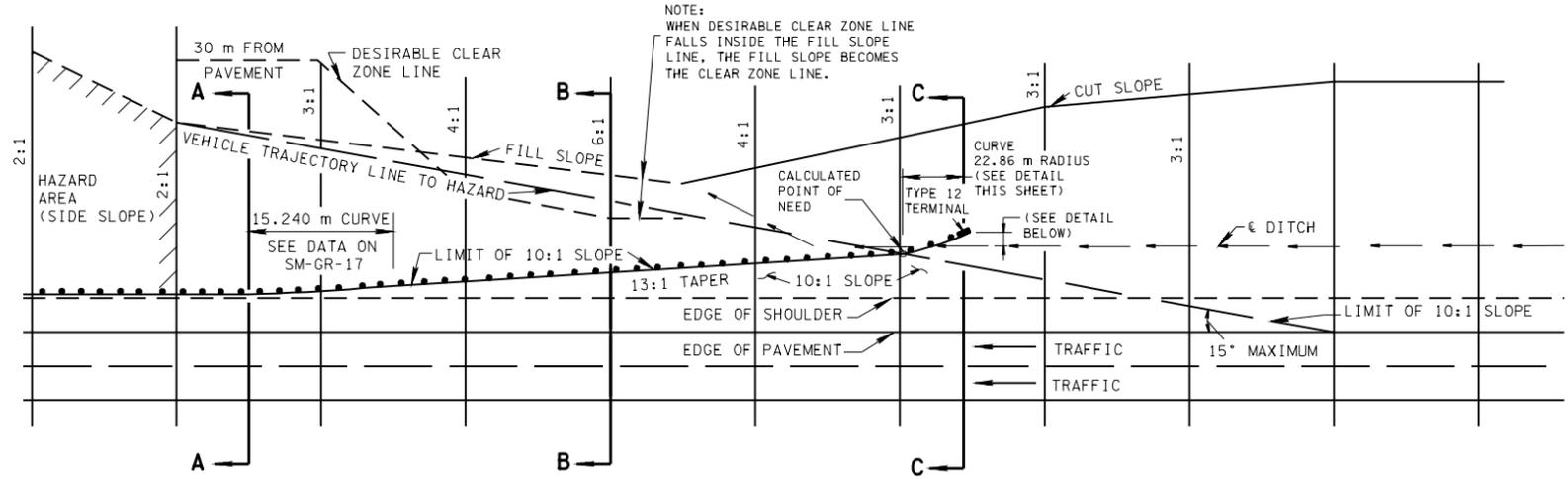


TYPICAL LAYOUT-CASE I
AVERAGE TERRAIN-DIVIDED HIGHWAY

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 OF APPROXIMATELY 15° 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

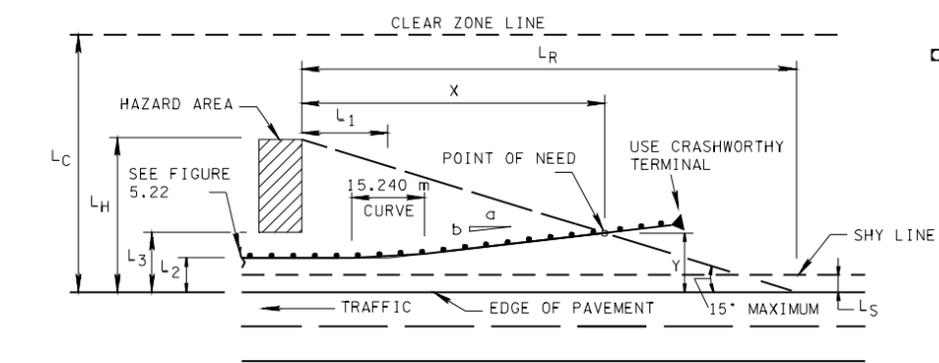


FIGURE 5.19 APPROACH BARRIER LAYOUT VARIABLES

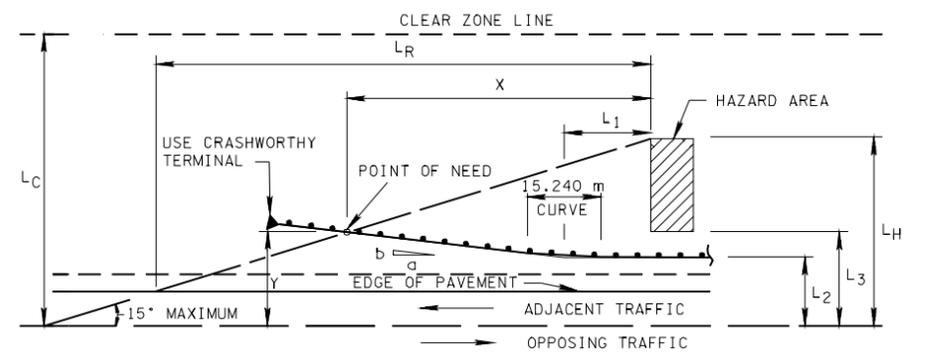


FIGURE 5.22 APPROACH BARRIER LAYOUT FOR OPPOSING TRAFFIC

DETAILS AND EQUATIONS COME FROM "ROADSIDE DESIGN GUIDE (1996)", CHAPTER 5. THE FOLLOWING EQUATIONS ARE TO BE USED TO CALCULATE THE "POINT OF NEED".

EQUATION NOTES

CASE I
WHEN $b/a=0$, THE POINT OF NEED WILL BE LOCATED AT POST NO. 3 OF THE TYPE 11 ANCHOR USING THE FOLLOWING EQUATIONS: (SEE DRAWING NO. SM-GR-18)

$$X = \frac{L_H - L_2 - 0.54}{L_H / L_R} \quad Y = L_2 + 0.54$$

CASE II
WHEN 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:

$$X = \frac{L_H \left(\frac{b}{a} \right) (L_1) - L_2}{\left(\frac{b}{a} \right) \left(\frac{L_H}{L_R} \right)} \quad Y = L_H \left(\frac{L_H}{L_R} \right) (X)$$

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).
 b/a = SLOPE OF FLARE
 L_1 = 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_2 = DISTANCE FROM EDGE OF PAVEMENT TO TANGENT SECTION OF BARRIER.
 L_R = RUNOUT LENGTH (SEE TABLE BELOW FOR VALUE).
 L_3 = DISTANCE FROM EDGE OF PAVEMENT TO NEAR FACE OF HAZARD.
 $L_3 - L_2$ = SHOULD BE GREATER THAN 1.2 m.

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.

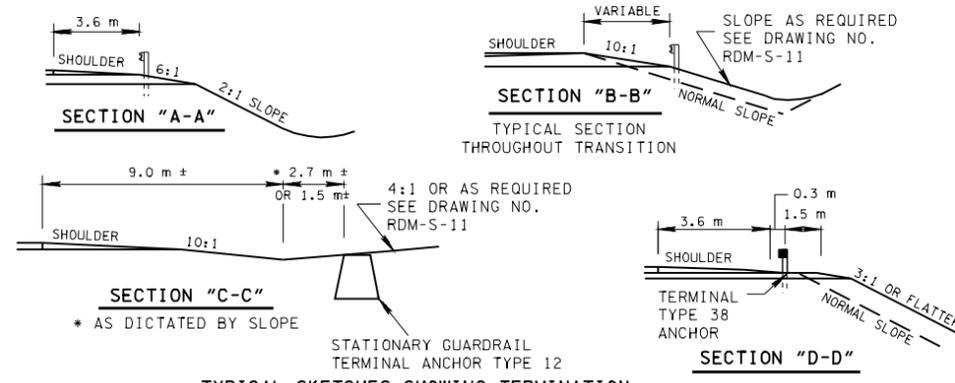
CASE II
 ① THE ROADWAY EMBANKMENT IS SHOWN GOING FROM A CUT SECTION INTO A STEEP FILL SECTION VERY CLOSE TO THE CUT TO FILL GRADE POINT. HERE THE "POINT OF NEED" FOR PROTECTION FROM THE STEEP SIDE SLOPE FALLS WITHIN THE CUT SLOPE AREA. THEREFORE, THE GUARDRAIL SHALL BE ANCHORED INTO THE CUT SECTION BACKSLOPE USING A STATIONARY GUARDRAIL TERMINAL ANCHOR TYPE 12.

GENERAL NOTES

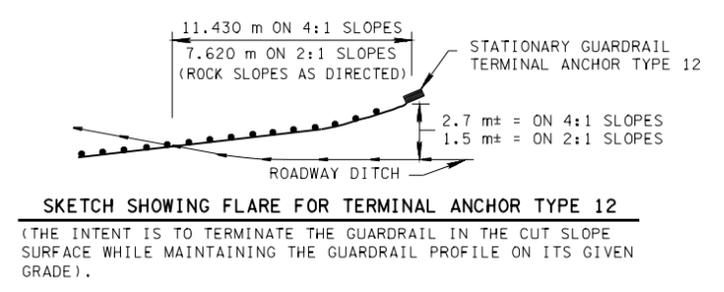
(A) EVERY LOCATION WHERE GUARDRAIL IS REQUIRED MUST BE INVESTIGATED SEPARATELY. THE HAZARD MUST BE IDENTIFIED AND THE "POINT OF NEED" CALCULATED TO DETERMINE THE BEST TREATMENT FOR PROTECTION OF VEHICLES FROM THE HAZARD.

(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 (1996)", SECTION 3.2 AND STANDARD DRAWING NO. RDM-S-17 TO HELP DECIDE WHAT THE NECESSARY CLEAR ZONE REQUIREMENTS ARE AND THE TYPE AND LOCATION OF THE PROTECTIVE MEASURE NEEDED.



TYPICAL SKETCHES SHOWING TERMINATION OF GUARDRAIL ON FILLS

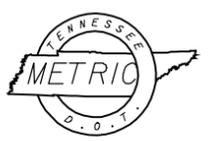


SKETCH SHOWING FLARE FOR TERMINAL ANCHOR TYPE 12
(THE INTENT IS TO TERMINATE THE GUARDRAIL IN THE CUT SLOPE SURFACE WHILE MAINTAINING THE GUARDRAIL PROFILE ON ITS GIVEN GRADE).

DESIGN TRAFFIC VOLUME (ADT)

OPERATING SPEED (km/h)	DESIGN TRAFFIC VOLUME (ADT)				L_S SHY LINE OFFSET (m)	FLARE RATE (a:b)
	OVER 6000	2000-6000	800-2000	UNDER 800		
110	145	135	120	110	2.8	XX 15:1
100	130	120	105	100	2.4	XX 14:1
80	100	90	80	75	2.0	XX 11:1
60	70	60	55	50	1.4	XX 8:1
50	50	50	45	40	1.1	XX 7:1

XX = VALUES FOR YIELDING BARRIER (0.6 m DYNAMIC DEFLECTION) FOR RIGID BARRIERS INCREASE NUMERATOR BY 0.1 $\left[\frac{V}{16} \right]^2$
 V = OPERATING SPEED (km/h)



ALL UNITS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.

MINOR REVISION -- FHWA APPROVAL NOT REQUIRED.

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

LENGTH OF NEED AND TERMINAL REQUIREMENTS IN FILLS