



STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION
ROADWAY DESIGN DIVISION
NASHVILLE, TENNESSEE 37243-0348

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INSTRUCTIONAL BULLETIN NO. 14-01

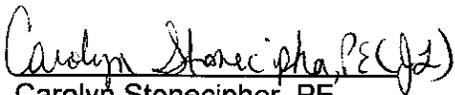
Regarding New Guardrail and Safety Roadway Standard Drawings

Effective for the May 2014 Letting (March 12th Turn-in), the following Guardrail and other Safety Standard Drawings are new. Section V of the Design Guidelines is revised for this update.

Overview of the Changes:

- The new standard drawing S-CZ-1 updates standard drawing RD01-S-12 for the 2011 Roadside Design Guide.
- The new S-PL series drawings are safety plans for typical hazards that occur along roadways. This series consists of some existing drawings that have been renamed and reorganized and some new drawings detailing previously uncovered situations. Designers should note that there are several new procedures included in this section (notably: Guardrail in curves and a major revision to protection of bridge piers in medians.)
- All previous guardrail standards have been combined into two drawings, one each for single sided (S-GR31-1) double sided (S-GR31-2). The height and various other construction details have changed for guardrails. However no changes for how designers layout guardrail have occurred.
- The new S-GRS series are special cases and S-GRC are connection details for guardrails and are essential existing drawings that have been renamed and reorganized. No changes to design procedure have occurred.
- The new S-GRT series are Guardrail Terminal Drawings and S-GRA series are Guardrail Anchor drawings. No design changes have occurred, however designers should note that each drawing indicates other drawings that are referenced in conjunction with it.
- The current drawing S-GR-48 has been renamed S-BPR-1 to match the new naming convention.

See the table on the next page showing which new standard drawing(s) should be used to replace the existing standard drawings


Carolyn Stonecipher, PE
Civil Engineering Director
Roadway Design Division

2/10/14
CS:ARH:MWC
Attachment

New Guardrail and Safety Drawings vs Existing Guardrail Drawings

Current Drawing	New Drawing	Notes
RD01-S-12	S-CZ-1	
S-GR-11 S-GR-12 (single sided g/r) S-GR-13 S-GR-13A (Hardware Only) S-GR-14	S-GR31-1	
S-GR-12 (median guardrail)	S-GR31-2	
S-GR-13A (Delinators)	S-PL-3	
S-GR-15	Incorporated in S-GRT-3D S-GRT-4 S-GRC-drawings	Each W- Beam barrier terminal is now included on the standard drawing for the end terminal or connection drawing that it belongs to. Flared End Element was eliminated.
S-GR-16	S-PL-4	NOTE: Major change to existing design practice
S-GR-17	S-PL-5	
S-GR-18	S-PL-2	
S-GR-19 (Type 12)	S-GRA-1	
S-GR-19 (Type 13)	S-GRT-4	Deadman Anchor Option Eliminated for Type 13
S-GR-19A	S-GRT-1	
S-GR-19B	S-GRA-1A	
S-GR-19C	S-GRA-3	
S-GR-20	S-GRC-3	
S-GR-21	S-PL-1	Added guidance for curves
S-GR-22	S-GRS-2	
S-GR-23	S-GRC-1	
S-GR-23A	S-GRC-2	
S-GR-24	S-PL-3	
S-GR-26 S-GR-27 S-GR-28	S-GRT-3 S-GRT-3D	
S-GR-38	S-GRT-2P	
S-GR-38A	S-GRT-2R	
S-GR-39	S-GRT-3P	
S-GR-43 S-GR-44	S-GRT-2	
S-GR-45	S-GRS-1	
S-GR-46	S-PL-2	
S-GR-47	S-GRS-3	
S-GR-48	S-BPR-1	

<u>DRAWING NUMBER</u>	<u>CURRENT REVISION DATE</u>	<u>DESCRIPTION</u>
S-CZ-1		CLEAR ZONE CRITERIA
S-PL-1		SAFETY PLAN AT ROADSIDE HAZARDS
S-PL-2		SAFETY PLAN AT SIDE ROADS OR PRIVATE DRIVES
S-PL-3		SAFETY PLAN: MINIMUM INSTALLATION AT BRIDGE ENDS
S-PL-4		SAFETY PLAN FOR PIERS IN CLEAR ZONE
S-PL-5		SAFETY PLAN FOR BRIDGE ENDS IN MEDIANS
S-PL-6		SAFETY PLAN: SAFETY HARDWARE PLACEMENT
S-GR31-1		W-BEAM GUARDRAIL
S-GR31-2		MEDIAN DIVIDER GUARDRAIL
S-GRS-1		SPECIAL CASE: LONG SPAN GUARDRAIL, ONE SPAN OMITTED
S-GRS-2		SPECIAL CASE: GUARDRAIL ATTACHMENT TO CONCRETE DECKS
S-GRS-3		SPECIAL CASE: GUARDRAIL FOOTING
S-GRC-1		GUARDRAIL CONNECTION TO BRIDGE ENDS OR BARRIER WALL
S-GRC-2		GUARDRAIL CONNECTION TO BRIDGE ENDS FOR LOW-VOLUME LOCAL ROADS (ADT <= 400)
S-GRC-3		MEDIAN DIVIDER GUARDRAIL TRANSITION TO CONCRETE MEDIAN BARRIERS
S-GRT-1		TYPE 12 GUARDRAIL TERMINAL (BURIED-IN-BACKSLOPE)
S-GRT-2		TYPE 38 GUARDRAIL TERMINAL
S-GRT-2P		EARTH PAD FOR TYPE 38 TERMINAL
S-GRT-2R		EARTH PAD FOR TYPE 38 TERMINAL (RETROFIT)
S-GRT-3		TYPE 21 GUARDRAIL TERMINAL
S-GRT-3D		TYPE 21 GUARDRAIL TERMINAL (DETAILS)
S-GRT-3P		EARTH PAD FOR TYPE 21 TERMINAL
S-GRT-4		TYPE 13 GUARDRAIL TERMINAL (TRAILING END)

IB 14-1

<u>DRAWING NUMBER</u>	<u>CURRENT REVISION DATE</u>	<u>DESCRIPTION</u>
S-GRA-1		GUARDRAIL ANCHOR FOR TYPE 12 TERMINAL
S-GRA-1A		GUARDRAIL ANCHOR FOR TYPE 12 TERMINAL (ALTERNATIVE)
S-GRA-3		GUARDRAIL ANCHOR FOR TYPE 21, 13 AND IN-LINE TERMINALS
S-BPR-1		BIKE/PEDESTRIAN SAFETY RAIL

The following drawings are voided on the effective date:

S-GR-11, S-GR-12, S-GR-13, S-GR-13A, S-GR-14, S-GR-15, S-GR-16, S-GR-17, S-GR-18, S-GR-19, S-GR-19A, S-GR-19B, S-GR-19C, S-GR-20, S-GR-21, S-GR-22, S-GR-23, S-GR-23A, S-GR-24, S-GR-26, S-GR-27, S-GR-28, S-GR-38, S-GR-38A, S-GR-43, S-GR-44, S-GR-45, S-GR-46, S-GR-47, S-GR-48, AND RD01-S-12. S-MB-1 through S-MB-8 are also voided at this time.

DESIGN SPEED	DESIGN ADT	FORESLOPES (H:V)			BACKSLOPES (H:V)		
		6:1 OR FLATTER	5:1 TO 4:1	3:1	6:1 OR FLATTER	5:1 TO 4:1	3:1
40 MPH OR LESS	UNDER 750 (7)	7 - 10	7 - 10	(4)	7 - 10	7 - 10	7 - 10
	750 - 1500	10 - 12	12 - 14	(4)	12 - 14	12 - 14	12 - 14
	1500 - 6000	12 - 14	14 - 16	(4)	14 - 16	14 - 16	14 - 16
	OVER 6000	14 - 16	16 - 18	(4)	16 - 18	16 - 18	16 - 18
45-50 MPH	UNDER 750 (7)	10 - 12	12 - 14	(4)	10 - 12	8 - 10	8 - 10
	750 - 1500	14 - 16	16 - 20	(4)	14 - 16	12 - 14	10 - 12
	1500 - 6000	16 - 18	20 - 26	(4)	16 - 18	14 - 16	12 - 14
	OVER 6000	20 - 22	24 - 28	(4)	20 - 22	18 - 20	14 - 16
55 MPH	UNDER 750 (7)	12 - 14	14 - 18	(4)	10 - 12	10 - 12	8 - 10
	750 - 1500	16 - 18	20 - 24	(4)	16 - 18	14 - 16	10 - 12
	1500 - 6000	20 - 22	24 - 30	(4)	20 - 22	16 - 18	14 - 16
	OVER 6000	22 - 24	26 - 32 (3)	(4)	22 - 24	20 - 22	16 - 18
60 MPH	UNDER 750 (7)	16 - 18	(9)	(9)	14 - 16	12 - 14	10 - 12
	750 - 1500	20 - 24	(9)	(9)	20 - 22	16 - 18	12 - 14
	1500 - 6000	26 - 30	(9)	(9)	24 - 26	18 - 22	14 - 18
	OVER 6000	30 - 32 (3)	(9)	(9)	26 - 28	24 - 26	20 - 22
65-70 MPH	UNDER 750 (7)	18 - 20	(9)	(9)	14 - 16	14 - 16	10 - 12
	750 - 1500	24 - 26	(9)	(9)	20 - 22	18 - 20	12 - 16
	1500 - 6000	28 - 32 (3)	(9)	(9)	26 - 28	22 - 24	16 - 20
	OVER 6000	30 - 34 (3)	(9)	(9)	28 - 30	26 - 30	22 - 24

ADAPTED FROM TABLE 3.1 OF THE "ROADSIDE DESIGN GUIDE," AASHTO, 2011.

$CZ_c = (L_c)(K_{cz})$
 WHERE CZ_c = CLEAR ZONE ON OUTSIDE OF CURVATURE, (FEET)
 L_c = CLEAR ZONE DISTANCE, (FEET) (FROM TABLE-A)
 K_{cz} = CURVE CORRECTION FACTOR

NOTE: THE CLEAR ZONE CORRECTION FACTOR IS APPLIED TO THE OUTSIDE OF CURVES ONLY. CURVES FLATTER THAN 2950 FEET DO NOT REQUIRE AN ADJUSTED CLEAR ZONE.

RADIUS (FT)	DESIGN SPEEDS (MPH)							
	40	45	50	55	60	65	70	
2950	1.1	1.1	1.1	1.2	1.2	1.2	1.2	
2300	1.1	1.1	1.2	1.2	1.2	1.2	1.3	
1970	1.1	1.2	1.2	1.2	1.3	1.3	1.4	
1640	1.1	1.2	1.2	1.3	1.3	1.4	1.4	
1475	1.2	1.2	1.3	1.3	1.4	1.4	1.5	
1315	1.2	1.2	1.3	1.3	1.4	1.4	-	
1150	1.2	1.2	1.3	1.4	1.5	1.5	-	
985	1.2	1.3	1.4	1.5	1.5	1.5	-	
820	1.3	1.3	1.4	1.5	-	-	-	
660	1.3	1.4	1.5	-	-	-	-	
495	1.4	1.5	-	-	-	-	-	
330	1.5	-	-	-	-	-	-	

ADAPTED FROM TABLE 3.2 OF THE "ROADSIDE DESIGN GUIDE," AASHTO, 2011.

IF HAZARD IS IDENTIFIED IN CLEAR ZONE

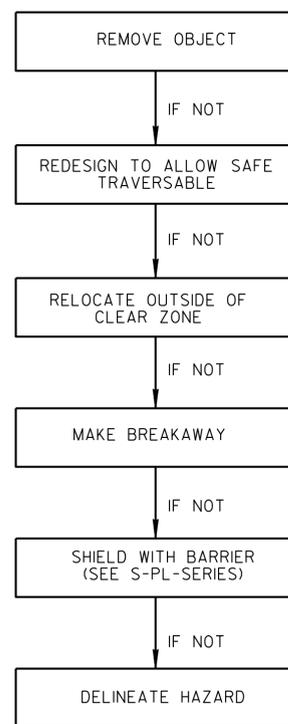


FIGURE A. DESIGN OPTIONS FOR HAZARDS IN CLEAR ZONE

GENERAL NOTES

- CLEAR ZONE IS DEFINED IN THE "ROADSIDE DESIGN GUIDE," AASHTO, 2011, AS THE TOTAL ROADSIDE BORDER AREA, STARTING AT THE EDGE OF THE TRAVELED WAY, AVAILABLE FOR SAFE USE BY ERRANT VEHICLES. THIS AREA MAY CONSIST OF A SHOULDER, A RECOVERABLE SLOPE, A NON-RECOVERABLE SLOPE, AND/OR A CLEAR RUN-OUT AREA. THE DESIRED WIDTH IS DEPENDENT ON THE TRAFFIC VOLUMES, SPEEDS, AND THE ROADSIDE GEOMETRY. SEE THE "ROADSIDE DESIGN GUIDE," AASHTO, 2011 FOR MORE DETAILED INFORMATION.
- CLEAR ZONE DISTANCES ARE RELATED TO DESIGN SPEED, TRAFFIC VOLUME AND SLOPE CONDITIONS AS SHOWN IN TABLE A.
- WHERE A SITE SPECIFIC INVESTIGATION INDICATES A HIGH PROBABILITY OF CONTINUING CRASHES, OR SUCH OCCURRENCES ARE INDICATED BY CRASH HISTORY, THE DESIGNER MAY PROVIDE CLEAR-ZONE DISTANCES GREATER THAN THE CLEAR ZONE SHOWN IN THE TABLE A.
- BECAUSE RECOVERY IS LESS LIKELY ON THE UNSHIELDED, TRAVERSABLE (3:1), FILL SLOPES, FIXED OBJECTS SHOULD NOT BE PRESENT IN THE VICINITY OF THE TOES OF THESE SLOPES. RECOVERY OF HIGH-SPEED VEHICLES THAT ENCROACH BEYOND THE EDGE OF THE SHOULDER MAY BE EXPECTED TO OCCUR BEYOND THE TOE OF SLOPE. DETERMINATION OF THE WIDTH OF THE RECOVERY AREA AT THE TOE OF THE SLOPE SHOULD TAKE INTO CONSIDERATION RIGHT-OF-WAY AVAILABILITY, ENVIRONMENTAL CONCERNS, ECONOMIC FACTORS, SAFETY NEEDS, AND CRASH HISTORIES. ALSO, THE DISTANCE BETWEEN THE EDGE OF THE THROUGH TRAVELED LANE AND THE BEGINNING OF THE 3:1 SLOPE SHOULD INFLUENCE THE RECOVERY AREA PROVIDED AT THE TOE OF THE SLOPE. SEE THE ROADSIDE DESIGN GUIDE, AASHTO 2011 FOR MORE INFORMATION.
- THESE MODIFICATIONS ARE NORMALLY CONSIDERED ONLY WHEN CRASH HISTORIES INDICATE A NEED OR A SPECIFIC SITE INVESTIGATION SHOWS A DEFINITE CRASH POTENTIAL THAT COULD BE SIGNIFICANTLY LESSENED BY INCREASING THE CLEAR-ZONE WIDTH, AND WHEN SUCH INCREASES ARE COST EFFECTIVE.
- SEE THE "ROADSIDE DESIGN GUIDE," AASHTO, 2011, FOR COMPOSITE ROADSIDE SECTIONS AND DISCUSSION ON OUTSIDE DITCHES AND CHANNELS.
- FOR ROADWAYS WITH LOW VOLUMES, IT MAY NOT BE PRACTICAL TO PROVIDE FULL CLEAR ZONE DISTANCE IN SUCH CASES PROVIDE MAXIMUM AMOUNT OF CLEAR ZONE THAT IS PRACTICAL.
- CLEAR ZONE DISTANCES DO NOT APPLY TO LOW SPEED URBAN ROADS. IN SUCH CASES PROVIDE A MINIMUM LATERAL OFFSET FROM EDGE OF TRAVELED WAY TO CURB. (SEE FIGURE B)
- USE 6:1 SLOPES ONLY ON ROADWAYS WITH DESIGN SPEEDS 60 MPH AND ABOVE. IF 6:1 IS IMPRACTICAL, CONSIDER SHIELDING AREA WITH BARRIER SYSTEM.
- STOPPING SIGHT DISTANCE THROUGHOUT THE HORIZONTAL CURVE SHALL BE MAINTAINED. IN SOME CASES ADDITIONAL RIGHT OF WAY MAY BE REQUIRED TO INSURE THIS AREA IS KEPT CLEAR OF SIGHT OBSTRUCTIONS.

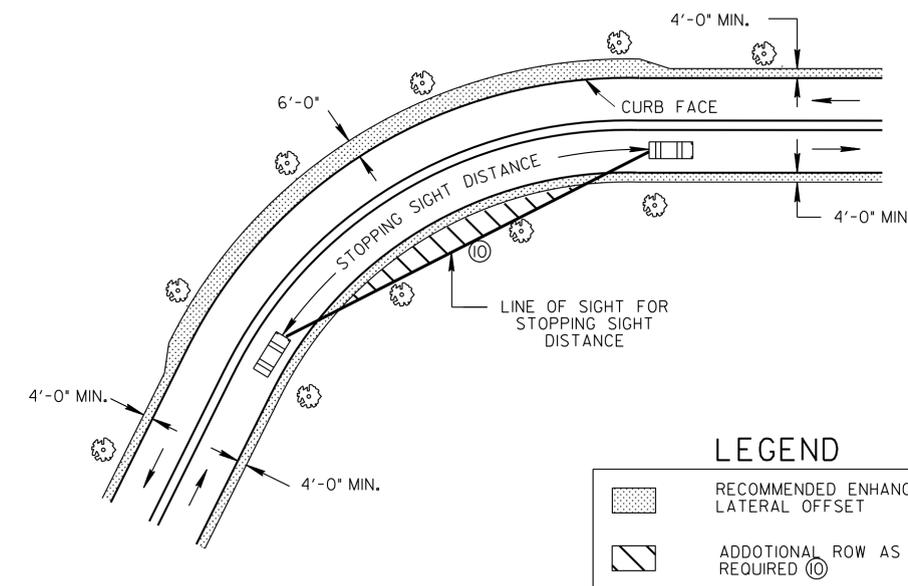
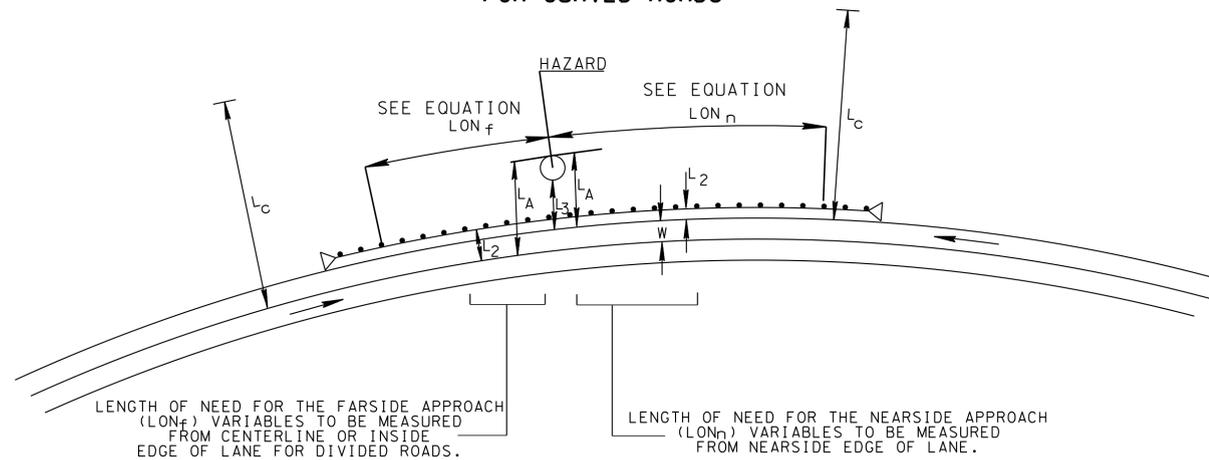


FIGURE B. MINIMUM LATERAL OFFSET FOR LOW SPEED URBAN ROADS (8)

**FIGURE A
LENGTH OF NEED DISTANCE
FOR CURVED ROADS**

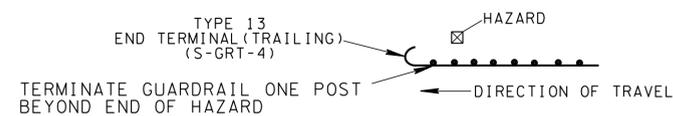


LENGTH OF NEED FOR CURVED ROADS CALCULATION

$LON = \pi AK / 180$	LEGEND	
CALCULATION STEPS	L_C = THE CLEAR ZONE DISTANCE AS DETERMINED BY THE CURVE EQUATION ON S-CZ-1 L_A = DISTANCE FROM EDGE OF TRAVELED WAY TO THE LATERAL EXTENT OF HAZARD. NOTE THAT L_A SHOULD NEVER EXCEED THE "CLEAR DISTANCE" (L_C). L_2 = DISTANCE FROM EDGE OF TRAVELED WAY TO BARRIER. L_3 = DISTANCE FROM EDGE OF PAVEMENT TO NEAR FACE OF HAZARD. R = HORIZONTAL CURVE RADIUS W = WIDTH OF LANES (DISTANCE BETWEEN CENTERLINE AND EDGE OF TRAVELED WAY) FOR THE FARSIDE LON CALCULATION $W = 0$	
<ol style="list-style-type: none"> 1. CALCULATE A, B, & H USING KNOWN INFORMATION 2. CALCULATE FOR I & J USING A, B & H 3. SOLVE FOR K 4. SOLVE FOR LON 	INTERMEDIATE CALCULATIONS	$I = \arcsin(B/H)$ $J = \arcsin(B/A)$ $K = 180 - I - J$

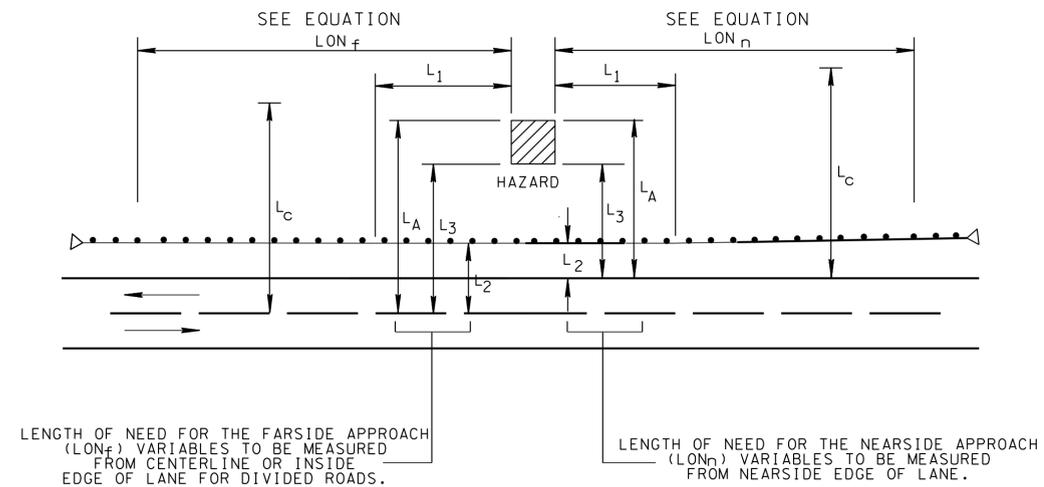
*NOTE: THE EQUATION FOR LON FOR THE NEARSIDE AND FARSIDE APPROACHES IS THE SAME. THE ONLY DIFFERENCES ARE $W=0$ FOR THE FARSIDE AND HOW THE VARIABLE ARE MEASURED AS NOTED ON FIGURE A

**FIGURE C
TRAILING END GUARDRAIL TERMINALS**



NOTE: MAY ONLY BE USED FOR DIVIDED ROADWAYS, ONE WAY ROADS, OR TWO WAY MULTI-LANE ROADS WHERE THE LANES ON THE NEAR SIDE ARE WIDER THAN THE CLEAR ZONE FOR THE OPPOSING DIRECTION TRAFFIC.

**FIGURE B
THE LENGTH OF NEED DISTANCE
FOR TANGENT ROADS**



LENGTH OF NEED FOR TANGENT ROADS CALCULATION

LON_f OR $LON_n = \frac{L_A - L_2 - 0.75}{L_A / L_R}$	LEGEND	
NOTE: (A) 0.75 ACCOUNTS FOR FLARE RATE OF TERMINAL (B) SEE ROADSIDE DESIGN GUIDE SECTION 5.6.4 FOR ADDITIONAL INFORMATION	L_C = THE CLEAR ZONE DISTANCE AS DETERMINED ON S-CZ-1 L_A = DISTANCE FROM EDGE OF TRAVELED WAY (EDGE OF PAVEMENT) TO THE LATERAL EXTENT OF HAZARD. NOTE THAT L_A SHOULD NEVER EXCEED THE "CLEAR DISTANCE" (L_C). L_2 = DISTANCE FROM EDGE OF TRAVELED WAY TO BARRIER. L_R = RUNOUT LENGTH (SEE TABLE BELOW FOR VALUE). L_3 = DISTANCE FROM EDGE OF PAVEMENT TO NEAR FACE OF HAZARD.	

*NOTE: THE EQUATION FOR LON FOR THE NEARSIDE AND FARSIDE APPROACHES IS THE SAME. THE ONLY DIFFERENCE IS HOW THE VARIABLE ARE MEASURED AS NOTED ON FIGURE B

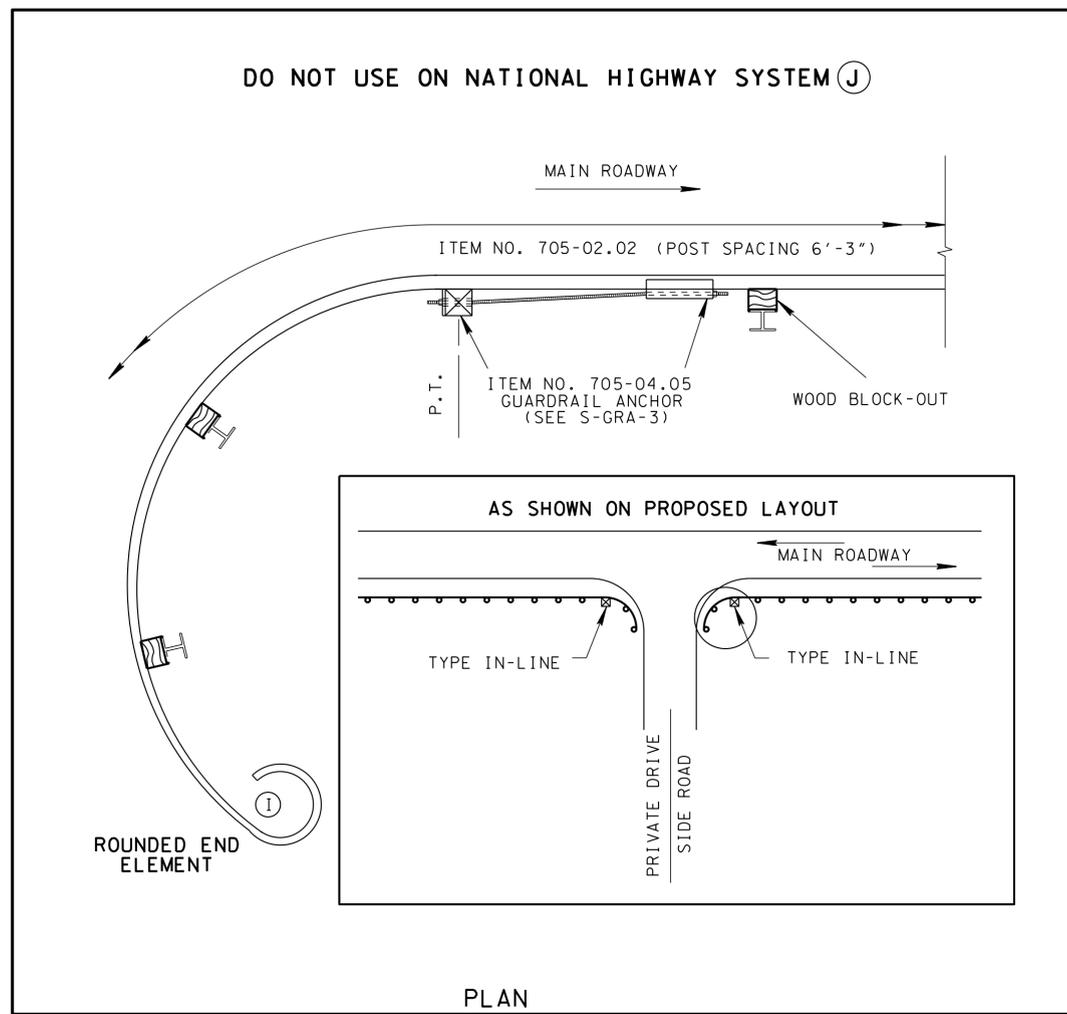
**RUNOUT LENGTHS (L_R) FOR
BARRIER DESIGN (FT)**

DESIGN SPEED (MPH)	DESIGN TRAFFIC VOLUME (ADT)			
	OVER 10000 VPD	5000-10000 VPD	1000-5000 VPD	UNDER 1000 VPD
70	360	330	290	250
60	300	250	210	200
50	230	190	160	150
40	160	130	110	100
30	110	90	80	70

GENERAL NOTES

- (A) 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 VEHICLES FROM THE HAZARD.
- (B) THE THIRD POST FROM THE END TREATMENT SHALL BE PLACED AT THE END OF THE LENGTH OF NEED EXCEPT FOR TRAILING ENDS AS SHOWN IN FIGURE C.
- (C) WHEN DESIRABLE CLEAR ZONE LINE FALLS INSIDE THE FILL SLOPE LINE (FOR 3:1 OR STEEPER), EXTEND THE CLEAR ZONE TO THE TOE OF THE SLOPE.
- (D) THIS DRAWING IS FOR TYPICAL ROADSIDE OBSTACLES OR STEEP SLOPES IN THE CLEAR ZONE. SEE THE FOLLOWING SAFETY PLAN DRAWINGS FOR THESE SPECIAL CASES:
 S-PL-2; HAZARDS NEAR INTERSECTIONS
 S-PL-3; TYPICAL BRIDGE ENDS
 S-PL-4; BRIDGE PIERS IN CLEAR ZONE
 S-PL-5; BRIDGE ENDS IN MEDIANS
 S-PL-6; NARROW MEDIAN PROTECTION
- (E) IF $L_3 - L_2$ IS LESS THAN 4.0 FEET USE CONCRETE MEDIAN BARRIER INSTEAD OF GUARDRAIL.
- (F) THE MINIMUM INSTALLATION DISTANCE IS EQUAL TO THE $LON_f + LON_n +$ THE LENGTH OF THE HAZARD

DO NOT USE ON NATIONAL HIGHWAY SYSTEM (J)



GUARDRAIL TERMINAL ANCHOR (TYPE IN-LINE) APPLICATION FOR LOCAL ROADS

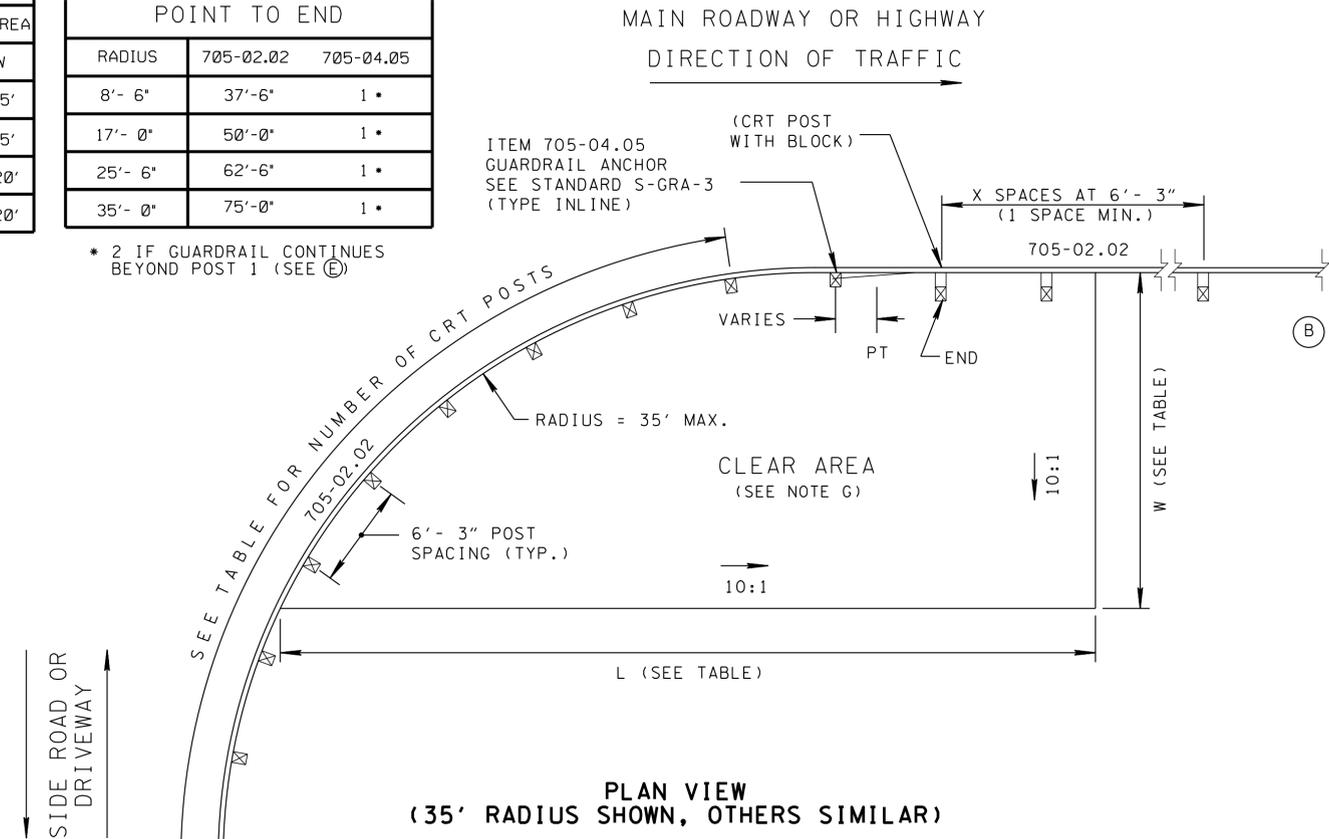
TABLE A
POST AND CLEAR AREA REQUIREMENTS

GUARDRAIL RADIUS	NUMBER OF CRT POSTS	CLEAR AREA	
		L	W
(F) 8'-6"	5	30'	15'
17'-0"	6	30'	15'
25'-6"	8	40'	20'
35'-0"	11	50'	20'

TABLE B
ESTIMATED QUANTITIES FROM BEGINNING POINT TO END

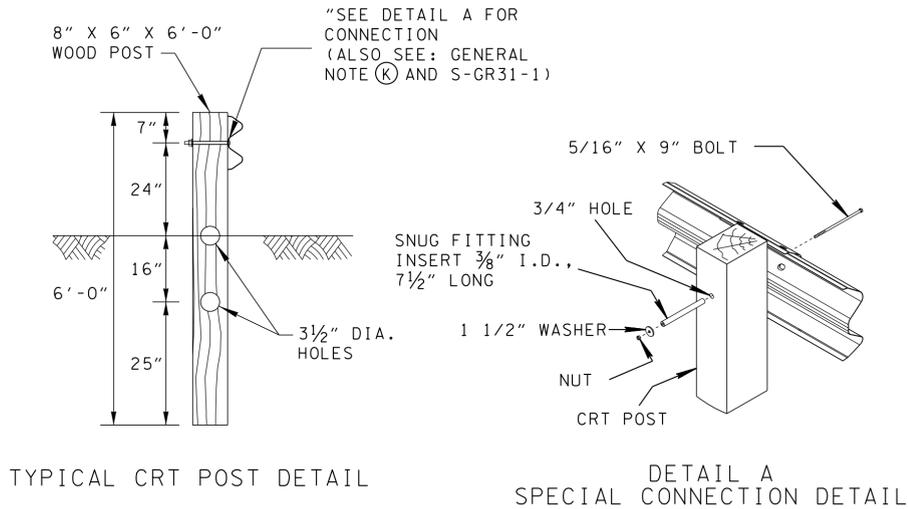
RADIUS	705-02.02	705-04.05
8'-6"	37'-6"	1 •
17'-0"	50'-0"	1 •
25'-6"	62'-6"	1 •
35'-0"	75'-0"	1 •

* 2 IF GUARDRAIL CONTINUES BEYOND POST 1 (SEE E)



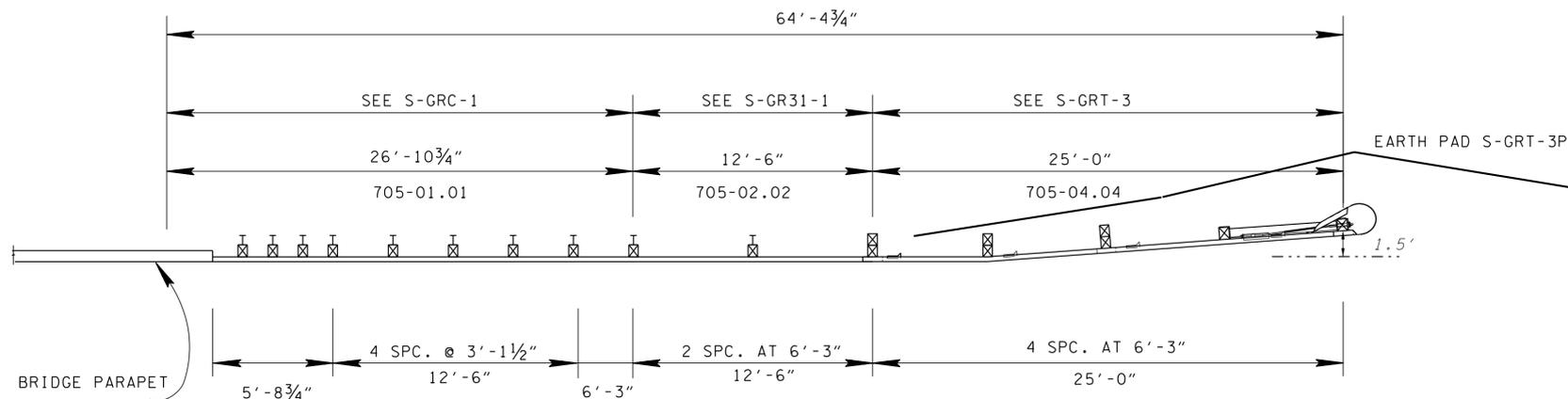
PLAN VIEW (35' RADIUS SHOWN, OTHERS SIMILAR)

- GENERAL NOTES
- (A) THIS STANDARD DRAWING IS TO BE USED WHEN THE L.O.N. EXTENDS TO OR BEYOND AN INTERSECTIONS. DESIGNER IS TO VERIFY THE ENTIRE LENGTH CAN BE CONSTRUCTED WITHIN THE PROPOSED RIGHT-OF-WAY. USE THE NEAREST, LARGER RADIUS FROM TABLE A THAN THE INTERSECTION RADIUS. FOR INSTALLATION WHERE GUARDRAIL RADIUS IS LARGER THAN 35 FEET USE STANDARD INSTALLATION PER S-GR31-1
 - (B) IF CONNECTING TO BRIDGE RAIL OR OTHER CONCRETE BARRIER SEE S-GRC-1 FOR MINIMUM LENGTH OF TRANSITION SECTION BETWEEN GUARDRAIL AND RIGID WALL.
 - (C) THE FORESLOPE FROM THE EDGE OF THE SHOULDER INTO THE FACE OF GUARDRAIL SHOULD NOT BE STEEPER THAN 10(H):1(V).
 - (D) SEE STANDARD DRAWINGS (S-GR31-1) FOR POSTS, RAIL, AND HARDWARE STANDARDS FOR CONSTRUCTION.
 - (E) USE APPROPRIATE END TERMINAL PER STANDARD DRAWINGS (S-GRT-SERIES). IF GUARDRAIL CONTINUES ALONG SIDE ROAD OR DRIVEWAY BEYOND THE POST INSTALL GUARDRAIL ANCHOR AT POST 1 (TYPE IN-LINE) SEE S-GRA-3.
 - (F) DO NOT CONNECT RAIL TO CENTER POST IN CURVE FOR 8'-6" RADIUS DESIGN.
 - (G) THE CLEAR AREA BEHIND THE GUARDRAIL SHALL REMAIN UNOBSTRUCTED AND UNENCUMBERED TO ALLOW THE GUARDRAIL TO FUNCTION PROPERLY. OBSTACLES (I.E., ENDWALLS, SIGNS, DITCHES, ETC.) WITHIN THIS AREA MUST BE REMOVED, RELOCATED, OR REDESIGNED.
 - (H) W-BEAMS SHALL BE SHOP BENT AS REQUIRED.
 - (I) INCLUDED IN THE COST OF OTHER ITEMS.
 - (J) TO DETERMINE IF ROAD IS ON THE NATIONAL HIGHWAY SYSTEM CONSULT THE FUNCTIONAL CLASSIFICATION MAPS MAINTAINED BY TDOT LONG RANGE PLANNING DIVISION. (TDOT.STATE.US/LONGRANGE/FUNCTIONALCLASS.HTM)



SPECIAL CRT POST NOTES

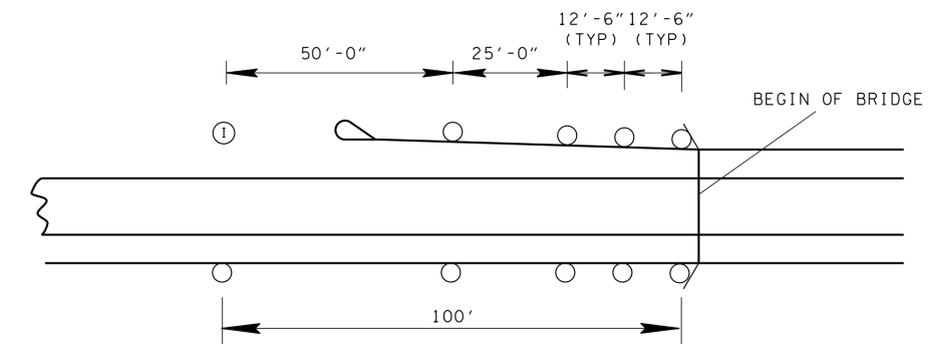
- (1) FEWER CRT POST ARE REQUIRED FOR SMALLER RADIUS; INCLUDE CRT POST AT POINT B. ATTACH GUARDRAIL TO POST WITH A 5/16" X 9" LONG BOLT, A 3/8" X 7 1/2" SNUG FITTING INSERT AND A 1 1/2" WASHER WITH NUT ON BACK OF POST.
- (2) THE FLAT WASHER IS USED UNDER THE NUT, BEHIND THE POST ONLY. NO WASHER IS USED AT THE RAIL.



PLAN

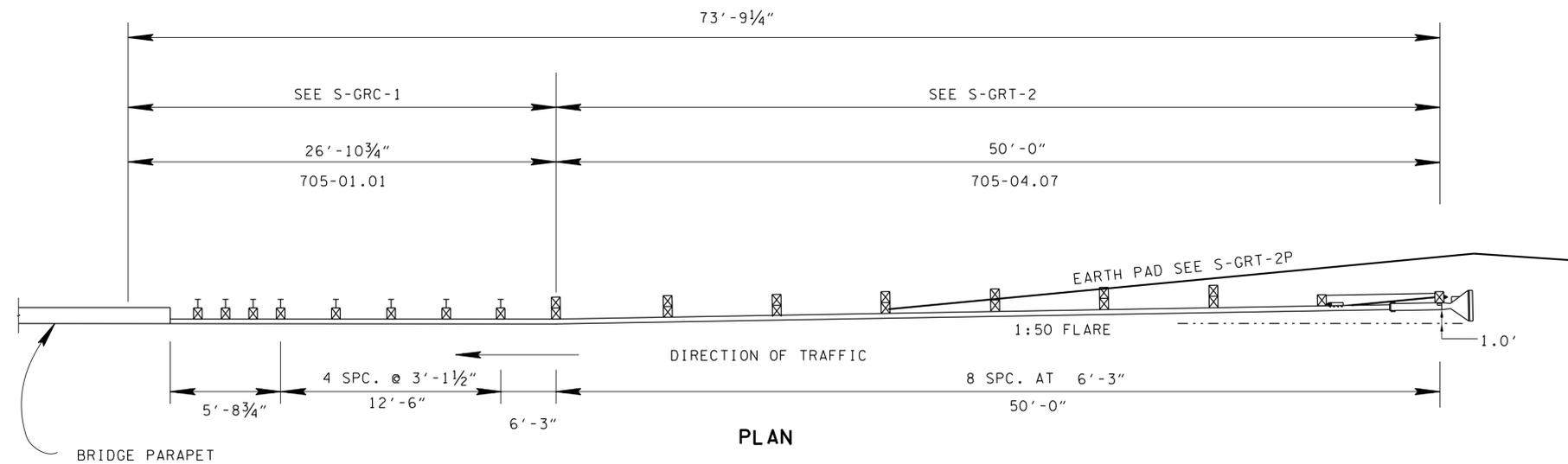
MINIMUM INSTALLATION LENGTH FOR SLOTTED GUARDRAIL TERMINAL

SAFETY PERFORMANCE OF SLOTTED GUARDRAIL TERMINAL IS ACCEPTABLE ACCORDING TO THE TL-2 EVALUATION CRITERIA SPECIFIED IN NCHRP REPORT 350. SLOTTED GUARDRAIL TERMINAL MAY BE USED ON ALL LOW SPEED ROADS NOT ON THE DESIGNATED NATIONAL HIGHWAY SYSTEM, INCLUDING SIDE ROADS TO STATE AND US ROUTES, WHEN THE CURRENT DESIGN SPEED EXCEEDS 40 MILES PER HOUR. EARTH PAD IS REQUIRED AS SHOWN ON S-GRT-3P. FOR LOW VOLUME LOCAL ROADS WITH ADT<400 VEH/DAY S-GRC-2 MAY BE USED.



MIN. DELINEATOR PLACEMENT AT BRIDGE APPROACHES INSTALLED ON GUARDRAIL POSTS

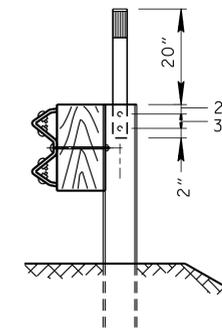
LEGEND: "o" DENOTES GUARDRAIL DELINEATORS. (SHOULDER LINES AND GUARDRAIL POSTS NOT SHOWN FOR CLARITY.)



PLAN

MINIMUM INSTALLATION LENGTH FOR TANGENTIAL GUARDRAIL END TERMINAL

SAFETY PERFORMANCE OF TANGENTIAL GUARDRAIL TERMINAL END SHALL MEET THE TL-3 EVALUATION CRITERIA SPECIFIED IN NCHRP REPORT 350 OR AASHTO MASH. ONLY TERMINAL LISTED ON OPL LIST 17 SHALL BE USED. EARTH PAD IS REQUIRED AS SHOWN ON S-GRT-2P OR S-GRT-2M AS DESCRIBED ON THE DRAWING.



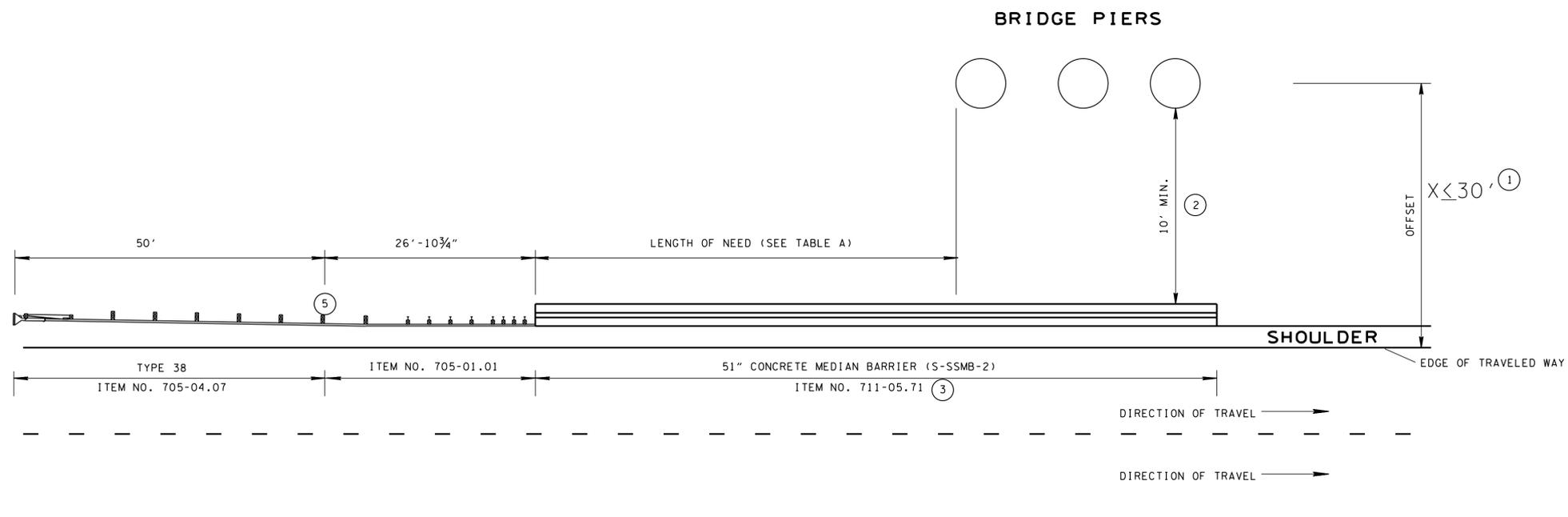
STEEL POST

GENERAL NOTES

- (A) THIS DRAWING SHALL BE USED FOR BRIDGE ENDS OR RIGID CONCRETE BARRIER WALL ENDS ONLY. FOR OTHER HAZARDS STANDARD DRAWING S-PL-1 SHALL BE USED TO DETERMINE LENGTH OF NEED FOR GUARDRAIL.
- (B) SEE STANDARD DRAWING S-GRC-1 FOR DETAILS AND SPECIFICATIONS REGARDING INSTALLATION OF PROTECTIVE GUARDRAIL AT BRIDGE ENDS PAID FOR UNDER ITEM NO. 705-01.01 GUARDRAIL AT BRIDGE ENDS.
- (C) IF A FIELD EVALUATION DISCOVERS A SECONDARY HAZARD, THEN STANDARD DRAWING S-GRP-1 SHALL BE USED TO DETERMINE LENGTH OF NEED.
- (D) LOCATIONS WHERE ABOVE SHOWN MINIMUM TRANSITION AND GUARDRAIL TERMINAL ANCHOR CAN NOT BE INSTALLED DUE TO SIDE ROAD OR DRIVEWAY, OTHER ALTERNATIVES SHALL BE CONSIDERED SUCH AS CURVED GUARDRAIL (S-PL-2) OR INTRODUCING NON-GATING ATTENUATOR.

FLEXIBLE DELINEATOR GENERAL NOTES

- (A) DELINEATORS SHALL CONFORM TO NOTES AND DETAILS SPECIFIED ON STANDARD DRAWING T-S-11,
- (B) DELINEATORS SHALL BE INSTALLED ACROSS BRIDGES ONLY WHEN GUARDRAIL IS CONTINUOUS ACROSS BRIDGES. DELINEATOR SPACING ON BRIDGES SHALL BE AT 12'-6" INTERVALS.
- (C) THE COLOR OF DELINEATORS SHALL CONFORM TO THE COLOR OF EDGELINES STIPULATED IN SECTION 3B.06 OF THE MUTCD (CURRENT EDITION).
- (D) DELINEATORS SHALL BE FACED TOWARD THE APPROACHING TRAFFIC IN LANE ADJACENT TO THE GUARDRAIL AT ALL LOCATIONS.
- (E) DELINEATORS SHALL BE FIRMLY SECURED TO POST BY TWO CONNECTIONS.
- (F) THE TWO HOLES IN THE STEEL GUARDRAIL POSTS USED TO ATTACH THE DELINEATOR SHALL BE 1/4" IN DIAMETER. IF THE HOLES ARE SHOP DRILLED IT SHALL BE 1/4" IN DIAMETER AND SHALL BE SHOP DRILLED OR BE DONE PRIOR TO GALVANIZING THE POST. IF THE HOLES ARE FIELD DRILLED THEY SHALL BE THOROUGHLY PAINTED WITH A TOUCH-UP GALVANIZING SPRAY PAINT PRIOR TO ATTACHING THE DELINEATOR POST.
- (G) THE COST OF FURNISHING AND INSTALLING THESE BRIDGE APPROACH GUARDRAIL DELINEATORS SHALL BE INCLUDED IN THE PRICE BID FOR THE ITEMS OF GUARDRAIL TO WHICH THE DELINEATORS ARE ATTACHED.
- (H) ONLY DELINEATORS LISTED ON THE OPL, LIST 1, SECTION G.2 GUARDRAIL POST DELINEATION, MAY BE USED.
- (I) DELINEATORS ARE NOT REQUIRED IF GUARDRAIL IS TERMINATED PRIOR TO INDICATED LOCATION.

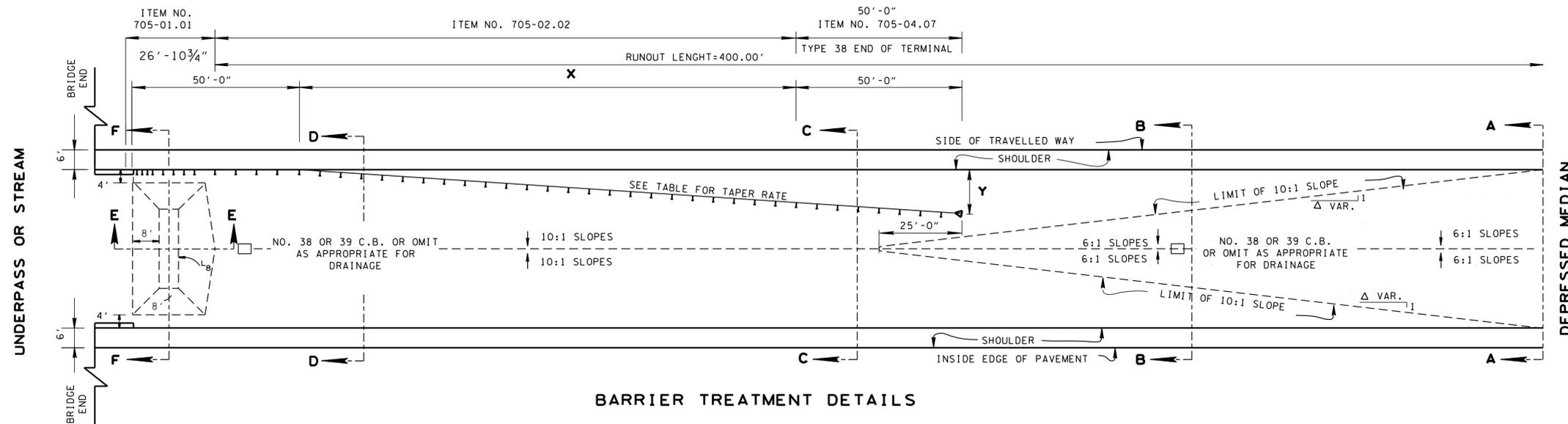


BRIDGE PIERS IN CLEAR ZONE

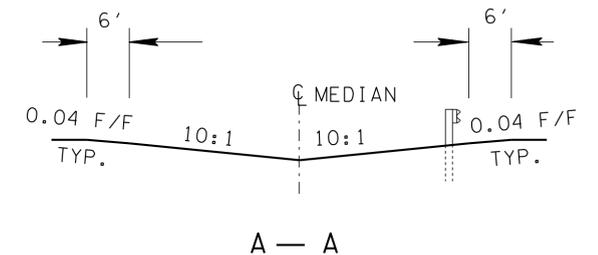
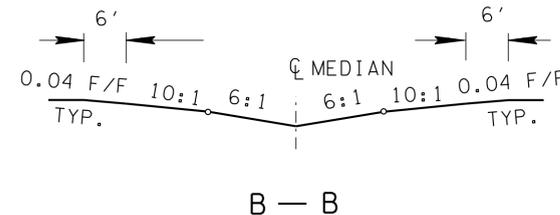
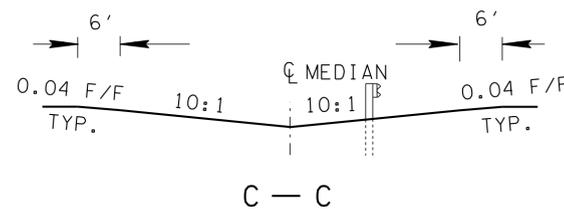
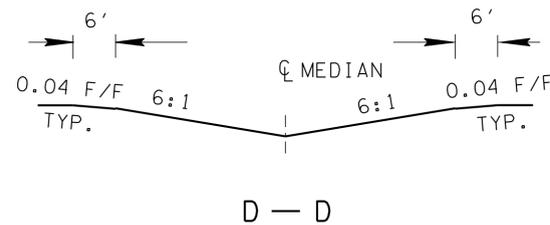
OFFSET	LENGTH OF NEED (LON)		
	50 MPH	60 MPH	70 MPH
12'	168'	218'	262'
18'	181'	236'	283'
24'	190'	247'	297'
30'	196'	255'	306'

TABLE A (6)
LENGTH OF NEED FOR CONCRETE MEDIAN BARRIER

- GENERAL NOTES**
- ① USE THIS STANDARD ON ALL HIGH SPEED FACILITIES (45 MPH AND ABOVE) WHERE THE DISTANCE FROM EDGE OF TRAVEL WAY TO THE PIER IS LESS THAN 30'.
 - ② IF THE DISTANCE FROM THE MEDIAN BARRIER TO THE FACE OF THE PIER IS LESS THAN 10 FEET, NOTIFY STRUCTURES DIVISION THAT THE REQUIREMENTS OF AASHTO BRIDGE DESIGN SPECIFICATION 3.6.5. CANNOT BE MET WITH STANDARD DESIGN AND SPECIAL DESIGN IS REQUIRED.
 - ③ LENGTH OF ITEM 711-05.71 TO INCLUDE DISTANCE BETWEEN BEGIN AND END STATION OF BRIDGE PIERS PLUS LENGTH OF NEED (LON) DISTANCE FROM TABLE A.
 - ④ PLAN SHOWN IS FOR TREATMENT ON ONE SIDE OF MEDIAN, BUT PLAN APPLIES TO STRUCTURAL BRIDGE COMPONENTS WITHIN 30 FEET OF THE ROADWAY ON THE RIGHT SIDE ALSO.
 - ⑤ IF SPACE IS LIMITED, NON-GATING ATTENUATOR MAY BE SUBSTITUTED AND ATTACHED TO THE END OF THE CONCRETE BARRIER WALL.
 - ⑥ THE LON DIMENSION SHOWN ON THIS TABLE ARE TO BE USED FOR TANGENT OR NEAR TANGENT CONDITIONS. IN THE CASE OF CURVATURE USE STANDARD DRAWING S-PL-1 TO DETERMINE THE POINT OF NEED.



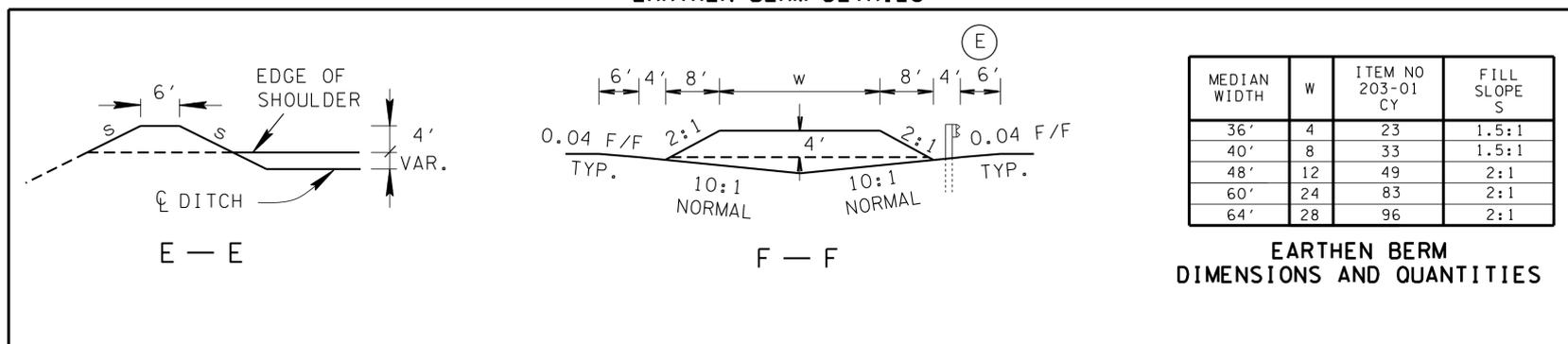
BARRIER TREATMENT DETAILS



DESIGN SPEED MPH	DIMENSIONS			ESTIMATED QUANTITIES (D)		
	TAPER RATE	X	Y	705-01.01	705-02.02	705-04.07
70	15:1	200'-0"	16'-8"	26'-10 3/4"	200'-0"	1 EACH
60	14:1	137'-6"	13'-5"	26'-10 3/4"	137'-6"	1 EACH
≤55	12:1	100'-0"	12'-6"	26'-10 3/4"	100'-0"	1 EACH

GUARDRAIL DIMENSIONS AND QUANTITIES

EARTHEN BERM DETAILS



EARTHEN BERM DIMENSIONS AND QUANTITIES

GENERAL NOTES

- (A) THE CONTRACTOR IS TO ELIMINATE THE 1 FOOT FLARE SHOWN ON GUARDRAIL STANDARD DRAWINGS FOR TANGENTIAL GUARDRAIL TERMINAL ANCHORS (FLARED INSTALLATIONS ONLY).
- (B) ONLY ONE APPROACH SHOWN OTHER APPROACH IDENTICAL.
- (C) THE DIMENSIONS SHOWN IN THIS TABLE ARE TO BE USED IN ALL TANGENT OR NEARLY TANGENT SITUATIONS WITH DESIGN SPEEDS 70 MPH OR BELOW. WHEN THE DESIGN SPEED EXCEEDS 70 MPH OR OTHER GEOMETRIC FEATURES SUCH AS CURVATURE, SKEWED BRIDGES, OR ADDITIONAL HAZARDS ARE PRESENT, THE DESIGNER SHALL USE STANDARD DRAWING S-PL-1.
- (D) QUANTITIES SHOWN ARE FOR ONE APPROACH.
- (E) BASED ON 6' SHOULDER, FOR OTHER WIDTH SHOULDERS ADJUST WIDTH OF BERM AS NECESSARY. PLACEMENT OF GUARDRAIL IS NOT AFFECTED.

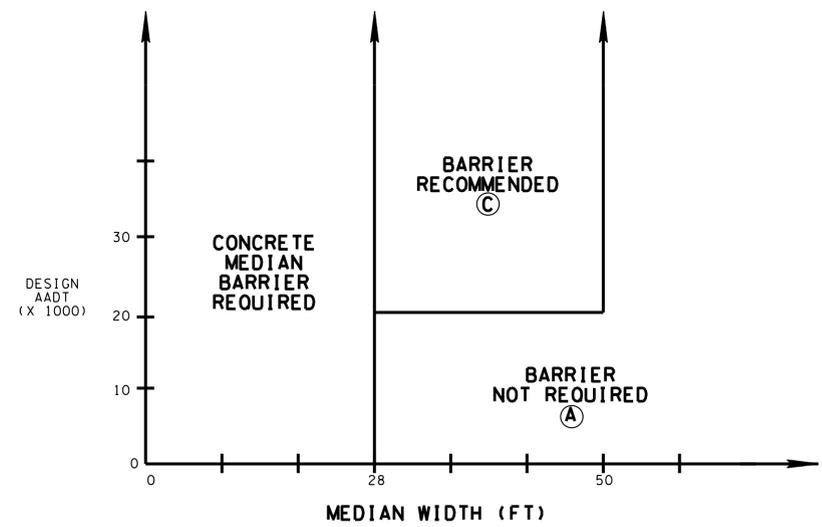
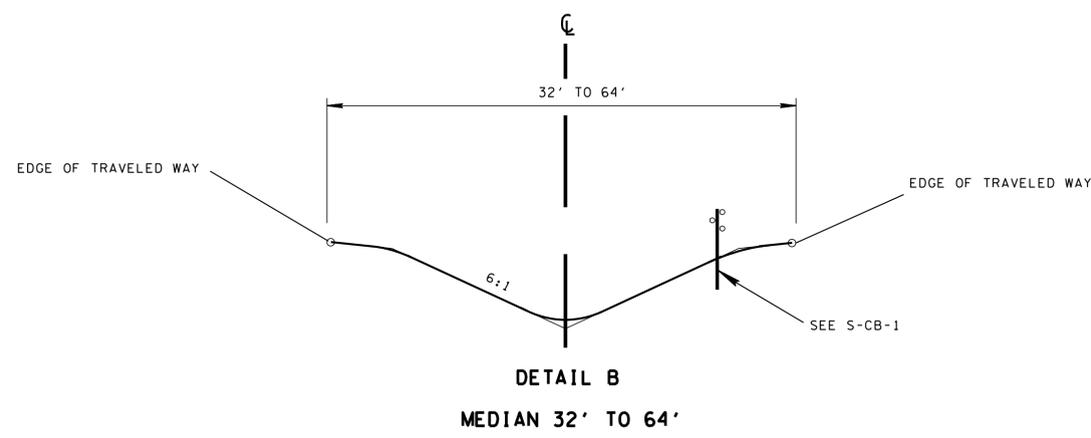
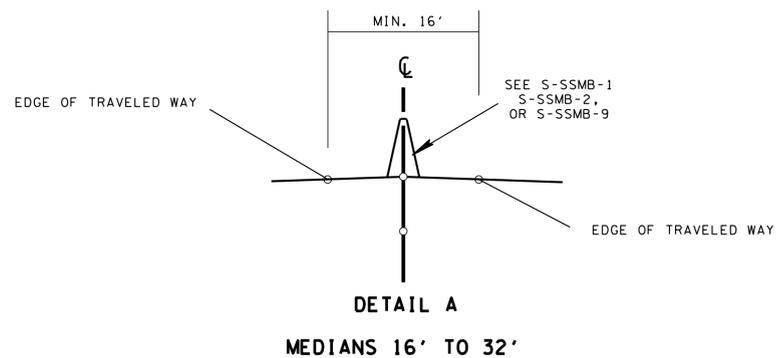
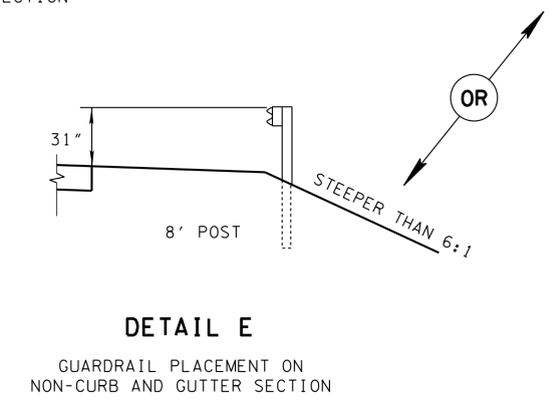
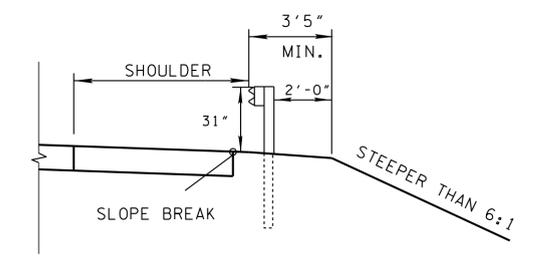
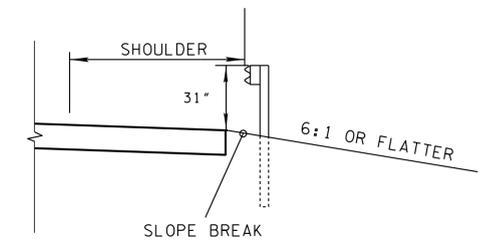
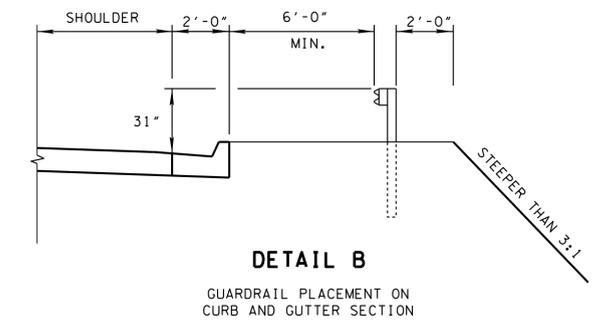
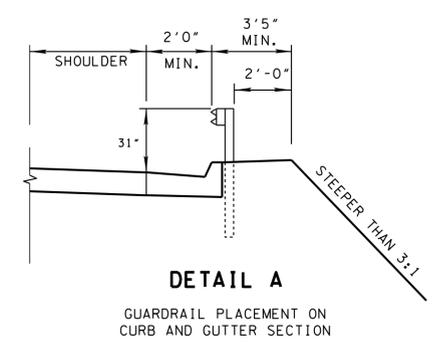


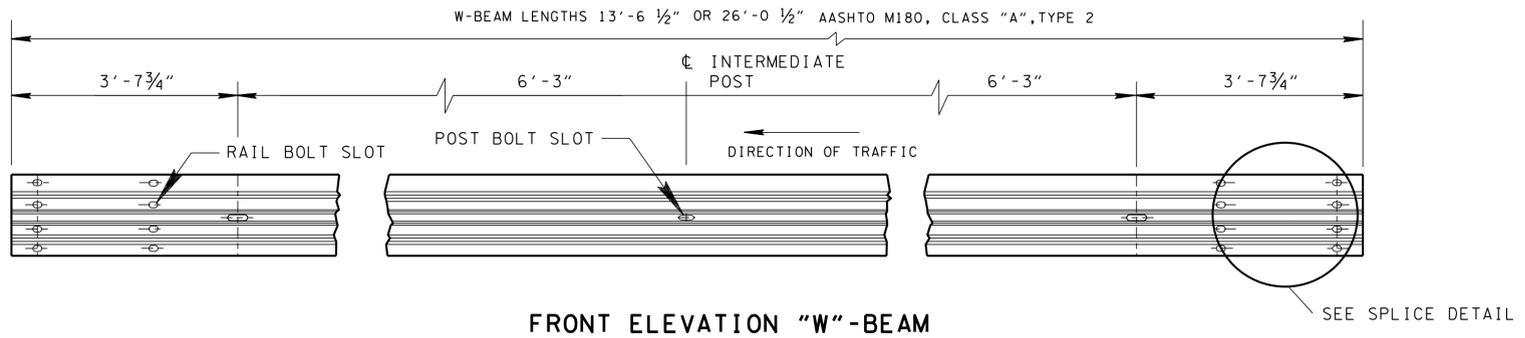
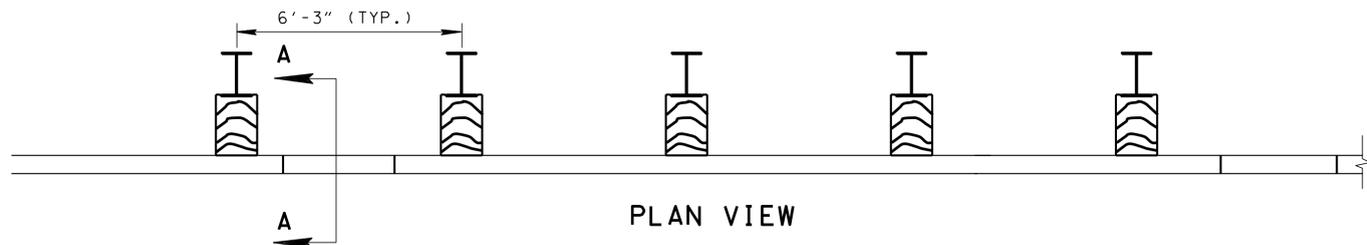
FIGURE A
THE NEED OF BARRIER DETERMINATION GUIDE FOR MEDIAN INSTALLATION

GENERAL NOTES FOR MEDIAN DEVICES	
(A)	THIS STANDARD IS TO BE USED AS A GUIDE, BUT IS NOT A SUBSTITUTE FOR GOOD ENGINEERING JUDGEMENT. OTHER CONSIDERATIONS, SUCH AS CRASH HISTORY, MAY BE USED TO JUSTIFY BARRIER INSTALLATION. THIS STANDARD DOES NOT APPLY TO FREEWAYS WITH INDEPENDENT ROADWAYS (SEE R001-TS-5A)
(B)	MEDIAN WIDTH INCLUDES SHOULDERS.
(C)	SEE DETAIL A AND DETAIL B FOR APPROPRIATE CONFIGURATION AND BARRIER SYSTEM.
(D)	END OF BARRIER SYSTEMS (EXPECT CABLE BARRIER) REQUIRE END TERMINAL OR ATTENUATORS.

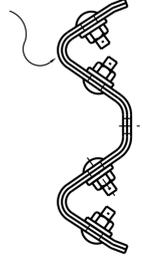
OUTSIDE SHOULDER GUARDRAIL PLACEMENT



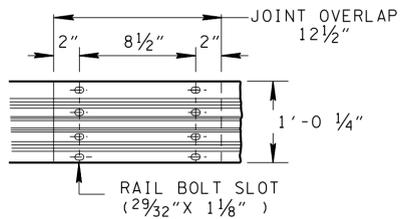
GENERAL NOTES FOR GUARDRAIL	
(A)	IF GUARDRAIL IN A CURB AND GUTTER SECTION IT SHALL BE PLACED SUCH THAT THE GUARDRAIL FACE IS EVEN WITH THE CURB (DETAIL A) OR A MINIMUM OF 6' FROM THE CURB (DETAIL B).
(B)	ON 6:1 OR FLATTER SLOPE GUARDRAIL MAY BE PLACED AT THE SLOPE BREAK.
(C)	ON SLOPES STEEPER THAN 6:1 GUARDRAIL SHALL BE PLACED A MINIMUM OF 2' IN FRONT OF SLOPE BREAK.
(D)	IF THE CONDITION IN NOTE (C) CANNOT BE MET GUARDRAIL MAY BE PLACED AT SLOPE BREAK IF POSTS ARE LENGTHENED TO 8'.



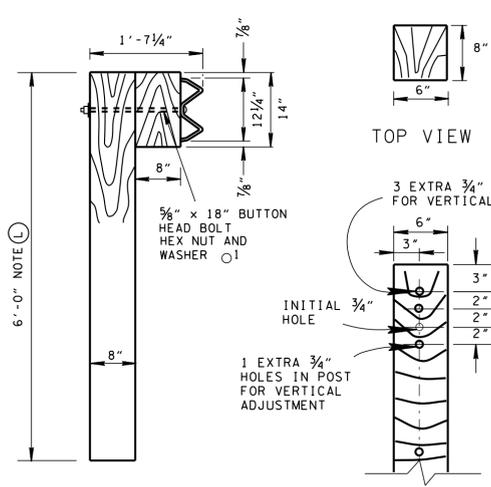
5/8" DIA. x 1 1/4" LENGTH, BUTTON HEAD BOLT WITH HEX NUT AND 1 ROUND WASHERS PER BOLT (TYPICAL).



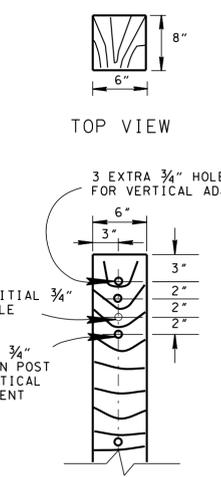
SECTION A-A
SPLICE CROSS-SECTION



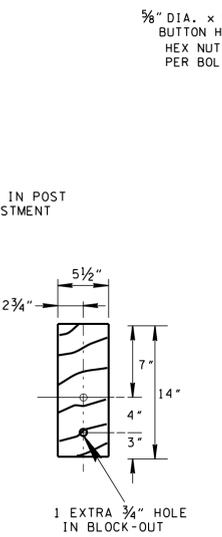
SPLICE DETAIL
(AT MID SPAN BETWEEN POSTS ONLY)



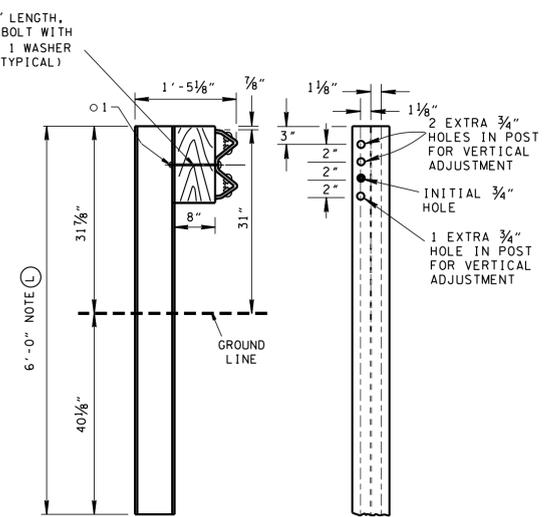
SIDE VIEW
SINGLE GUARDRAIL
WOOD POST



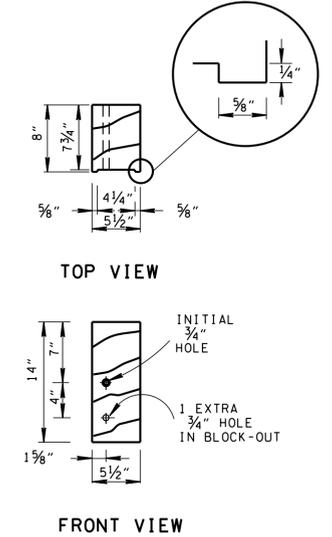
FRONT ELEVATION
WOOD POST



FRONT ELEVATION
WOOD BLOCK-OUT
FOR WOOD POST



SIDE VIEW
SINGLE GUARDRAIL
STEEL POST



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

LEGEND FOR WASHER REQUIREMENTS	
1 OR 2 ROUND WASHERS	o1 o2

NOTE: SIDE VIEW FOR STEEL POST DIMENSIONS BASED ON W6 X 8.5, OTHER DETAILS APPLY TO W6 X 9.0 AND W6 X 15.0 POSTS AND BLOCK-OUTS.

GENERAL NOTES

METAL BEAM

- (A) METAL BEAMS SHALL CONFORM TO AASHTO M 180: TYPE 1, CLASS "A" UNLESS OTHERWISE NOTED ON THE PLANS.
- (B) WHERE GUARDRAIL IS PLACED ON A CURVE WITH A RADIUS LESS THAN 150 FEET, THE RAIL IS TO BE SHOP-FORMED TO THE REQUIRED RADIUS.
- (C) AT THE OPTION OF THE CONTRACTOR THE RAIL ELEMENTS FOR THE GUARDRAIL MAY BE FURNISHED IN EITHER 12 1/2 OR 25 FOOT NOMINAL LENGTHS WITH POST BOLT SLOTS FOR CONNECTION TO POSTS.

HARDWARE

- (D) BOLTS SHALL CONFORM TO THE REQUIREMENTS OF ASTM A307 AND NUTS TO THE REQUIREMENTS OF ASTM A563M, GRADE "A" OR BETTER, AND BE GALVANIZED IN ACCORDANCE WITH ASTM A153.
- (E) DIMENSIONAL TOLERANCES NOT SHOWN OR IMPLIED ARE INTENDED TO BE THOSE CONSISTENT WITH THE PROPER FUNCTION OF THE PART, INCLUDING ITS APPEARANCE AND ACCEPTED MANUFACTURING PRACTICES.
- (F) BOLTS FOR CONNECTING RAIL TO POST THROUGH BLOCKOUT SHALL BE 5/8" DIAMETER X 9 1/2" (STEEL POST) OR 5/8" DIAMETER BY 18" (WOOD POST) BUTTON HEAD WITH ROUND STEEL WASHER.
- (G) BOLTS SHALL BE OF SUFFICIENT LENGTH TO EXTEND THROUGH THE FULL THICKNESS OF THE NUT AND NO MORE THAN 3/4" BEYOND IT.

POSTS

- (H) THE CONTRACTOR MAY HAVE THE CHOICE OF EITHER HOT ROLLED OR WELDED STEEL W6 X 8.5 OR W6 X 9 OR 8" X 6" WOOD POST. EXCEPT AS NOTED
 - ① THE MIXING OF ANY POST TYPES ON A GIVEN PROJECT WILL BE AVOIDED IF AT ALL POSSIBLE.
 - ② SHOULD IT BECOME NECESSARY TO MIX POST TYPES ON A GIVEN PROJECT POSTS SHALL NOT BE MIXED ON A SINGLE RUN OF GUARDRAIL EXCEPT AS NECESSARY AT END TERMINALS.
 - ③ W6 X 15 IS USED WITH GUARDRAIL CONNECTION TO STRUCTURES.

- (I) STEEL POSTS SHALL CONFORM TO ASTM A36 AND BE GALVANIZED IN ACCORDANCE WITH ASTM A123. BOLT HOLES SHALL BE APPROXIMATELY CENTERED BETWEEN WEB AND EDGE OF FLANGE OF SPACERS AND POSTS.
- (J) WOOD POSTS SHALL CONFORM WITH TDOT CONSTRUCTION STANDARD SPECIFICATION.
- (K) WELDED STEEL POSTS SHALL CONFORM TO ASTM A769 AND BE GALVANIZED IN ACCORDANCE WITH ASTM A123, UNLESS OTHERWISE SPECIFIED ON THE PLANS.
- (L) ON STEEP SLOPES, WHEN GUARDRAIL IS PLACED AT SLOPE BREAK, MINIMUM POST LENGTH SHALL BE 8 FEET. ADDITIONAL EXPENSE TO BE INCLUDED IN THE COST OF THE RUN OF GUARDRAIL (SEE S-GR31-1A).

BLOCKOUTS

- (M) BLOCKOUTS SHALL BE WOOD CONFORMING TO THE REQUIREMENTS OF TDOT CONSTRUCTION STANDARD SPECIFICATIONS OR PLASTIC GUARDRAIL BLOCKOUTS LISTED ON THE TDOT QUALIFIED PRODUCT LIST.
- (N) ONLY WOODEN BLOCKOUTS MAY BE USED WITH WOODEN POSTS, PLASTIC OR WOODEN BLOCKOUTS MAY BE USED WITH STEEL POSTS.
- (O) ALL BLOCKOUTS SHALL MEET NCHRP-350 OR MASH GUIDELINES.
- (P) MIXING THE BLOCKOUT MATERIAL ON A GIVEN PROJECT SHOULD BE AVOIDED. IF MIXING OF BLOCKOUT MATERIAL IS NECESSARY, BLOCKOUTS SHALL NOT BE MIXED ON A SINGLE RUN OF GUARDRAIL.

FUTURE ADJUSTMENTS

- (Q) BLOCKOUTS SHALL HAVE ONE ADDITIONAL 3/4" HOLE, FOUR INCHES BELOW THE INITIAL HOLE FOR FUTURE ADJUSTMENT.
- (R) INITIAL INSTALLATION REQUIRES ONE BOLT CONNECTION, EACH ADJUSTMENT THEREAFTER REQUIRES TWO BOLT CONNECTIONS.

END TREATMENTS

- (S) ALL RUNS OF GUARDRAIL WILL BEGIN AND END WITH AN ANCHOR SYSTEM (SEE S-GRA-SERIES).
- (T) GUARDRAIL ENDS THAT ARE INSIDE THE CLEARZONE AND EXPOSED TO ONCOMING TRAFFIC SHALL HAVE A CRASH WORTHY END TERMINAL AS NOTED:
 - ① ANY ROAD WITH SUITABLE BACKSLOPES SHALL USE END TERMINALS BURIED IN BACK SLOPE (SEE S-GRT-1).
 - ② ALL HIGHWAY SYSTEM ROADS WITHOUT SUITABLE BACKSLOPES SHALL USE TANGENTIAL END TERMINALS (SEE S-GRT-2).
 - ③ ALL OTHER ROADS SHALL USE SLOTTED RAIL END TERMINALS UNLESS OTHERWISE NOTED (SEE S-GRT-3).

DESIGN

- (U) 4' BEHIND GUARDRAIL SHALL BE CLEAR AT OBSTRUCTION FOR DEFLECTION.
- (V) REFER TO SAFETY PLAN STANDARDS FOR HOW TO DETERMINE THE BEGINNING AND END.

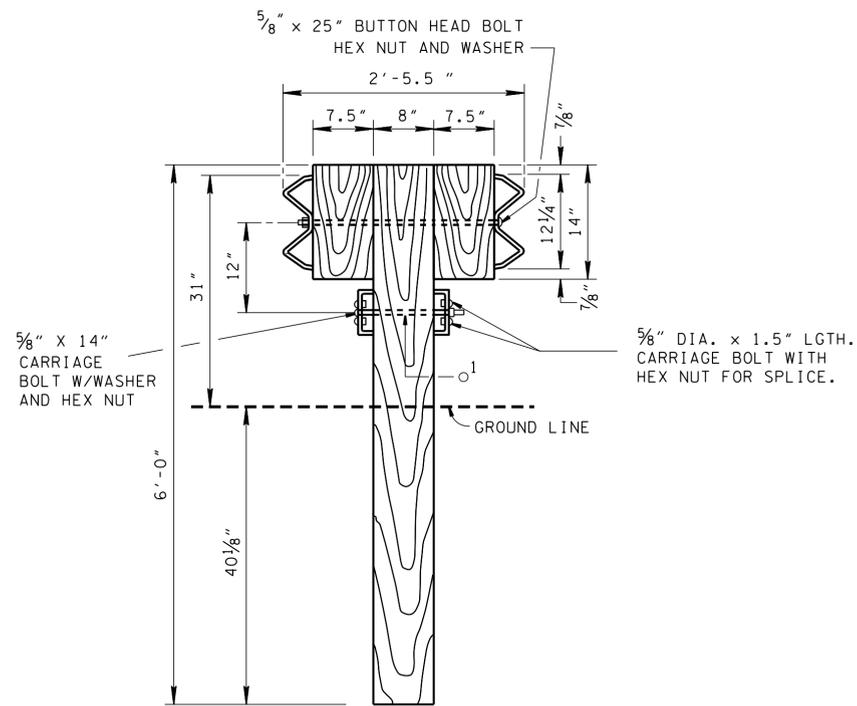
PAYMENT

- (W) PAYMENT FOR GUARDRAIL WILL BE UNDER ITEM:
705-02.02 SINGLE GUARDRAIL (TYPE 2) LF
- (X) GUARDRAIL WILL BE PAID FOR ONLY IN LENGTHS THAT ARE MULTIPLES OF 6'-3".
- (Y) PAYMENT FOR SPECIAL CONNECTIONS AND GUARDRAIL SECTIONS REQUIRED FOR END TREATMENTS WILL BE AS NOTED ON THOSE DRAWINGS.

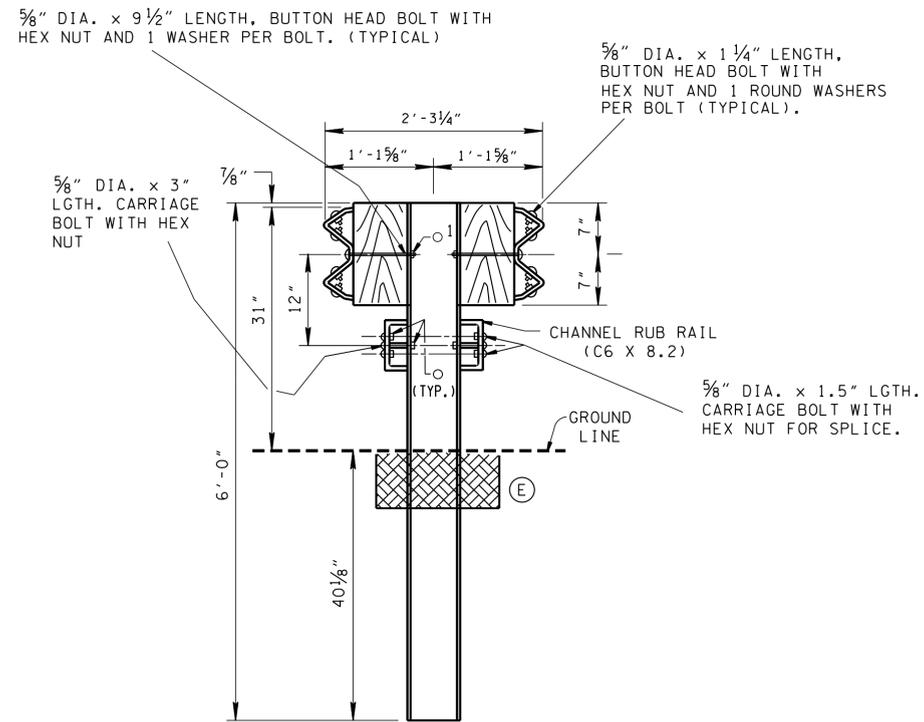
MINOR REVISION -- FHWA APPROVAL NOT REQUIRED.

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

W-BEAM
GUARDRAIL



WOOD POSTS



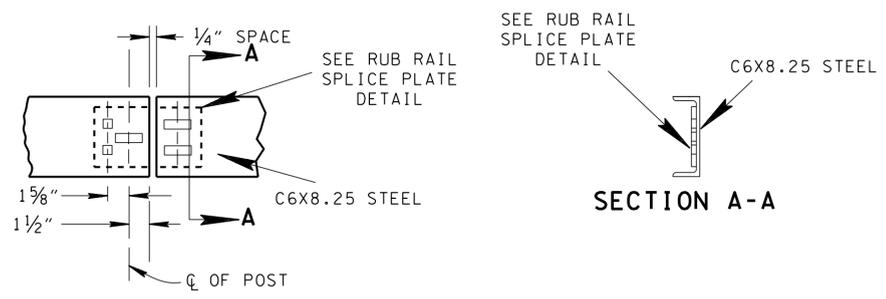
STEEL POSTS

COMPACTED EARTH NO ASPHALT

MEDIAN DIVIDER GUARDRAIL

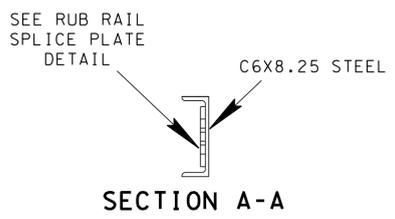
GENERAL NOTES

- (A) TO BE USED IN MEDIANS BETWEEN 10 TO 32 FEET ONLY WHERE CONCRETE MEDIAN BARRIER CAN NOT BE USED.
- (B) SEE S-GR31-1 FOR DETAILS NOT SHOWN.
- (C) RUB RAIL TO BE C6 X 8.25 STEEL MEMBER OR BENT PLATE STEEL WITH EQUIVALENT DIMENSIONS.
- (D) RUB RAIL SHALL BE ASTM A36 STEEL AND GALVANIZED IN ACCORDANCE WITH ASTM A123.
- (E) THE POST SHALL NOT BE PLACED IN ASPHALT. IF PLACED ON PAVED MEDIAN ASPHALT SHALL BE REMOVED AT POST LOCATIONS.
- (F) FOR CONNECTION TO CONCRETE MEDIAN BARRIER SEE S-GRC-3.
- (G) PAY ITEM NO:
705-03.01 MEDIAN DIVIDER GUARDRAIL WITH RUB RAIL PER LF

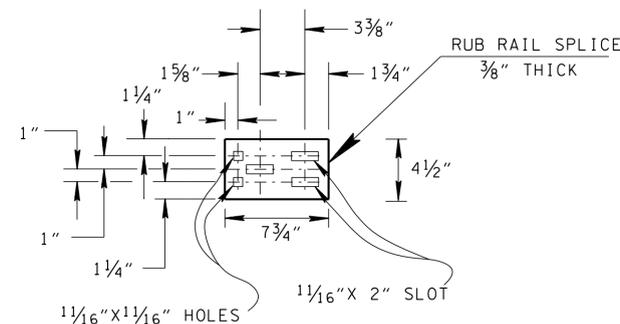


CHANNEL RUB RAIL SPLICE DETAIL
CHANNEL RUB RAIL SPLICES PERMITTED ONLY AT POST

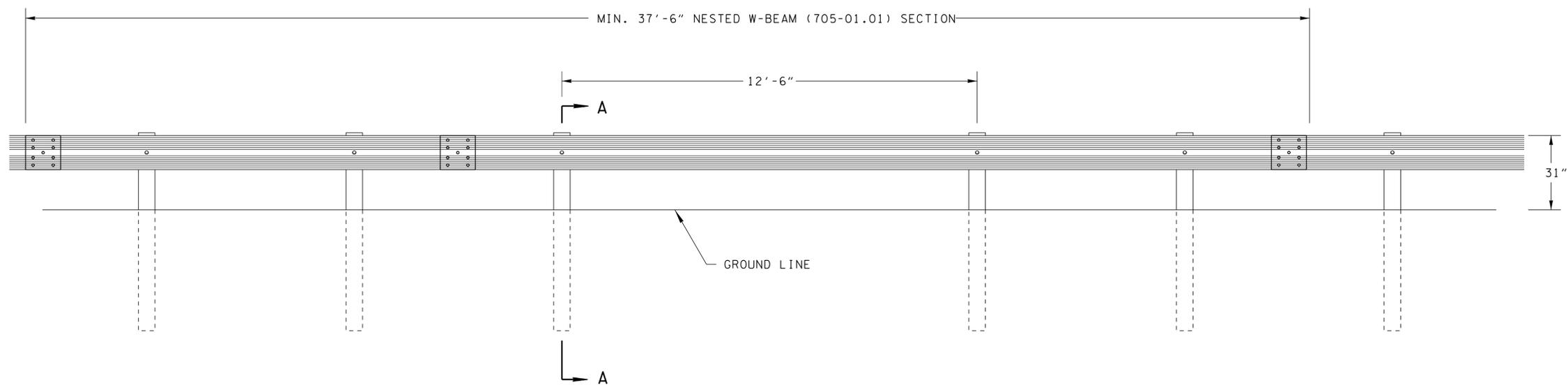
NOTE: HOLES IN RUB-RAIL SAME AS IN SPICE PLATE



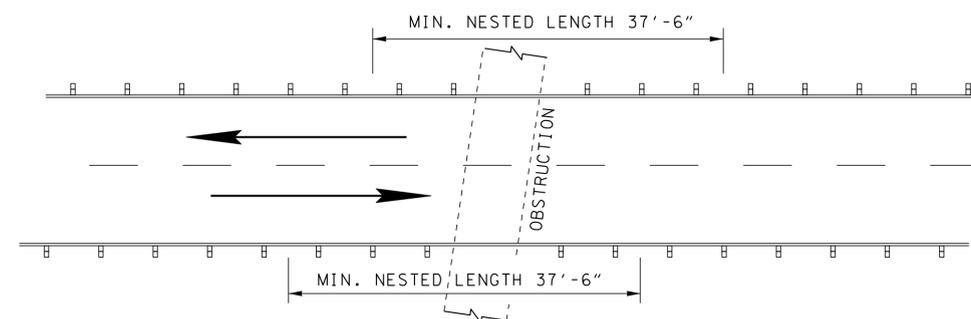
SECTION A-A



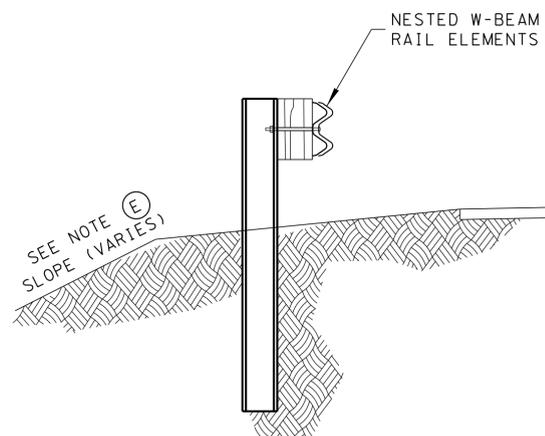
NOTE: HOLES IN RUB-RAIL SAME AS IN SPICE PLATE
RUB RAIL SPLICE PLATE DETAIL



ELEVATION



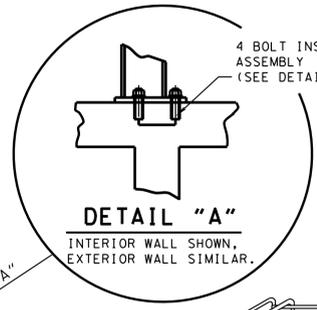
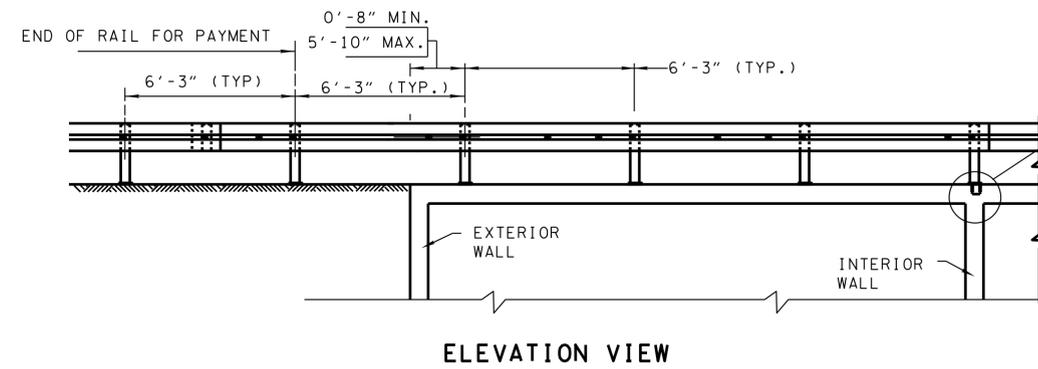
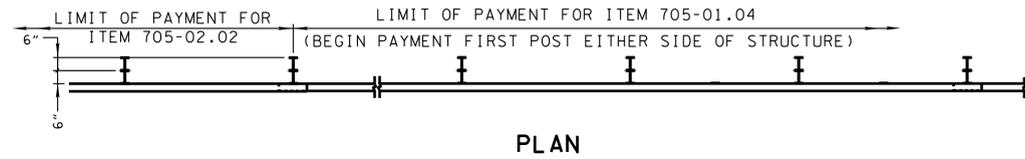
EXAMPLE
TWO-WAY TRAFFIC LAYOUT



SECTION "A-A"

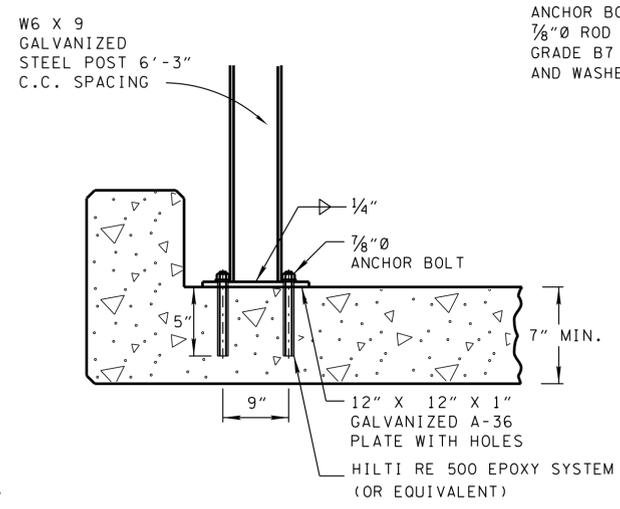
GENERAL NOTES

- (A) DRAWING TO BE USED FOR GUARDRAIL PLACEMENT WHEN ENCOUNTERING AN OBSTRUCTION WHICH WILL PREVENT GUARDRAIL POST TO BE INSTALLED PROPERLY.
- (B) A POST MAY BE OMITTED ON A RUN OF GUARDRAIL ONLY. THIS APPLICATION IS NOT TO BE USED AS PART OF AN END TERMINAL. IF OBSTRUCTION IS ENCOUNTERED AT TERMINAL LOCATION, EXTEND GUARDRAIL RUN TO A POINT WHERE TERMINAL MAY BE INSTALLED PROPERLY.
- (C) ONLY ONE POST MAY BE OMITTED AT AN OBSTRUCTION.
- (D) WHEN MORE THAN ONE OBSTRUCTION IS ENCOUNTERED ON A RUN OF GUARDRAIL, THREE CONSECUTIVE POSTS SHALL BE INSTALLED PRIOR TO OMITTING ANOTHER POST.
- (E) SEE STANDARD DRAWING RD01-SERIES FOR SLOPE CRITERIA.
- (F) IF ANY OF THE CONDITIONS NOTED IN GENERAL NOTES A, C, OR D CAN NOT BE MEET, USE GUARDRAIL WITH FOOTING OPTION SEE (S-GRS-3).
- (G) THE NESTED SECTION WILL BE BUILT AS SHOWN BUT PAYMENT WILL BE MEASURED FOR A LENGTH OF 3 POSTS ON EITHER SIDE OF THE OMITTED POST.



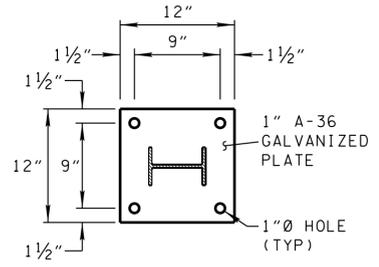
INSERT ASSEMBLY
FOR 3/4" DIAMETER X 4" HEX HEAD BOLTS
(ASTM A-307 SPECIFICATION)

INSERT ASSEMBLY IS FOR CONNECTION OF POSTS OVER WALLS ONLY AND NOT A SUBSTITUTE FOR PLATE ASSEMBLY ELSEWHERE.

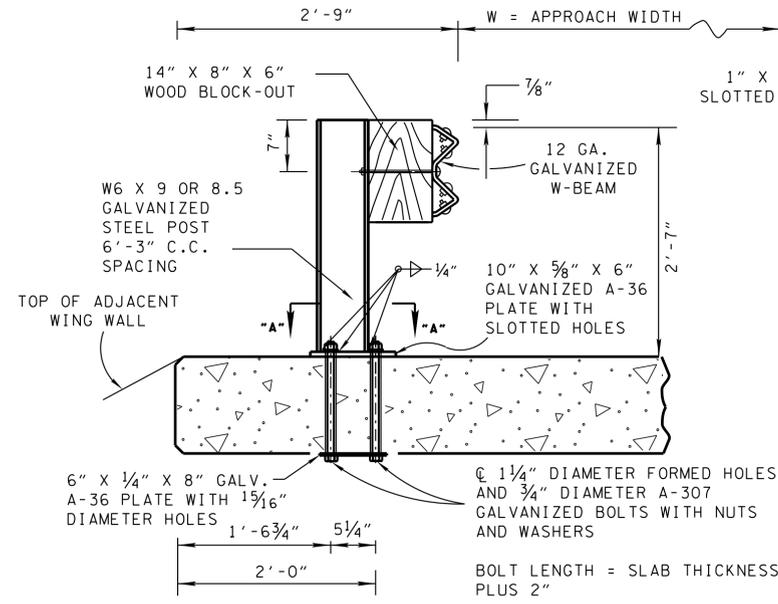


"DETAIL A" ALTERNATE POST ATTACHMENT USING ANCHOR BOLTS

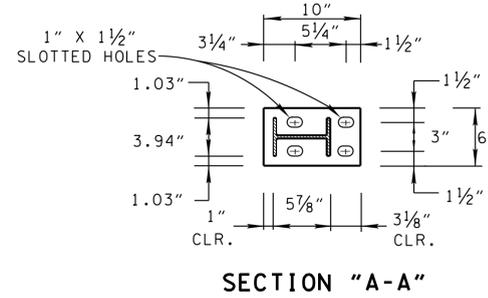
ANCHOR BOLT:
7/8" Ø ROD MATERIAL ASTM A193,
GRADE B7 MATERIAL WITH NUTS
AND WASHERS GALVANIZED



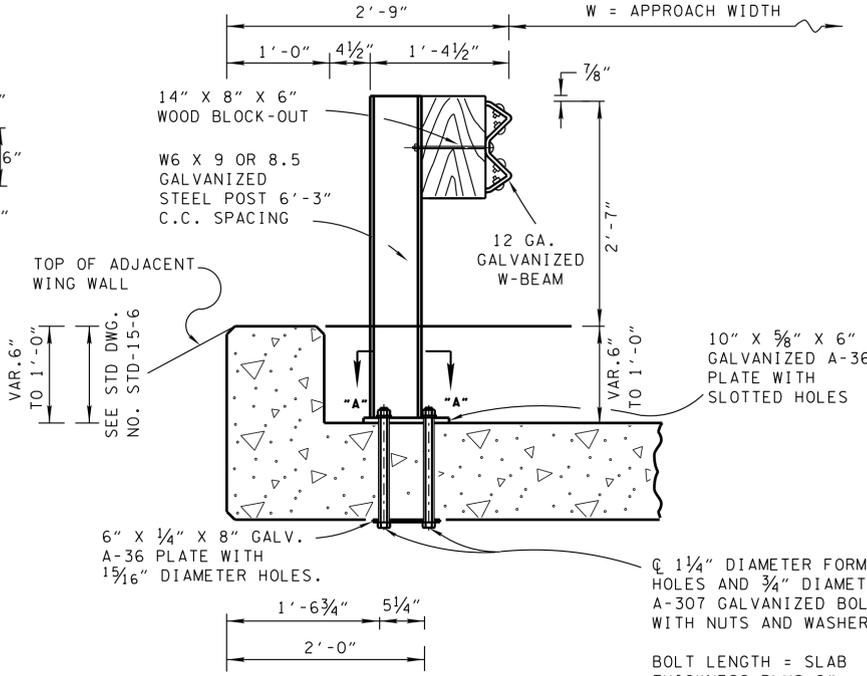
BASEPLATE DETAILS



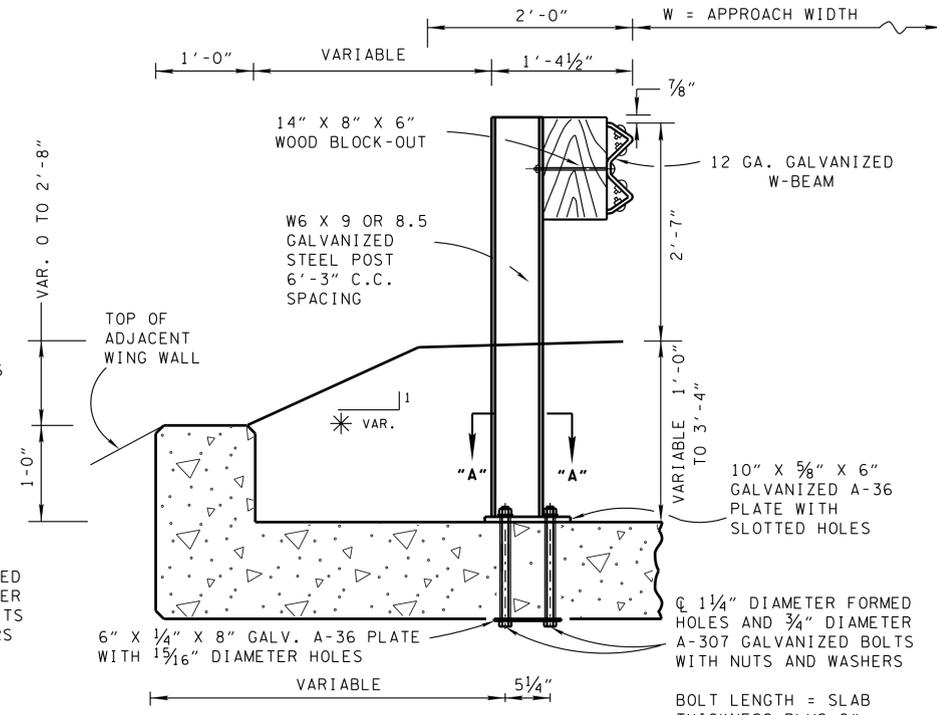
DETAIL FOR CONCRETE DECK USED AS A RIDING SURFACE



SECTION "A-A"



DETAIL FOR CONCRETE DECK WITH 6" TO 1'-0" OF ROADWAY FILL COVER



DETAIL FOR CONCRETE DECK WITH 1'-0" TO 3'-4" OF ROADWAY FILL COVER

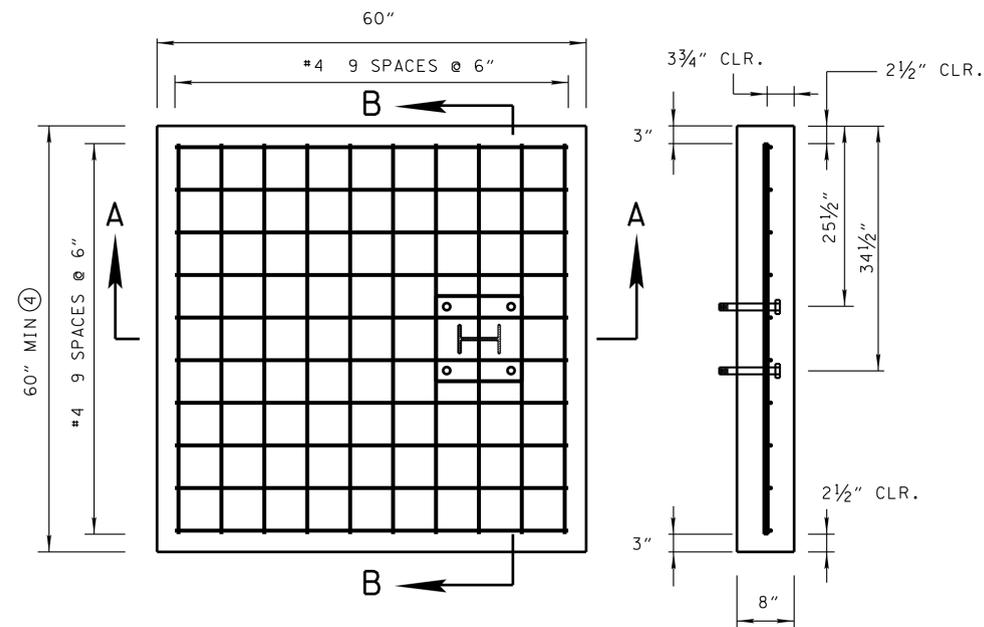
* DENOTES ADJOINING ROADWAY SIDE SLOPE

- DESIGN NOTES**
- 1 WHEN DEPTH OF FILL AT FACE OF GUARDRAIL EXCEEDS 3'-4" USE ITEM 705-02.02 AS SHOWN ON S-GR31-1.
 - 2 DO NOT USE ON PRECAST CONCRETE STRUCTURE WITHOUT PRIOR APPROVAL FROM MANUFACTURERS.
 - 3 THIS RAIL SYSTEM HAS BEEN TESTED AND PASSED BY THE CRITERIA SET FORTH BY AASHTO MASH TEST LEVEL 3, AS DOCUMENTED IN ROADSIDE SAFETY RESEARCH PROGRAM POOLED FUND STUDY NO. TPF-5(114) DATED NOV. 11, 2011.
 - 4 ANY REINFORCING STEEL THAT INTERFERES WITH THE 1 1/4" DIAMETER FORMED HOLES SHALL BE MOVED HORIZONTALLY TO PROVIDE A 1" MINIMUM CLEARANCE TO THE HOLE.

- GENERAL NOTES**
- A IN ORDER TO EXPEDITE INSTALLATION, GUARDRAIL POST MAY BE FIELD CUT TO ADJUST THE LENGTH REQUIRED. ALL CUT SURFACES MUST RECEIVE GALVANIZING COATING.
 - B FOR DIMENSIONS AND DETAILS NOT SHOWN SEE STANDARD DRAWING NOS. STD-15-6, STD-15-7, AND S-GR31-1.
 - C TO BE PAID FOR UNDER ITEM NO. 705-01.04 METAL BEAM GUARD FENCE PER LF.

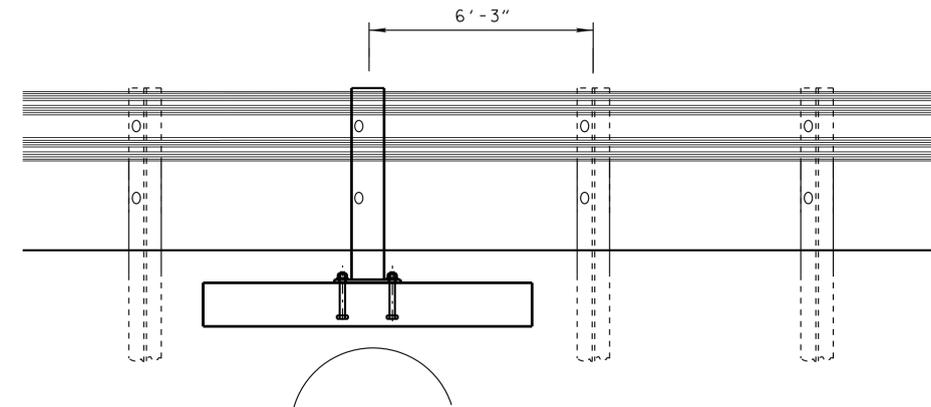
STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

**SPECIAL CASE:
GUARDRAIL ATTACHMENT
TO CONCRETE DECKS**

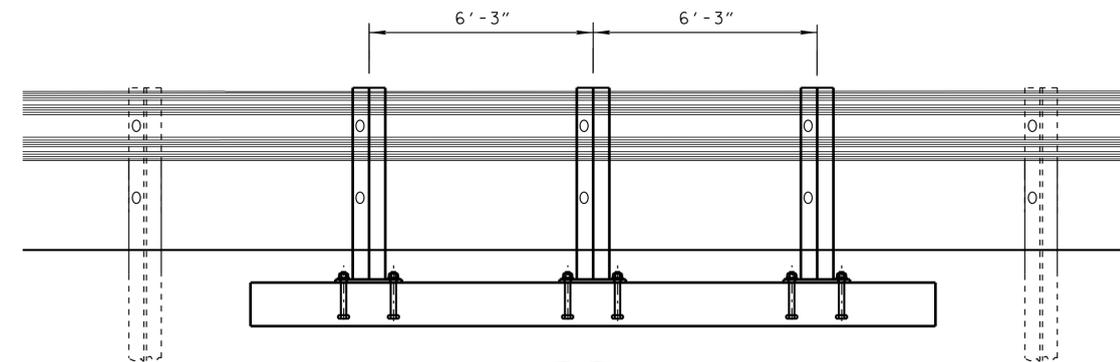


PLAN VIEW
60"X60"X8" SINGLE POST SLAB DETAIL

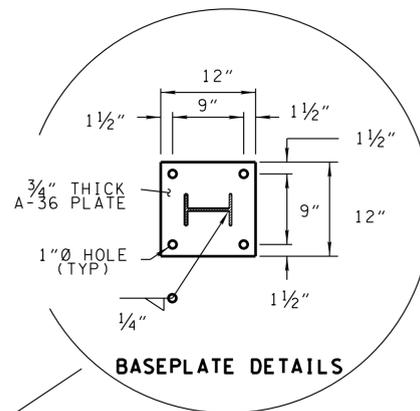
SECTION B-B



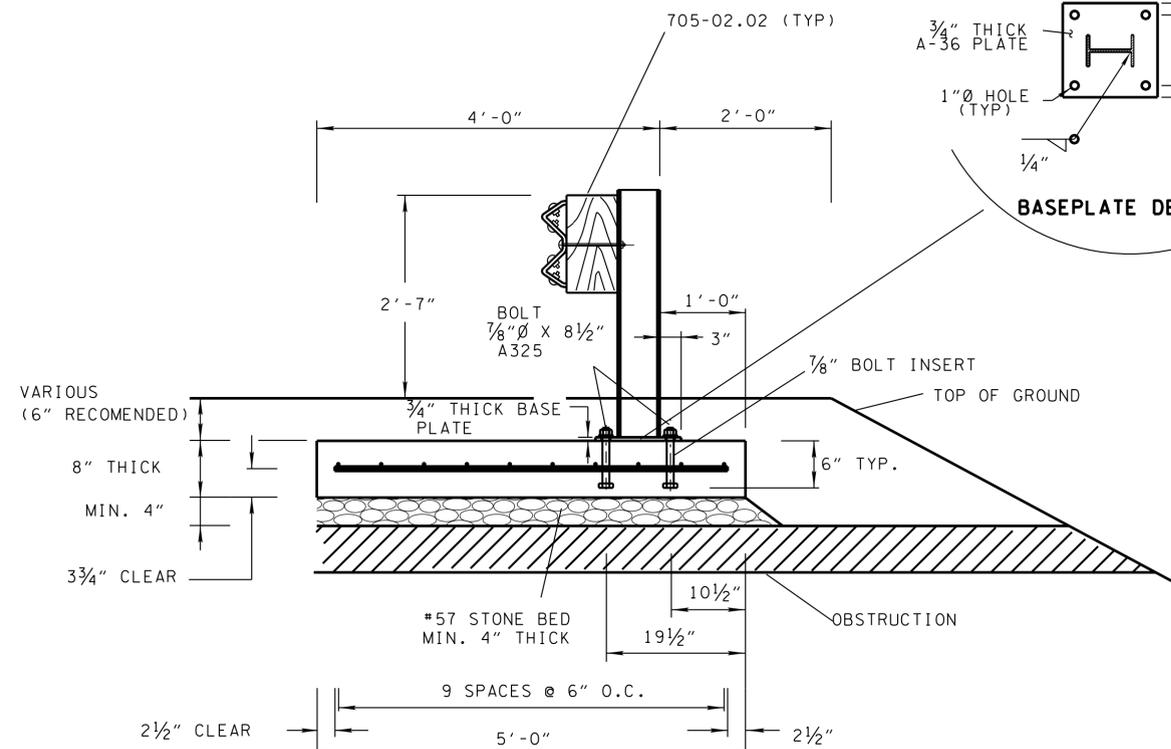
SMALL OBSTRUCTION



LARGE OBSTRUCTION



BASEPLATE DETAILS



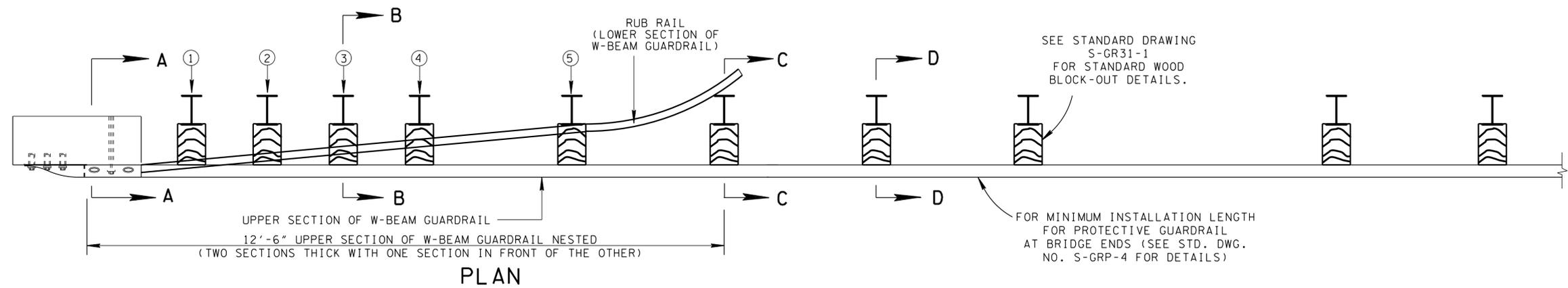
SECTION A-A

ESTIMATED QUANTITIES
FOR CONCRETE PAD (PER LF)

	604-01.01 CLASS A CONCRETE CY/LF	602-01 STRUCTURAL STEEL LB/LF
5' WIDE	0.123	12.89

GENERAL NOTES

- THIS DRAWING TO BE USED WHERE AN UNDERGROUND UTILITY CONFLICT IS IDENTIFIED DURING DESIGN OR CONSTRUCTION WHERE STANDARD POST COULD NOT BE INSTALLED.
- THE INSTALLATION HAS BEEN STUDIED UNDER ROADSIDE SAFETY POOLED FUND AND DOCUMENTED UNDER TTI REPORT 405160-12 "STEEL POSTS OVER UNDERGROUND STRUCTURES".
- CONCRETE PAD TO BE PAID FOR UNDER ITEMS
602-01 STRUCTURAL STEEL LB
604-01.01. CLASS A CONCRETE CY
- CONCRETE PAD IS A SUBSTITUTE FOR REGULAR LENGTH GUARDRAIL POSTS. NO SPECIAL PAYMENT SHALL BE MADE FOR GUARDRAIL.

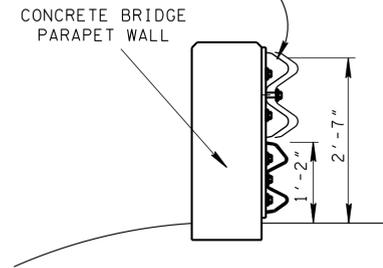


PLAN

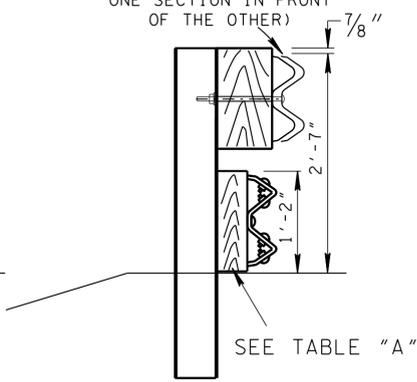
12'-6" UPPER SECTION OF W-BEAM GUARDRAIL WHICH IS TO BE NESTED (TWO SECTIONS THICK WITH ONE SECTION IN FRONT OF THE OTHER)

12'-6" UPPER SECTION OF W-BEAM GUARDRAIL WHICH IS TO BE NESTED (TWO SECTIONS THICK WITH ONE SECTION IN FRONT OF THE OTHER)

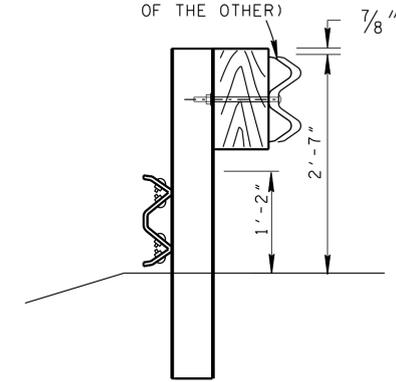
12'-6" UPPER SECTION OF W-BEAM GUARDRAIL WHICH IS TO BE NESTED (TWO SECTIONS THICK WITH ONE SECTION IN FRONT OF THE OTHER)



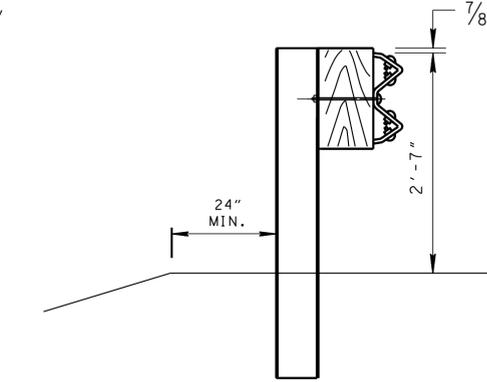
SECTION A-A



SECTION B-B



SECTION C-C

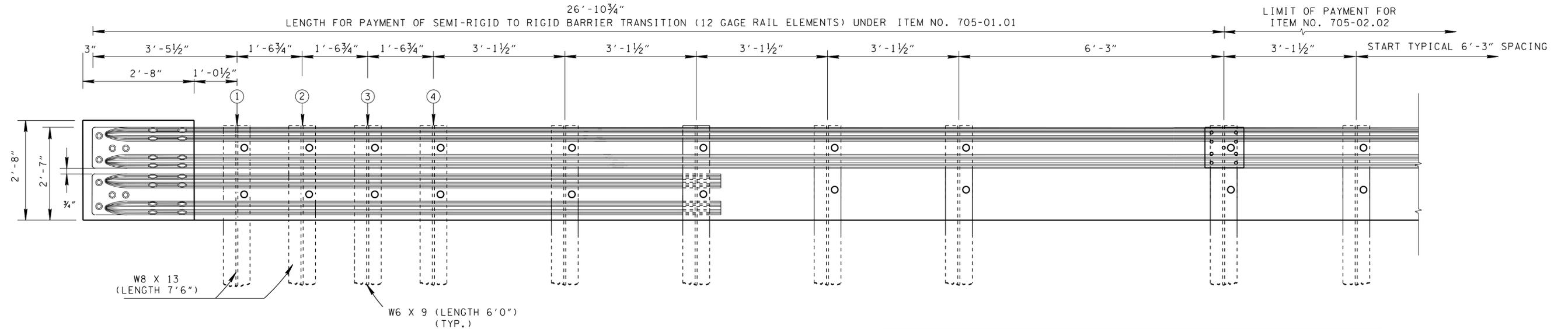


SECTION D-D

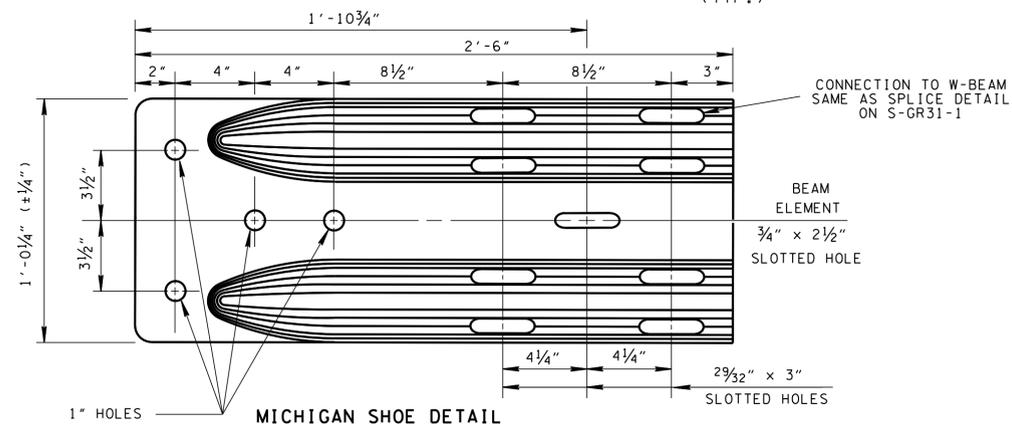
TABLE A

GUARDRAIL RUB-RAIL BLOCK-OUT THICKNESS TABLE	
POST	THICKNESS
①	0.556'
②	0.446'
③	0.338'
④	0.230'
⑤	NO BLOCK

TREATED TIMBER 14½" X 4" BLOCK-OUT



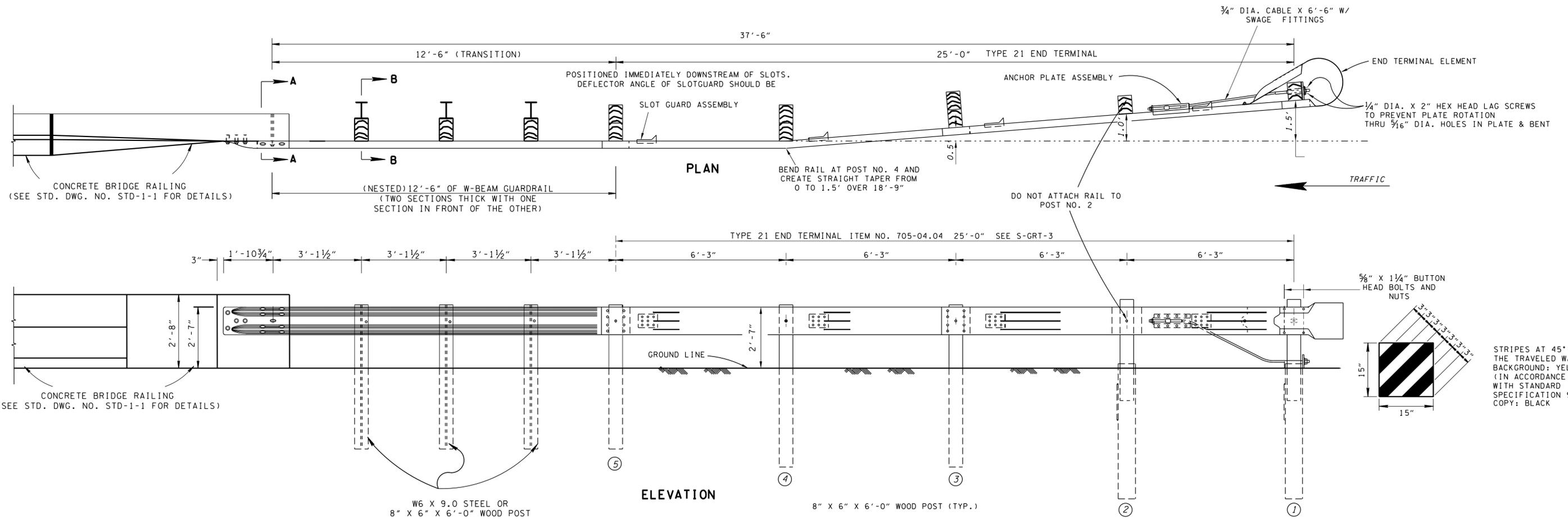
ELEVATION



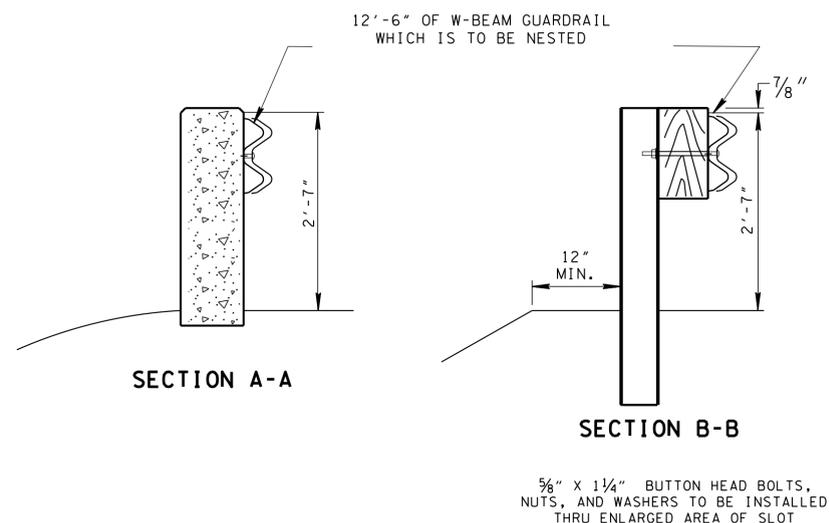
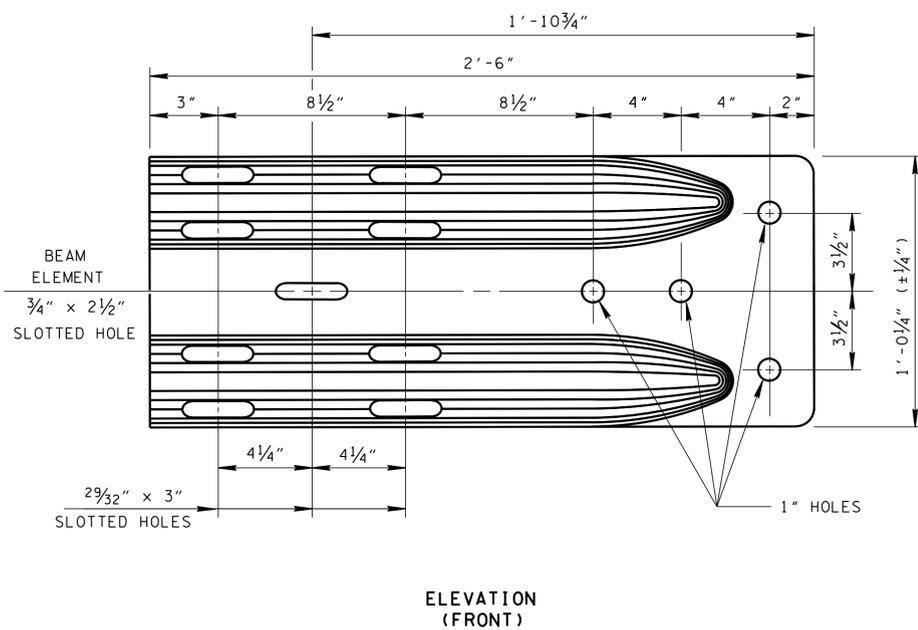
GENERAL NOTES

- (A) TO BE USED AT ALL GUARDRAIL TRANSITIONS TO BRIDGE RAIL OR CONCRETE BARRIER WALLS WITH ADT > 400 VEH/DAY.
- (B) CONNECTION TO BRIDGE RAIL SHOWN FOR CONNECTION TO CONCRETE BARRIER WALLS SEE S-SSMB-6.
- (C) BOLTS FROM MICHIGAN SHOE TO BRIDGE RAIL TO BE AS SHOWN ON STRUCTURE'S BRIDGE RAIL STANDARD DRAWINGS.
- (D) SEE S-GR31-1 FOR ALL OTHER DETAILS AND MATERIAL PROPERTIES NOT SHOWN.
- (E) RUB RAIL IS ONLY REQUIRED AT BRIDGES.
- (F) PAY ITEM 705-01.01 GUARDRAIL AT BRIDGE ENDS.
- (G) SEE S-PL-3 FOR MINIMUM LENGTH AND DELINEATOR REQUIREMENTS.

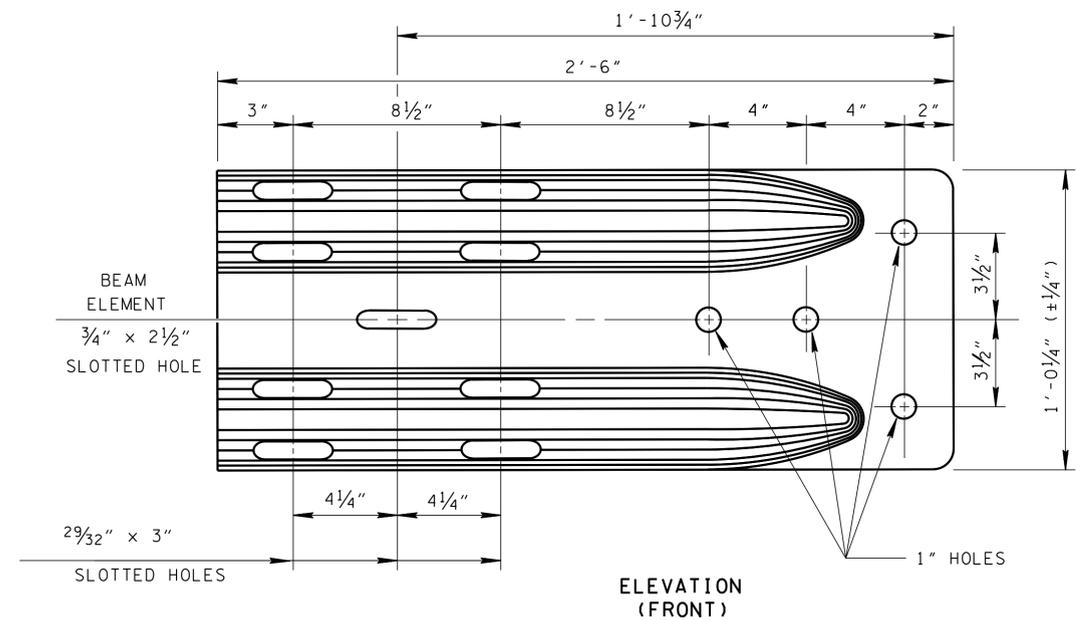
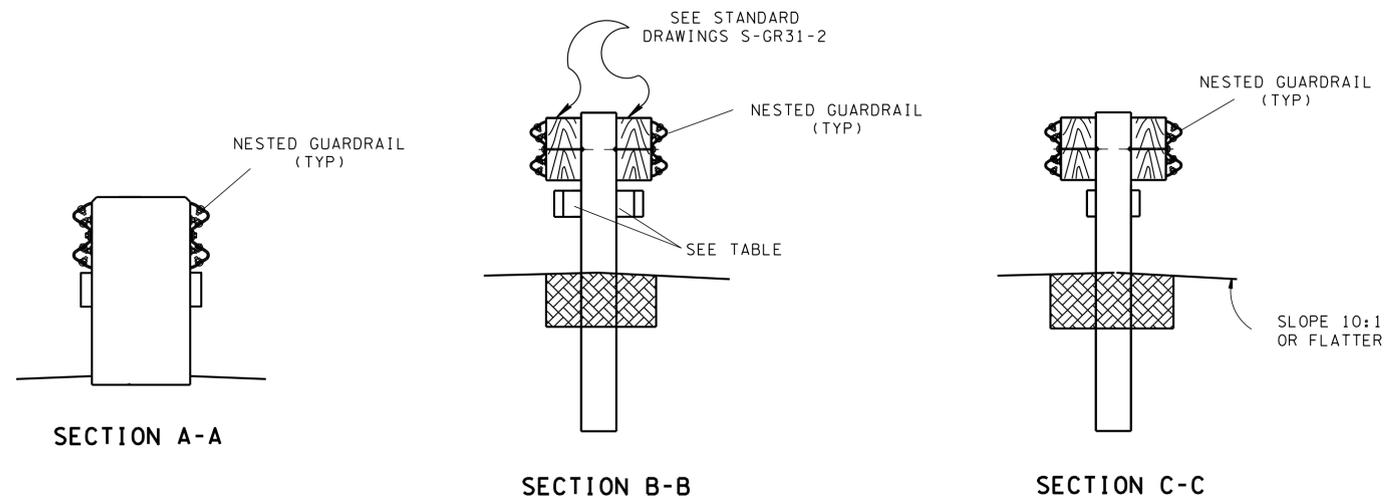
THIS DRAWING IS TO BE USED FOR LOW-VOLUME LOCAL ROADS (ADT < 400) ONLY



NOTE TO DESIGNER
DO NOT USE WITHOUT REFERENCE S-GRT-3 AND S-GRT-3D



- GENERAL NOTES**
- (A) SEE STANDARD DRAWING RD01-TS-1A FOR DETAILS AND SPECIFICATIONS REGARDING DESIGN STANDARDS FOR LOW-VOLUME LOCAL ROADS.
 - (B) THE POST OFFSET DIMENSIONS ARE GIVEN TO THE CENTER OF THE TRAFFIC FACE OF THE BLOCKOUTS, EXCEPT AT THE FIRST TWO POSTS, WHERE THE DIMENSION IS TO THE CENTER OF THE TRAFFIC FACE OF THE POST. OFFSET POINTS ARE TO BE LOCATED BY CHORD MEASUREMENTS AT THE BACK OF THE RAIL EQUAL TO THE NOMINAL POST SPACINGS SHOWN. POSTS ARE TO BE SET APPROXIMATELY RADIAL TO THE RAILINGS AT EACH POST LOCATION.
 - (C) SEE S-GRT-3 FOR SLOTTED RAIL TERMINAL DETAILS (TYPE 21).
 - (D) SEE STRUCTURE'S BRIDGE RAIL STANDARD DRAWING FOR BOLT CONNECTION FOR MICHIGAN SHOE TO BRIDGE RAIL
 - (E) EARTH PAD NOT REQUIRED FOR LOW VOLUME INSTALLATION.



COMPACTED EARTH
NO ASPHALT

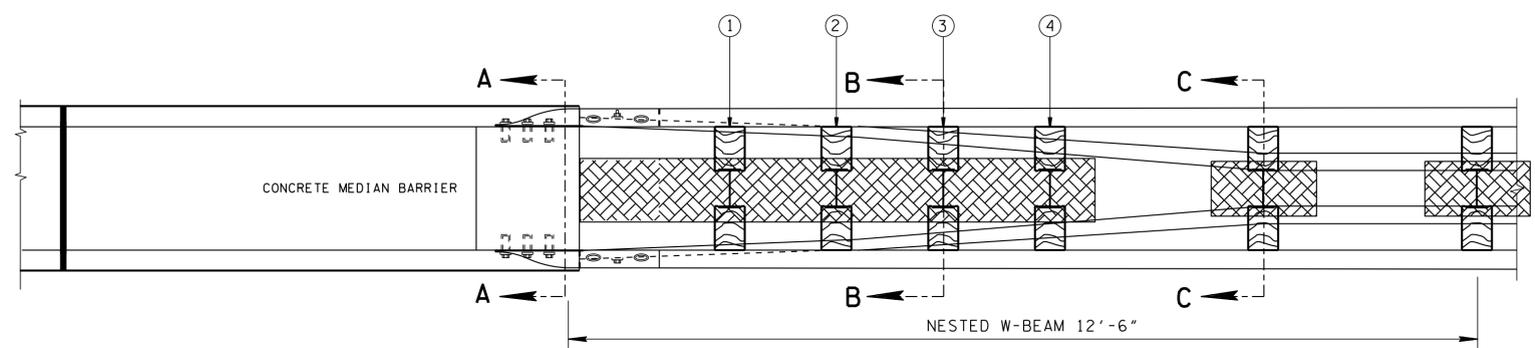
GUARDRAIL RUB-RAIL
BLOCK-OUT
THICKNESS TABLE

POST	THICKNESS
1	0.556'
2	0.446'
3	0.338'
4	0.230'

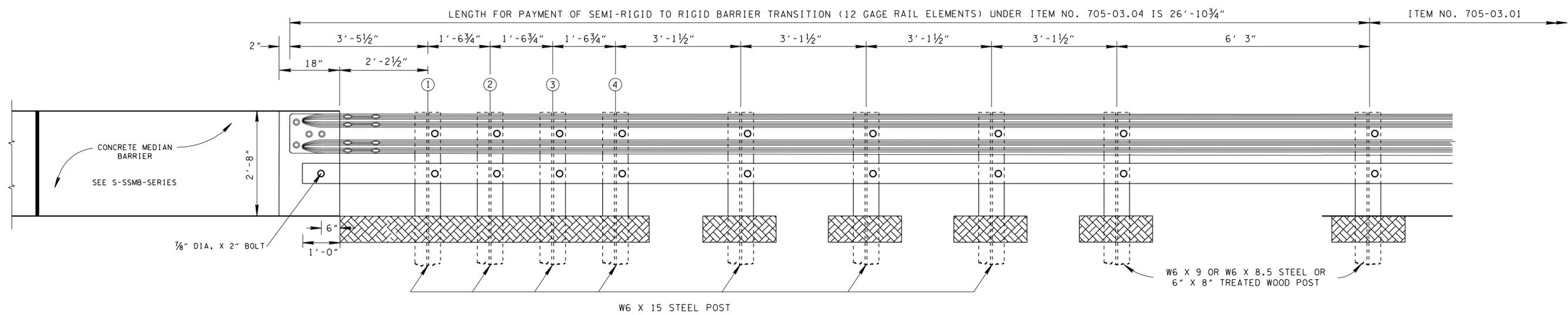
TREATED TIMBER 14 1/2" X 4" BLOCK-OUT

GENERAL NOTES

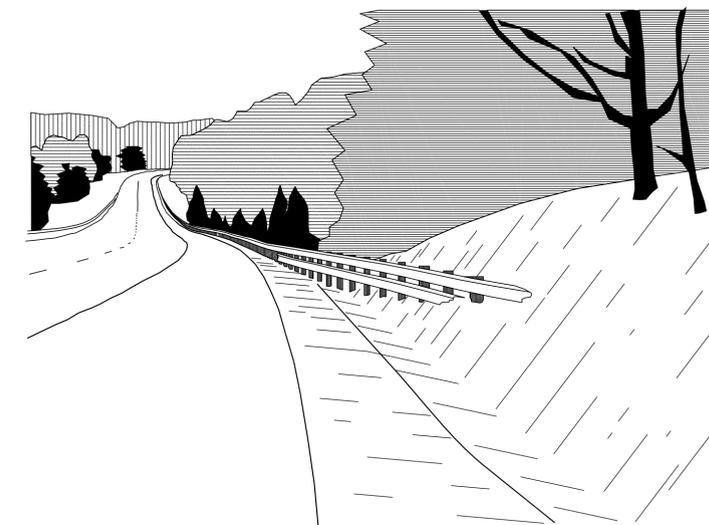
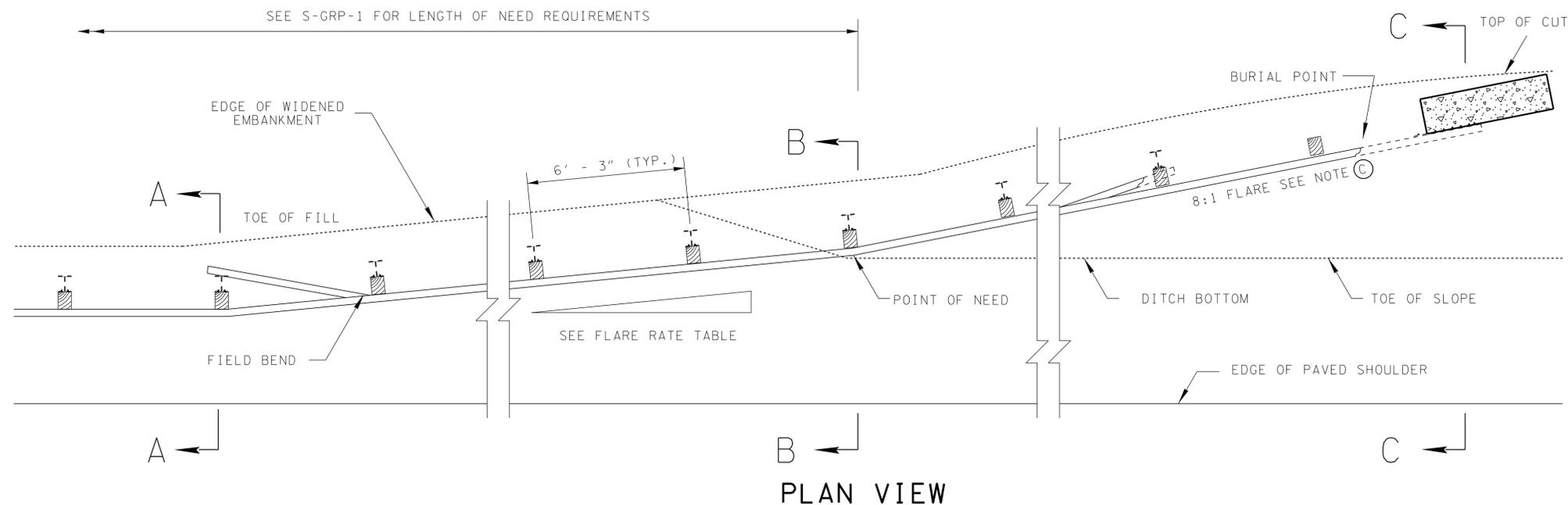
- (A) TO BE USED AT ALL TRANSITIONS FROM CONCRETE MEDIAN BARRIER TO MEDIAN DIVIDER GUARDRAIL.
- (B) SEE S-SSMB-6 FOR CONNECTION DETAILS TO MEDIAN BARRIER.
- (C) PAY ITEM NO. 705-03.04. MEDIAN DIVIDER GUARDRAIL AT CONCRETE BARRIER PER LF.



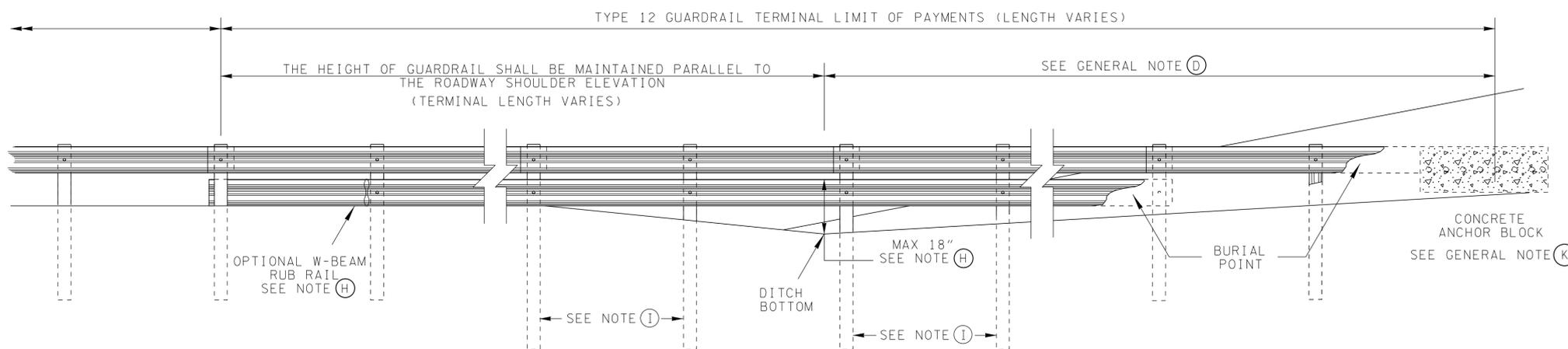
TRANSITION TO CONCRETE MEDIAN BARRIER DETAIL
PLAN



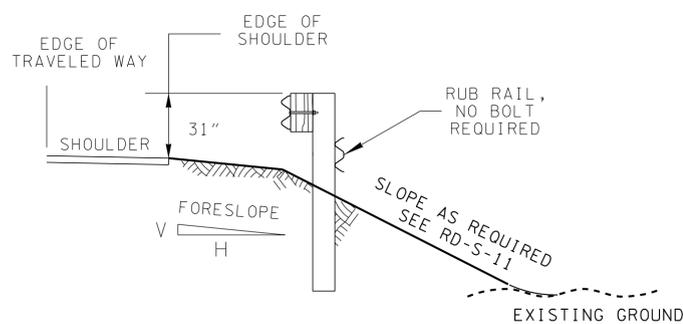
ELEVATION



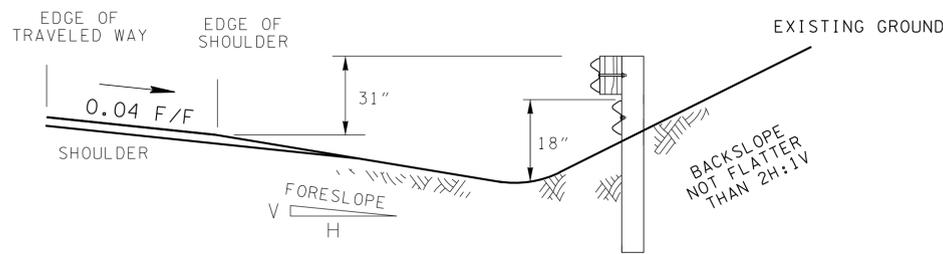
PERSPECTIVE VIEW



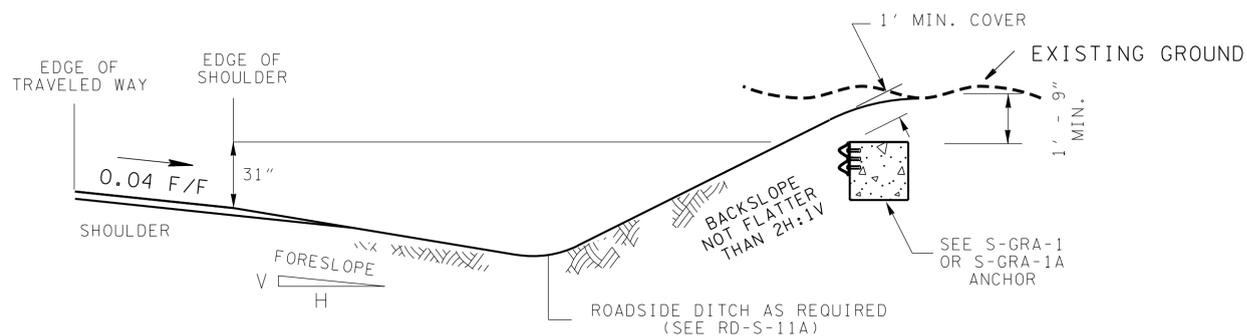
ELEVATION VIEW
(ALONG GUARD RAIL)



SECTION A-A



SECTION B-B



SECTION C-C

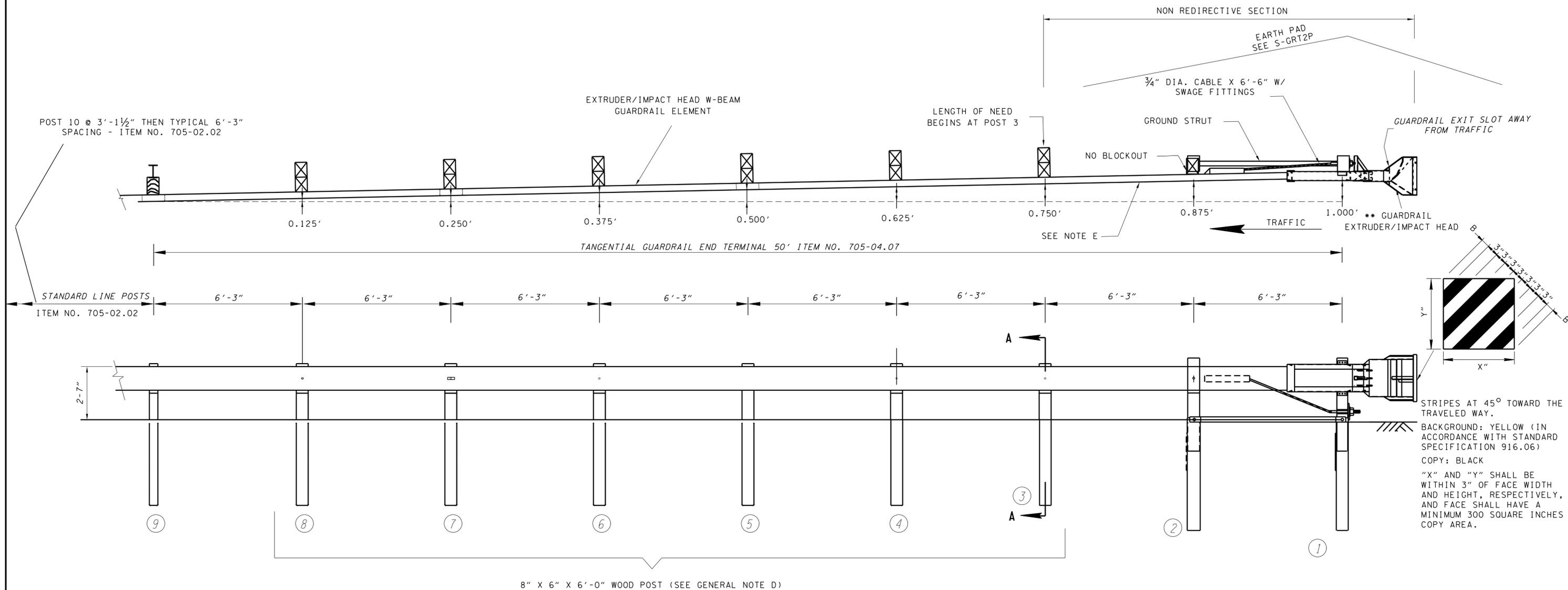
FLARE RATE TABLE	
RATE	POSTED SPEED (mph)
15:1	70
14:1	60
11:1	50
8:1	40
7:1	30

- GENERAL NOTES**
- (A) THE TYPE 12 GUARDRAIL TERMINAL SHOULD BE USED ONLY WITH 2:1 OR STEEPER BACK SLOPE. IF BACK SLOPE IS FLATTER, THE FULL DESIGN LENGTH OF NEED OF THE BARRIER MUST BE PROVIDED.
 - (B) THE FILL SLOPE MUST NOT BE ALLOWED TO SPILL UNDER THE RAIL THROUGHOUT THE LENGTH OF NEED BECAUSE THIS EFFECTIVELY DECREASES THE RAIL HEIGHT AND ALLOW VEHICLE OVERRIDE RATHER THAN CONTAINMENT AND REDIRECTION.
 - (C) THE FLARE RATE OF THE GUARDRAIL MAY BE STEEPENED TO 8:1 AFTER CROSSING THE DITCH BOTTOM TO SHORTEN THE LENGTH OF THE TERMINAL.
 - (D) IF MIN. 1' COVER OVER THE CONCRETE BLOCK CAN NOT BE ACHIEVED THE ELEVATION OF GUARDRAIL MAY BE LOWERED 1:10 SLOPE RATE AFTER CROSSING THE DITCH BOTTOM.
 - (E) THE CONTRACTOR SHALL CONSTRUCT FORE SLOPES AS PART OF THE INITIAL GRADING OPERATIONS AS SHOWN ON THIS STANDARD DRAWING AFTER FIELD VERIFICATION OF HAZARD LOCATION AND ENGINEERS APPROVAL.
 - (F) ONLY USE TYPE 38 OR TYPE 21 (WHERE APPROPRIATE) IF SUITABLE BACKSLOPE IS NOT AVAILABLE.
 - (G) THE DESIGNER SHALL INCORPORATE THE DETAILS SHOWN ON THIS DRAWING IN THE RIGHT-OF-WAY AND CONSTRUCTION PLANS AS WELL AS THE ROADWAY CROSS-SECTION SHEETS.
 - (H) ADD W-BEAM RUB RAIL WHENEVER THE CLEARANCE FROM THE BOTTOM OF THE W-BEAM TO THE GROUND LINE EXCEEDS 18 INCHES.
 - (I) FOR THE RUB RAIL SECTION USE 8' LONG POSTS.
 - (J) UNIT PRICE FOR ITEM NO. 705-04.02 GUARDRAIL TERMINAL (TYPE 12) PER EACH SHALL INCLUDE COSTS OF FURNISHING AND INSTALLING ALL COMPONENTS AS SHOWN.
 - (K) SEE S-GRA-1 FOR DETAILS OR S-GRA-1A ALTERNATE INSTALLATION.

NOTE TO DESIGNER
DO NOT USE WITHOUT REFERENCING S-GRA-1 OR S-GRA-1A

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

TYPE 12
GUARDRAIL
TERMINAL
BURIED-IN-
BACKSLOPE



POST 10 @ 3'-1 1/2" THEN TYPICAL 6'-3" SPACING - ITEM NO. 705-02.02

EXTRUDER/IMPACT HEAD W-BEAM GUARDRAIL ELEMENT

LENGTH OF NEED BEGINS AT POST 3

GROUND STRUT

GUARDRAIL EXIT SLOT AWAY FROM TRAFFIC

0.125'

0.250'

0.375'

0.500'

0.625'

0.750'

0.875'

1.000'

** GUARDRAIL EXTRUDER/IMPACT HEAD

TANGENTIAL GUARDRAIL END TERMINAL 50' ITEM NO. 705-04.07

STANDARD LINE POSTS ITEM NO. 705-02.02

6'-3"

6'-3"

6'-3"

6'-3"

6'-3"

6'-3"

6'-3"

6'-3"

6'-3"

2'-7"

9

8

7

6

5

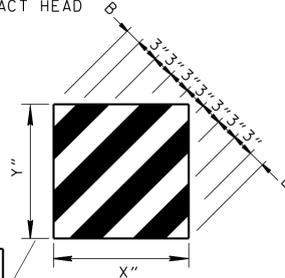
4

3

2

1

8" X 6" X 6'-0" WOOD POST (SEE GENERAL NOTE D)



STRIPES AT 45° TOWARD THE TRAVELED WAY.
BACKGROUND: YELLOW (IN ACCORDANCE WITH STANDARD SPECIFICATION 916.06)
COPY: BLACK
"X" AND "Y" SHALL BE WITHIN 3" OF FACE WIDTH AND HEIGHT, RESPECTIVELY, AND FACE SHALL HAVE A MINIMUM 300 SQUARE INCHES COPY AREA.

NOTE TO DESIGNER
DO NOT USE WITHOUT REFERENCING S-GRT-2P

SPECIAL INSTALLATION NOTES

ANY NCHRP 350 OR MASH COMPLIANT TL-3 TANGENTIAL END TERMINAL ON THE TDOT QUALIFIED PRODUCTS LIST MAY BE INSTALLED. MANUFACTURER'S SHOP DRAWINGS SHALL BE REQUIRED BEFORE ANY TANGENTIAL END TERMINAL INSTALLATIONS CAN BEGIN. THE CONTRACTOR SHALL HAVE ONE COMPLETE SET OF SHOP DRAWINGS ON SITE DURING INSTALLATION OR REPAIR OF ANY TANGENTIAL GUARDRAIL TERMINAL ANCHOR. THE CONTRACTOR SHALL ALSO PROVIDE THE CONSTRUCTION OR MAINTENANCE SUPERVISOR WITH ONE COMPLETE SET OF SHOP DRAWINGS INCLUDING TDOT OPL EVALUATION NUMBER.

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

DIFFERENT TANGENTIAL TERMINAL SYSTEMS OR PARTS SHALL NOT BE COMBINED ON A RUN OF GUARDRAIL.

POST MATERIAL SIZE, GUARDRAIL SPLICING LOCATION, TAPER RATE, OFFSET GUARDRAIL HEIGHT, EXTRUDER HEAD DIMENSION, AND ALL OTHER MISCELLANEOUS HARDWARE MAY BE DIFFERENT. INSTALLATION SHALL FOLLOW THE MANUFACTURER'S SHOP DRAWINGS.

GENERAL NOTES

(A) FOR ADDITIONAL DETAILS OF TERMINAL SYSTEM, REFER TO THE MANUFACTURER'S INSTALLATION INSTRUCTIONS.

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

(C) THE TANGENT ENERGY ABSORBING TERMINAL (INCLUDING ANCHOR) IS TO BE INSTALLED UNDER THE PRICE BID FOR ITEM NO. 705-04.07 PER EACH.

(D) METAL POSTS ARE AN ACCEPTABLE ALTERNATE TO WOOD POSTS WHEN THE SYSTEM IS ON APPROVED PRODUCTS LIST, NCHRP 350 COMPLIANT AND INSTALLED IN ACCORDANCE WITH MANUFACTURER'S SHOP DRAWINGS.

(E) TERMINAL SYSTEM MUST BE CONSTRUCTED SO THAT THE FULL LENGTH OF THE TERMINAL SYSTEM GUARD RAILING IS IN STRAIGHT ALIGNMENT. THE GUARD RAIL EXTRUDER/IMPACT HEAD SHALL NOT ENCR OACH UPON THE ADJACENT PAVED SHOULDER OR LANE.

(F) SYSTEM IS APPROVED FOR USE ON STATE HIGHWAYS, FEDERAL HIGHWAYS, INTERSTATE HIGHWAYS AND LOCAL ROADS (WITH DESIGN SPEEDS GREATER THAN 40 MPH).

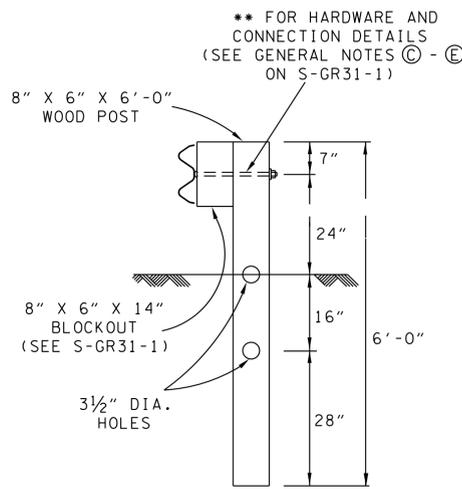
(G) FIRST 12'-6" FROM END IS GATING, DO NOT USE THIS SECTION IN LENGTH OF NEED.

(H) IF LENGTH OF NEED FOR GUARDRAIL NEEDS TO BE EXTENDED BEYOND THE THIRD POST EXTEND RUN OF GUARDRAIL.

(I) ALL HOLES IN WOOD POSTS ARE TO BE DRILLED BEFORE PRESERVATIVE TREATMENT.

(J) ALL CUTTING, DRILLING, AND WELDING OF STEEL COMPONENTS SHALL BE DONE BEFORE GALVANIZING.

(K) THE FINISHED CABLE ASSEMBLY WILL NOT BE ACCEPTABLE UNLESS IT IS IN TENSION WITH NO SAG.



SECTION "A-A"

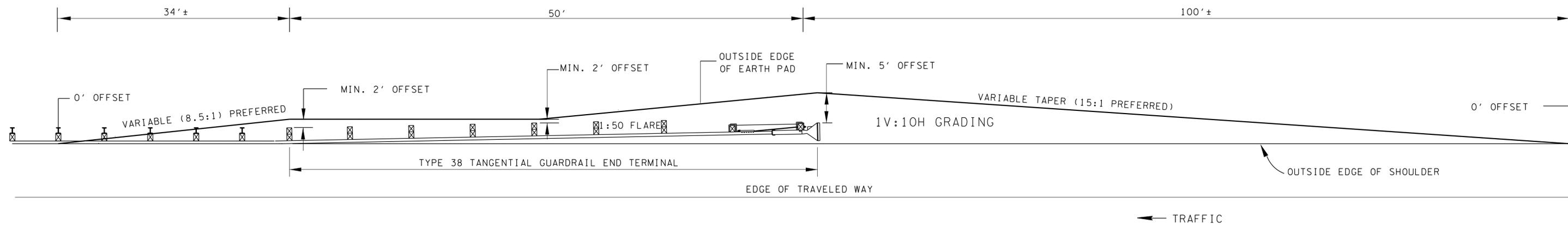
(TYPICAL AT POST NO. 3, 4, 5, 6, 7, & 8)

50:1 TAPER OVER 50' LENGTH OF SYSTEM

POST NO.	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'

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

**TYPE 38
GUARDRAIL
TERMINAL**

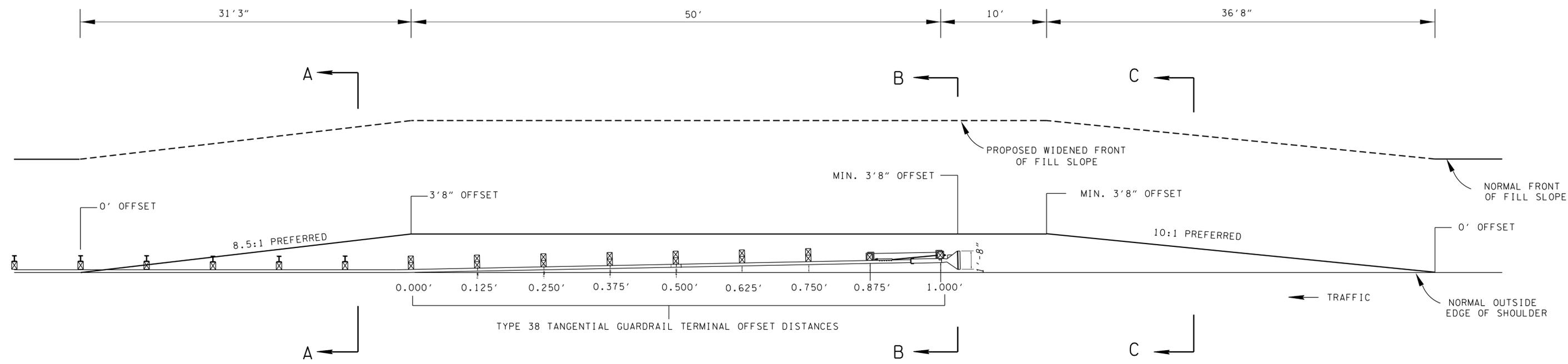


PLAN VIEW OF EARTH PAD CONSTRUCTION

GENERAL NOTES

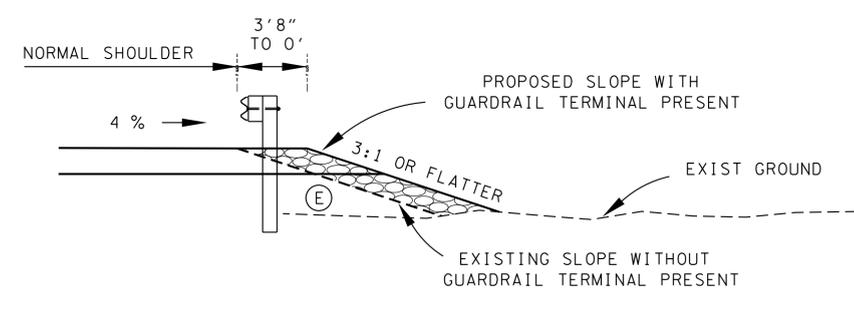
- (A) REFER TO RD01-S-SERIES FOR ROADSIDE SLOPE DEVELOPMENT AND ROADSIDE DITCH DETAILS.
- (B) FOR DETAILS NOT SHOWN SEE S-GRT-2, S-GRA-2.
- (C) THE DESIGNER SHALL INCORPORATE THIS EARTH PAD IN CONJUNCTION WITH ALL TYPE 38 GUARDRAIL TERMINALS IN THE RIGHT-OF-WAY AND CONSTRUCTION PLANS AS WELL AS THE ROADWAY CROSS-SECTION SHEETS.
- (D) THE CONTRACTOR SHALL CONSTRUCT THIS EARTH PAD AS PART OF THE INITIAL GRADING OPERATIONS AS SHOWN ON THIS STANDARD DRAWING AFTER FIELD VERIFICATION OF HAZARD LOCATION AND ENGINEERS APPROVAL. THE OFFSETS SHOWN INDICATE THE MINIMUM OFFSETS REQUIRED BEHIND THE GUARDRAIL END TERMINAL, ACTUAL OFFSETS FROM THE OUTSIDE SHOULDER FOR THE GRADED PAD WILL DEPEND ON THE APPROVED TYPE 38 GUARDRAIL END TERMINAL WHICH IS UTILIZED IN THE LOCATION.
- (E) ON ALL NEW GRADE AND DRAIN PROJECTS THE EARTH PAD SHALL BE BUILT AS SHOWN ON THIS STANDARD DRAWING WITHOUT EXCEPTION AND PAID UNDER ROADWAY GRADING RESURFACING, MAINTENANCE OR BRIDGE REPAIR PROJECTS MAY SUBSTITUTE RETROFIT STANDARD (S-GRT-2R).
- (F) REFER TO STANDARD DRAWING S-GRP-1 FOR LENGTH OF NEED AND CLEAR ZONE REQUIREMENTS.
- (G) ON PROJECTS OF LIMITED SCOPE OR WITH NO ADDITIONAL ROADWAY GRADING THE EARTH PAD SHALL BE PAID UNDER THE ITEM NUMBER:
705-04.09 EARTH PAD FOR TANGENTIAL GUARDRAIL END TERMINAL PER EACH.

THIS DRAWING IS TO BE USED FOR RESURFACING, MAINTENANCE AND BRIDGE REPAIR PROJECTS ONLY.
 THIS DRAWING IS NOT INTENDED TO BE USED FOR NEW CONSTRUCTION OR RECONSTRUCTION PROJECTS.

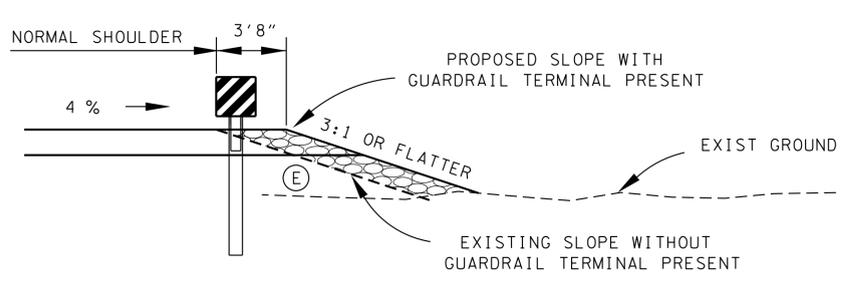


ALL OFFSET DISTANCES TAKEN FROM
 OUTSIDE EDGE OF SHOULDER

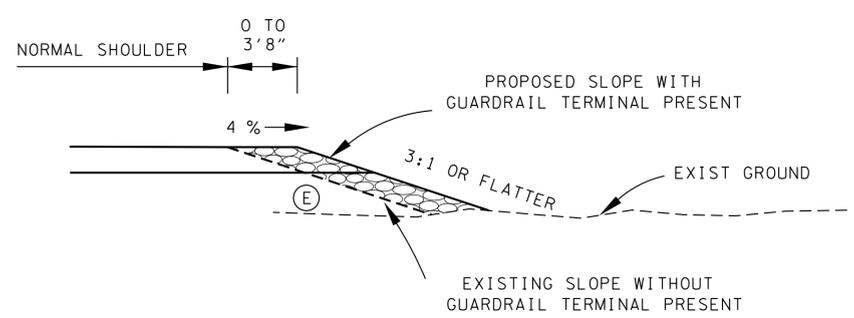
PLAN VIEW OF PROPOSED CONSTRUCTION OF EARTH PAD FOR TYPE 38 GUARDRAIL TERMINAL



SECTION "A-A"

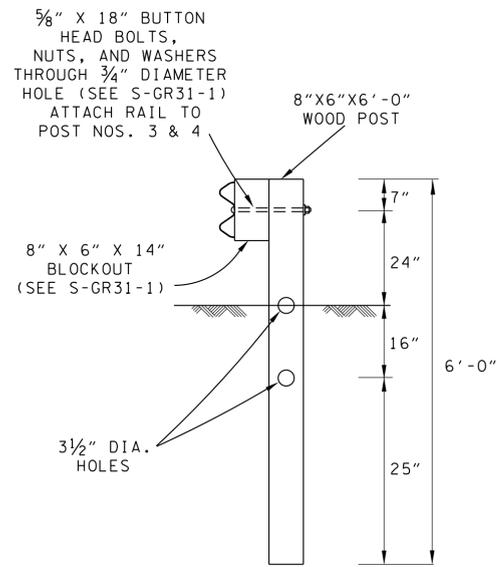


SECTION "B-B"

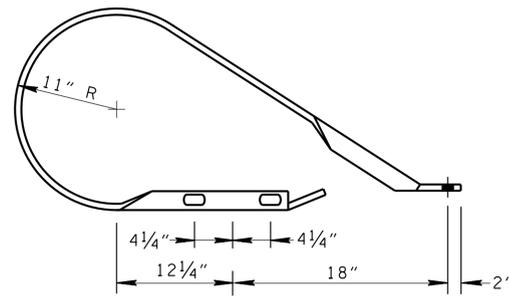


SECTION "C-C"

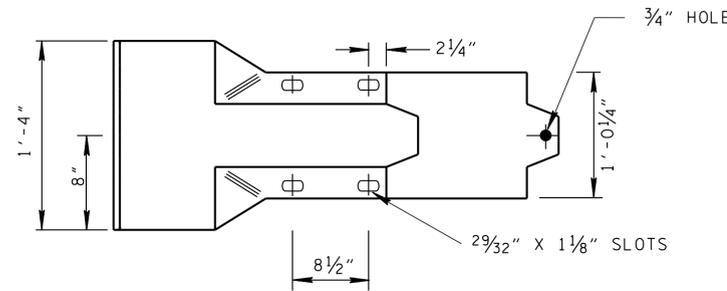
- GENERAL NOTES**
- (A) THIS STANDARD DRAWING IS AN ALTERNATE TO THE PREFERRED STANDARD DRAWING S-GRT-2P FOR MAINTENANCE, RESURFACING AND BRIDGE REPAIR PROJECTS. THIS STANDARD DRAWING IS FOR USE WHEN RIGHT-OF-WAY OR OTHER LIMITATIONS MAKES THE USE OF STANDARD DRAWING S-GRT-2P IMPRACTICAL.
 - (B) FOR DETAILS NOT SHOWN SEE S-GRT-2, S-GRA-2.
 - (C) WHEN GUARDRAIL END TERMINALS (TYPE 38) ARE USED, THE FORESLOPE MUST BE A 3:1 OR FLATTER. WHEN THE SLOPE IS STEEPER THAN 3:1 OR DRAINAGE DITCHES EXIST THAT DO NOT ALLOW THE USE OF THIS PAD DETAIL, THE GUARDRAIL MAY BE EXTENDED BEYOND THE MINIMUM LENGTH OF NEED AS SHOWN ON S-PL-1.
 - (D) REFER TO STANDARD DRAWING S-PL-1 FOR LENGTH OF NEED REQUIREMENTS AND CLEAR AREAS AT GUARDRAIL TERMINALS.
 - (E) EARTH PAD SHALL BE CONSTRUCTED OF AGGREGATE MEETING THE REQUIREMENTS OF STANDARD SPECIFICATION 903.05. THE AGGREGATE SHALL BE PLACED IN LAYERS AND COMPACTED.



SECTION "B-B" (S-GRT-3)
(TYPICAL AT POST NOS. 3 & 4)



PLAN



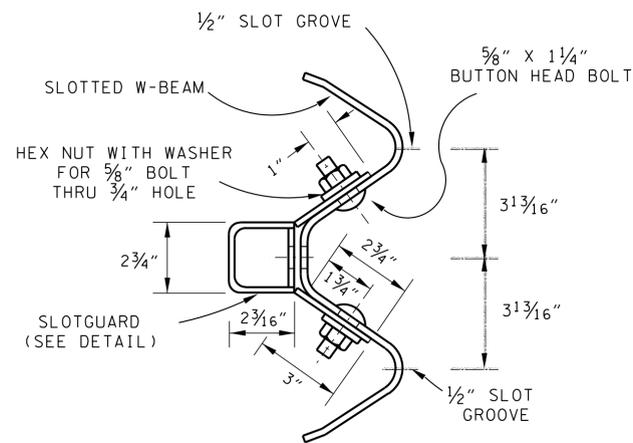
ELEVATION

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

SEE S-GRT-3 FOR SYSTEM VIEW

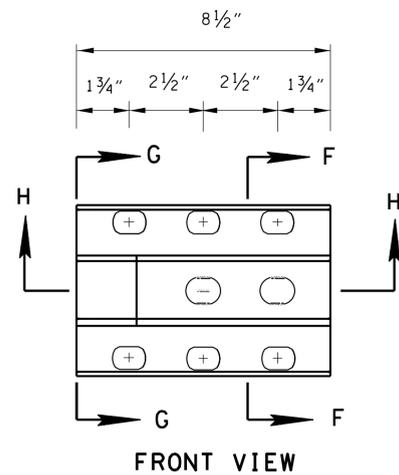
SPECIAL NOTES FOR END ELEMENT

- Ⓐ 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 GAGE STEEL CONFORMING TO THE REQUIREMENTS OF AASHTO M180, CLASS A, TYPE 2.
- Ⓒ RAIL MATERIAL SHALL HAVE A MINIMUM YIELD STRENGTH 50 KIPS PER SQUARE INCH AND A TENSILE STRENGTH OF 70 KIPS PER SQUARE INCH.

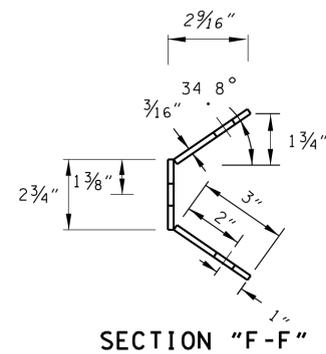


SECTION "E-E" (S-GRT-3)

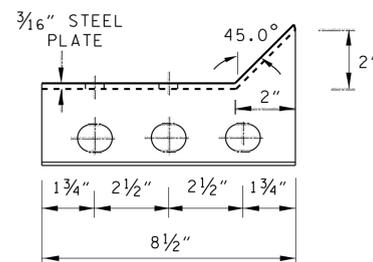
NOTE: 8 - 5/8" X 1 1/4" BUTTON HEAD BOLTS AND NUTS REQUIRED FOR EACH SLOTGUARD ASSAMBLY.



FRONT VIEW



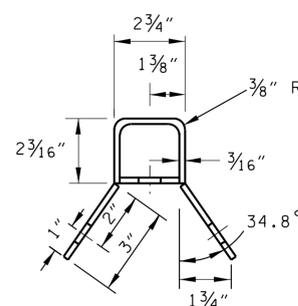
SECTION "F-F"



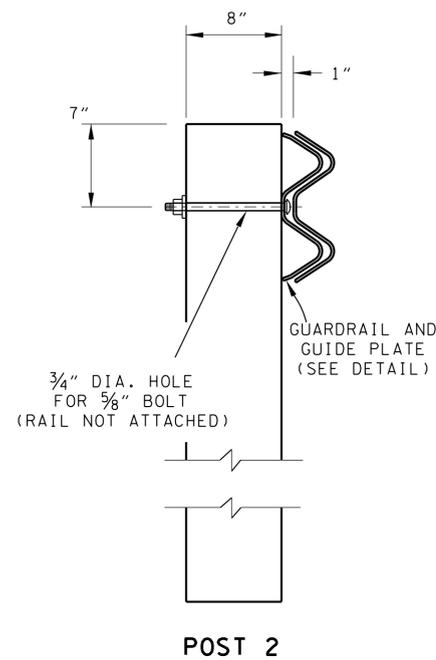
SECTION "H-H"

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

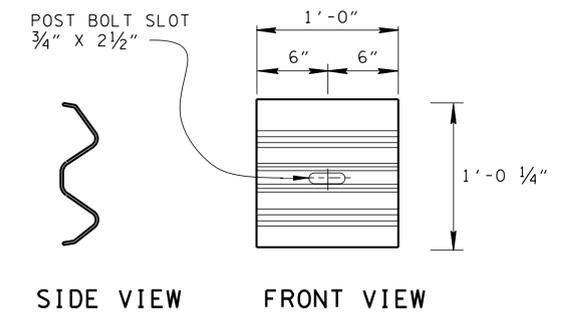
SLOTGUARD DETAIL



SECTION "G-G"
SIDE VIEW



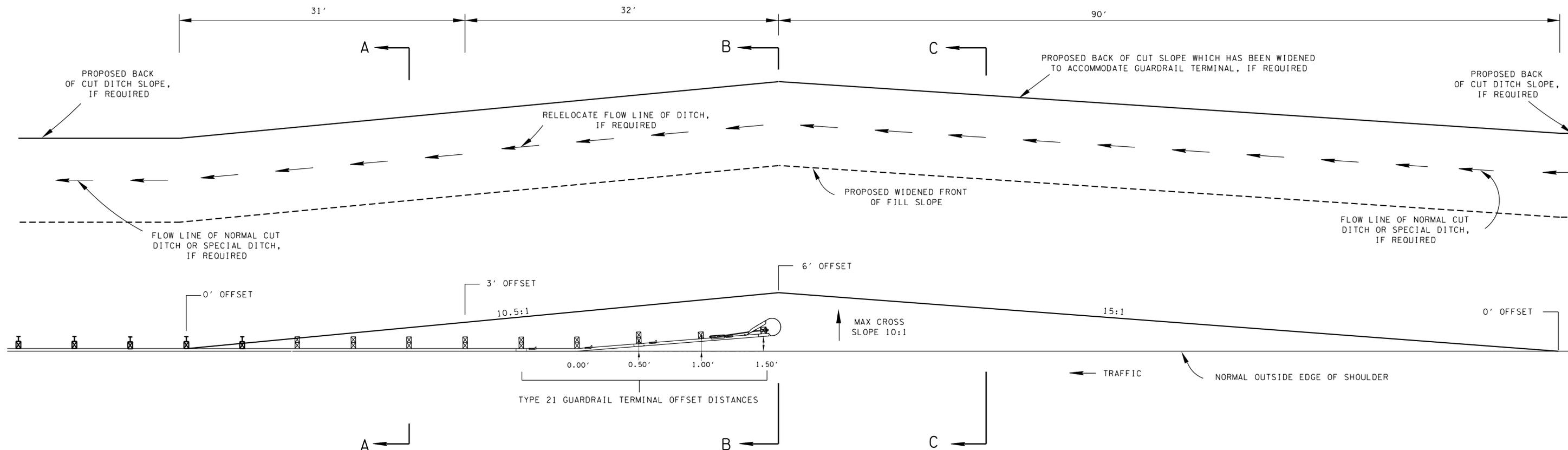
GUARDRAIL WITH BACK UP PLATE DETAIL



GUIDE PLATE (AASHTO M180)

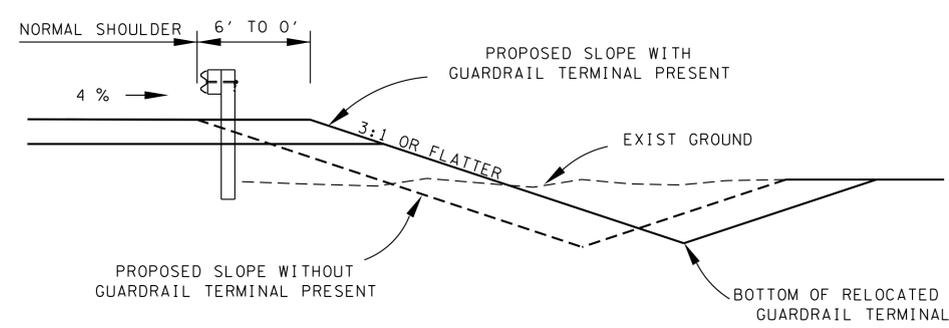
(SAME CLASS AND TYPE AS RAIL ELEMENT)

NOTE: GUARDRAIL AT POST 2 SITS ON TOP OF GUIDE PLATE, BUT IS NOT ATTACHED TO POST BY BOLT. ONLY GUIDE PLATE IS TO BE BOLTED TO POST.

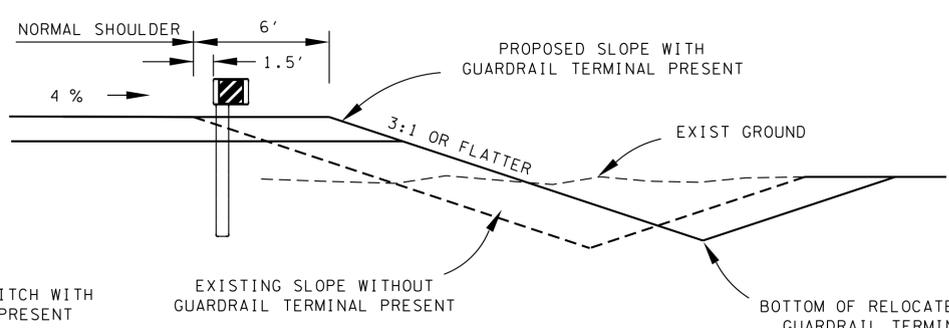


PLAN VIEW OF PROPOSED CONSTRUCTION OF EARTH PAD FOR TYPE 21 GUARDRAIL TERMINAL

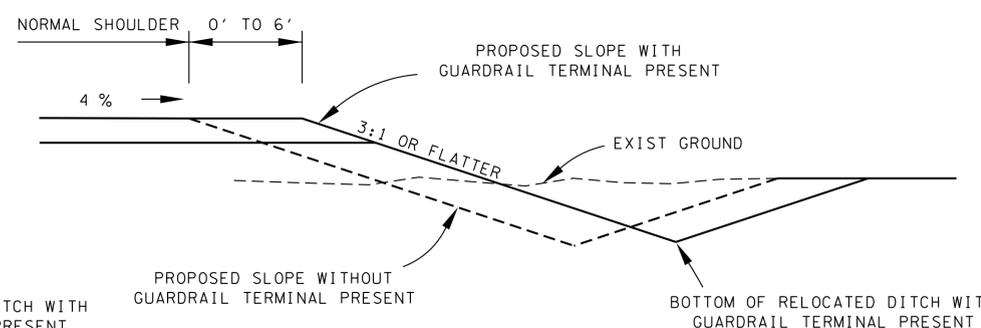
ALL OFFSET DISTANCE TAKEN FROM
OUTSIDE EDGE OF SHOULDER



SECTION "A-A"



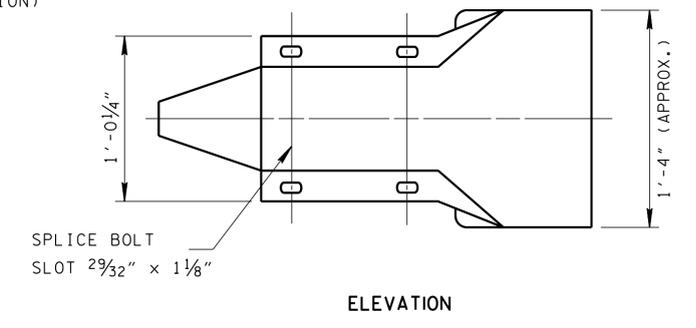
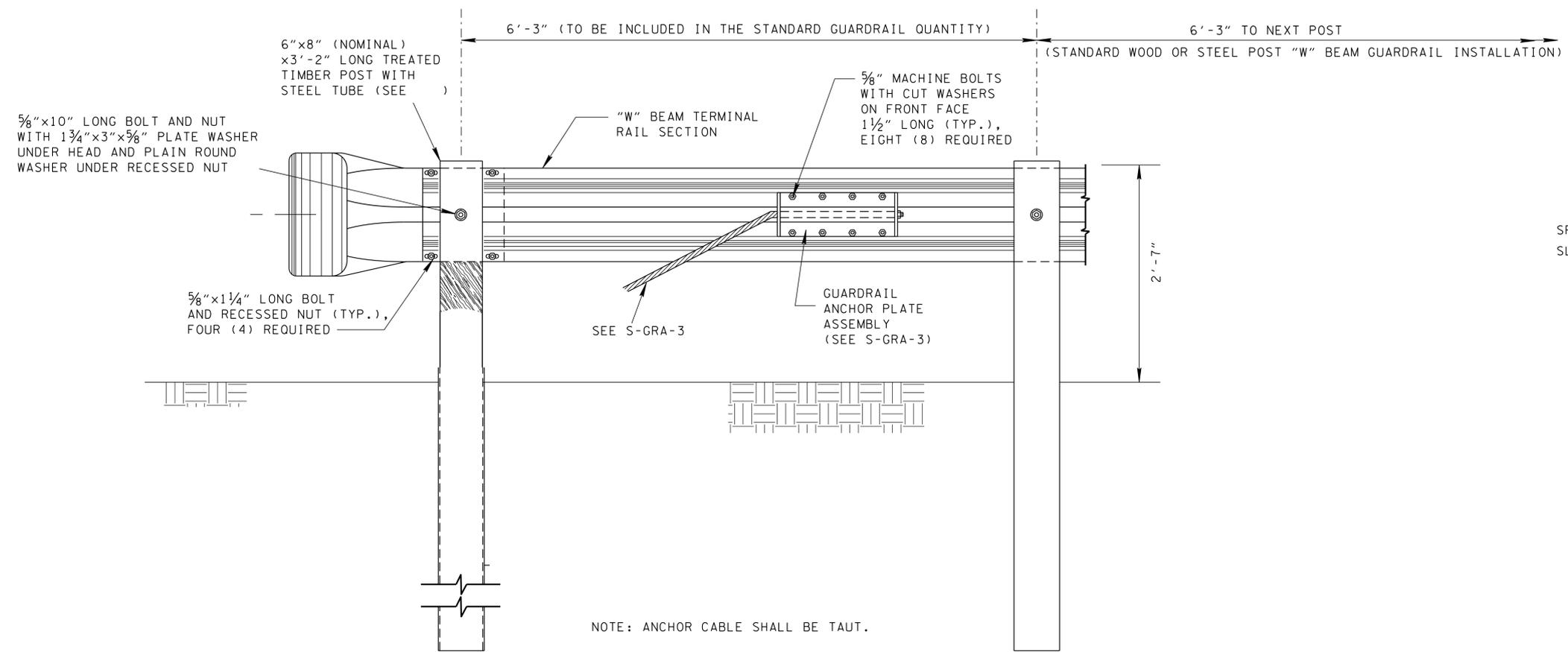
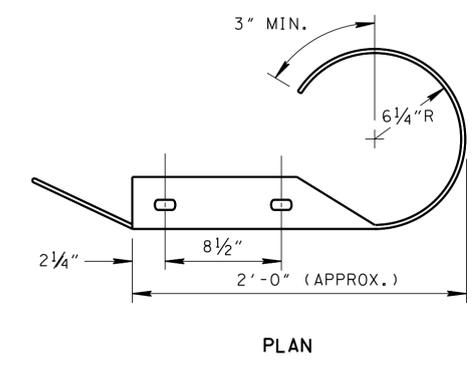
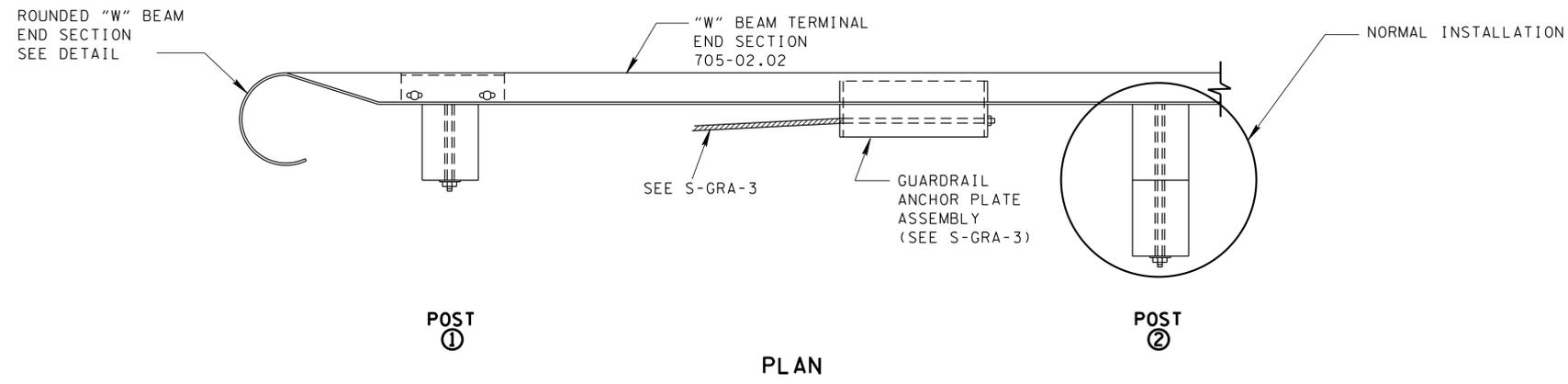
SECTION "B-B"



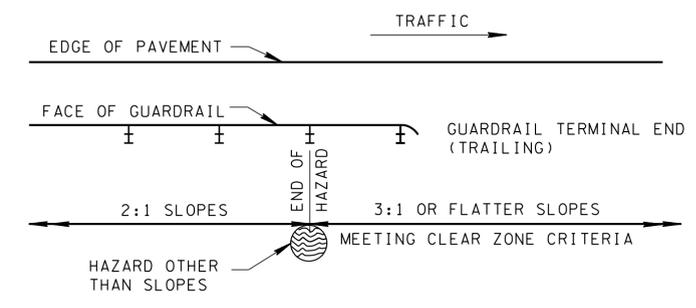
SECTION "C-C"

- GENERAL NOTES**
- (A) FOR DETAILS NOT SHOWN SEE S-GRT-3, S-GRT-3D AND S-GRA-3.
 - (B) THE DESIGNER SHALL INCORPORATE THIS EARTH PAD IN CONJUNCTION WITH ALL SLOTTED GUARDRAIL TERMINALS IN THE RIGHT-OF-WAY AND CONSTRUCTION PLANS AS WELL AS THE ROADWAY CROSS-SECTION SHEETS.
 - (C) THE CONTRACTOR SHALL CONSTRUCT THIS EARTH PAD AS PART OF THE INITIAL GRADING OPERATIONS AS SHOWN ON THIS STANDARD DRAWING AFTER FIELD VERIFICATION OF HAZARD LOCATION AND ENGINEERS APPROVAL.
 - (D) ON ALL NEW GRADE AND DRAIN PROJECTS THE EARTH PAD SHALL BE BUILT AS SHOWN ON THIS STANDARD DRAWING WITHOUT EXCEPTION.
 - (E) ON ALL OTHER TYPE OF PROJECTS (SUCH AS 4R, BRIDGE REPLACEMENT, ETC.) WHERE THIS TERMINAL IS USED, THE DESIGNER SHALL INCORPORATE THIS PAD IN THE CONSTRUCTION PLANS.

DO NOT USE WITHOUT ALSO REFERENCING S-GRA-3.



ROUNDED END ELEMENT
(TO BE PERFORMED BY THE MANUFACTURER)



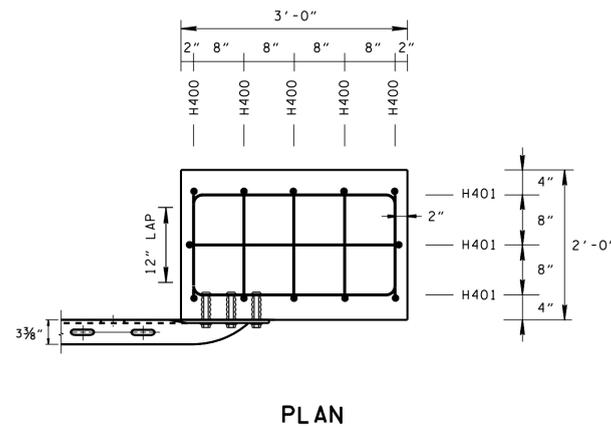
SKETCH SHOWING APPLICATION OF TRAILING END TREATMENT

GENERAL NOTES

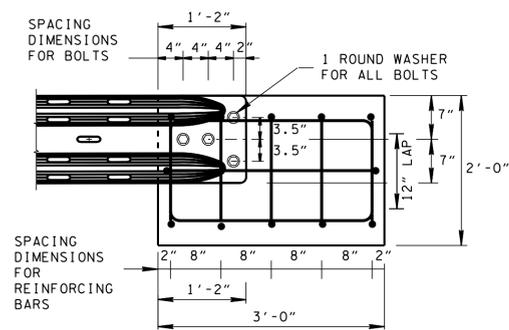
- (A) THIS ANCHORAGE MAY ONLY BE USED ON THE TRAILING END OF A BARRIER WHICH IS NOT EXPOSED TO DIRECT VEHICULAR IMPACT (ONLY DIVIDED HIGHWAYS OR ROADS WITH ONE WAY TRAFFIC).
- (B) GUARDRAIL SHALL MEET THE REQUIREMENTS OF AASHTO M 180, CLASS A, TYPE 1 UNLESS OTHERWISE DESIGNATED.
- (C) ALL WOOD POSTS AND BLOCKOUTS SHALL BE TREATED TIMBER IN ACCORDANCE WITH TENNESSEE DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS.
- (D) MUST BE INSTALLED WITH SOIL PLATE ANCHOR (S-GRA-3)
- (E) WHEN SOIL PLATE ANCHOR IS USED SEE NOTE (H) ON S-GRA-3.

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

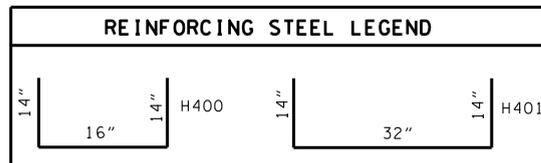
TYPE 13
GUARDRAIL
TERMINAL
(TRAILING END)



PLAN



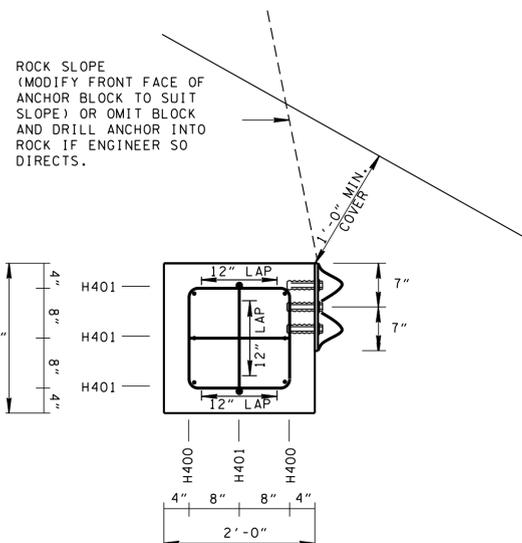
ELEVATION (FRONT)



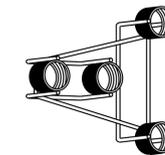
SPECIAL INSTALLATION NOTE

FOR THIS GUARDRAIL ANCHOR TO FUNCTION AS IT WAS CRASH TESTED UNDER NCHRP-350 TEST LEVEL 3 IT MUST BE CONSTRUCTED PER STANDARD DRAWING NO. S-GRT-1.

TO BE USED WITH S-GRT-1 ONLY



ELEVATION (SIDE)

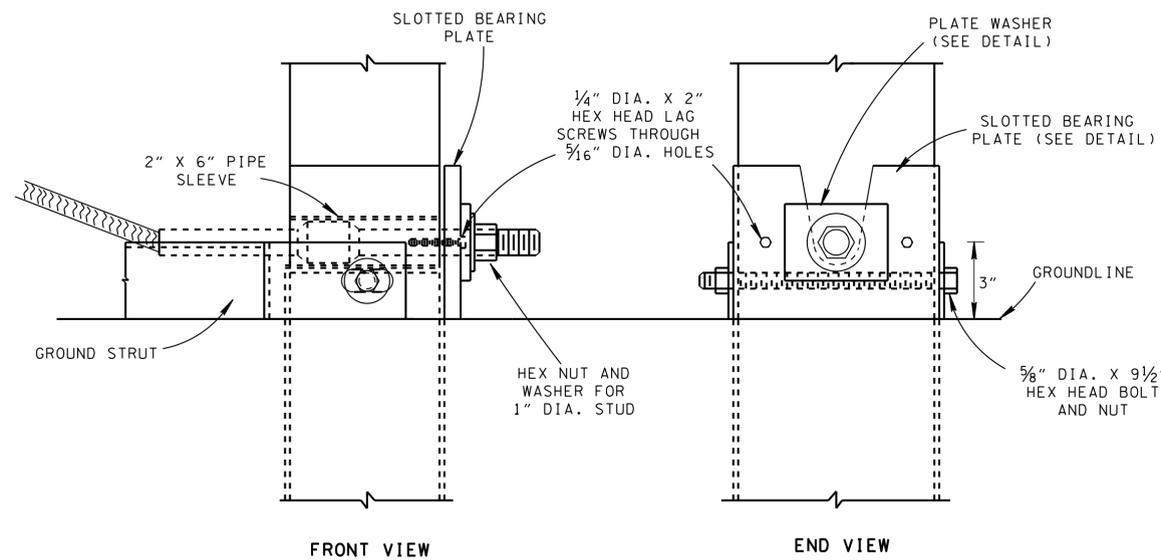
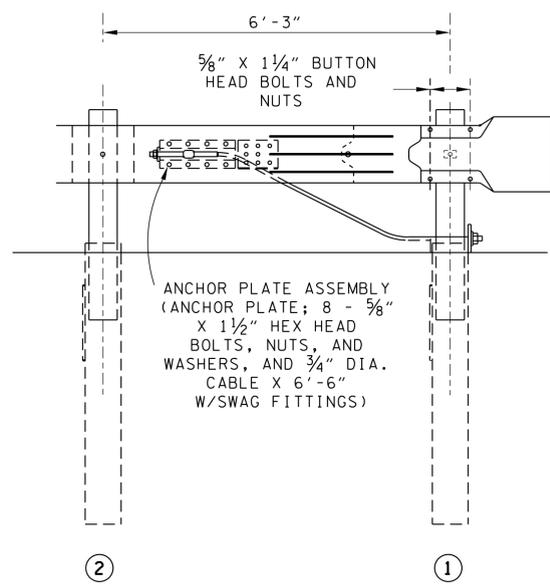


ANCHOR BLOCK INSERT ASSEMBLY

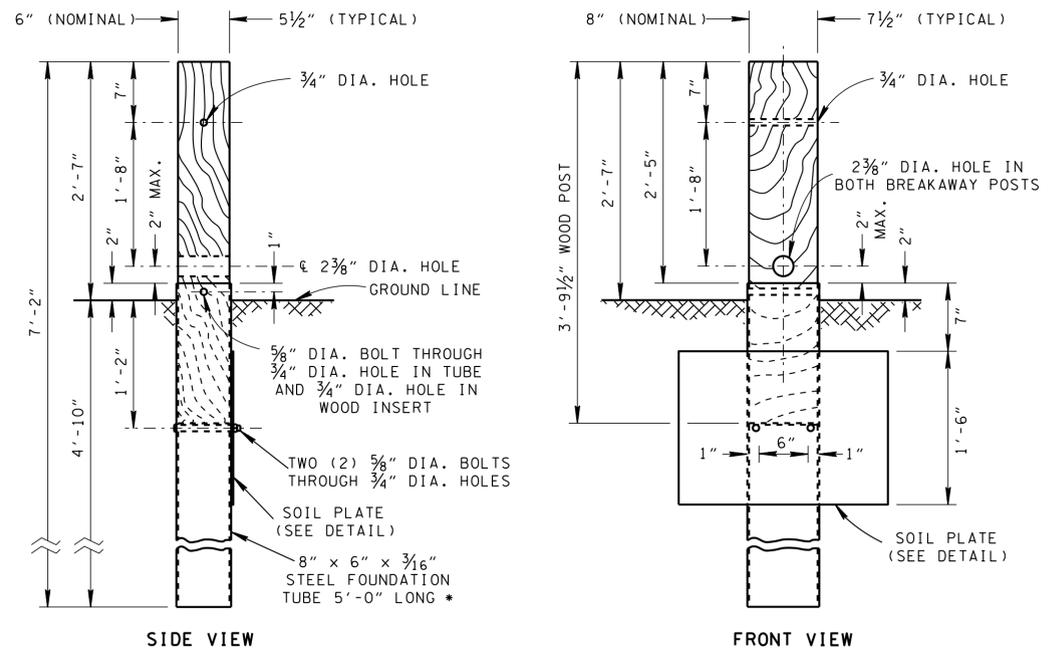
CAST IN PLACE THREADED STEEL INSERT WITH
 7/8" DIA. X 2" HEX HEAD GALVANIZED BOLTS (ASTM A307)
 HOT DIP ZINC COATING ASTM A153

GUARDRAIL ANCHOR (BURIED-IN-BACKSLOPE) GENERAL NOTES

- (A1) REQUIREMENTS FOR ANCHOR INSERT BOLTS SHALL BE 7/8" HEX HEAD INSTALLED IN 7/8" MASONRY ANCHOR. THE INSERTS ARE TO BE THREADED A MINIMUM OF 1 3/4 INCHES. 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 7/8" ANCHOR SHALL BE 19,000 POUNDS. BOLTS SHALL CONFORM TO ASTM A307.
- (A2) THE MASONRY ANCHORS SHALL BE SUB-SET IN THE CONCRETE AT A DEPTH OF BETWEEN 3/52" TO 1/4" 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".
- (A3) 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 CONTRACTORS EXPENSE.
- (A4) THE CONTRACTOR MAY ELECT TO USE 7/8 INCH DIAMETER DRILLED IN ANCHORS WITH 50 KIPS PER SQUARE INCH OR GREATER YIELD STRENGTH WHEN ATTACHING THE TERMINAL END ELEMENTS INTO ROCK. SEE ABOVE GENERAL NOTE (A2) FOR PULL OUT REQUIREMENTS.
- (A5) 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.
- (A6) COST OF ANCHOR TO BE INCLUDED IN THE COST OF ITEM NO. 705-04.02.
- (A7) ESTIMATED QUANTITIES OF CONCRETE AND STEEL ARE:
 CLASS "A" CONCRETE= 0.44 CUBIC YARD
 NO. 4 STEEL REINFORCING BARS= 52 POUNDS
- (A8) SEE STD. DWG. S-GRA-1A FOR ALTERNATE BURIED-IN-BACKSLOPE ANCHOR.

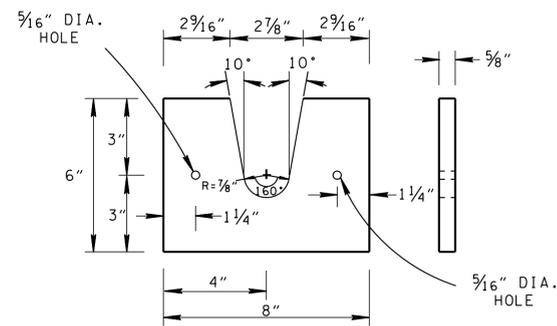


SLOTTED BEARING PLATE ASSEMBLY DETAIL



NO. 1 & 2 BREAKAWAY POSTS WITH 5'-0" TUBE SLEEVE

• ALTERNATE 6'-0" TUBE SLEEVE WITHOUT SOIL PLATE



SLOTTED BEARING PLATE DETAIL

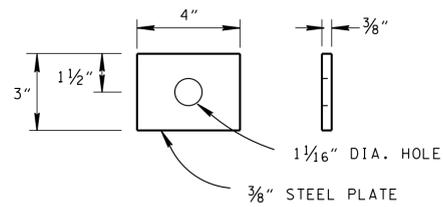
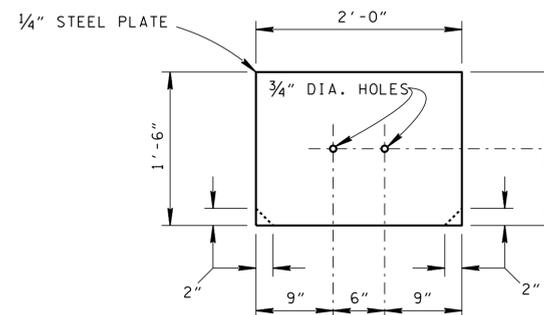


PLATE WASHER DETAIL



SOIL PLATE

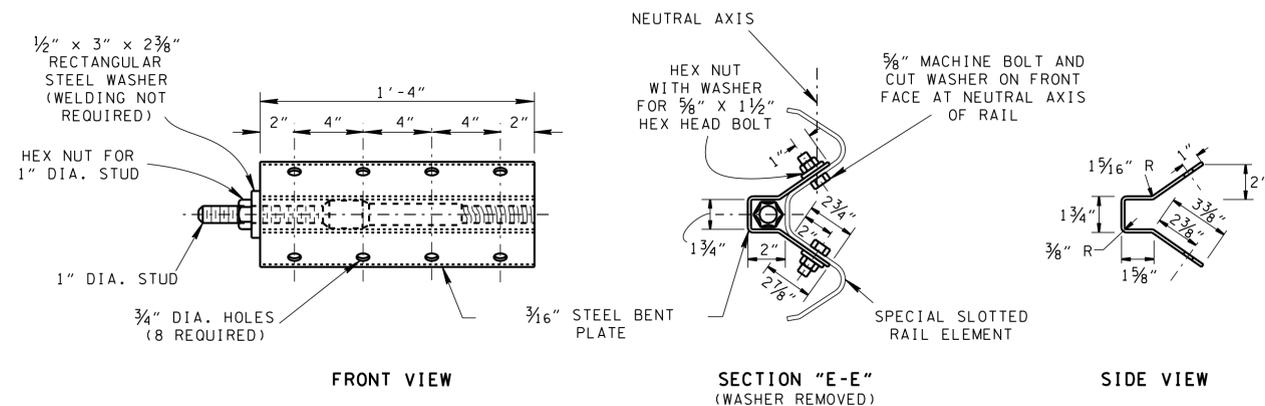
(TO BE ATTACHED TO BREAKAWAY POST NOS. 1 & 2 ON SIDE OPPOSITE TO END TERMINAL SECTION)

NOTE: THE CONTRACTOR HAS THE OPTION OF CLIPPING 2" X 2" TRIANGLES OFF BOTTOM CORNERS TO AID IN DRIVING.

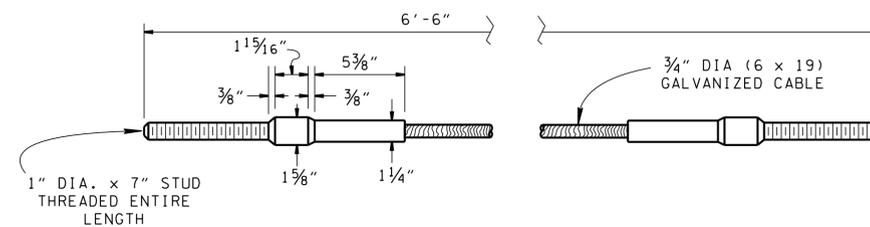
SLOTTED BEARING PLATE

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 3/8" DIAMETER HOLE CENTERED 2'-0" BELOW THE TOP OF THE POST ON THE 8" SIDE AS SHOWN. ALL POSTS SHALL BE ERECTED SO THAT THE GUARDRAIL WILL HAVE A TOP-OF-RAIL HEIGHT OF 2'-7".
- (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 NOT BE ACCEPTABLE UNLESS IT IS IN TENSION WITH NO SAG.
- (E) OTHER ANCHOR CABLE ASSEMBLIES PROVIDING A MINIMUM BREAKING STRENGTH OF 40,000 POUNDS PER SQUARE INCHES WILL BE ACCEPTABLE.
- (F) COST OF ANCHOR TO BE INCLUDED IN THE COST OF END TERMINAL EXCEPT AS STATED IN NOTE (C).
- (G) IF USED WITHOUT END TERMINAL TO BE PAID UNDER ITEM NO. 705-04.05 GUARDRAIL TERMINAL (TYPE IN LINE) PER EACH. (SEE S-PL-2)
- (H) WHEN USED WITH A TRAILING END TERMINAL (TYPE 13) OR IN-LINE, ONLY FIRST POST IS REQUIRED, SECOND POST SHALL BE A STANDARD POST SEE S-GR31-1.

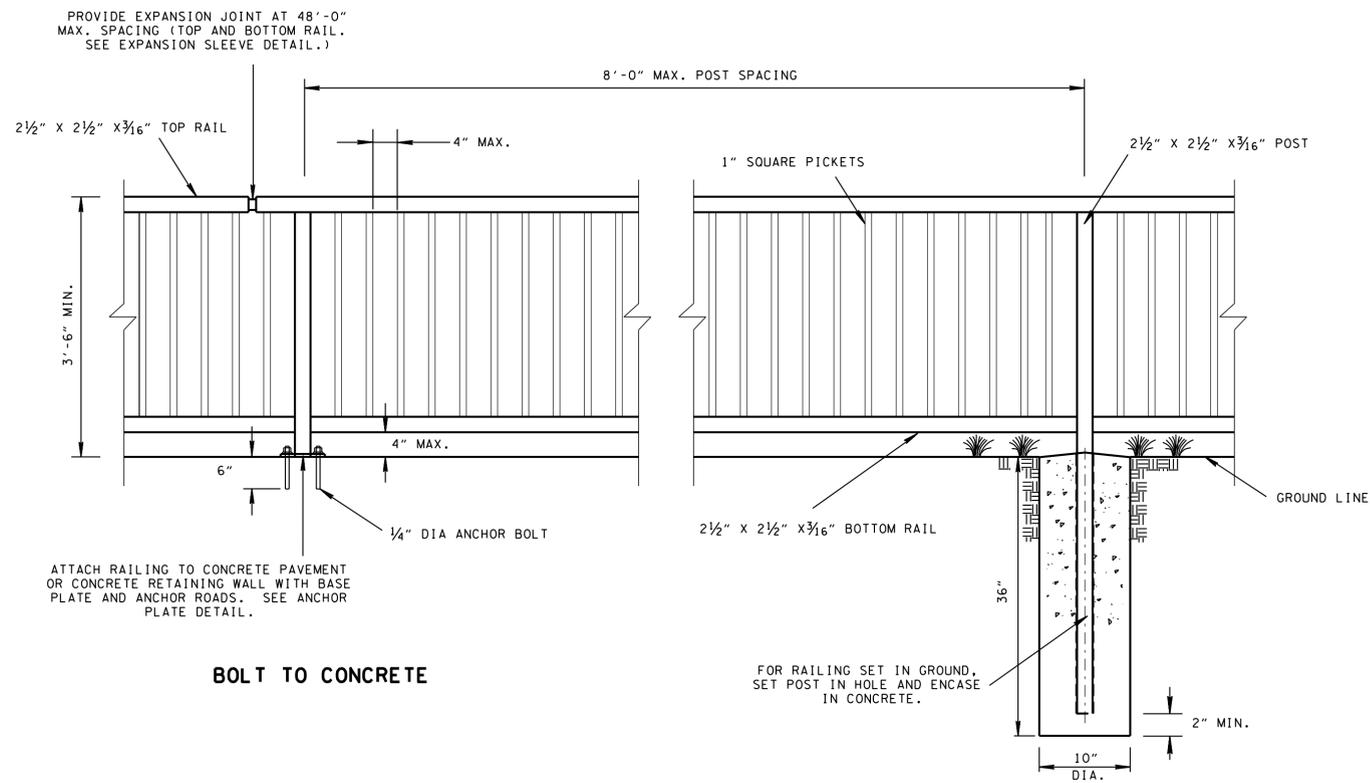


ANCHOR PLATE ASSEMBLY DETAILS



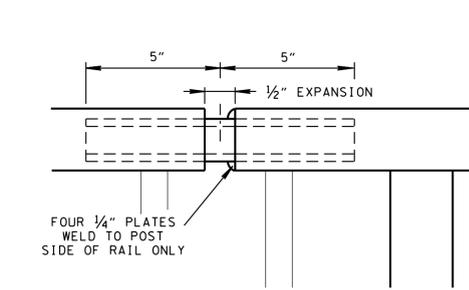
STANDARD SWAGE FITTING AND STUD

NOTE: CABLE TO BE SWAGE-CONNECTED

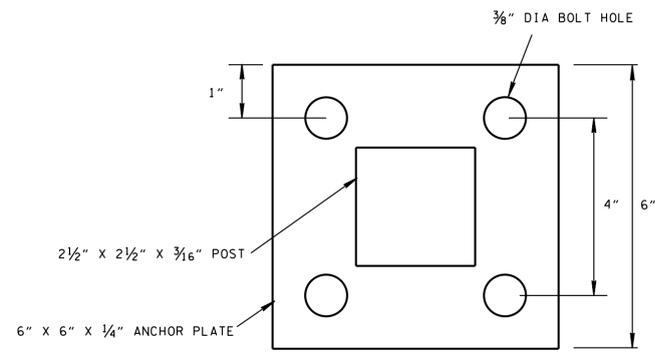


BOLT TO CONCRETE

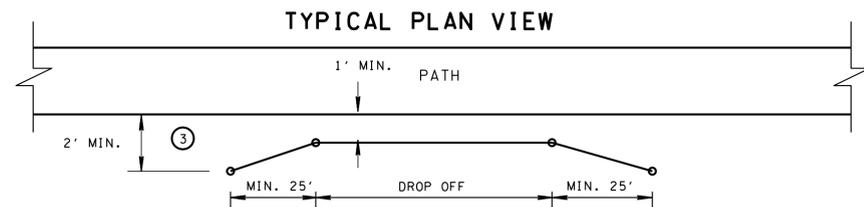
POST SET IN GROUND



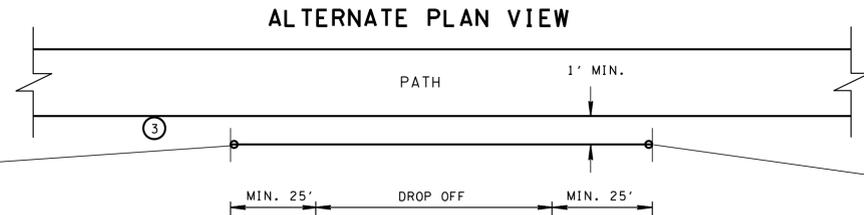
EXPANSION SLEEVE DETAIL ⑤



ANCHOR PLATE DETAIL

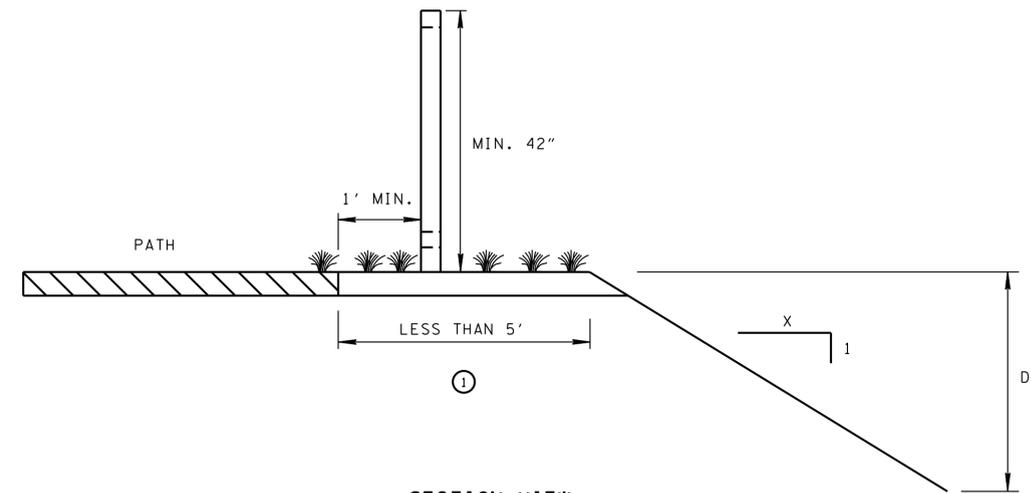
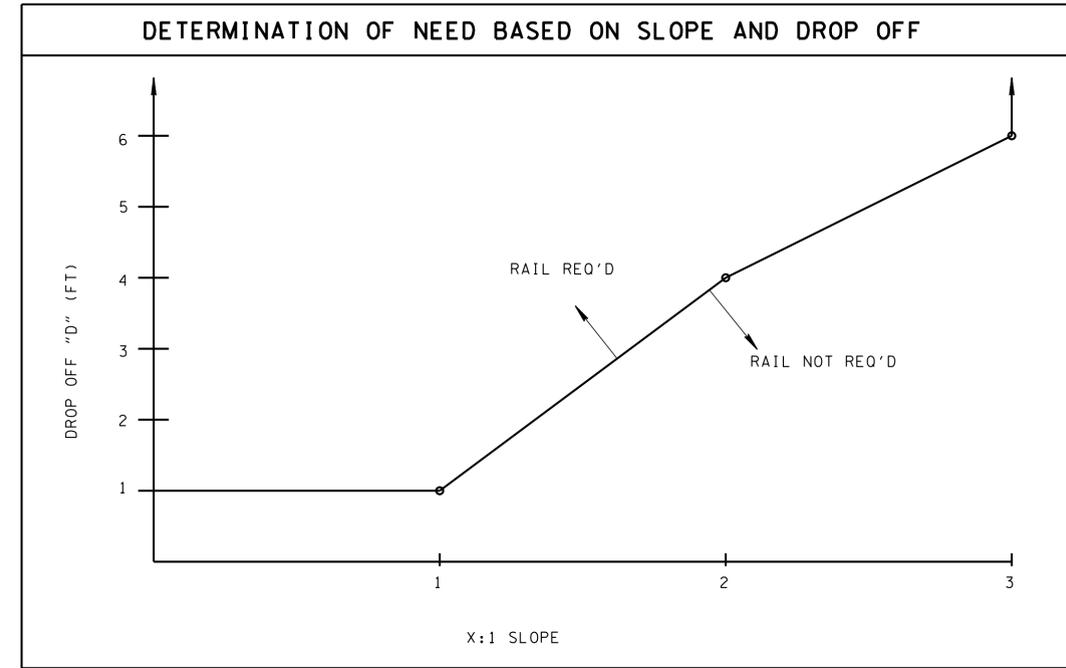


TYPICAL PLAN VIEW



ALTERNATE PLAN VIEW

FIGURE A



SECTION VIEW

GENERAL NOTES

- ① TO DETERMINE IF SAFETY RAIL IS REQUIRED, REFER TO FIGURE A WHEN SHARED USE PATH SIDEWALK EDGE DROP OFF IS WITHIN 5'. INFORMATION IS PROVIDED FOR GUIDANCE ONLY SOME SITES MAY REQUIRE A RAIL PER ENGINEER JUDGMENT.
- ② SAFETY RAIL SHALL BEGIN 25' BEFORE AND EXTEND 25' BEYOND AREA OF NEED.
- ③ SAFETY RAIL ENDS SHALL BE FLARED TO BEYOND 2' OF THE EDGE OF THE PATH OR MARKED WITH OBJECT MARKERS.
- ④ STEEL SHALL CONFORM TO ASTM A36 WELD ALL COMPONENTS POST THICKNESS IS 3/16" FILLET WELDS. GRIND WELDS AND CONNECTIONS AS REQUIRED TO PROVIDE A SMOOTH SURFACE, FREE OF BURRS.
FIELD PAINT SAFETY RAIL AFTER INSTALLATION AS SPECIFIED IN THE CONTRACT DOCUMENTS.
- ⑤ DETAIL SHOWN IS FOR TOP RAIL. EXPANSION JOINT FOR BOTTOM RAIL IS SIMILAR.
- ⑥ SYSTEM REPLACEMENTS MAY BE ALLOWED PROVIDING THAT THE HEIGHT AND SPACING LIMITATIONS SHOWN ON THIS DRAWING ARE MET.
- ⑦ SAFETY RAIL (INCLUDING FOOTINGS OR ANCHOR PLATE AND BOLTS) TO BE PAID FOR UNDER ITEM NO. 604-01.04 PER LINER FOOT.