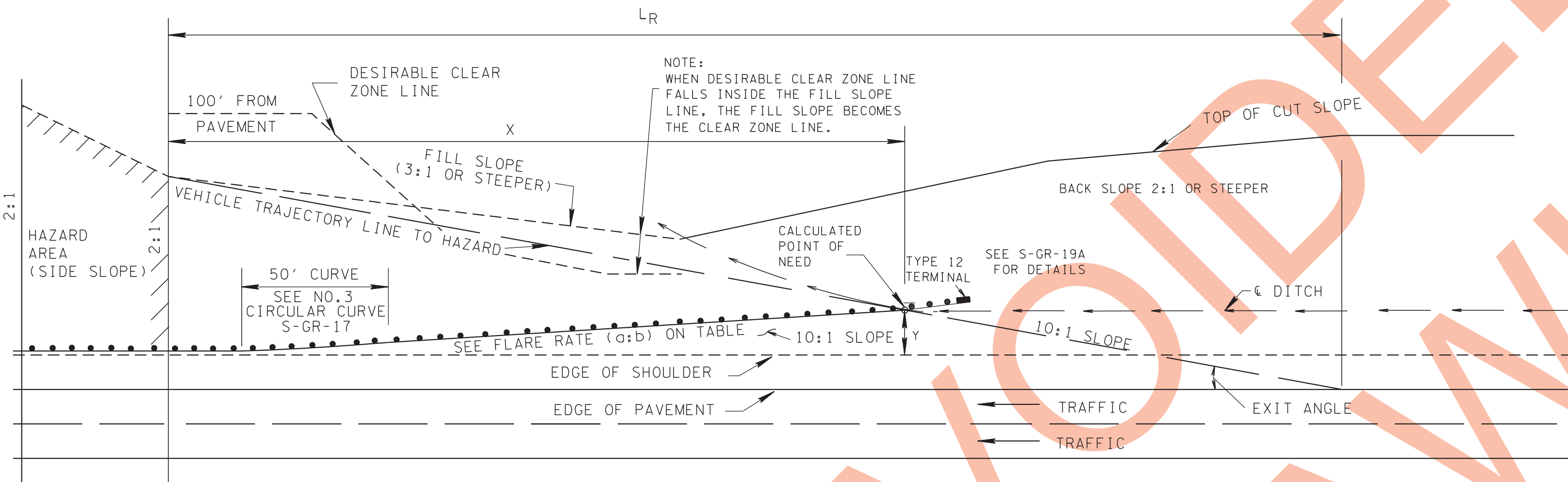


TYPICAL LAYOUT-CASE I
AVERAGE TERRAIN-DIVIDED HIGHWAY

POINT OF THEORETICAL NEED FOR EMBANKMENT GUARDRAIL
 THE POINT OF NEED SHALL 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, IT WOULD BE SAFER FOR THE VEHICLE TO GO OVER THE SLOPE. AN EXIT ANGLE FROM THE ROADWAY AS DETERMINED BY THE CASE I EQUATION ON THIS DRAWING SHOULD BE UTILIZED FOR DETERMINING THE POINT OF THEORETICAL NEED. WHERE FEASIBLE CONSIDERATION 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.



TYPICAL LAYOUT-CASE II
STEEPER TERRAIN-DIVIDED HIGHWAY

NOTES

- CASE I**
- ① 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**
- ① THE ROADWAY EMBANKMENT IS SHOWN GOING FROM A CUT 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 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

- (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) R.O.W. FENCES WILL NOT BE CONSIDERED A HAZARD, BUT HAZARDS WHICH ARE OUTSIDE THE R.O.W. LINE BUT INSIDE THE DESIRABLE CLEAR ZONE SHOULD BE CONSIDERED AND APPROPRIATE ACTION TAKEN FOR VEHICLE PROTECTION. COST EFFECTIVE EVALUATION MAY BE NEEDED TO HELP DECIDE THE APPROPRIATE ACTION NEEDED.
- (C) WHERE THE HAZARD APPEARS ON THE OUTSIDE OF A ROADWAY CURVE, GOOD ENGINEERING JUDGEMENT MUST BE USED TO DETERMINE THE LIMITS OF GUARDRAIL NEEDED. REFER TO THE "ROADSIDE DESIGN GUIDE (2006)", SECTION 3.2 AND STANDARD DRAWING NO. RD01-S-12 TO HELP DECIDE WHAT THE NECESSARY CLEAR ZONE REQUIREMENTS ARE AND THE TYPE AND LOCATION OF THE PROTECTIVE MEASURE NEEDED.

**MEDIAN APPLICATION
TAPERED TANGENTIAL GUARDRAIL END TERMINAL**

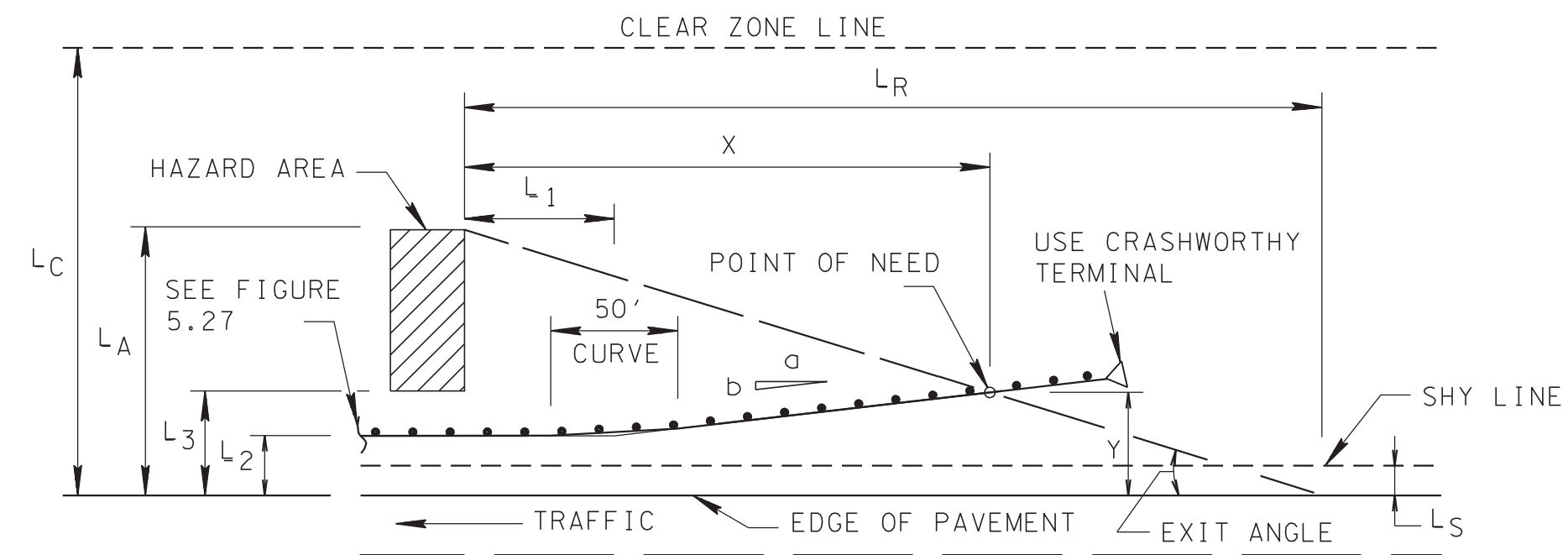


FIGURE 5.24 APPROACH BARRIER LAYOUT VARIABLES

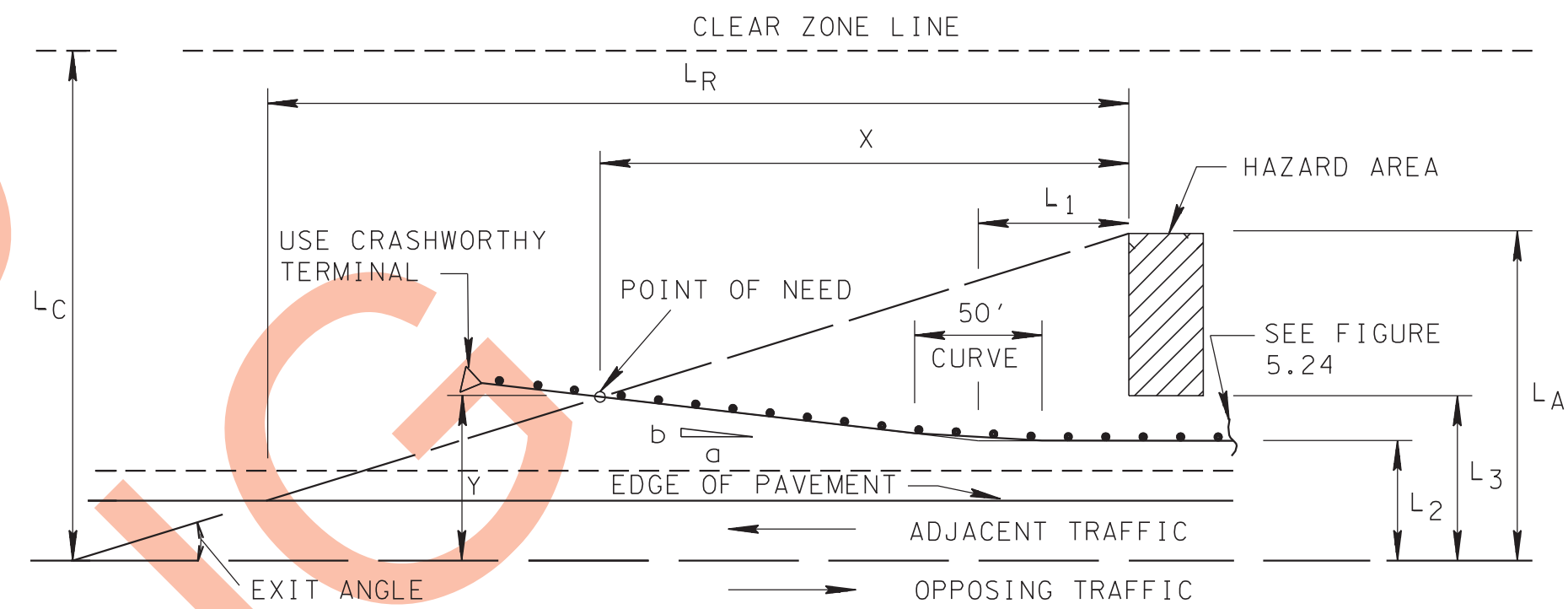


FIGURE 5.27 APPROACH BARRIER LAYOUT FOR OPPOSING TRAFFIC

DETAILS AND EQUATIONS COME FROM "ROADSIDE DESIGN GUIDE (2006)", CHAPTER 5. THE FOLLOWING EQUATIONS ARE TO BE USED TO CALCULATE THE "POINT OF NEED".

DESIGN SPEED (MPH)	DESIGN TRAFFIC VOLUME (ADT)				SHY LINE OFFSET L _S (FT)	MEDIAN APPLICATION	
	OVER 6000 VPD	2000-6000 VPD	800-2000 VPD	UNDER 800 VPD		FLARE RATE (a:b)	
						CONCRETE BARRIER	W-BEAM BARRIER
70	480	445	400	360	10.0	20:1	15:1
60	425	400	345	330	8.0	18:1	14:1
50	330	300	260	245	6.5	14:1	11:1
40	240	200	200	180	5.0	10:1	8:1
30	165	165	150	130	3.5	8:1	7:1

"POINT OF NEED" EQUATIONS FOR STRAIGHT OR NEAR STRAIGHT ROAD SECTIONS

- CASE I**
FOR TYPE 38 (SEE DRAWING NO. S-GR-43)
 TANGENTIAL b/a=0, THE POINT OF NEED WILL BE LOCATED AT POST NO. 3 OF THE TYPE 38 ANCHOR USING THE FOLLOWING EQUATIONS:

$$X = \frac{L_A - L_2 - 0.75}{L_A / L_R}$$

$$Y = L_2 + 0.75$$
- CASE II**
FOR TYPE 12, TYPE 38 AT MEDIANS, OR TYPE 21
SEE STANDARD DRAWING NOS. S-GR-19 AND S-GR-19A)
 FLARED b/a HAS A VALUE, THE POINT OF NEED WILL BE LOCATED AS SHOWN AT LEFT AND GUARDRAIL SHALL PASS THROUGH IT USING THE FOLLOWING EQUATIONS:

$$X = \frac{L_A + \left(\frac{b}{a}\right)(L_1) - L_2}{\left(\frac{b}{a}\right) + \left(\frac{L_A}{L_R}\right)}$$

$$Y = L_A - \left(\frac{L_A}{L_R}\right)(X)$$

EQUATION VARIABLE LEGEND

- L_C = THE CLEAR DISTANCE
 L_A = 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).
 b/a = 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.
 L_R = RUNOUT LENGTH (SEE TABLE BELOW FOR VALUE).
 L₃ = DISTANCE FROM EDGE OF PAVEMENT TO NEAR FACE OF HAZARD.
 L₃-L₂ = SHOULD BE GREATER THAN 4.0 FEET.

REV. 9-15-82: S-GR-9 REDRAWN, NO. CHANGED TO S-GR-21.

REV. 7-1-84: ADDED REFERENCE FOR POST NO. 3 UNDER CASE ① NOTE.

REV. 1-19-92: REDREW AND REORGANIZED SHEET. CHANGED ALL REFERENCES AND CROSS-REFERENCING FROM THE "BARRIER GUIDE" TO THE "ROADSIDE DESIGN GUIDE (1989)".

REV. 7-29-95: IN TYPICAL LAYOUT-CASE I DETAIL CHANGED GUARDRAIL APPROACH TERMINAL.

REV. 9-5-95: CORRECTED SECTION "D-D".

REV. 2-14-96: IN TYPICAL LAYOUT-CASE I DETAIL CHANGED GUARDRAIL APPROACH TERMINAL.

REV. 5-27-96: IN TYPICAL LAYOUT-CASE I DETAIL ELIMINATED 4' FLARE DIMENSION.

REV. 7-29-98: REMOVED REFERENCE TO TYPE 11, 16, AND 20 GUARDRAIL TERMINALS. ADDED TYPE 38 GUARDRAIL TERMINAL.

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 I EQUATION AND REFERENCES TO ROADSIDE DESIGN GUIDE.

REV. 3-10-05: ELIMINATED REFERENCE TO 15 DEGREE EXIT ANGLE ON THIS DRAWING.

REV. 6-2-08: REMOVED CROSS SECTIONS, REFERRED TO S-GR-19A. INCLUDED EARTH PAD, REFERRED TO S-GR-38 RUNOUT LENGTHS TABLE UPDATED TO ROADSIDE DESIGN GUIDE 2006.

REV. 6-30-09: MODIFIED TYPICAL LAYOUT-CASE II.

MINOR REVISION -- FHWA APPROVAL NOT REQUIRED.

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

LENGTH OF NEED AND TERMINAL REQUIREMENTS IN FILLS