEM NO. 705-04-03, GUARDRAIL TERMINAL (TYPE 13) PER EACH SHALL INCLUDE COSTS OF FURNISHING AND INSTALLING CABLE ANCHOR AND ALL COMPONENTS AS DETAILED. CONCRETE DEADMAN, AND TERMINAL END ELEMENT, COMPLETE, IN PLACE. SEE STANDARD DRAWING NO S-GR-28 FOR DETAILS AND SPECIFICATIONS ON CABLE AND ANCHOR PLATE.
- (2) CABLE TO BE PARALLEL TO GUARDRAIL FOR STRAIGHT RUNS OF RAIL. CABLE MAY HAVE ANGLE POINT AT ANCHOR PLATE IF GUARDRAIL IS CURVED.
- (3) ESTIMATED QUANTITIES OF CONCRETE AND STEEL FOR GUARDRAIL TERMINAL (TYPE 13) ARE:
- (4) CLASS "A" CONCRETE= 0.33 CUBIC YARD
- (5) NO. 8 STEEL REINFORCING BARS= 77 POUNDS
- (6) THIS TERMINAL SHALL NOT BE USED ON THE APPROACH END OF A SECTION OF GUARDRAIL.



<ul style="list-style-type: none"> (1) STANDARD SWAGE FITTING WITH ONE (1) INCH DIAMETER STUD TO BE USED ONLY WITH STANDARD ONE (1) INCH TURNBuckle. SWAGE FITTING ON ANCHOR PLATE IS SAME AS DETAIL ON STANDARD DRAWING S-GR-28, 40,000 POUNDS. (2) DROP FORGED GALVANIZED STEEL TURNBuckle SHALL PROVIDE A MINIMUM BREAKING STRENGTH OF 40,000 POUNDS. (3) THE FINISHED CABLE ASSEMBLY WILL NOT BE ACCEPTABLE UNLESS IT IS IN TENSION WITH NO SAG. (4) THESE FITTINGS SHALL BE INSTALLED ABOVE GROUND. 	<p>REVISIONS:</p> <ul style="list-style-type: none"> REV. 5-27-96 MODIFIED ANCHOR (TYPE 12) IN DETAIL ON LOWER RIGHT CORNER. REV. 7-29-96 MADE NUMER DIMENSIONING CHANGES. REV. 7-29-98 MODIFIED DETAIL "C". REV. 12-18-98 MODIFIED ANCHOR FOR GUARDRAIL TERMINAL ANCHOR (TYPE 13). REV. 1-27-01 CHANGED ROD END ELEMENT DIMENSIONS CHANGED SHEET NAME. REV. 7-29-03 CHANGED CONCRETE ANCHOR BLOCK. REV. 10-26-03 ADDED SPECIAL GUARDRAIL TERMINAL (TYPE 12) NOTE.
--	---

ALTERNATE FITTING GENERAL NOTES

GUARDRAIL TERMINAL ANCHORS, TYPE 12 AND TYPE 13

STATE OF TENNESSEE DEPARTMENT OF TRANSPORTATION

APPROVAL NOT REQUIRED

S-GR-19

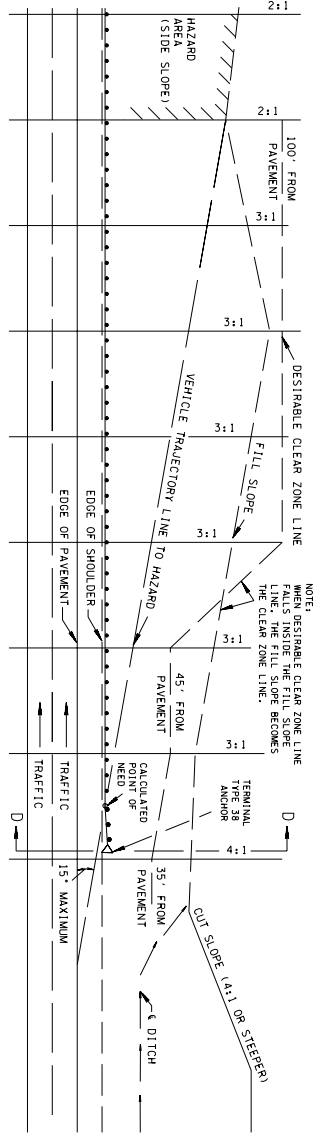


FIGURE 5.24 APPROACH BARRIER LAYOUT VARIABLES

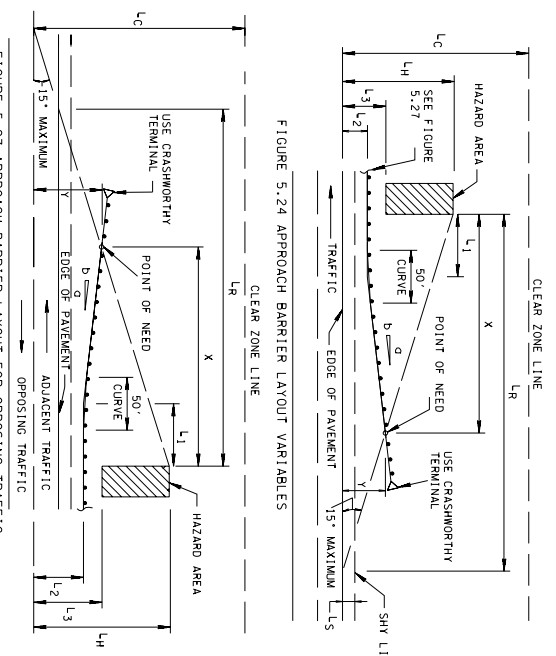


FIGURE 5.27 APPROACH BARRIER LAYOUT FOR OPPOSING TRAFFIC

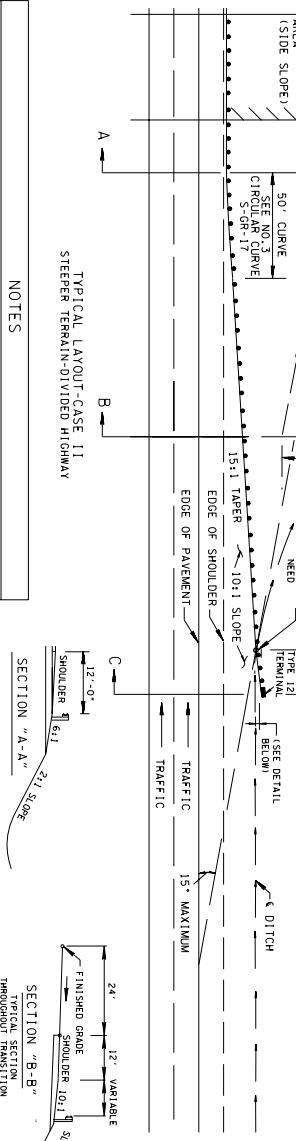


FIGURE 5.28 APPROACH BARRIER LAYOUT VARIABLES

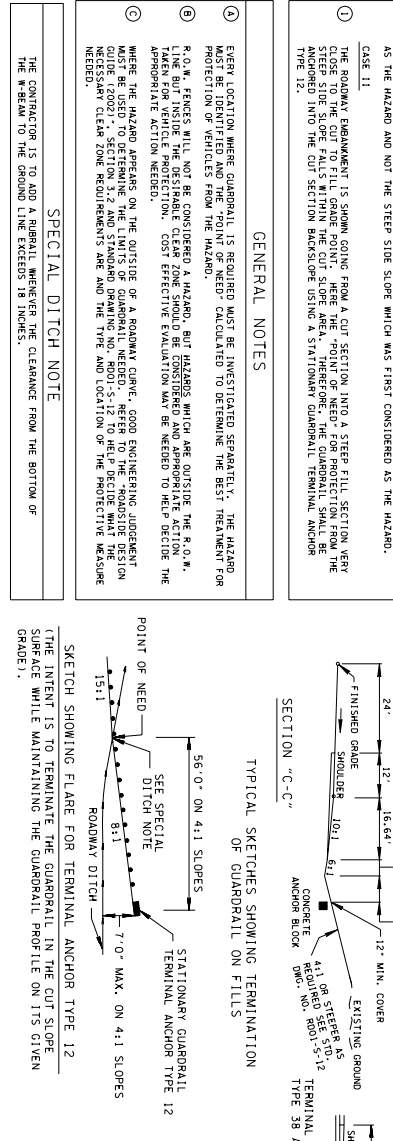


FIGURE 5.29 APPROACH BARRIER LAYOUT VARIABLES

GENERAL NOTES

- IF ANY OBSTACLE (HAZARD) APPEARS IN THE DESIRABLE CLEAR ZONE AREA, IT MUST BE REMOVED. AS THE HAZARD AND NOT THE STEEP SIDE SLOPE WHICH WAS FIRST CONSIDERED AS THE HAZARD.
- THE ROADWAY EMBANKMENT IS SHOWN GOING FROM A CUT SECTION INTO A STEEP FILL SECTION VERY STEEP SIDE SLOPE FALLS WITHIN THE CUT SLOPE AREA, THEREFORE THE GUARDRAIL SHALL BE ANCHORED INTO THE CUT SECTION BACKSLOPE USING A STATIONARY GUARDRAIL TERMINAL ANCHOR TYPE 12.

GENERAL NOTES

EVERY LOCATION WHERE GUARDRAIL IS REQUIRED MUST BE INVESTIGATED SEPARATELY. THE HAZARD MUST BE IDENTIFIED AND THE POINT OF NEED CALCULATED TO DETERMINE THE BEST TREATMENT FOR PROTECTION OF TRAVELERS FROM THE HAZARD.

GENERAL NOTES

R.O.M. FENCES WILL NOT BE CONSIDERED A HAZARD, BUT HAZARDS WHICH ARE OUTSIDE THE R.O.M. ARE TO BE CONSIDERED AS HAZARDS. THE POINT OF NEED SHOULD BE LOCATED AT THE POINT OF APPROXIMATE 15:1 SLOPE FOR DETERMINING THE POINT OF THEORETICAL NEED, WHERE FEASIBLE. POINT OF NEED AND THEREBY REDUCE THE LENGTH OF NEEDED GUARDRAIL.

SPECIAL DITCH NOTE

THE CONTRACTOR IS TO ADD A BARRIAR ANCHOR THE CLEARANCE FROM THE BOTTOM OF THE B-BEAM TO THE GROUND LINE EXCEEDS 18 INCHES.

DESIGN TRAFFIC VOLUME (ADT)

OPERATING SPEED (MPH)	OVER 6000	2000-6000	800-2000	UNDER 800	L _S	FLARE RATE (G:D)
70	480	400	360	300	xx	15:1
60	400	350	330	300	xx	13:1
50	320	290	260	240	xx	9:1
40	240	200	180	180	xx	9:1
30	170	160	140	130	xx	7:1

xx = VALUES FOR YIELDING BARRIER (2" DYNAMIC DEFLECTION) FOR RIGID BARRIERS INCREASE INCREMENT BY 0.1 [X]² V = OPERATING SPEED (MPH)

STATE OF TENNESSEE DEPARTMENT OF TRANSPORTATION

LENGTH OF NEED AND TERMINAL REQUIREMENTS IN FILLS

S-GR-21

EQUATION VARIABLE LEGEND

L_C = THE CLEAR DISTANCE
 L_H = DISTANCE FROM EDGE OF TRAVELED WAY (EDGE OF PAVEMENT) TO THE LATERAL EXTENT OF HAZARD, NOTE THAT L_H SHOULD NEVER EXCEED THE "CLEAR DISTANCE" (L_C)²
 D₀ = SLOPE OF FLARE
 L₁ = LENGTH OF TANGENT SECTION OF BARRIER FROM HAZARD, TENNESSEE DEPARTMENT OF TRANSPORTATION WILL USE THIS POINT AS THE P.I. FOR A 50' CIRCULAR CURVE.
 L₂ = DISTANCE FROM EDGE OF PAVEMENT TO TANGENT SECTION OF BARRIER.
 L₃ = RADIUS LENGTH (SEE TABLE BELOW FOR VALUES).
 L₃ = DISTANCE FROM EDGE OF PAVEMENT TO NEAR FACE OF HAZARD.
 L₃-L₂ SHOULD BE GREATER THAN 4.0 FEET.

EQUATION NOTES

CASE I
 WHEN D₀>0, THE POINT OF NEED WILL BE LOCATED AT DIST NO. 3 OF THE TYPE 38 ANCHOR USING THE FOLLOWING EQUATIONS: (SEE DRAWING NOS.: S-GR-32, S-GR-35, AND S-GR-40)

$$L_1 = L_2 + 0.75$$

$$L_3 = 2 \cdot 0.75$$

$$L_3 = 1.5$$

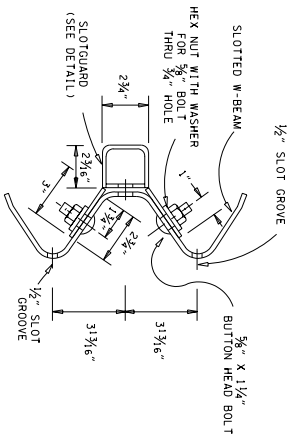
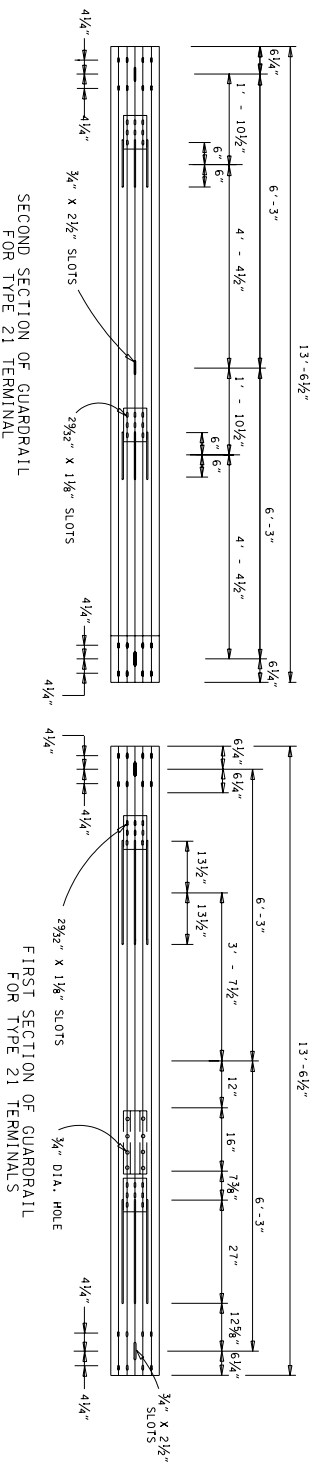
CASE II
 WHEN D₀ WAS A VALUE, THE POINT OF NEED WILL BE LOCATED AS SHOWN AT LEFT AND GUARDRAIL SHALL PASS THROUGH IT USING THE FOLLOWING EQUATIONS:

$$L_1 = \frac{L_H \left(\frac{D_0}{L_H} \right) + L_2}{\left(\frac{D_0}{L_H} \right) + 1}$$

$$L_3 = L_1 \left(\frac{D_0}{L_H} \right) + L_2$$

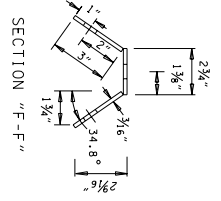
REV. 9-15-83, S-GR-3 BARRIAR, NO. CHANGED TO S-GR-21
 REV. 7-1-84, ADDED REFERENCE NOTE.
 REV. 1-19-91, BARRIAR AND REORGANIZED SHEET, CHANGED REFERENCE FROM BARRIAR GUIDE TO THE "ROADSIDE DESIGN GUIDE" (1989).
 REV. 7-29-95, IN TYPICAL LAYOUT CASE 1, DETAIL CHANGED GUARDRAIL APPROACH TERMINAL.
 REV. 9-5-95, CORRECTED SECTION 10-9-95.
 REV. 7-29-98, REVISED REFERENCE TO TYPE 11, 16, 38 AND TYPE 38 GUARDRAIL TERMINAL.
 REV. 5-27-01, MODIFIED REFERENCE REGARDING GUARDRAIL TERMINAL.
 REV. 9-11-03, MADE GENERAL REFERENCE TO TYPE 11, 16, 38 AND TYPE 38 GUARDRAIL TERMINAL.
 REV. 4-15-04, CHANGED CASE I EQUATION AND REFERENCES TO ROADSIDE DESIGN GUIDE.

SLOTTED W-BEAM GUARDRAIL ELEMENT DETAILS

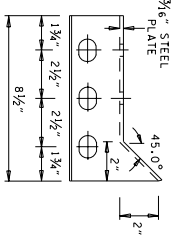


SECTION "E-E"
(SEE DRAWING NO. S-GR-26)

NOTE: 8 - 5/8" X 1 1/2" BUTTON HEAD BOLTS AND NUTS REQUIRED FOR EACH SLOTTED GUARDRAIL ASSEMBLY.



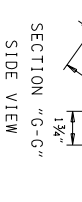
SECTION "F-F"



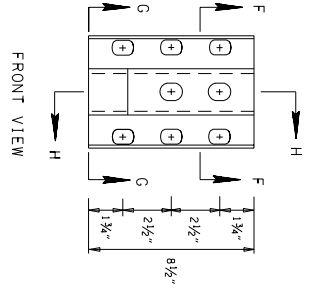
SECTION "H-H"

NOTE: ALL HOLES 2 9/32" X 1 1/8" DIAMETER

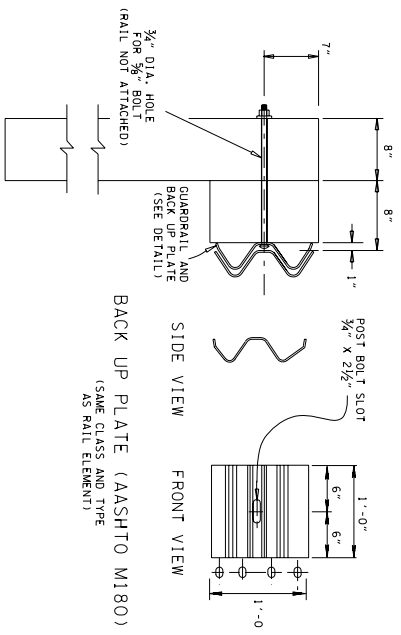
SLOTTED GUARDRAIL DETAIL



SECTION "G-G"
SIDE VIEW



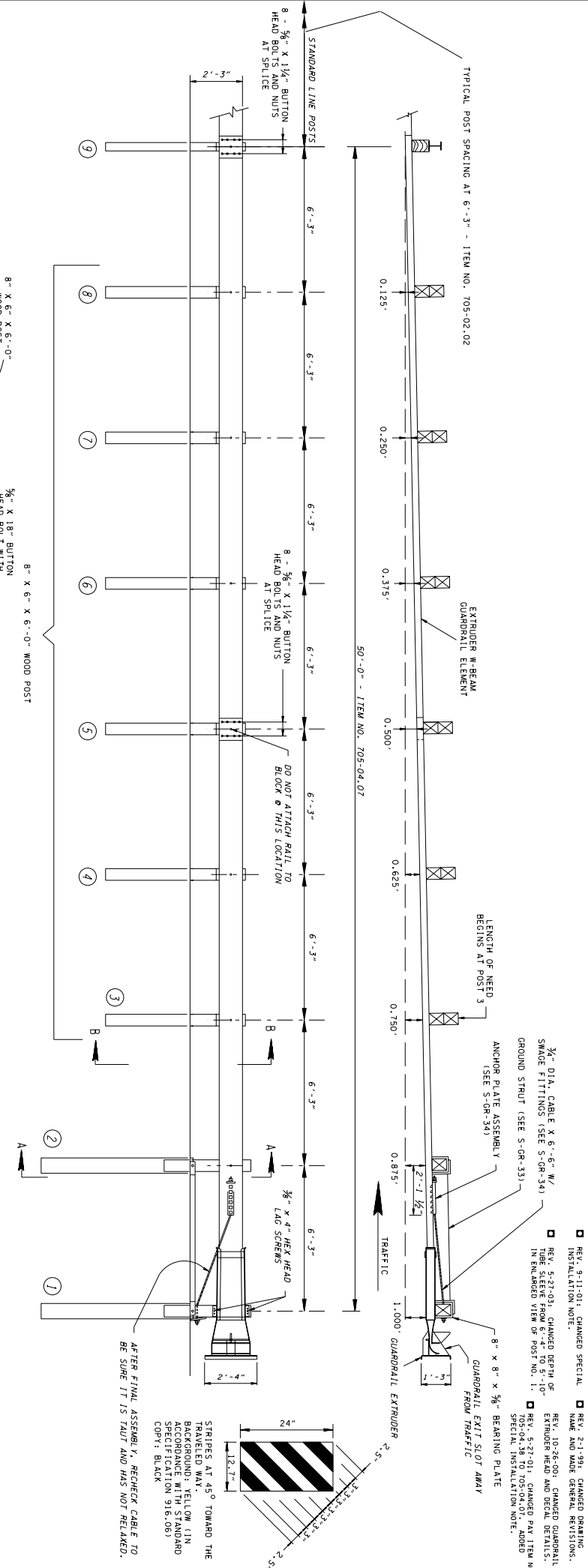
FRONT VIEW



GUARDRAIL WITH BACK UP PLATE DETAIL

BACK UP PLATE (AASHTO M180) (SAME CLASS AND TYPE AS RAIL ELEMENT)

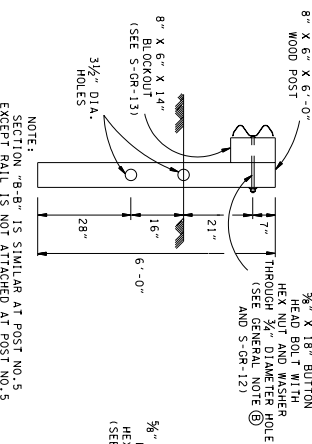
- ☑ REV. 2-14-98: ELIMINATED 26-01/2 ELEMENT "B" SLOTTED W-BEAM GUARDRAIL.
- ☑ REV. 5-27-98: REFINED SHELF ANGLE DETAIL WITH BACK UP PLATE DETAIL. ADDED ADDITIONAL GUARDRAIL ELEMENT DETAIL.
- REV. 12-18-98: REMOVED GUARDRAIL AND GROUND STRUT DETAILS FOR TYPE 21 GUARDRAIL ASSEMBLY. CHANGED SHEET NAME TO TYPE 21.
- ☑ REV. 5-27-03: CORRECTED SPELLING IN SECTION "E-E".



- REV. 9-11-01: CHANGED SPECIAL INSTALLATION NOTE.
- REV. 2-1-91: CHANGED DRAWING NAME AND MADE GENERAL REVISIONS.
- REV. 5-27-03: CHANGED DEPTH OF ANCHOR STRUT AND BEAR DETAIL. IN ENLARGED VIEW OF POST NO. 1.
- REV. 5-21-01: CHANGED MAX ITEM NO. 705-04-38 TO 705-04-07. ADDED SPECIAL INSTALLATION NOTE.

50:1 TAPER OVER LENGTH OF SYSTEM

CODE	DECIMAL	X	Y
9	0.00	0.00	
8	0.125	6.25	
7	0.250	12.50	
6	0.375	18.75	
5	0.500	25.00	
4	0.625	31.25	
3	0.750	37.50	
2	0.875	43.75	
1	1.000	50.00	



SECTION "B-B"
(TYPICAL AT POST NO. 3, 4, 6, 7, 8 & 9)

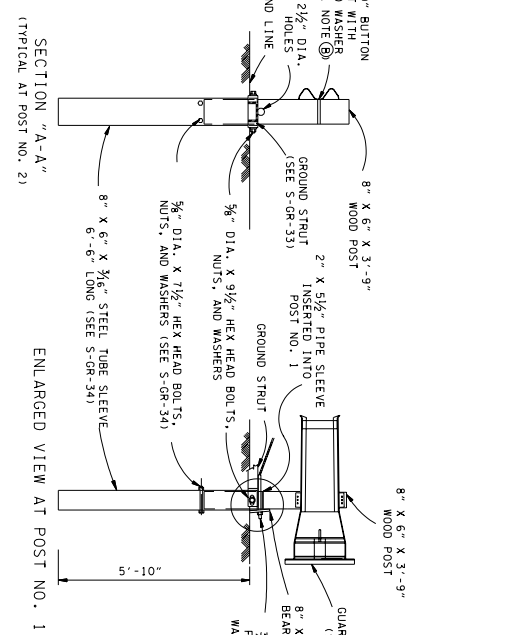
GENERAL NOTES

Ⓐ THE POST OFFSET DIMENSIONS ARE GIVEN TO THE CENTER OF THE TRAFFIC FACE OF THE GUARDRAIL.

Ⓑ THE 3/8" FLAT WASHER IS USED UNDER THE NUT, BEHIND THE POST ONLY. NO WASHER IS USED AT THE RAIL.

Ⓒ ET-2000 (2-TUBE) TERMINAL IS TO BE INSTALLED UNDER THE PRICE BID FOR ITEM NO. 705-04-07 TANGENT ENERGY ABSORBING TERMINAL (NCHRP 350-TL3) PER EACH.

Ⓓ A FOUR (4) TUBE OR EIGHT (8) TUBE OPTION MAY BE USED. SHOP DRAWINGS WILL BE REQUIRED.

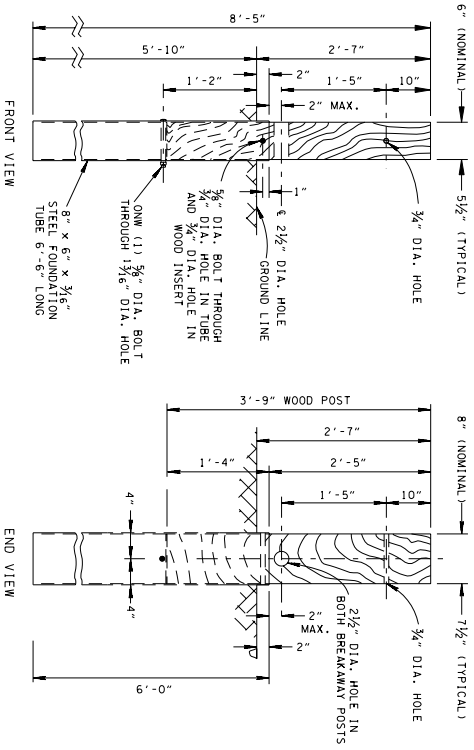
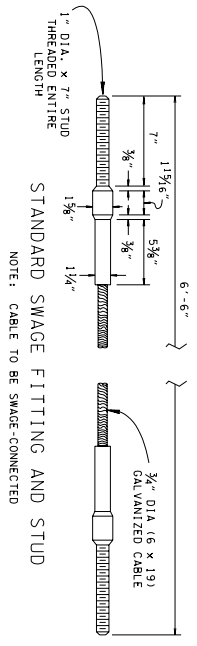
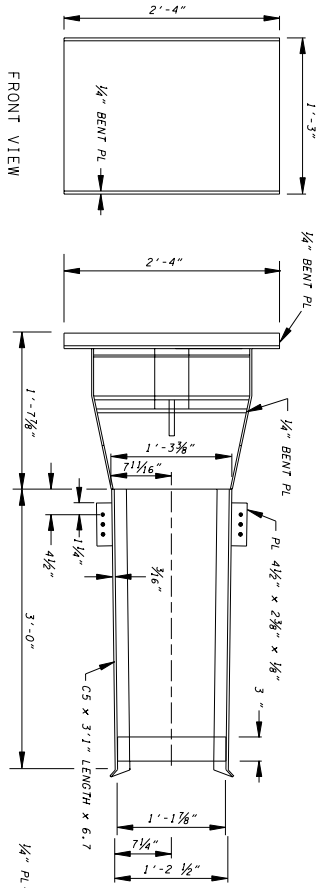
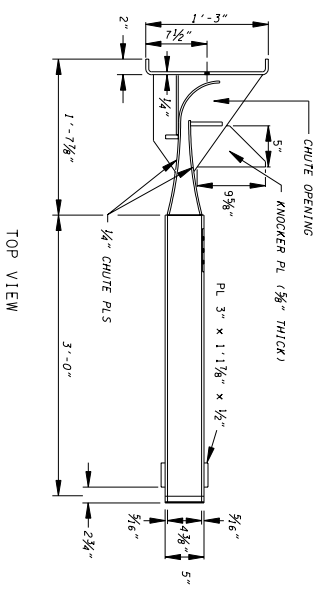


SECTION "A-A"
(TYPICAL AT POST NO. 2)

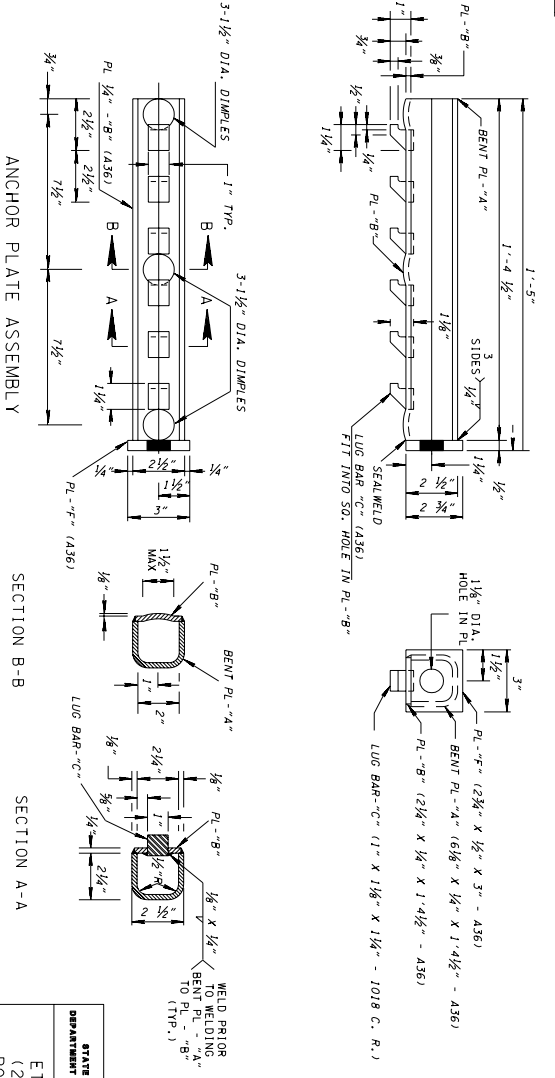
ENLARGED VIEW AT POST NO. 1

SPECIAL INSTALLATION NOTE

FOR THE TYPE 38 GUARDRAIL TERMINAL TO FUNCTION AS IT WAS CRASH TESTED UNDER NCHRP 350 TEST LEVEL 3 THE EARTH PAD UNDER IT MUST BE CONSTRUCTED PER STANDARD DRAWING NO. S-CR-38.

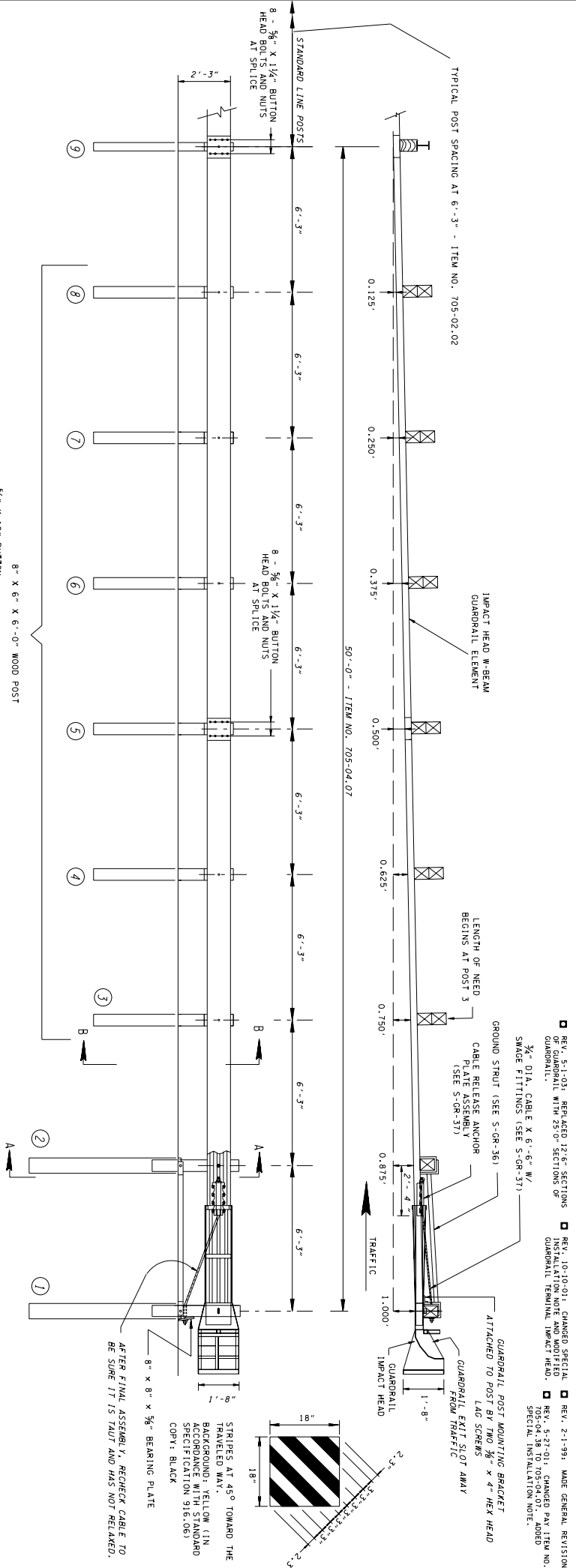


NO. 1 & 2 BREAKAWAY POSTS WITH 6'-0" TUBE SLEEVE



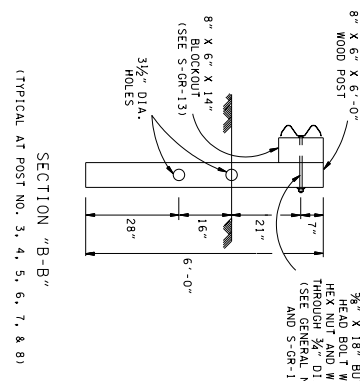
REV. 2-1-98: CHANGED DRAWING NAME AND MADE GENERAL REVISIONS.
 REV. 10-26-00: CHANGED GUARDRAIL EXTRUDER DETAIL FROM ORIGINAL HEAD TO ET-PLUS HEAD.
 REV. 5-27-03: CHANGED LENGTH OF TUBE SLEEVE FROM 6'-6" TO 6'-0" WITH 1/4" CLASS. EXCEEDED DEPTH FROM 6" TO 5'-10".

- GENERAL NOTES**
- (A) THE NO. 1 AND NO. 2 BREAKAWAY POSTS WILL HAVE A 6" x 8" (NOMINAL) CROSS-SECTION AREA AND WILL HAVE A 2 1/2" DIAMETER HOLE CENTERED 2'-03" BELOW THE AS SHOWN. ALL POSTS SHALL BE ERRECTED SO THAT THE GUARDRAIL WILL HAVE A TOP-OF-RAIL HEIGHT OF 2'-5".
 - (B) ALL HOLES IN WOOD POSTS ARE TO BE DRILLED BEFORE PRESERVATIVE TREATMENT.
 - (C) ALL CUTTING, DRILLING, AND WELDING OF STEEL COMPONENTS SHALL BE DONE BEFORE GALVANIZING.
 - (D) THE FINISHED CABLE ASSEMBLY WILL HAVE A TENSILE STRENGTH OF 17.5 IN TENSION WITH NO SAG. SEE STANDARD DRAWING NOS. S-GR-32 AND S-GR-33 FOR ADDITIONAL DETAILS AND GENERAL NOTES.
 - (E) THE STEEL TUBES ARE TO BE DRIVEN INTO GROUND BEFORE THE WOODEN POSTS ARE INSERTED.



50:1 TAPER OVER LENGTH OF SYSTEM

CODE NO.	DECIMAL	Y
1	0.00	0.00
2	0.125	6.25
3	0.250	12.50
4	0.375	18.75
5	0.500	25.00
6	0.625	31.25
7	0.750	37.50
8	0.875	43.75
9	1.000	50.00



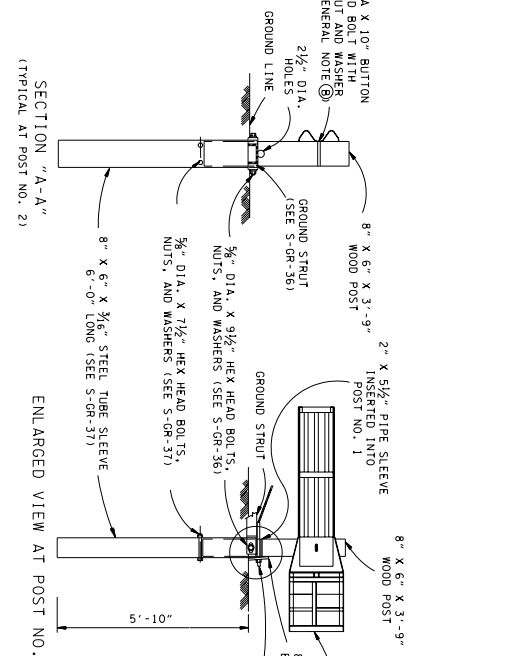
GENERAL NOTES

(A) THE POST OFFSET DIMENSIONS ARE GIVEN TO THE CENTER OF THE TRAFFIC FACE OF THE GUARDRAIL.

(B) THE 3/8" FLAT WASHER IS USED UNDER THE NUT, BEHIND THE POST ONLY. NO WASHER IS USED AT THE RAIL.

(C) SKT-350 (2-TUBE) TERMINAL IS TO BE INSTALLED UNDER THE PRICE BID FOR ITEM NO. 705-04.07 TANGENT ENERGY ABSORBING TERMINAL (NCHRP 350-113) PER EACH.

(D) A FOUR (4) TUBE OR EIGHT (8) TUBE OPTION MAY BE USED. SHOP DRAWINGS WILL BE REQUIRED.



SPECIAL INSTALLATION NOTE

FOR THE TYPE 38 GUARDRAIL TERMINAL TO FUNCTION AS IT WAS CRASH TESTED UNDER NCHRP-350 TEST LEVEL 3 THE EARTH PAD UNDER IT MUST BE CONSTRUCTED PER STANDARD DRAWING NO. S-CR-38.

MINOR REVISION -- FHWA APPROVAL NOT REQUIRED.

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

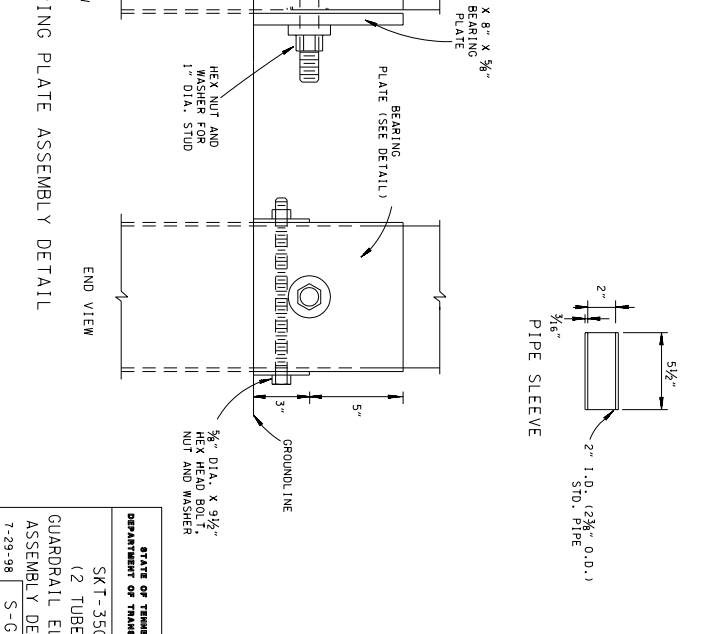
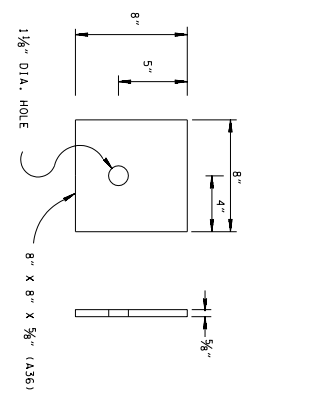
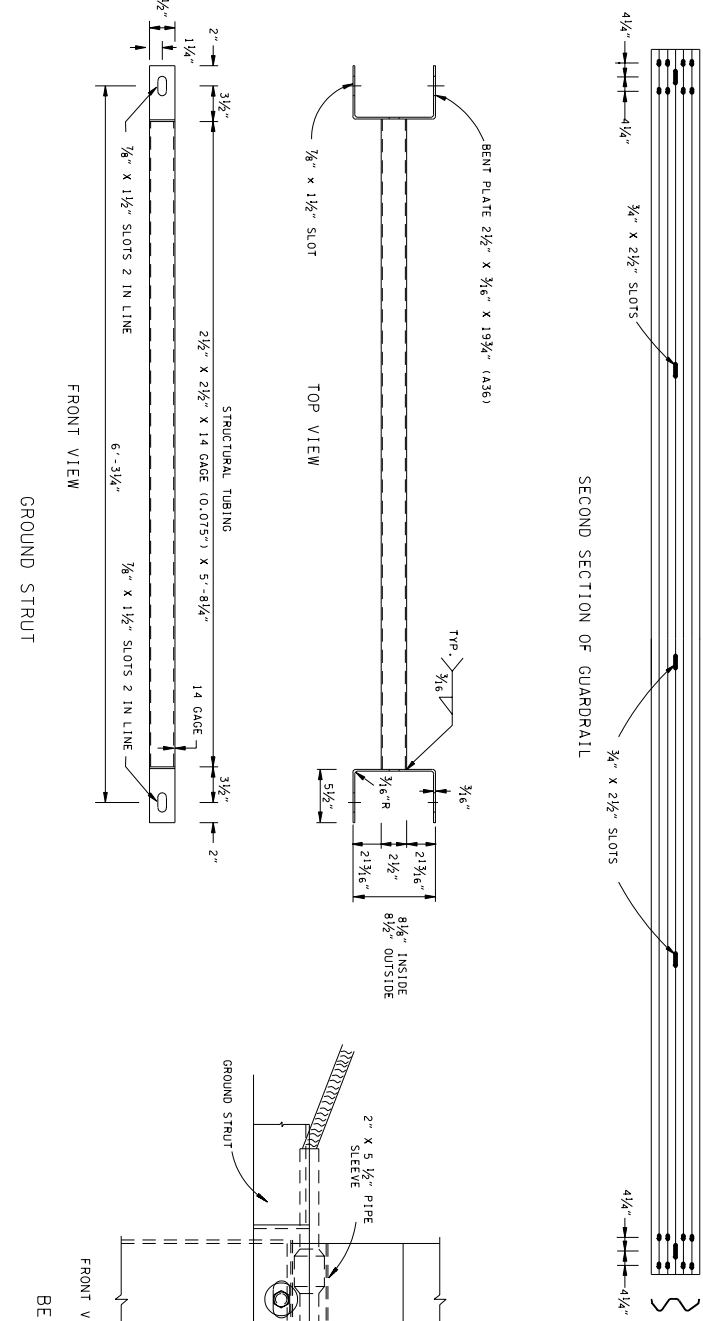
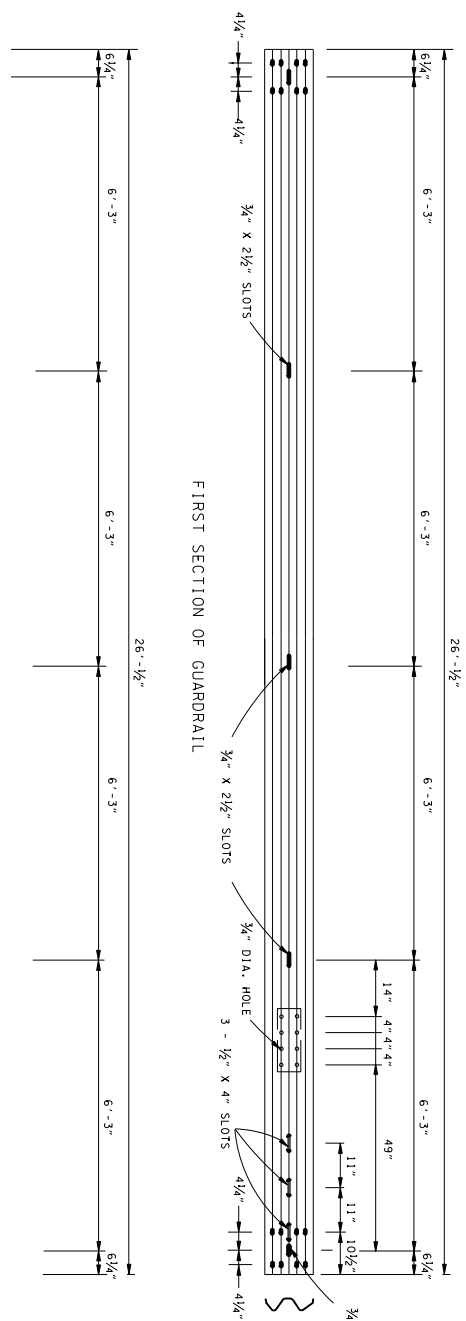
SKT-350 GUARDRAIL TERMINAL ANCHOR (TYPE 38) POST LAYOUT AND ERECTION DETAILS

7-29-98 S-CR-35

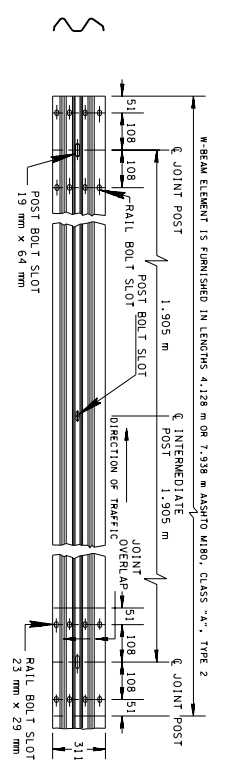
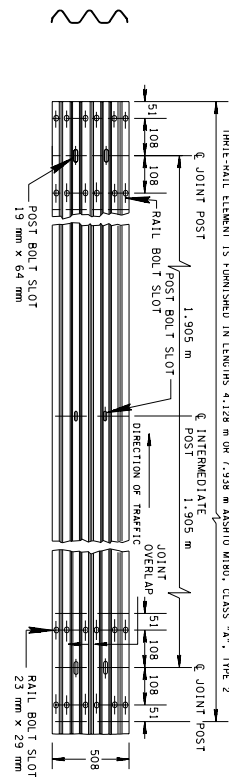
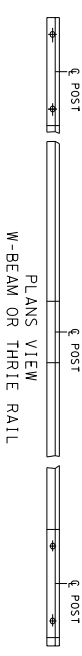
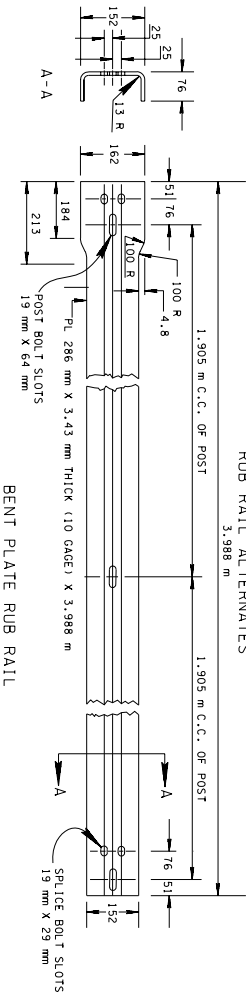
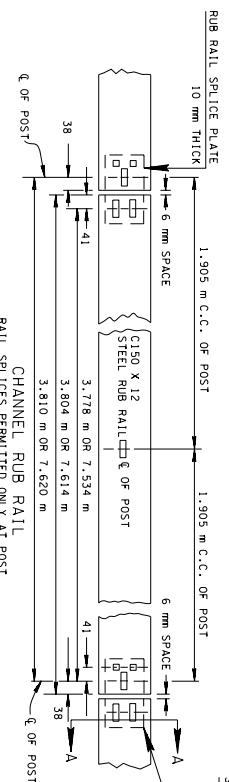
- REV. 2-1-93: REHAGED 12'6" SECTIONS
- REV. 10-10-01: CHANGED SPECIAL INSTALLATION NOTE AND MODIFIED GUARDRAIL
- REV. 5-27-01: CHANGED PA ITEM NO. 705-04.38 TO 705-04.07. ADDED SPECIAL INSTALLATION NOTE.
- REV. 2-1-99: MADE GENERAL REVISION.
- REV. 5-27-01: CHANGED PA ITEM NO. 705-04.38 TO 705-04.07. ADDED SPECIAL INSTALLATION NOTE.

IMPACT HEAD W-BEAM GUARDRAIL ELEMENT DETAILS

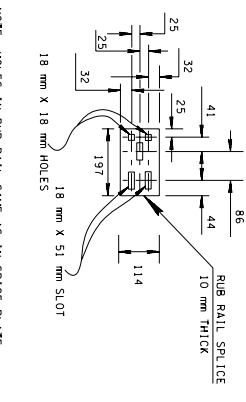
REV. 2-1-99: MADE GENERAL REVISION.
REV. 5-1-03: REPLACED 12x6 SECTIONS
OF GUARDRAIL WITH 25" SECTIONS OF
GUARDRAIL.



STATE OF TENNESSEE DEPARTMENT OF TRANSPORTATION
SK T - 350 (2 TUBE) GUARDRAIL ELEMENT ASSEMBLY DETAILS
7-29-98 S - GR - 36



NOTE: HOLES IN RUB-RAIL SAME AS IN SPlice PLATE

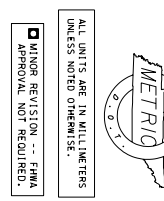


NOTE: HOLES IN RUB-RAIL SAME AS IN SPlice PLATE

GENERAL NOTES

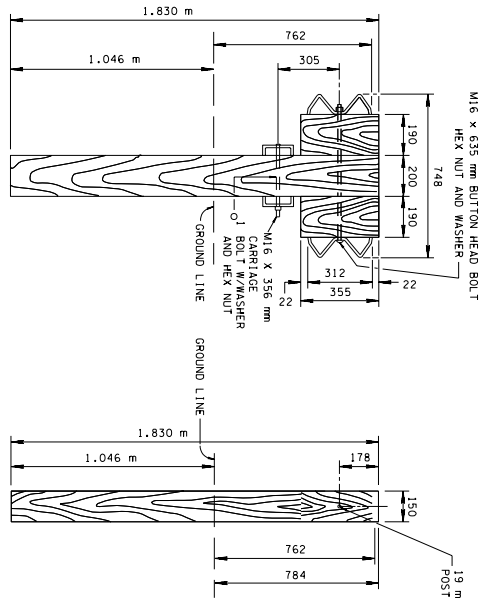
- A CORRUGATED SHEET STEEL BEAMS SHALL CONFORM TO THE CURRENT REQUIREMENTS OF ASHTO M.B.O. CLASS A, TYPE 2 RAIL MATERIAL SHALL HAVE A YIELD STRENGTH OF 345 MEGAPASCALS AND A TENSILE STRENGTH OF 483 MEGAPASCALS.
 - B RUB RAILS AND RUB RAIL SPlice PLATES SHALL CONFORM TO ASTM A386 AND SHALL BE GALVANIZED IN ACCORDANCE WITH ASTM A123.
 - C WHERE GUARDRAIL IS TO BE PLACED ON A CURVE WITH A RADIUS LESS THAN 45 m, THE RAIL SECTION SHALL BE SHOP-FORMED TO THE REQUIRED RADIIUS.
 - D SEE THE "RDM-TS" STANDARD SERIES FOR GUARDRAIL PLACEMENT.
 - E ITEM NUMBERS FOR PAYMENT AS DETAILED ON THESE "SM-GR" SERIES OF DRAWINGS ARE AS FOLLOWS:
- | ITEM NO. | DESCRIPTION | ON DWG NO. |
|-----------|--|-------------------------------|
| 709M01.01 | GUARDRAIL AT BRIDGE ENDS | SM-GR-17 & SM-GR-23 |
| 709M01.02 | META-BEAM GUARD FENCE | SM-GR-22 & DM-GR-5 |
| 709M02.01 | SINGLE GUARDRAIL WITH RUB-RAIL (TYPE 2) | SM-GR-13 & SM-GR-18 |
| 709M02.02 | MEDIAN DIVIDER GUARDRAIL (TYPE 2) | SM-GR-13 & SM-GR-18 |
| 709M03.01 | MEDIAN DIVIDER GUARDRAIL W/RUB-RAIL (TYPE 2) | SM-GR-13 & SM-GR-18 |
| 709M03.02 | MEDIAN DIVIDER GUARDRAIL (TYPE 2) WITH RUB-RAIL | SM-GR-13 & SM-GR-18 |
| 709M03.03 | MEDIAN DIVIDER GUARDRAIL AT CONCRETE BARRIER | SM-GR-13 & SM-GR-18 |
| 709M03.04 | MEDIAN DIVIDER GUARDRAIL AT CONCRETE BARRIER WITH RUB-RAIL | SM-GR-13 & SM-GR-18 |
| 709M04.01 | GUARDRAIL TERMINAL (TYPE 121) | SM-GR-20 |
| 709M04.02 | GUARDRAIL TERMINAL (TYPE 122) | SM-GR-19 |
| 709M04.03 | GUARDRAIL TERMINAL (TYPE 123) | SM-GR-21 |
| 709M04.04 | GUARDRAIL TERMINAL (TYPE 211) | SM-GR-26 |
| 709M04.05 | GUARDRAIL TERMINAL (TYPE 212) | SM-GR-25 |
| 709M04.06 | TANGENT ENERGY ABSORBING TERMINAL (NCHRP 350 - TL3) | SM-GR-32, SM-GR-18 & SM-GR-40 |
| 709M04.07 | TANGENT ENERGY ABSORBING TERMINAL (NCHRP 350 - TL3) | SM-GR-35 |
| TYPE 1: | 0.953 m SPACING | |
| TYPE 2: | 1.905 m SPACING | |
| TYPE 3: | 3.910 m SPACING | |

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION
W-BEAM & THRILE
BEAM BARRIER
RAIL AND RUB RAIL
ALTERNATES
11-1-95 SM-GR-11

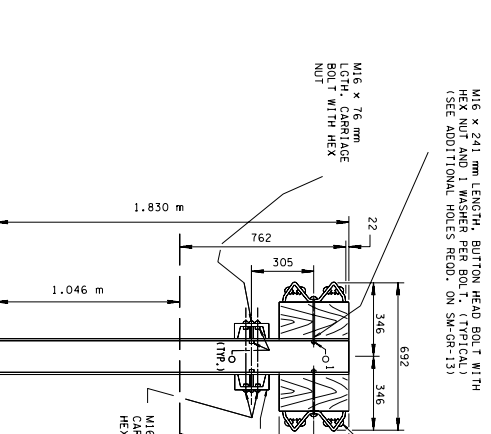


ALL UNITS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
MINOR REVISION -- FIMA APPROVAL NOT REQUIRED.

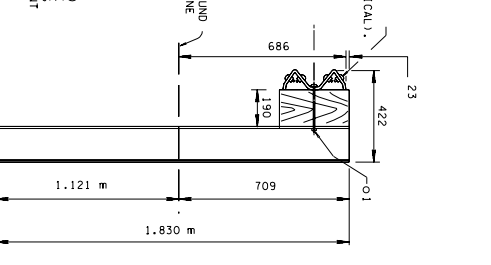
- REV. 11-1-95: CHANGED TO METRIC.
- REV. 7-29-98: MODIFIED GENERAL NOTE (E).
- REV. 9-5-98: MODIFIED GENERAL NOTE (E).
- REV. 10-26-99: DELETED BACK UP PLATE DETAILS.
- REV. 9-5-00: IN GENERAL NOTES CORRECTED NOTE (E).
- REV. 5-27-01: IN GENERAL NOTE (E) CHANGED ITEM NUMBERS OF GUARDRAIL TO CONCUR WITH NEW PAY ITEM SYSTEM.
- REV. 9-5-01: CORRECTED DESCRIPTION FOR ITEM NO. 709M04.01.
- REV. 9-11-02: DELETED ITEM NO. 709M01.02.
- REV. 9-5-03: CHANGED GENERAL NOTE (A) DELETED GENERAL NOTE (B) REMEMBERED REMAINING GENERAL NOTES.



NOTE
WOOD POSTS AND WOOD BLOCK-OUTS SHALL BE FURNISHED WITH HOLES FOR FUTURE ADJUSTMENT IN ACCORDANCE WITH STANDARD DRAWING SM-OR-13.



NOTE
METAL POSTS AND WOOD BLOCK-OUTS SHALL BE FURNISHED WITH HOLES FOR FUTURE ADJUSTMENT IN ACCORDANCE WITH STANDARD DRAWING SM-OR-13.



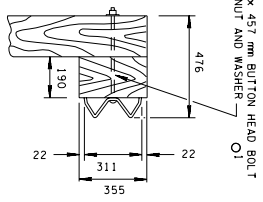
SIDE VIEW
MEDIAN DIVIDER GUARDRAIL
(W-BEAM/RIB RAIL ALT.)

FRONT VIEW
MEDIAN DIVIDER GUARDRAIL
(SHOWING BOLT HOLES FOR W-BEAM RAIL)

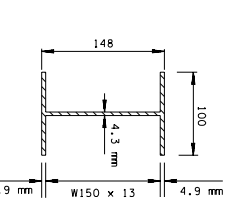
SIDE VIEW
MEDIAN DIVIDER GUARDRAIL

SIDE VIEW DIMENSIONS BASED ON W150 x 12.6. OTHER DETAILS APPLY TO W150 x 13.5 AND W150 x 22 POSTS.

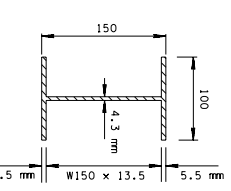
SIDE VIEW
SINGLE GUARDRAIL



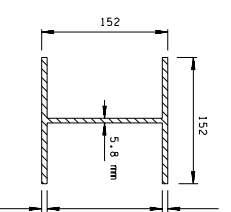
SIDE VIEW
SINGLE GUARDRAIL



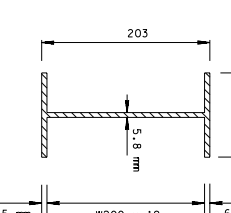
WELDED STEEL SHAPE



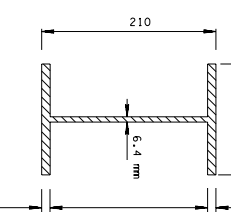
WELDED STEEL SHAPE



WELDED STEEL SHAPE



WELDED STEEL SHAPE



WELDED STEEL SHAPE

LEGEND FOR WASHER REQUIREMENTS
1 OR 2 ROUND WASHERS — O1

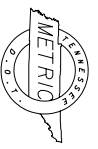
WOOD SPECIFICATIONS

- 51 POSTS AND BLOCK-OUTS SHALL BE OF TIMBER WITH A STRESS GRADE OF 8.3 MGD OR MORE. POSTS WILL HAVE NOMINAL SIZE OF 150 mm x 200 mm. BLOCK-OUTS WILL BE IN ACCORDANCE WITH WEST COAST LUMBER INSPECTION BUREAU, SOUTHERN PINE INSPECTION BUREAU, OR OTHER APPROPRIATE TIMBER ASSOCIATIONS. TIMBER FOR POSTS SHALL BE ROUGH SAW (UNPLANED) WITH NOMINAL DIMENSIONS INDICATED. TIMBER FOR BLOCK-OUTS SHALL BE S4S WITH THE TYPICAL DIMENSIONS INDICATED.
- 52 ALL WOOD POSTS AND BLOCK-OUTS SHALL BE TREATED WITH TIMBER PRESERVATIVE AS REQUIRED BY SUBSECTION 911.02(A) OF THE TENNESSEE STANDARD SPECIFICATION. WOOD POSTS AND BLOCK-OUTS SHALL BE FURNISHED WITH HOLES FOR FUTURE RAIL ADJUSTMENT IN ACCORDANCE WITH DETAILS SHOWN ON STANDARD DRAWINGS SM-OR-13.
- 53

GENERAL NOTES

- A MATERIALS AND SPECIFICATIONS NOT SHOWN IN THESE SM-OR-13 SERIES DRAWINGS SHALL BE IN ACCORDANCE WITH STANDARD PROVISIONS READING SECTION 105.
- B THE CONTRACTOR MAY HAVE OPTIONAL CHOICE OF EITHER THE STEEL W150 x 12.6 OR W150 x 13.5 HOT ROLLED OR WELDED STEEL SHAPE. THE WOOD POSTS AND WOOD BLOCK-OUTS AS SHOWN ABOVE SHALL BE USED UNLESS OTHERWISE SPECIFIED IN THE DRAWING.
- C ON EXISTING STRUCTURES NOT HAVING A VERTICAL FACE FOR THE ATTACHMENT OF TWO RAIL ELEMENTS, USE OF THE W150 x 22 POSTS IS REQUIRED ON THE SEMI-RIGID TO RIGID BARRIER TRANSITION DETAILS. SEE STANDARD DRAWINGS SM-OR-16 AND SM-OR-20. THE BOLT HOLES WILL BE ORIENTED TO THE CENTERLINE OF THE FLANGE OF THE POST AS SHOWN ON STANDARD DRAWING SM-OR-13.
- D METAL POSTS AND ALL BLOCK-OUTS SHALL BE FURNISHED WITH HOLES FOR FUTURE RAIL ADJUSTMENT IN ACCORDANCE WITH DETAILS SHOWN ON STANDARD DRAWINGS SM-OR-13 AND SM-OR-13A.
- E W150 x 13.5 OR W150 x 12.6 POST SHALL BE USED FOR INSTALLATIONS ON BRIDGES AS SHOWN ON STANDARD DRAWING SM-OR-22.
- F WELDED STEEL POSTS MAY BE USED AS ALTERNATES TO THE HOT ROLLED STEEL SHAPE. THEY MUST CONFORM TO ASTM A159M AND BE GALVANIZED ACCORDING TO ASTM A123.

- REV. 11-1-95: CHANGED TO METRIC.
- REV. 7-29-95: ADDED DIMENSION TO SIDE VIEW FOR SINGLE GUARDRAIL.
- REV. 7-29-95: DELETED DETAILS FOR RAIL. CHANGED STEEL BLOCK-OUT TO WOOD BLOCK-OUT IN ALL DETAILS AND NOTES.
- REV. 9-5-98: GENERAL REVISION TO SIDE VIEW FOR SINGLE GUARDRAIL TO POST FROM 2 TO 1.
- REV. 3-22-99: CHANGED NUMBER OF WASHERS WHERE BLOCK-OUT ATTACHES TO POST FROM 2 TO 1.
- NOTE: 9-11-02: ADDED GENERAL NOTE FOR W200X19 AND W200X31.3 GUARDRAIL POSTS.
- REV. 2-27-03: CHANGED GENERAL NOTE TO STANDARD DRAWINGS SM-OR-13 AND SM-OR-13A.



ALL UNITS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.

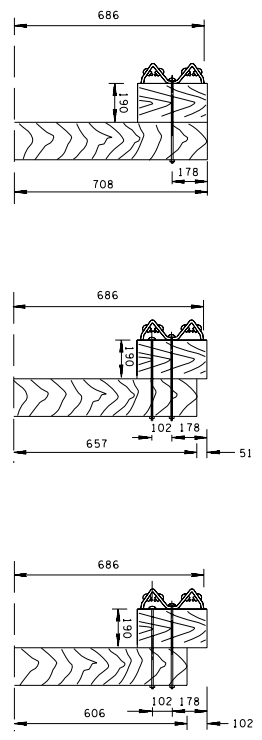
MINOR REVISION -- FHMA APPROVAL NOT REQUIRED.

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

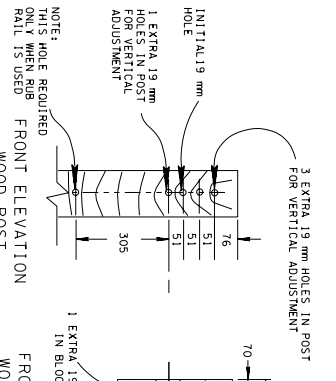
W-BEAM BARRIER
POST DETAILS AND
SPECIFICATIONS

11-1-95 SM-OR-12

DETAILS SHOWING HOLES REQUIRED IN POSTS AND BLOCK-OUTS (FOR USE IN FUTURE RAIL ADJUSTMENT)



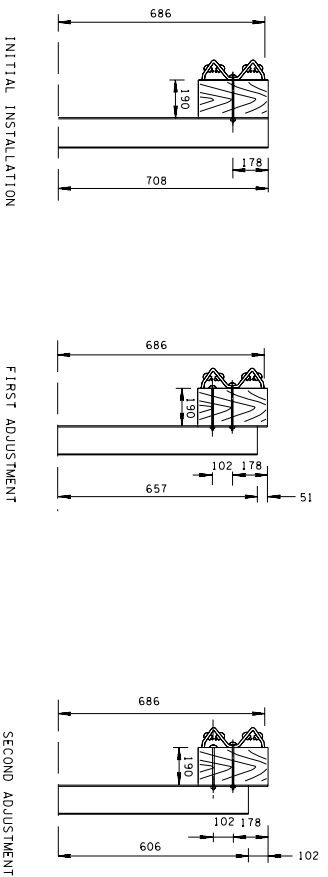
INITIAL INSTALLATION
FIRST ADJUSTMENT
SECOND ADJUSTMENT



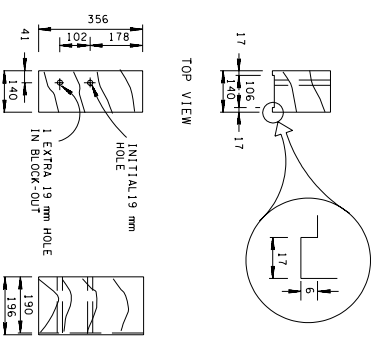
FRONT ELEVATION
WOOD POST
FRONT ELEVATION
WOOD BLOCK-OUT
FOR WOOD POST

**WOOD BLOCK-OUT FOR WOOD POST
INSTALLATION NOTES**

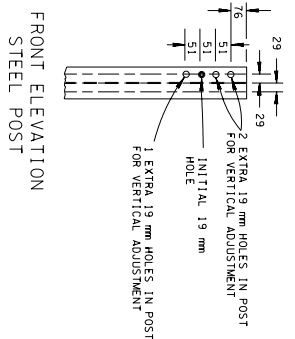
(B) THE INITIAL INSTALLATION WILL REQUIRE ONE M16 X 457 MM LONG BUTTON HEAD BOLT WITH ROUND STEEL WASHER.
(B2) THE FIRST ADJUSTMENT AND THE SECOND ADJUSTMENT WILL REQUIRE ONE M16 X 457 MM LONG HEX HEAD BOLT AND ONE ROUND STEEL WASHER.



INITIAL INSTALLATION
FIRST ADJUSTMENT
SECOND ADJUSTMENT



WOOD BLOCK-OUT DETAIL FOR STEEL POST
WITH VERTICAL ADJUSTMENT HOLES



FRONT ELEVATION
STEEL POST

INSTALLATION NOTES FOR BLOCK-OUTS WITH VERTICAL ADJUSTMENT HOLES

- (B) THE INITIAL INSTALLATION WILL REQUIRE ONE M16 X 241 MM LONG BUTTON HEAD BOLT WITH ROUND STEEL WASHER.
- (B2) THE FIRST ADJUSTMENT AND THE SECOND ADJUSTMENT WILL REQUIRE ONE M16 X 241 MM LONG HEX HEAD BOLT AND ONE ROUND STEEL WASHER.

GENERAL NOTES

- (A) SEE STANDARD DRAWING SM-GR-12 FOR ADDITIONAL POST DETAILS AND SPECIFICATIONS.
- (B) SEE STANDARD DRAWING SM-GR-14 FOR ADDITIONAL BOLT, WASHER AND NUT DETAILS AND SPECIFICATIONS.
- (C) SEE STANDARD DRAWING S-GR-13A FOR BLOCK-OUTS WITH HORIZONTAL ADJUSTMENT HOLES AND MOUNTING DETAILS.
- (D) RECYCLED PLASTIC GUARDRAIL BLOCKOUTS LISTED ON THE TENNESSEE DEPARTMENT OF TRANSPORTATION'S QUALIFIED PRODUCTS LIST MAY BE SUBSTITUTED FOR WOOD BLOCKOUTS. THE USE OF RECYCLED PLASTIC GUARDRAIL BLOCKOUTS ARE SUBJECT TO THE FOLLOWING SPECIFICATIONS:
 - (1) THE MIXING OF BLOCKOUTS ON A GIVEN PROJECT WILL BE AVOIDED IF POSSIBLE.
 - (2) SHOULD IT BECOME NECESSARY TO CHANGE THE BLOCKOUT TYPE ON A GIVEN PROJECT, THE BLOCKOUTS SHOULD NOT BE MIXED ON A GIVEN RUN OR GUARDRAIL.
 - (3) BLOCKOUTS SHALL MEET KDMRP-350 GUIDELINES.



ALL UNITS ARE IN MILLIMETERS
UNLESS NOTED OTHERWISE.

MINOR REVISION -- FHMA
APPROVAL NOT REQUIRED.

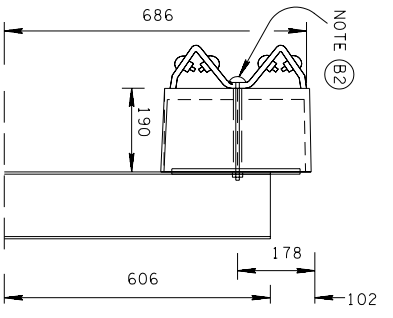
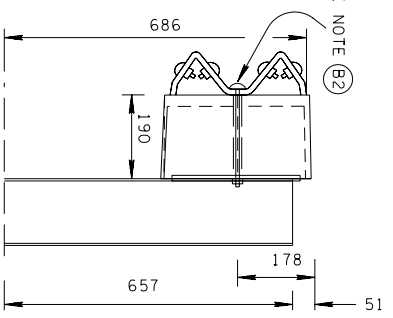
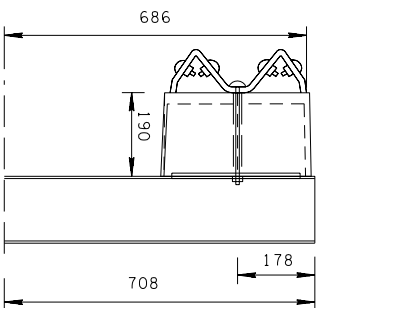
STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

BARRIER RAIL
MOUNTING POST
BLOCK-OUTS
WITH VERTICAL
ADJUSTMENT HOLES

SM-GR-13

REV. 11-1-95: CHANGED TO METRIC.
REV. 7-29-98: ADDED WOOD BLOCK-OUT
DETAILS FOR STEEL POST. MODIFIED
WOOD BLOCK-OUT DETAIL FOR WOOD POST.
MODIFIED BLOCK-OUT DETAIL FOR WOOD POST.
ADDED IRREGULAR SHOULDER LINE DETAIL AND
GENERAL NOTES (C), (D), AND (E) TO STANDARD
DRAWING S-GR-18.
REV. 9-5-98: GENERAL REVISION
THROUGHOUT DRAWING. CHANGED DRAWING
NO. FROM SM-GR-12 TO SM-GR-13.
REV. 5-27-03: ADDED GENERAL NOTES (C)
AND (D). CHANGED SHEET NAME.

DETAILS SHOWING HOLES REQUIRED IN POSTS AND BLOCK-OUTS
(FOR USE IN FUTURE RAIL ADJUSTMENT)

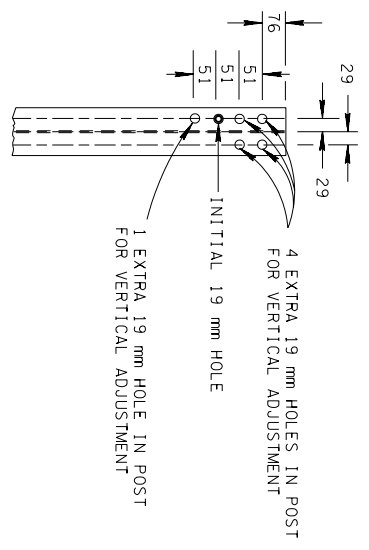


INITIAL INSTALLATION

FIRST ADJUSTMENT

SECOND ADJUSTMENT

FRONT ELEVATION
STEEL POST



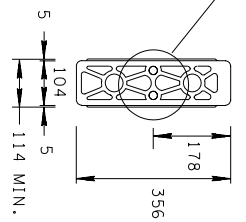
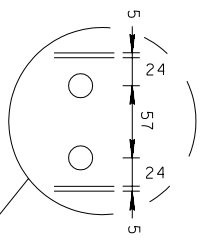
ADJUSTABLE STEEL POSTS AND BLOCK-OUTS AT VARIOUS ADJUSTMENTS

INSTALLATION NOTES FOR BLOCK-OUTS WITH HORIZONTAL ADJUSTMENT HOLES

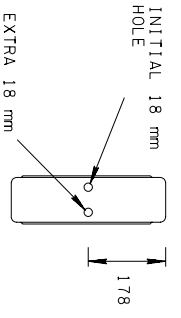
(A)	THE INITIAL INSTALLATION WILL REQUIRE ONE M16 X 241 mm LONG BUTTON HEAD BOLT WITH ROUND STEEL WASHER.
(B2)	THE FIRST ADJUSTMENT AND THE SECOND ADJUSTMENT WILL REQUIRE TWO M16 X 241 mm LONG BUTTON HEAD BOLTS. EACH BOLT WILL REQUIRE ONE ROUND STEEL WASHER.

GENERAL NOTES

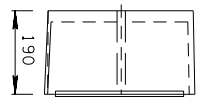
- (A) SEE STANDARD DRAWING SM-GR-12 FOR ADDITIONAL POST DETAILS AND SPECIFICATIONS.
- (B) SEE STANDARD DRAWING SM-GR-14 FOR ADDITIONAL BOLT, WASHER AND NUT DETAILS AND SPECIFICATIONS.
- (C) SEE STANDARD DRAWING SM-GR-13 FOR BLOCK-OUTS WITH VERTICAL ADJUSTMENT HOLES AND MOUNTING DETAILS. THE METAL POST SHOWN ON THIS SHEET MAY BE USED WITH WOOD BLOCK-OUTS.
- (D) RECYCLED PLASTIC GUARDRAIL BLOCKOUTS LISTED ON THE TENNESSEE DEPARTMENT OF TRANSPORTATION QUALIFIED PRODUCTS LIST MAY BE SUBSTITUTED FOR WOOD BLOCKOUTS. RECYCLED PLASTIC GUARDRAIL BLOCKOUTS ARE SUBJECT TO THE FOLLOWING SPECIFICATIONS:
 - (1) THE MIXING OF BLOCKOUTS ON A GIVEN PROJECT WILL BE AVOIDED IF POSSIBLE.
 - (2) SHOULD IT BECOME NECESSARY TO CHANGE THE BLOCKOUT TYPE ON A GIVEN PROJECT, THE BLOCKOUTS SHOULD NOT BE MIXED ON A GIVEN RUN OF GUARDRAIL.
 - (3) BLOCKOUTS SHALL MEET NCHRP-350 GUIDELINES.



BACK VIEW



FRONT VIEW



SIDE VIEW

PLASTIC BLOCK-OUT DETAIL FOR STEEL POST

INITIAL 18 mm HOLE TO BE USED FOR VERTICAL ADJUSTMENT

EXTRA 18 mm HOLE TO BE USED FOR VERTICAL ADJUSTMENT

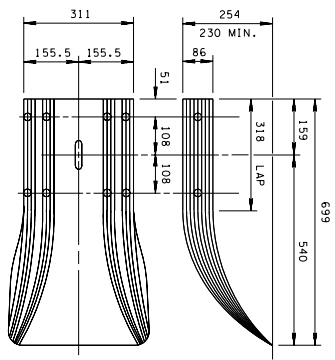
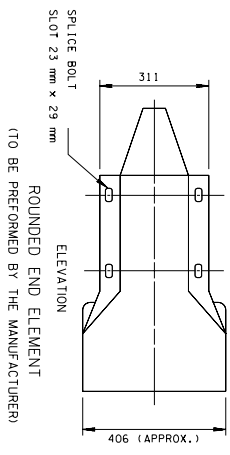
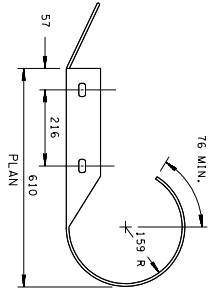


ALL UNITS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
MINOR REVISION -- FHMA APPROVAL NOT REQUIRED.

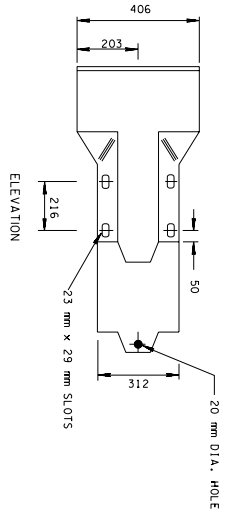
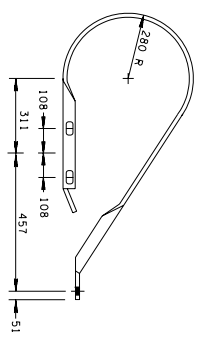
STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

BARRIER RAIL MOUNTING POST FOR PLASTIC WITH HORIZONTAL ADJUSTMENT HOLES

SM-GR-13A
5-21-03

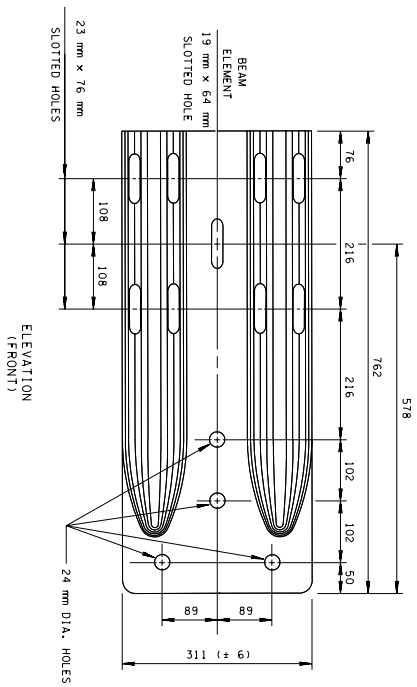
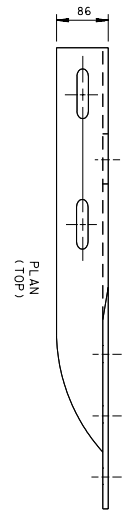


FLARED END ELEMENT
(TO BE PERFORMED BY THE MANUFACTURER)



END ELEMENT FOR GUARDRAIL TERMINAL ANCHOR TYPE 21
(TO BE PERFORMED BY THE MANUFACTURER)

NOTES REGARDING END TERMINALS (EXCEPT MICHIGAN SHOE)
HOLE SPACING IS THE SAME AS FOR ELEMENT DETAILS. OTHER DIMENSIONS SHOWN MAY VARY SLIGHTLY ACCORDING TO MANUFACTURERS DETAILS. ALL END ELEMENTS SHALL BE 12 GAUGE (2.67 mm THICK) STEEL CONFORMING TO THE REQUIREMENTS OF AASHTO M190, CLASS A1, TYPE 2. RAIL MATERIAL SHALL HAVE YIELD STRENGTH 345 MEGAPASCALS AND A TENSILE STRENGTH OF 483 MEGAPASCALS.



TERMINAL ELEMENT FOR ANCHOR BLOCK AND BRIDGE CONNECTIONS
THIS TERMINAL IS COMMONLY KNOWN AS "MICHIGAN END SHOE"

"MICHIGAN END SHOE" TERMINALS END ELEMENT SHALL BE 10 GAUGE (3.43 mm THICK) STEEL, MATERIAL AND GALVANIZING REQUIREMENTS OF AASHTO M190, CLASS B (3.43 mm NOMINAL) THICKNESS. TERMINAL END ELEMENT MATERIAL SHALL HAVE A YIELD STRENGTH OF 345 MEGAPASCALS AND A TENSILE STRENGTH OF 483 MEGAPASCALS.
BOLTS USED FOR ATTACHMENT OF TERMINAL ELEMENT TO BRIDGE RAIL OR GUARDRAIL TERMINAL ANCHOR, TYPE 12 OR CONCRETE MEDIUM BARRIER SHALL BE M22 HEX HEAD, CONFORMING TO THE REQUIREMENTS OF ASTM A307, WITH ROUND FLAT WASHER, 50 mm OUTSIDE DIAMETER X 4.2 mm THICK, PLACED UNDER BOLT HEAD BOLTS AND WASHERS TO BE GALVANIZED CONFORMING TO THE REQUIREMENTS OF ASTM A153.
SEE THE STRUCTURE PLANS AND BRM-2 SERIES BRIDGE REPAIR STANDARD DRAWINGS FOR ATTACHMENT TO BRIDGE RAIL.
SEE STANDARD DRAWING SM-CR-19 FOR ATTACHMENT TO GUARDRAIL TERMINAL ANCHOR TYPE 12 AND STEEL INSERT SPECIFICATIONS
SEE STANDARD DRAWINGS SM-WB-1 AND SM-WB-2 FOR ATTACHMENT TO CONCRETE MEDIUM BARRIER WALLS.
ALL TERMINAL ELEMENT JOINTS SHALL BE OVERLAPPED SO THAT THE OUTSIDE TERMINAL EDGE OF JOINT WILL BE FACED AWAY FROM APPROACHING TRAFFIC.

- REV. 11-1-95: CHANGED TO METRIC.
- REV. 7-29-98: DELETED TYPE 11 GUARDRAIL TERMINAL ANCHOR DETAIL AND MEDIUM DIVIDER END ELEMENT DETAILS.
- REV. 9-5-98: CHANGED LABELING FOR END ELEMENT FOR TYPE 21 GUARDRAIL TERMINAL.
- REV. 5-27-01: CORRECTED REFERENCES TO TYPE 12 AND 21 GUARDRAIL TERMINALS.
- REV. 9-5-03: CHANGED SPECIFICATION REQUIREMENTS FOR TERMINAL END ELEMENTS.



ALL UNITS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
□ MINOR REVISION -- FHMA APPROVAL NOT REQUIRED.

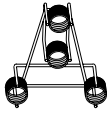
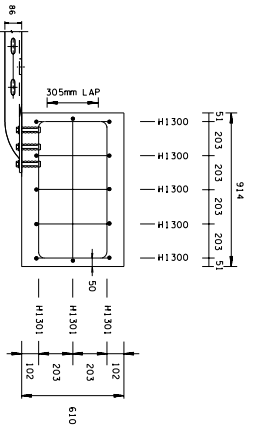
STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

W-BEAM BARRIER
TERMINAL ELEMENT
DETAILS

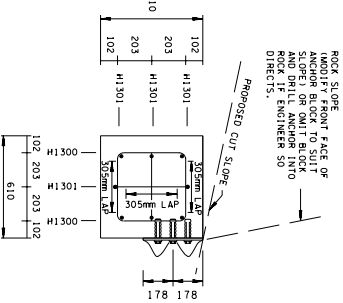
11-1-95 SM-CR-15

95	95	95	95
96	96	96	96
96	H1300	96	H1301
406			813
			96 H1301

ANCHOR BLOCK INSERT ASSEMBLY
CAST IN PLACE TREADED STEEL INSERT WITH
M22 DIA. x 50 mm HEX HEAD GALVANIZED BOLTS ASTM A307
HOT DIP ZINC COATING ASTM A153



ROCK SLOPE
FACED SIDE OF
ANCHOR BLOCK TO SUIT
SLOPE OR ONIT BLOCK
ROCK IF ENGINEER SO
DIRECTS.



ELEVATION
(FRONT)

GUARDRAIL TERMINAL (TYPE 12)
ITEM NO. TOSM04.02 PER EACH

SPECIAL INSTALLATION NOTE

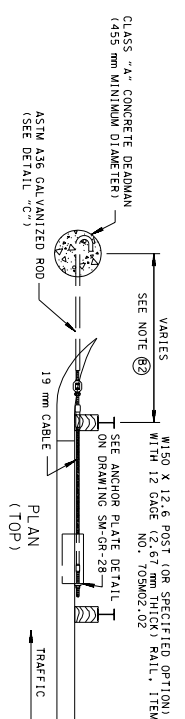
FOR THE GUARDRAIL TERMINAL ANCHOR (TYPE 12) TO FUNCTION AS IT WAS CRASH TESTED UNDER NCHRP-350 TEST LEVEL 3 IT MUST BE CONSTRUCTED PER STANDARD DRAWING NO. SM-GR-19A.

GUARDRAIL TERMINAL ANCHOR (TYPE 12) GENERAL NOTES

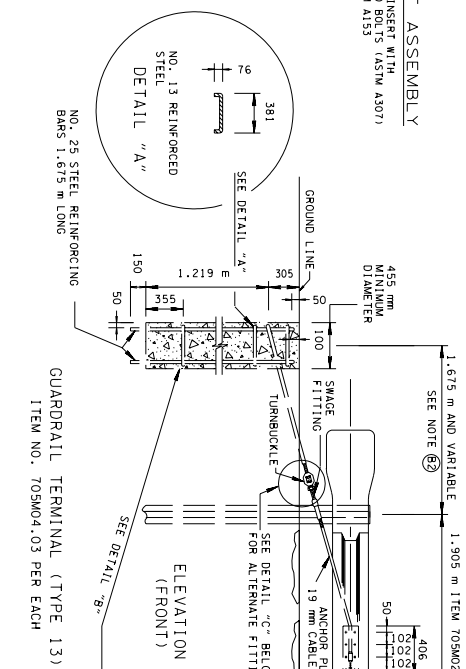
- REQUIREMENTS FOR ANCHOR INSERT BOLTS SHALL BE M22 HEX HEAD INSTALLED IN M22 ANCHOR BLOCK AS PER STANDARD DRAWING NO. SM-GR-19A.
- THE CONTRACTOR SHALL FURNISH ANCHOR PULL-OUT DATA FROM AN INDEPENDENT TESTING LABORATORY USING CLASS "A" CONCRETE IN ACCORDANCE WITH STATE OF TENNESSEE STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION. THE ULTIMATE LOAD FOR M22 ANCHOR SHALL BE 85000 N. BOLTS SHALL CONFORM TO ASTM A307.
- THE MASONRY ANCHORS SHALL BE SUB-SET IN THE CONCRETE AT A DEPTH OF BETWEEN 2.5 mm TO 6 mm AND TORQUED WITH THE END TERMINAL IN THE PLACE TO AN EQUIVALENT DIRECT PULL-OUT LOAD OF 55000 N. SLIPPAGE SHALL NOT EXCEED 6 mm.
- THE CONTRACTOR WILL PERFORM ON-SITE TESTING OF EACH BOLT IN THE PRESENCE OF 80% PERSONNEL TO INSURE THESE REQUIREMENTS AND ANY INSTALLATION NOT MEETING THESE REQUIREMENTS SHALL BE CORRECTED AT THE CONTRACTORS EXPENSE.
- THE CONTRACTOR MAY ELECT TO USE M22 DIAMETER DRILLED IN ANCHORS WITH 345 MEGAPASCALS OR GREATER YIELD STRENGTH WHEN ATTACHING THE TERMINAL END ELEMENTS INTO ROCK. SEE ABOVE GENERAL NOTE 12 FOR PULL OUT REQUIREMENTS. IF THE CONTRACTOR DRILLS THESE ANCHOR BOLTS IN ROCK, THE SAME FLARE RATE MUST BE USED THAT WOULD BE USED WITH THE CRASH TESTED CONCRETE ANCHOR BLOCK.

- UNIT PRICE FOR ITEM NO. TOSM04.02, GUARDRAIL TERMINAL (TYPE 12) PER EACH SHALL INCLUDE COSTS OF FURNISHING AND INSTALLING ONE (1) REINFORCED CONCRETE GUARDRAIL TERMINAL ANCHOR BLOCK, ONE (1) TERMINAL ANCHOR OR ANCHOR BLOCK INSERT, WASHERS AND LABOR NECESSARY TO COMPLETE THIS ITEM.
- ESTIMATED QUANTITIES OF CONCRETE AND STEEL FOR GUARDRAIL STATIONARY TERMINAL (TYPE 12) ARE:

CLASS "A" CONCRETE = 0.34 m ³
NO. 13 STEEL REINFORCING BARS = 23.59 KG



- REV. 11-1-95) CHANGED TO METRIC DIMENSIONING CHANGES.
- REV. 7-29-96, MADE MINOR DIMENSIONING CHANGES.
- REV. 7-29-96, MODIFIED DETAIL "C".
- REV. 12-18-98, MODIFIED ALL DETAILS FOR GUARDRAIL TERMINAL ANCHOR (TYPE 13).
- REV. 5-27-01, CHANGED DESCRIPTION FOR ITEM NUMBERS CHANGED TO TOSM04.03.
- REV. 7-26-03, CHANGED CONCRETE ANCHOR BLOCK.
- REV. 10-28-04, ADDED SPECIAL GUARDRAIL TERMINAL (TYPE 13) NOTE.

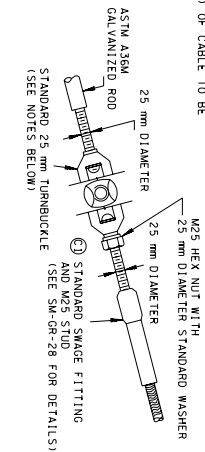
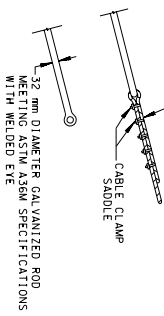


GUARDRAIL TERMINAL (TYPE 13)
ITEM NO. TOSM04.03 PER EACH

GUARDRAIL TERMINAL ANCHOR (TYPE 13) GENERAL NOTES

- UNIT PRICE FOR ITEM NO. TOSM04.03, GUARDRAIL TERMINAL (TYPE 13) PER EACH SHALL INCLUDE THE COST OF FURNISHING AND INSTALLING ONE (1) REINFORCED CONCRETE "DEADMAN" AND TERMINAL RAIL END ELEMENT COMPLETE IN PLACE. SEE STANDARD DRAWING NO. SM-GR-28 FOR DETAILS AND SPECIFICATIONS ON CABLE AND ANCHOR PLATE.
- CABLE TO BE PARALLEL TO GUARDRAIL FOR STRAIGHT RUNS OF RAIL. CABLE MAY HAVE ANGLE POINT AT ANCHOR PLATE IF GUARDRAIL IS CURVED.
- ESTIMATED QUANTITIES OF CONCRETE AND STEEL FOR GUARDRAIL TERMINAL (TYPE 13) ARE:
CLASS "A" CONCRETE = 0.25 m³
NO. 25 STEEL REINFORCING BARS = 35 KG
- THIS TERMINAL SHALL NOT BE USED ON THE APPROACH END OF A SECTION OF GUARDRAIL.

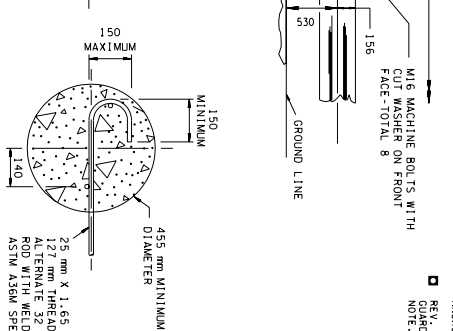
SECURE CABLE LOOP WITH 5 U-BOLT CABLE CLAMPS. CONTRACTOR IS TO VERIFY THAT U-BOLTS ARE SUFFICIENTLY EMBEDDED IN CONCRETE AND CABLE WIRE REST IN THE SADDLE. DEAD END (SHORT END) OF CABLE TO BE ON TOP SIDE OF LIVE CABLE.



DETAIL "C" ALTERNATE FITTINGS

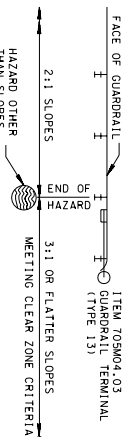
ALTERNATE FITTING GENERAL NOTES

- STANDARD SWAGE FITTING WITH 5/16 STUD TO BE USED ONLY WITH STANDARD 25 mm TURNBUCKLE. SWAGE FITTING ON ANCHOR PLATE IS SAME AS DETAIL ON STANDARD DRAWING SM-GR-28.
- DRIP FORGED GALVANIZED STEEL TURNBUCKLE SHALL PROVIDE A MINIMUM BREAKING STRENGTH OF 180000 N.
- THE FINISHED CABLE ASSEMBLY WILL NOT BE ACCEPTABLE UNLESS IT IS IN TENSION WITH NO SAG.
- THESE FITTINGS SHALL BE INSTALLED ABOVE GROUND.



DETAIL "B" SECTION THRU DEADMAN

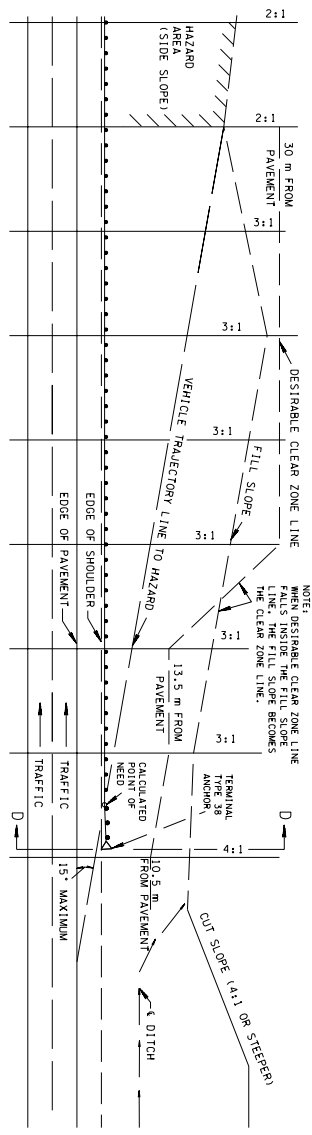
SKETCH SHOWING APPLICATION OF TRAILING END TREATMENT ON DIVIDED HIGHWAYS



- ALL UNITS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
- MINOR REVISION - - TMA APPROVAL NOT REQUIRED.

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

GUARDRAIL
TERMINAL ANCHORS,
TYPE 12 AND
TYPE 13
SM-GR-19



TYPICAL LAYOUT - CASE 11
AVERAGE TERRAIN-DIVIDED HIGHWAY

NOTE: WHEN DESIRABLE CLEAR ZONE LINE FALLS INSIDE THE FILL SLOPE, THE FILL SLOPE BECOMES THE CLEAR ZONE LINE.

NOTE: POINT OF THEORETICAL NEED FOR EMBANKMENT GUARDRAIL. THE POINT OF NEED SHOULD BE CONSIDERED THAT POINT WHERE, TO ONE SIDE OF THE POINT, IT WOULD BE SAFER FOR THE VEHICLE TO CONTACT AND BE DIRECTED BY THE GUARDRAIL INSTEAD OF GOING OVER THE SLOPE. TO THE OTHER SIDE OF THE POINT, THE VEHICLE SHOULD BE SAFER TO GO OVER THE SLOPE AND EXIT THE ROADWAY THAN TO GO OVER THE ROADWAY AND CONTACT THE GUARDRAIL. THE POINT OF NEED SHOULD BE GIVEN TO FLATTENING OR FURTHER WARPING OF THE SLOPE IN ORDER TO "MOVE BACK" THE POINT OF NEED AND THEREBY REDUCE THE LENGTH OF NEEDED GUARDRAIL.

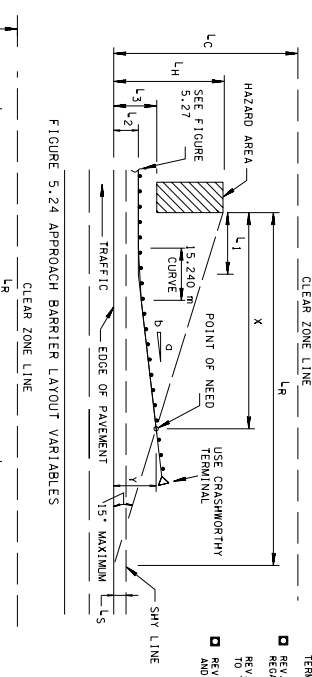


FIGURE 5.24 APPROACH BARRIER LAYOUT VARIABLES

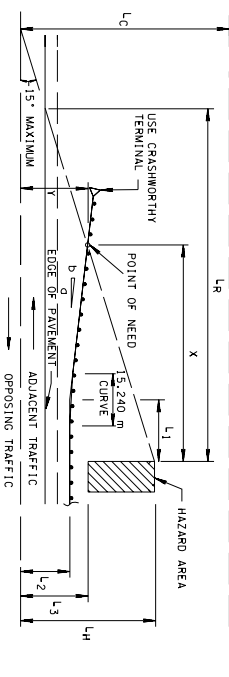


FIGURE 5.27 APPROACH BARRIER LAYOUT FOR OPPOSING TRAFFIC

DETAILS AND EQUATIONS COME FROM "PROPOSED DESIGN GUIDE (2002)", CHAPTER 5. THE FOLLOWING EQUATIONS ARE TO BE USED TO CALCULATE THE "POINT OF NEED".

EQUATION NOTES

CASE I. THE POINT OF NEED WILL BE LOCATED AT POINT NO. 3 OF THE TYPE 39 ANCHOR USING THE FOLLOWING EQUATIONS: (SEE DRAWING NOS. SM-GR-32, SM-GR-33, AND SM-GR-40)

$$L_1 = L_2 - 0.23$$

$$L_2 = 0.23$$

CASE II. WHEN D/SLO IS A VALUE, THE POINT OF NEED WILL BE LOCATED AS SHOWN AT LEFT AND GUARDRAIL SHALL PASS THROUGH IT USING THE FOLLOWING EQUATIONS:

$$L_1 = L_2 - 0.23$$

$$L_2 = 0.23$$

EQUATION VARIABLE LEGEND

L_1 = THE CLEAR DISTANCE

L_2 = DISTANCE FROM EDGE OF TRAVELED WAY (EDGE OF PAVEMENT) TO THE LATERAL EXTENT OF HAZARD. NOTE THAT L_2 SHOULD NEVER EXCEED THE "CLEAR DISTANCE" (L_1).

D/SLO = SLOPE OF FLARE

L_3 = LENGTH OF TANGENT SECTION OF BARRIER FROM HAZARD. TENNESSEE DEPARTMENT OF TRANSPORTATION WILL USE THIS POINT AS THE P.I. FOR A 15.240 M CIRCULAR CURVE.

L_4 = DISTANCE FROM EDGE OF PAVEMENT TO TANGENT SECTION OF BARRIER.

L_5 = RADIUS LENGTH (SEE TABLE BELOW FOR VALUES).

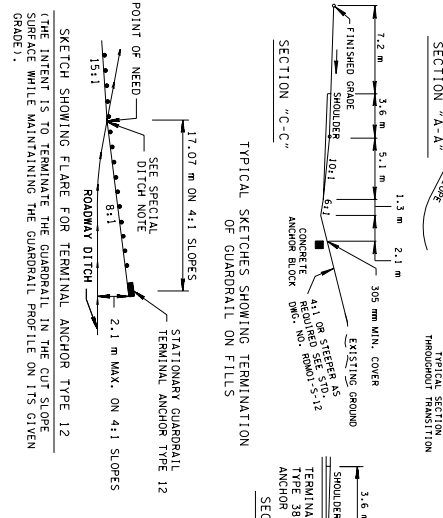
L_6 = DISTANCE FROM EDGE OF PAVEMENT TO NEAR FACE OF HAZARD.

L_7 = L_2 SHOULD BE GREATER THAN 1.2 M.

DESIGN TRAFFIC VOLUME (ADT)

OPERATING SPEED (km/h)	OVER 6000	2000-6000	800-2000	UNDER 800	LS	FLARE RATE (G/D)
110	145	135	120	110	2.8	15.1
100	130	120	105	100	2.4	14.1
80	100	90	80	75	2.0	11.1
60	70	60	55	50	1.4	8.1
50	50	45	40	35	1.1	7.1

- NOTES
- IF ANY OBSTACLE (HAZARD) APPEARS IN THE DESIRABLE CLEAR ZONE AREA, IT MUST BE REMOVED. IF IT CANNOT BE REMOVED, THEN A NEW "POINT OF NEED" MUST BE COMPUTED USING THE OBSTACLE AS THE HAZARD AND NOT THE STEEP SIDE SLOPE WHICH WAS FIRST CONSIDERED AS THE HAZARD.
 - CASE II: THE ROADWAY EMBANKMENT IS SHOWN GOING FROM A CURT SECTION INTO A STEEP FILL SECTION VERY CLOSE TO THE CUT TO FILL GRADE POINT. HERE THE "POINT OF NEED" FOR PROTECTION FROM THE STEEP SLOPE FALLS WITHIN THE CURVE AREA. THEREFORE, THE GUARDRAIL SHALL BE THROUGH THE CURVE SECTION PROCEEDING TO A STEEPER DOWNWARD TERMINAL ANCHOR TYPE 12.
- GENERAL NOTES
- EVEN LOCATION WHERE GUARDRAIL IS REQUIRED MUST BE INVESTIGATED SEPARATELY. THE HAZARD MUST BE IDENTIFIED AND THE "POINT OF NEED" CALCULATED TO DETERMINE THE BEST TREATMENT FOR PROTECTION OF VEHICLES FROM THE HAZARD.
 - R.O.M. FENCES WILL NOT BE CONSIDERED A HAZARD, BUT HAZARDS WHICH ARE OUTSIDE THE R.O.M. LINE BUT INSIDE THE DESIRABLE CLEAR ZONE SHOULD BE CONSIDERED AND APPROPRIATE ACTION APPROPRIATE ACTION NEEDED. SEE EFFECTIVE EVALUATION MAY BE NEEDED TO HELP DECIDE THE APPROPRIATE ACTION NEEDED.
 - WHERE THE HAZARD APPEARS ON THE OUTSIDE OF A ROADWAY CURVE, GOOD ENGINEERING JUDGMENT MUST BE USED TO DETERMINE THE LIMITS OF GUARDRAIL NEEDED. REFER TO THE "ROADSIDE DESIGN GUIDE (2002)", SECTION 3.7 AND STANDARD DRAWING NO. RD-001-S-12 TO HELP DECIDE WHAT THE APPROPRIATE ACTION NEEDED. SEE EFFECTIVE EVALUATION MAY BE NEEDED TO HELP DECIDE THE APPROPRIATE ACTION NEEDED.
- SPECIAL DITCH NOTE
- THE CONTRACTOR IS TO ADD A BENTONITE FENCE TO THE CLEARANCE FROM THE BOTTOM OF THE WEIRWAY TO THE GROUND LINE EXCEPT WHERE NOTED OTHERWISE.



TYPICAL SKETCHES SHOWING TERMINATION OF GUARDRAIL ON FILLS

SKETCH SHOWING FLARE FOR TERMINAL ANCHOR TYPE 12 (THE INTENT IS TO TERMINATE THE GUARDRAIL IN THE CUT SLOPE SURFACE WHILE MAINTAINING THE GUARDRAIL PROFILE ON ITS GIVEN GRADE).

xx = VALUES FOR YIELDING BARRIER (0.6 m DYNAMIC DEFLECTION) FOR RIGID BARRIERS INCREASE INCREMENT BY 0.1m

v = OPERATING SPEED (km/h)

ALL UNITS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.

MINOR REVISIONS -- FHWA APPROVAL NOT REQUIRED.

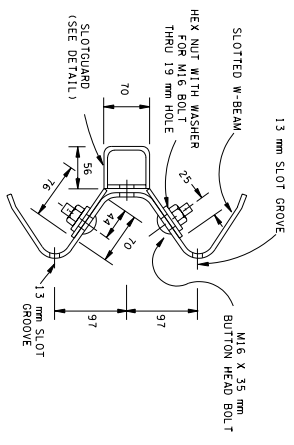
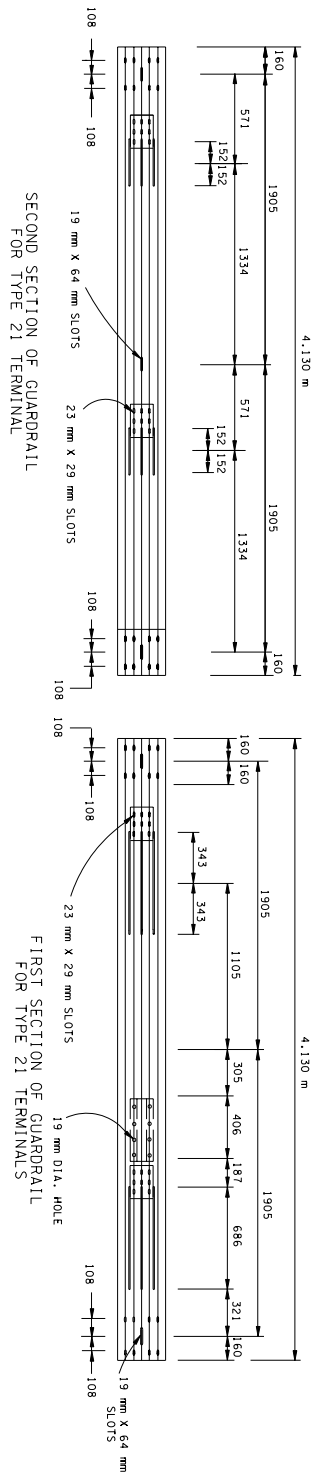
STATE OF TENNESSEE DEPARTMENT OF TRANSPORTATION

LENGTH OF NEED AND TERMINAL REQUIREMENTS IN FILLS

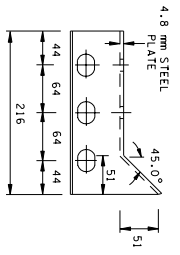
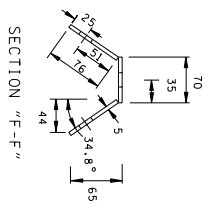
11-1-95 SM-GR-21

- REV. 11-1-95: CHANGED TO METRIC.
- REV. 7-29-98: REMOVED REFERENCE TO TYPE 11, 16, AND 20 GUARDRAIL TERMINALS. ADDED TYPE 38 GUARDRAIL TERMINALS.
- REV. 5-27-01: MODIFIED REFERENCE REGARDING GUARDRAIL TERMINALS.
- REV. 9-11-03: MADE GENERAL CHANGES TO TYPE 12 GUARDRAIL TERMINAL.
- REV. 4-15-04: CHANGED CASE 1 EQUATION AND REFERENCES TO ROADSIDE DESIGN GUIDE.

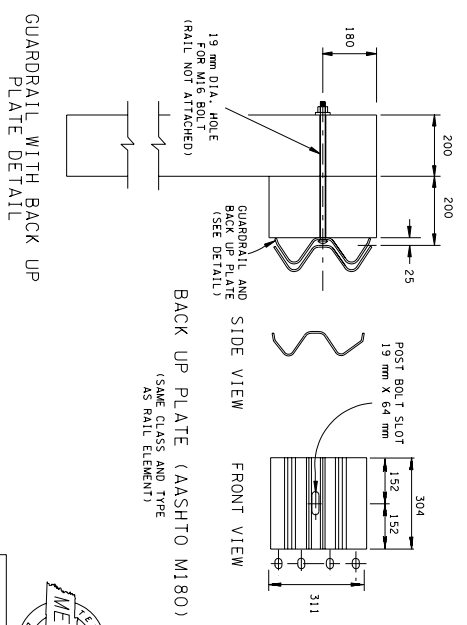
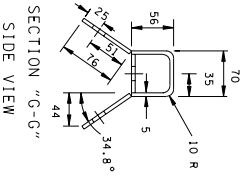
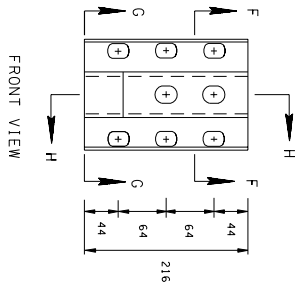
SLOTTED W-BEAM GUARDRAIL ELEMENT DETAILS



SECTION "E-E"
 (SEE DRAWING NO. SM-CR-261)
 NOTE: 8 - M16 X 35 mm BUTTON HEAD BOLTS AND NUTS REQUIRED FOR EACH SLOUGUARD ASSEMBLY.



SECTION "H-H"
 NOTE: ALL HOLES 23 mm X 29 mm DIAMETER
 SLOUGUARD DETAIL



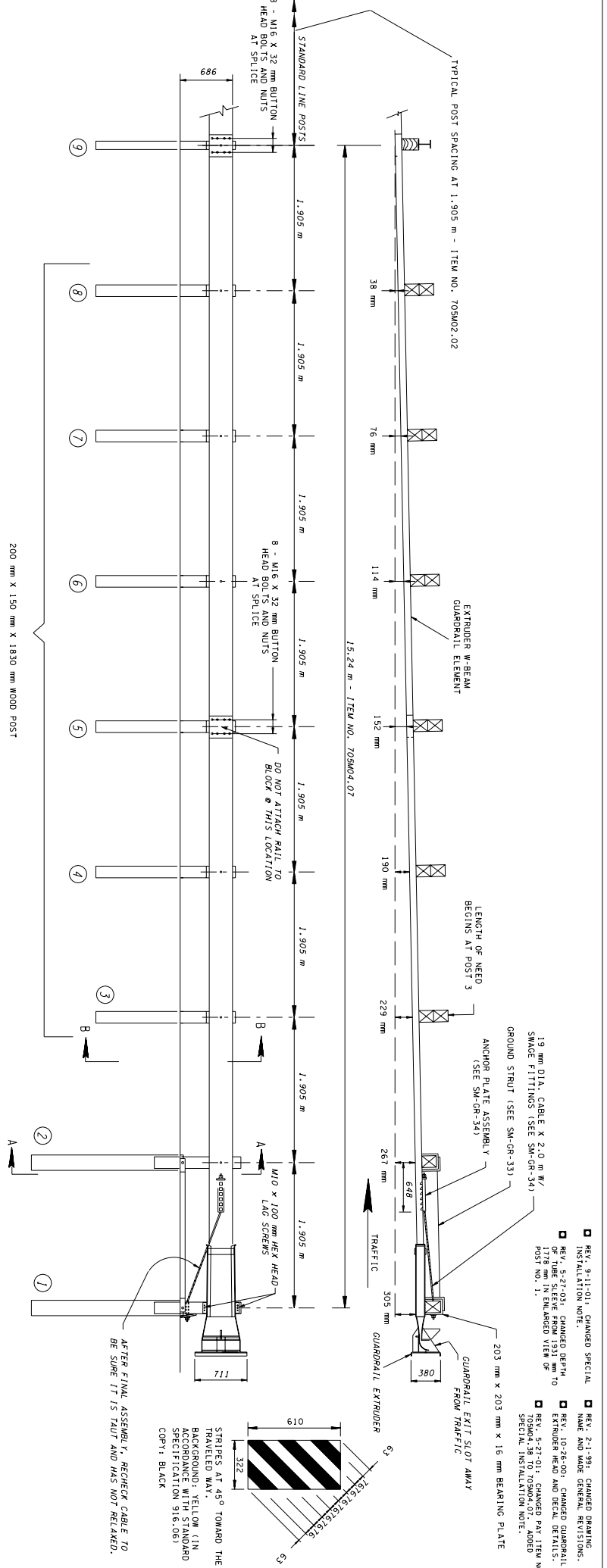
GUARDRAIL WITH BACK UP PLATE DETAIL
 BACK UP PLATE (AASHTO M180)
 (SAME CLASS AND TYPE AS RAIL ELEMENT)

- REV. 11-1-95: CHANGED TO METRIC.
- REV. 5-27-98: REPLACED SHELF ANGLE DETAIL WITH BACK UP PLATE DETAIL. DELETED ADDITIONAL GUARDRAIL ELEMENT.
- REV. 10-18-98: REWORK GUARDRAIL AND GROUND STRUT DETAILS FOR GUARDRAIL TERMINAL ANCHOR - TYPE 22. CHANGED SHEET NAME.
- REV. 5-27-03: CORRECTED SPELLING IN SECTION "E-E".



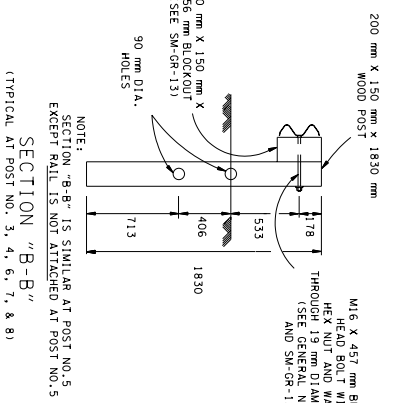
STATE OF TENNESSEE
 DEPARTMENT OF TRANSPORTATION

GUARDRAIL TERMINAL ANCHOR (TYPE 21) ELEMENT ASSEMBLY DETAILS
 11-1-95 SM-CR-27



50:1 TAPER OVER 15.24 m LENGTH OF SYSTEM

CODE NO.	DECIMAL (m)	X	Y
9	0.000	0.000	
8	0.038	1.905	
7	0.076	3.810	
6	0.114	5.715	
5	0.152	7.620	
4	0.190	9.525	
3	0.229	11.430	
2	0.267	13.335	
1	0.305	15.240	

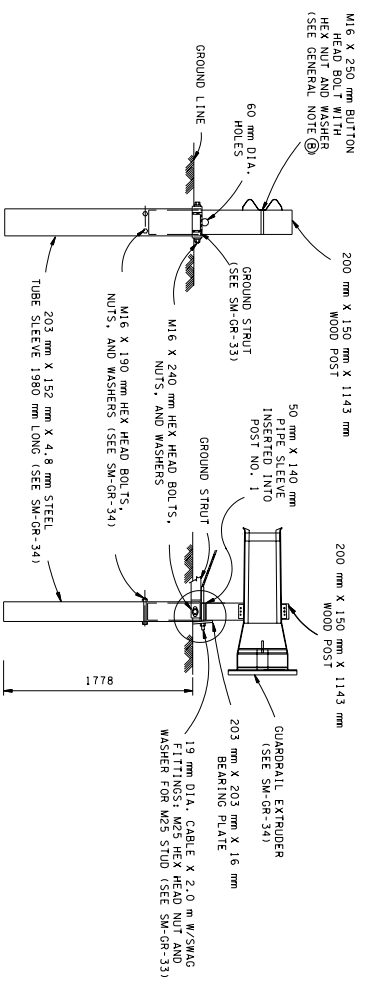


GENERAL NOTES

- Ⓐ THE POST OFFSET DIMENSIONS ARE GIVEN TO THE CENTER OF THE TRAFFIC FACE OF THE GUARDRAIL.
- Ⓑ THE M16 FLAT WASHER IS USED UNDER THE NUT. NO WASHER IS USED AT THE RAIL.
- Ⓒ ET-2000 (2-TUBE) TERMINAL IS TO BE INSTALLED UNDER THE PRICE BID FOR ITEM NO. 705M04.07 TANGENT ENERGY ABSORBING TERMINAL (NCHRP 350-TL3) PER EACH.
- Ⓓ A FOUR (4) TUBE OR EIGHT (8) TUBE OPTION MAY BE USED. SHOP DRAWINGS WILL BE REQUIRED.

SPECIAL INSTALLATION NOTE

FOR THE TYPE 38 GUARDRAIL TERMINAL TO FUNCTION AS IT WAS CRASH TESTED UNDER NCHRP-350 TEST LEVEL 3 THE EARTH PAD UNDER IT MUST BE CONSTRUCTED PER STANDARD DRAWING NO. SM-GR-38.



SECTION "A-A" ENLARGED VIEW AT POST NO. 1

- REV. 9-11-01: CHANGED SPECIAL INSTALLATION NOTE.
- REV. 5-27-03: CHANGED DEPTH TO 178 mm IN ENLARGED VIEW OF POST NO. 1.
- REV. 10-26-00: CHANGED GUARDRAIL EXTRUDER HEAD AND BEAR PLATE.
- REV. 5-27-01: CHANGED PAY ITEM NO. SPECIAL INSTALLATION NOTE.
- REV. 7-2-99: CHANGED DRAWINGS AND MADE GENERAL REVISIONS.
- REV. 10-26-00: CHANGED GUARDRAIL EXTRUDER HEAD AND BEAR PLATE.
- REV. 5-27-01: CHANGED PAY ITEM NO. SPECIAL INSTALLATION NOTE.

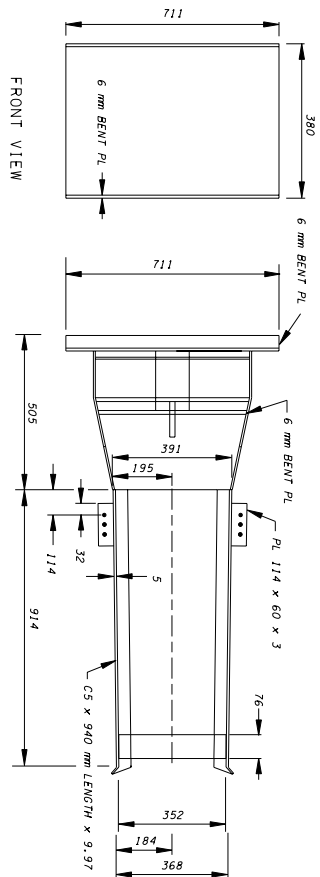
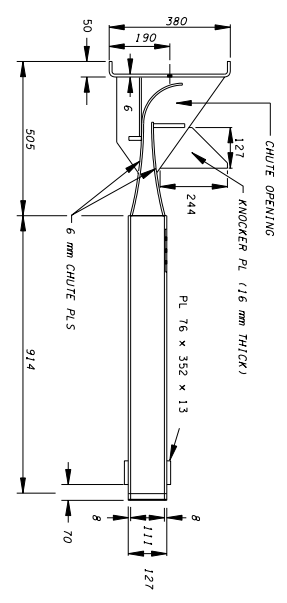


ALL UNITS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
 MINOR REVISION -- FINAL APPROVAL NOT REQUIRED.

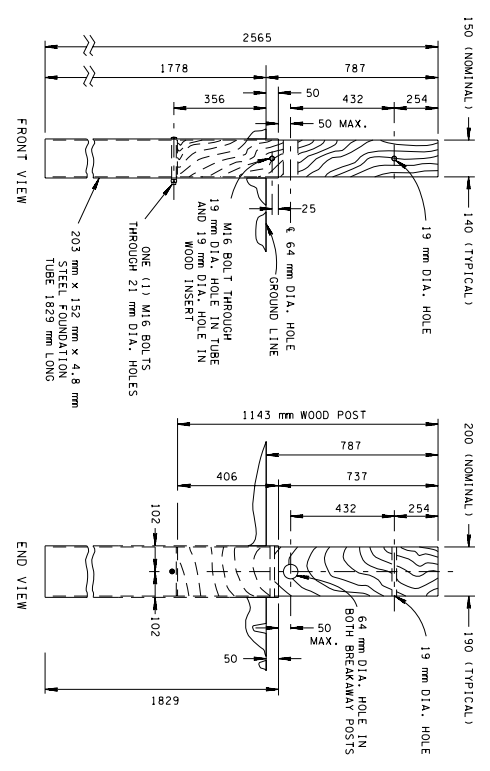
STATE OF TENNESSEE
 DEPARTMENT OF TRANSPORTATION

ET-2000
 GUARDRAIL TERMINAL ANCHOR (TYPE 38) POST LAYOUT AND ERECTION DETAILS
 7-29-98 SM-GR-32

REV. 2-1-99: CHANGED DRAWING NAME AND MADE GENERAL REVISIONS.
 REV. 10-26-01: CHANGED GUARDRAIL TO ET-PLUS HEAD FROM ORIGINAL HEAD.
 REV. 5-27-03: CHANGED LENGTH OF TUBE SLEEVE FROM 1981 mm TO 1829 mm WHICH CHANGES EMBEDDED DEPTH FROM 1931 mm TO 1178 mm.



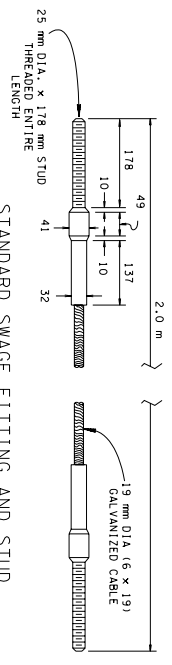
GUARDRAIL EXTRUDER DETAILS FOR ET-PLUS



NO. 1 & 2 BREAKAWAY POSTS WITH 1829 mm TUBE SLEEVE

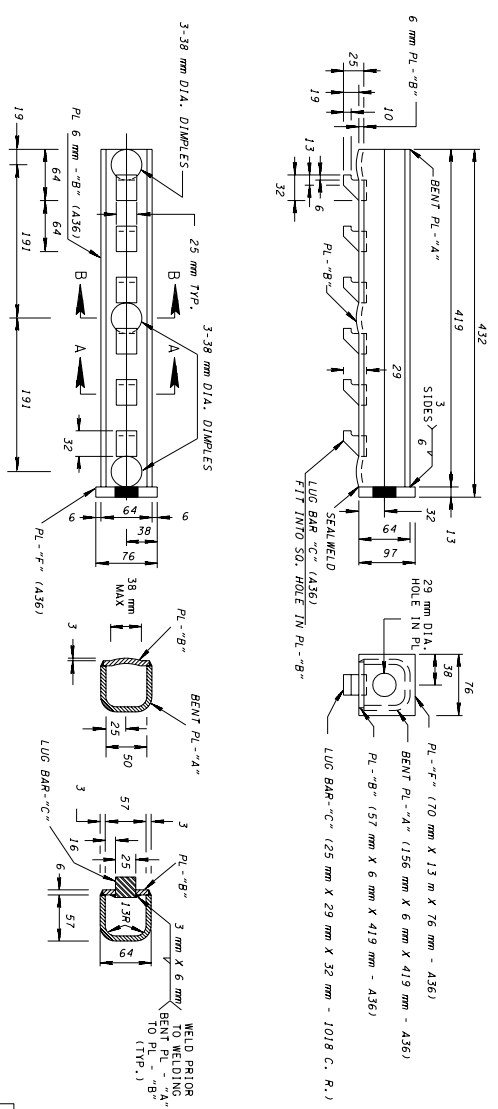
GENERAL NOTES

- Ⓐ THE NO. 1 AND NO. 2 BREAKAWAY POSTS WILL HAVE A 150 mm X 150 mm X 150 mm X 150 mm AREA AND WILL HAVE A 64 mm DIAMETER HOLE CENTERED 688 mm BELOW THE TOP OF THE POST ON THE 200 mm SIDE AS SHOWN. ALL THE GUARDRAIL WILL HAVE A TOP-OF-FALL HEIGHT OF 686 mm.
- Ⓑ ALL HOLES IN WOOD POSTS ARE TO BE DRILLED BEFORE PRESERVATIVE TREATMENT.
- Ⓒ ALL CUTTING, DRILLING, AND WELDING OF STEEL COMPONENTS SHALL BE DONE BEFORE GALVANIZING.
- Ⓓ THE FINISHED CABLE ASSEMBLY WILL NOT BE ACCEPTABLE UNLESS IT IS IN TENSION WITH NO SAG. SEE STANDARD DRAWING NOS. SM-GR-32 AND SM-GR-33 FOR ADDITIONAL DETAILS AND GENERAL NOTES.
- Ⓔ THE STEEL TUBES ARE TO BE DRIVEN INTO THE GROUND BEFORE THE WOODEN POSTS ARE INSERTED.



STANDARD SWAGE FITTING AND STUD
 NOTE: CABLE TO BE SWAGE-CONNECTED

ANCHOR PLATE ASSEMBLY



SECTION B-B

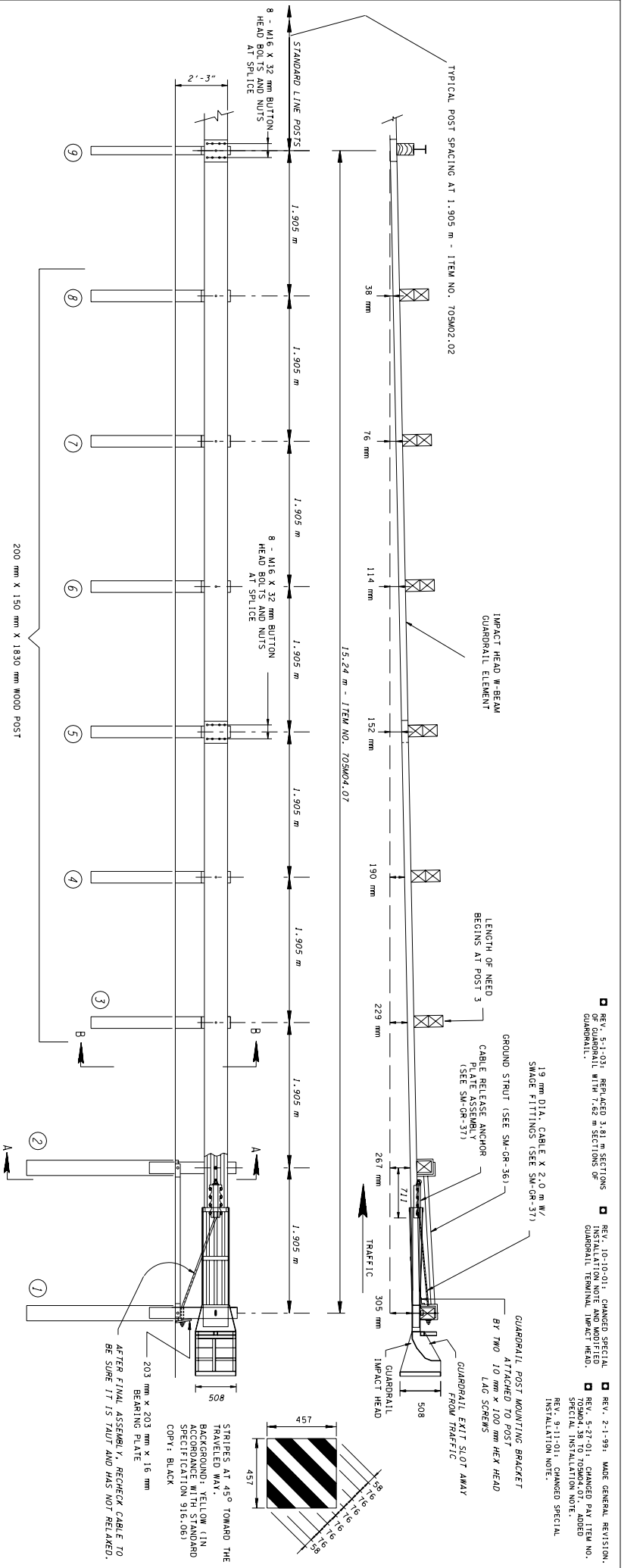
SECTION A-A



ALL UNITS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
 MINOR REVISION - E-MAIL APPROVAL NOT REQUIRED.

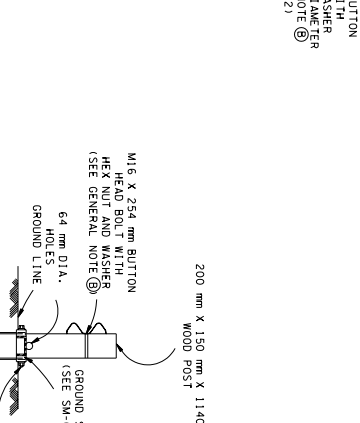
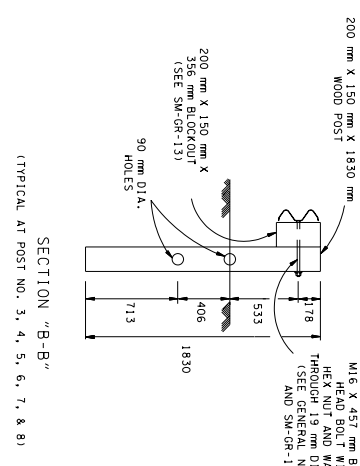
STATE OF TENNESSEE
 DEPARTMENT OF TRANSPORTATION

ET-2000
 (2 TUBE)
 POST AND
 ASSEMBLY DETAILS
 7-29-98 SM-GR-34



50:1 TAPER OVER 15.24 m LENGTH OF SYSTEM

CODE NO.	DECIMAL (m)
1	0.305
2	0.267
3	0.229
4	0.190
5	0.152
6	0.114
7	0.076
8	0.038
9	0.000



- GENERAL NOTES
- ① THE POST OFFSET DIMENSIONS ARE GIVEN TO THE CENTER OF THE TRAFFIC FACE OF THE GUARDRAIL.
 - ② THE M16 FLAT WASHER IS USED UNDER THE NUT, BEHIND THE POST ONLY. NO WASHER IS USED AT THE BALL.
 - ③ SKT-350 (2-TUBE) TERMINAL IS TO BE INSTALLED UNDER THE PRICE BID FOR ITEM NO. 705M04.07 TANGENT ELEMENT ASSUMING TERMINAL (NCHM-350-TL3) PER EACH.
 - ④ A FOUR (4) TUBE OR EIGHT (8) TUBE OPTION MAY BE USED. SHOP DRAWINGS WILL BE REQUIRED.

REVISIONS:

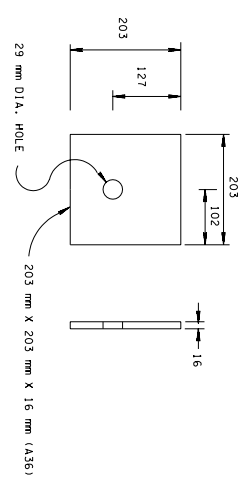
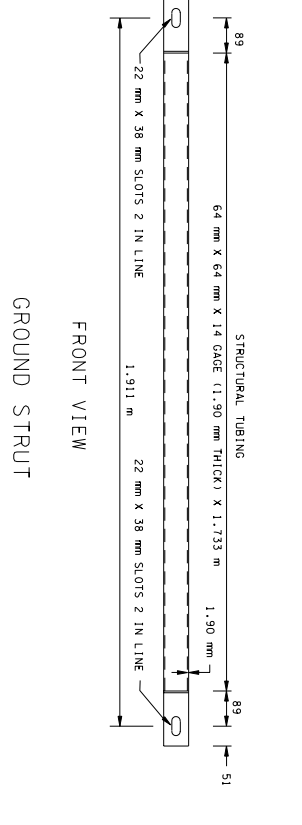
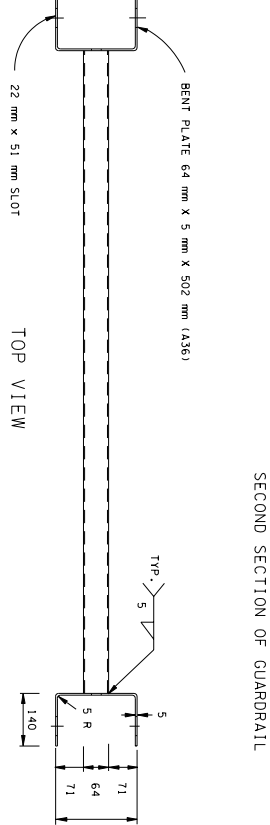
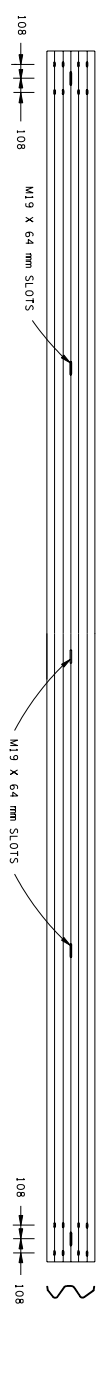
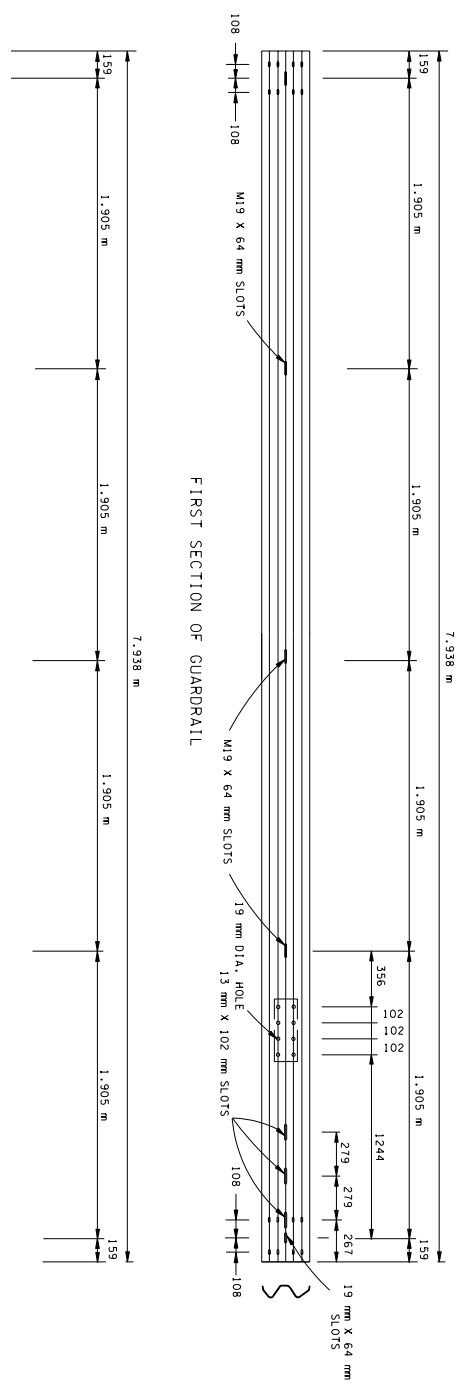
- REV. 5-1-03: REHANCED 3.81 m SECTIONS OF GUARDRAIL WITH 7.62 m SECTIONS OF GUARDRAIL.
- REV. 10-10-01: CHANGED SPECIAL GUARDRAIL TERMINAL IMPACT HEAD.
- REV. 2-1-99: MADE GENERAL REVISION.
- REV. 5-27-01: CHANGED PAY ITEM NO. 705M04.38 TO 705M04.07. ADDED SPECIAL INSTALLATION NOTE.
- REV. 9-11-01: CHANGED SPECIAL INSTALLATION NOTE.

DATE OF TERMINATE DEPARTMENT OF TRANSPORTATION

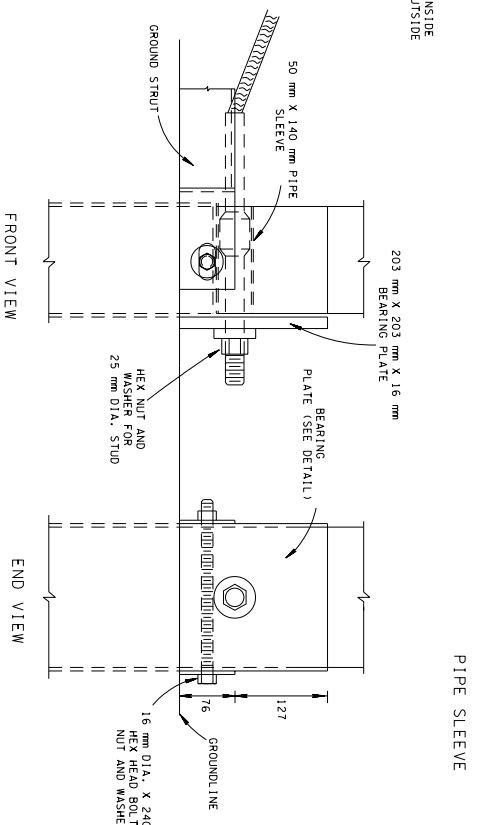
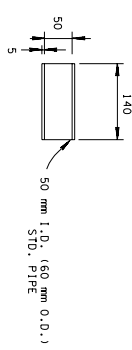
SKT-350 GUARDRAIL TERMINAL ANCHOR (TYPE 38) POST LAYOUT AND ERECTION DETAILS

7-29-98 SM-CR-35

IMPACT HEAD W-BEAM GUARDRAIL ELEMENT DETAILS



FOR BEARING PLATE PLACEMENT THE 127 mm SIDE SHOULD BE INSTALLED UP.



REV. 2-1-99: MADE GENERAL REVISION.
 REV. 5-1-03: RECALC'D 3.81 m SECTIONS OF GUARDRAIL WITH 7.93 m SECTIONS OF GUARDRAIL.



ALL UNITS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
 MINOR REVISION -- FINAL APPROVAL NOT REQUIRED.

STATE OF TENNESSEE
 DEPARTMENT OF TRANSPORTATION

SKT-350
 (2 TUBE)
 GUARDRAIL ELEMENT
 ASSEMBLY DETAILS
 7-29-98 SM-CR-36