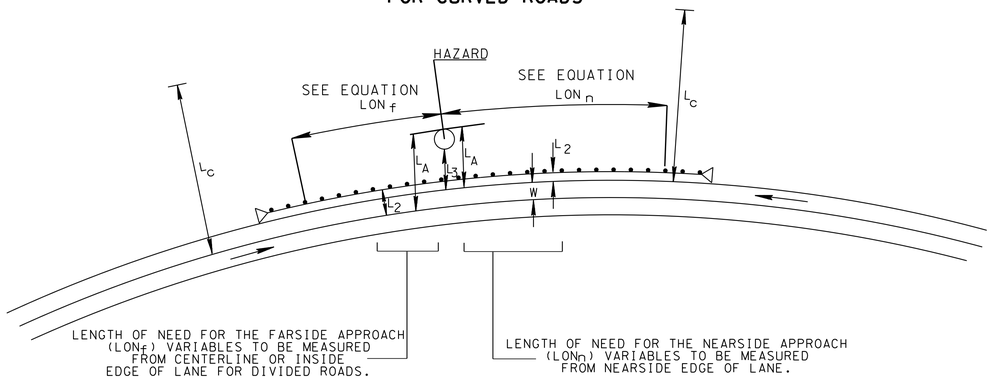
FIGURE A
LENGTH OF NEED DISTANCE FOR CURVED ROADS



LENGTH OF NEED FOR CURVED ROADS CALCULATION

$$LON = \pi AK/180$$

CALCULATION STEPS

1. CALCULATE A, B, & H USING KNOW INFORMATION
2. CALCULATE FOR I & J USING A, B & H
3. SOLVE FOR K
4. SOLVE FOR LON

LEGEND

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

INTERMEDIATE CALCULATIONS

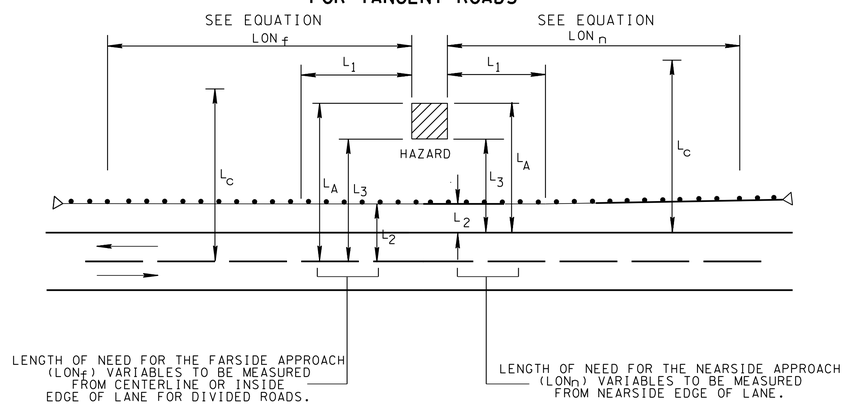
$A = R + W + L_2$ $\quad$ $I = \text{ARCSIN}(B/H)$

$B = R + W$ $\quad$ $J = \text{ARCSIN}(B/A)$

$H = R + W + L_A$ $\quad$ $K = J - I$

*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 B
THE LENGTH OF NEED DISTANCE FOR TANGENT ROADS



LENGTH OF NEED FOR TANGENT ROADS CALCULATION

$$\begin{matrix} LON_f \\ * \text{ or} \\ LON_n \end{matrix} = \frac{L_A - L_2 - 0.75}{L_A / L_R}$$

NOTE:

(a) 0.75 ACCOUNTS FOR FLARE RATE OF TERMINAL

(b) SEE ROADSIDE DESIGN GUIDE SECTION 5.6.4 FOR ADDITIONAL INFORMATION

LEGEND

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_H 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

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.

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

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

SAFETY PLAN AT ROADSIDE HAZARDS

7-10-13 | S-PL-1