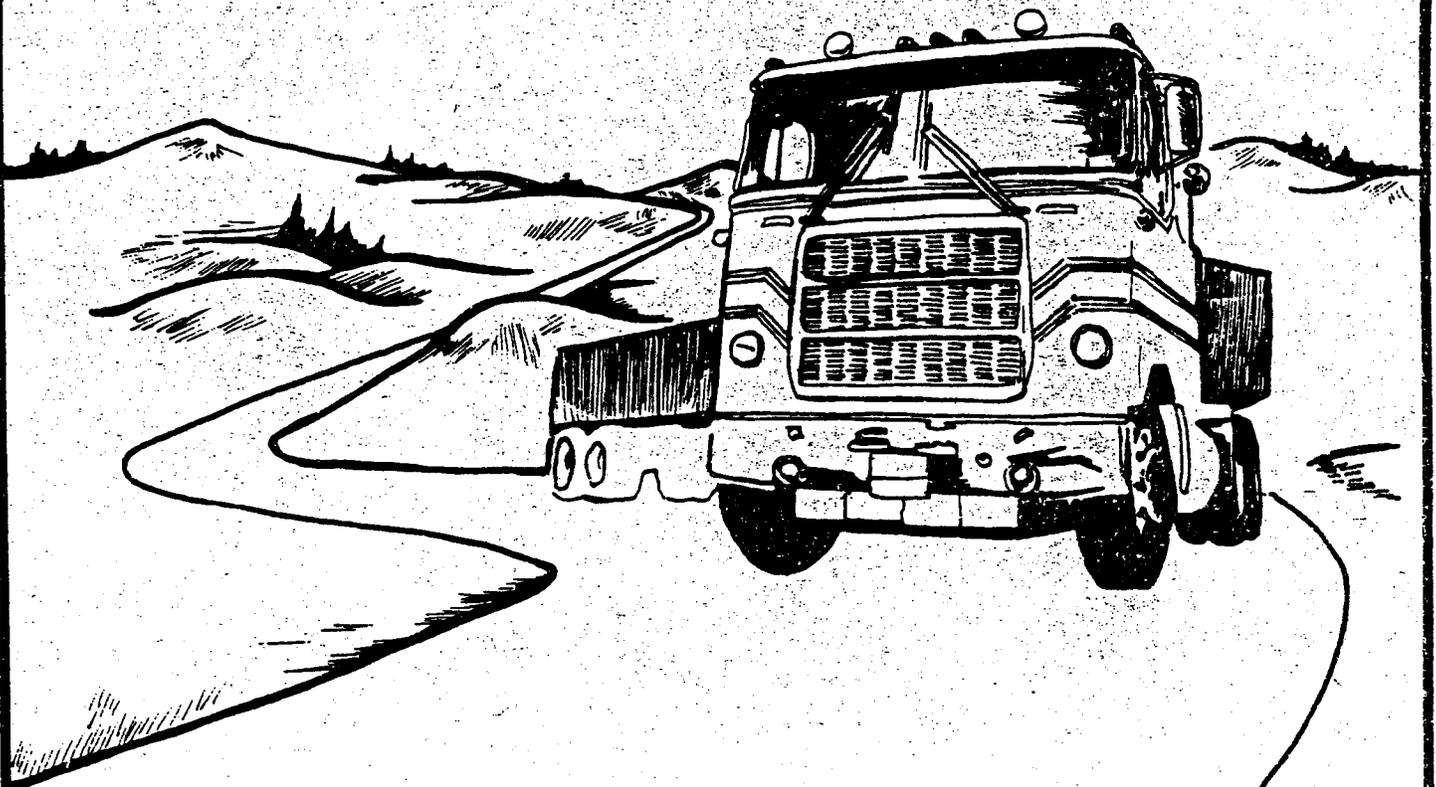


*Guidelines For*

# **DETERMINATION of CURVE WIDENING**



BLM Manual Handbook 9113-1

H-9113-1 - ROADS

GUIDELINES FOR THE DETERMINATION OF CURVE WIDENING

Table of Contents

	Page
I. PURPOSE . . . . .	1
II. CONSIDERATIONS . . . . .	3
A. DESIGN VEHICLE . . . . .	3
B. TRAFFIC SERVICE LEVEL . . . . .	3
III. DETERMINATION . . . . .	5
A. MINIMUM LANE WIDTH . . . . .	5
B. TAPER LENGTHS . . . . .	6
IV. MINIMUM LANE WIDTH USED WITH RDS . . . . .	7
A. ROADWAY . . . . .	7

ILLUSTRATIONS

1. Roadway Template Data (Form 9100-18)
2. Exhibit "A"
3. Exhibit "B"

## H-9113-1 - ROADS

I. PURPOSE. The purpose of this Handbook is to outline the considerations and minimum lane width (MLW) equations for the determination of widening of sub-base and surfacing materials required on some curves to provide for the off-tracking of tractor-trailer vehicles and for some light vehicle-trailer combinations. This widening is referred to as curve widening. Exhibits "A" and "B" (Illustrations 2 and 3) are graphs developed from the minimum lane width equation and the vehicle configuration described. Illustration 1 is an example of an input data form to be used to submit curve widening data for use with the Road Design System (RDS).

## H-9113-1 - ROADS

II. CONSIDERATIONS.A. DESIGN VEHICLE1. GENERAL DESCRIPTION

Curve widening is considered a part of the traveled way. As such, the determination of the amount of the widening should consider several types of vehicles.

2. VEHICLES MOST COMMONLY CONSIDERED

a. Tractor-trailer combinations where the fifth wheel is located directly over the drive wheels, such as a lowboy or gravel truck.

b. Tractor-trailer combinations with towing pivot point offset to the rear of the drive wheels, such as logging trucks with "stingers" to facilitate making short radius turns.

c. Tractor-trailer combinations which have two fifth wheels and accessory axles.

d. Yarders arranged in operational mode or travel configuration.

B. TRAFFIC SERVICE LEVEL1. GENERAL DESCRIPTION

A factor to be considered in determining the type of vehicle to design for is the traffic service level of the road to be designed. The determination of the traffic service level should be based on present and future needs of the area the road is going to service.

2. TRAFFIC SERVICE LEVEL CONSIDERATIONa. TRAFFIC SERVICE LEVEL A - Usually Collector Roads.

CONSIDERATION - Design curve widening to accommodate the design vehicle (normally lowboy) at the design speed for each curve. Curve widening for critical vehicles should be provided if the needed width is not available. The critical vehicle should be accommodated in its normal travel configuration. Curve widening should be provided in each lane of double-lane roads.

b. TRAFFIC SERVICE LEVEL B - Usually Local Roads.

CONSIDERATION - Same as Traffic Service Level A except that curve widening for critical vehicles should be provided by the use of other road elements, if planned, such as turnouts and shoulders. The critical vehicle configuration may have to be altered.

## H-9113-1 - ROADS

c. TRAFFIC SERVICE LEVEL C - Usually Resource Roads

CONSIDERATION - Curve widening should be provided only for the design vehicle. Loads carried by the critical vehicle should be off-loaded and walked to the project or transferred to vehicles capable of traversing the road. Temporary widening to permit the passage of larger vehicles may be accomplished by methods such as temporarily filling of the ditch at narrow sections.

## H-9113-1 - ROADS

III. DETERMINATION.A. MINIMUM LANE WIDTH1. GENERAL DESCRIPTION

Curve widening is affected by the type of vehicle, radius of curvature, and the delta or central angle. Generally, the need for curve widening increases as the radius decreases; shorter curves require less curve widening than longer curves. It is not necessary to add curve widening to all curves; if the minimum lane width is equal to or less than the basic traveled way width no curve widening is required.

2. THE EQUATION

The minimum lane width, which includes 2 feet for tracking corrections, is given by the following equation which was developed by combining the delta or central angle variation characteristics of trailer tractrix equations with the off-tracking equations commonly used. The equation is accurate for a radius of 50 feet or greater and has been field checked.

$$MLW=10+\left[\left(R-\sqrt{R^2-L^2}\right)\left(1-e^{\frac{-.015\Delta R}{L}}+.216\right)\right]$$

Where:

R = Centerline radius (in feet)  
 e = Base for natural logarithms  
 Δ = Central angle (in degrees)

a. For a lowboy or standard tractor-trailer:

$$L = \sqrt{L_1^2 + L_2^2 + L_3^2}$$

Where:

L1 = Wheel base of the tractor (in feet)

L2 = Distance from the fifth wheel to the middle of the rear duals for the 1st trailer (in feet)

L3 = Distance from the fifth wheel to the middle of the rear duals for the 2nd trailer (in feet)

## H-9113-1 - ROADS

- b. For a "stinger" type log truck:

$$L = \sqrt{L_1^2 + L_3^2 - L_2^2}$$

Where:

L1 = Wheel base of the tractor (in feet)

L2 = Length of the "stinger" measured from the middle of the tractor rear duals to the end of the "stinger" (in feet)

L3 = Bunk to bunk distance minus the length of the "stinger" (in feet)

Exhibit "A" and Exhibit "B" were developed from these equations and can be used for the common lowboy and logging truck configuration described.

B. TAPER LENGTHS

1. GENERAL DESCRIPTION

Curve widening tapers should be straight lined before the point of curvature (PC) and after the point of tangency (PT) for the following lengths:

	<u>RADIUS (R) (in feet)</u>	<u>TAPER LENGTH (in feet)</u>
Less than	70	60
	70-85	50
	86-100	40
Greater than	100	30

## H-9113-1 - ROADS

IV. MINIMUM LAND WIDTH USED WITH RDS.A. ROADWAY1. GENERAL DESCRIPTION

The ROADWAY program in RDS will figure minimum land width for both single land and double lane roads. The actual amount of curve widening applied will be calculated by subtracting the basic lane width from the 'MLW' calculated for each curve.

2. DOUBLE LANE

A road will be considered a double lane road if the sum of the left and right lane widths, excluding shoulders, is 18 feet or more (subgrade widths). The 'MLW' for double land roads will be applied to either the left or right lane depending on whether the delta or central angle is to the left or right. The 'MLW' can be applied to both lanes, as may be the case for traffic service Level "A" roads, when specifically requested under special instructions on the Engineering Data Processing (EDP) transmittal sheet, Form 9100-10.

3. TAPER LENGTHS

The curve widening taper lengths, as set forth in this Handbook, will be used. However, it is possible to set the curve widening taper length equal to the superelevation transition distance (if superelevation criteria has been input) to simplify construction staking and construction, by specifically requesting it under special instructions on the EDP transmittal sheet, Form 9100-10.

4. TURNOUTS

The elimination of curve widening, whenever curve widening and turnouts occur at the same section on the same side of the road, is available as an option with the ROADWAY program.

5. INPUT DATA

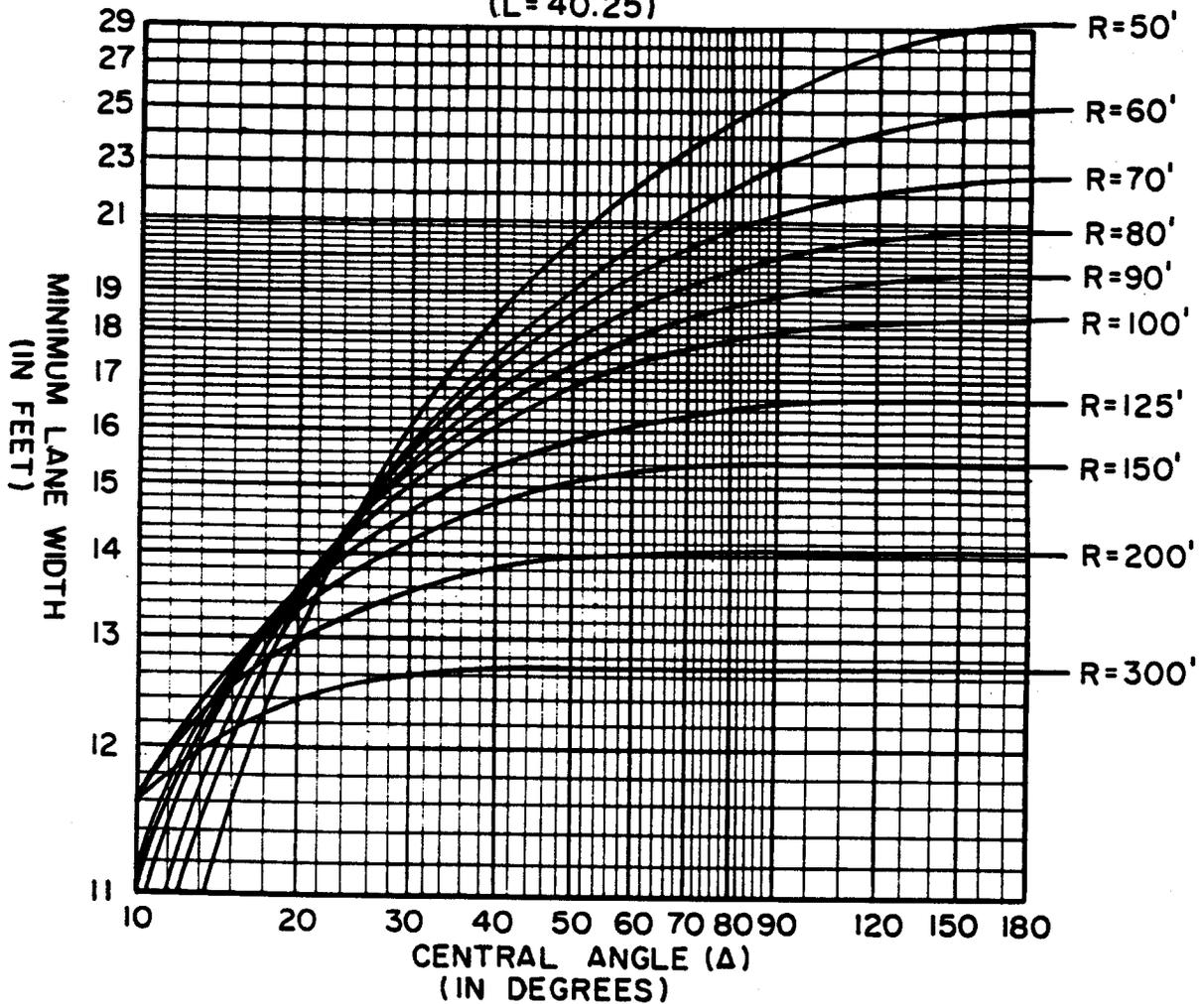
The data is input by entering the value for L<sub>1</sub>, L<sub>2</sub>, and L<sub>3</sub> on the CT-04 data portion of the Roadway Template Data, Form 9100-18, as shown in Illustration 1.

a. L<sub>2</sub> will be plus (+) if design vehicle is a lowboy or standard tractor trailer.

b. L<sub>2</sub> will be minus (-) if design vehicle is a "stinger" type log truck.



**EXHIBIT "A"**  
**MINIMUM LANE WIDTH**  
**FOR**  
**LOWBOY WITH AN 18' TRACTOR AND A 36' TRAILER**  
**(L = 40.25)**



H-9113-1 - ROADS

**EXHIBIT "B"**  
**MINIMUM LANE WIDTH**  
**FOR**  
**LOG TRUCK WITH A 20' TRACTOR, A 10'**  
**"STINGER", AND 30' BUNK TO BUNK**  
**(L = 26.46)**

