Roadway Horizontal Alignments II

Course Number: CE-03-909

PDH: 3

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INTRODUCTION

The roadway **horizontal alignment** is a series of horizontal tangents (straight roadway sections), circular curves, and spiral transitions. It shows the proposed roadway location in relation to the existing terrain and adjacent land conditions. Together with the vertical alignment (grades and vertical curves) and roadway cross-sections (lanes, shoulders, curbs, medians, roadside slopes, ditches, sidewalks), the horizontal alignment (tangents and curves) helps to provide a three-dimensional roadway layout.

This course is the second of two that focuses on the geometric design of **horizontal alignments** for modern roads and highways. Its contents are intended to serve as guidance and not as an absolute standard or rule.

Upon course completion, you should be familiar with the general design of horizontal roadway alignments. The course objective is to give engineers and designers an in-depth look at the principles to be considered when designing horizontal alignments.

Subjects covered include:

Design Considerations
- *Cross slopes*
- *Radii*
- *Grades*

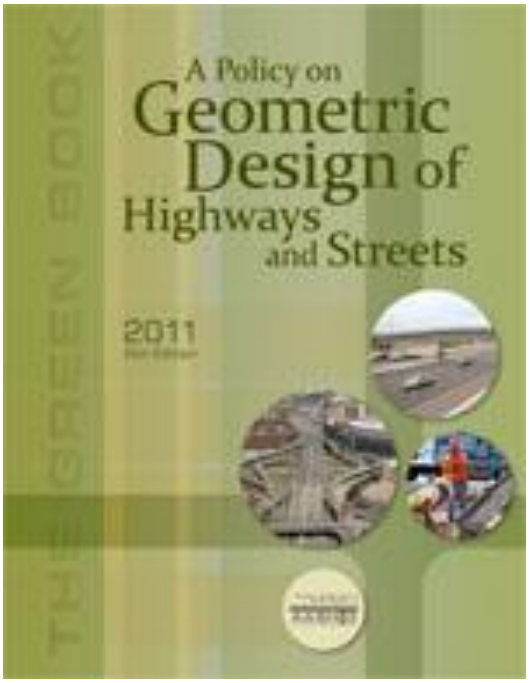
Traveled-way Widening
- *Design Methods*

Sight Distance
- *Stopping*
- *Decision*
- *Passing*
- *Intersection*

General Design Controls

Coordination of Horizontal & Vertical Curves

A Policy on Geometric Design of Highways and Streets (also known as the "Green Book") published by the American Association of State Highway and Transportation Officials (AASHTO) is considered to be the primary guidance for U.S. roadway design. For this course, Chapter 3 (Section 3.3 Horizontal Alignment) will be used exclusively for fundamental roadway geometric design principles.



BACKGROUND

Roadway geometric design consists of the following fundamental three-dimensional features:

Vertical alignment - grades and vertical curves

Horizontal alignment - tangents and curves

Cross section - lanes and shoulders, curbs, medians, roadside slopes and ditches, sidewalks

Combined, these elements contribute to the roadway's operational quality and safety by providing a smooth-flowing, crash-free facility.

Engineers must understand how all of the roadway elements contribute to overall safety and operation. Applying design standards and criteria to 'solve' a problem is not enough.

The fundamental objective of good geometric design will remain as it has always been **– to produce a roadway that is safe, efficient, reasonably economic and sensitive to conflicting concerns.**

TRAVELED-WAY WIDENING ON HORIZONTAL CURVES

Often, traveled ways on horizontal curves may need to be widened to produce operational characteristics that are similar to tangent sections. While the need for widening on modern highways is less than that for past roadways, there are some cases where *speed, curvature, or width* may require appropriate traveled way widening.

Primary Reasons for Widening on Curves

- Design vehicle off tracks when negotiating curve
- Driver difficulty in remaining in center of the lane

AASHTO Equation 3-34 calculates the amount of traveled way widening for horizontal curves by using the difference between the width needed on the curve and the tangent width. The needed curve width has several variables: track width for passing/meeting vehicles; lateral vehicle clearance; width of inner lane vehicle front overhang; curve difficulty allowance width.

In most cases, the design vehicle is a truck (typically WB-62) since off tracking is much greater for heavy vehicles versus passenger cars.

Since sight distance can be restricted when meeting opposing vehicles on curved two-way roads, widening procedures for two-lane, one-way traveled way (divided highway) should be similar to those for two-lane, two-way roadways.

Any widening for horizontal curves should transition gradually on the approaches to align traveled way edges and vehicle paths. AASHTO Equation 3-35 provides values for the width of traveled way on curves.

Curve Widening Design Concerns

- Widen only the inside edge of traveled way for simple curves
- Widen on the inside edge or equally divided from the centerline for spirals
- Transition gradually over the length (typically 100 to 200 ft) to make all traveled way fully usable
- Avoid tangent transition edges – no angular breaks at pavement edges
- One-half to two-thirds transition length should be along tangent sections for roads without spirals
- Width increases should be distributed along the spiral length for highways with spirals
- Fully detail widening areas on construction plans

Factors for determining turning roadway widths at intersections include:

- Expected speed
- Curve radius: combined with design vehicle track width determine turning roadway width
- Types of vehicles: size and frequency of users or expected users

Turning roadways are classified operationally as:

One-lane (with or without passing opportunities)
or *two-lane (one-way or two-way)*

Design Methods for Turning Roadways

Case I One-lane, one-way operation
No passing stalled vehicles provision
For minor turning movements, moderate turning volumes, short connecting roadway
Remote chance of vehicle breakdown
Preferable sloping curb or flush edge of traveled way

Case II One-lane, one-way operation
Contains passing provision for stalled vehicles
Low speeds with adequate passing clearance
Sufficient widths for all turning movements of moderate to heavy traffic volumes within capacity of single-lane connection
For breakdowns, low traffic can be maintained

Case III Two-lane operation, either one or two-way
Two lanes necessary for traffic volume

Since precise data regarding traffic volumes for each vehicle type is not readily available, traffic conditions used to define turning roadway widths are described in broad terms.

Traffic Conditions for Turning Roadway Widths

Traffic Condition A	Predominantly Passenger Car (P) vehicles
	Some Single-Unit Trucks (SU-30)
	Small volume of trucks with occasional large truck
Traffic Condition B	Majority of Single-Unit Trucks (SU-30)
	Some tractor- semitrailer combination trucks (WB-40)
	Moderate volume of trucks - 5 to 10%
Traffic Condition C	Predominantly tractor-semitrailer combo (WB-40)
	More and larger trucks

Widths for turning roadways include shoulders or lateral clearance outside the traveled way. Shoulder widths may vary from none (curbed urban streets) to open-highway cross-section.

Table 3-30. Range of Usable Shoulder Widths or Equivalent Lateral Clearances Outside of Turning Roadways, Not on Structure

	Metric		U.S. Customary	
Turning Roadway Condition	Shoulder Width or Lateral Clearance Outside of Traveled-Way Edge (m)		Shoulder Width or Lateral Clearance Outside of Traveled-Way Edge (ft)	
	Left	Right	Left	Right
Short length, usually within channelized intersection	0.6 to 1.2	0.6 to 1.2	2 to 4	2 to 4
Intermediate to long length or in cut or on fill	1.2 to 3.0	1.8 to 3.6	4 to 10	6 to 12

Note: All dimensions should be increased, where appropriate, for sight distance.

Source: AASHTO "Green Book" Table 3-30

For roadways without curbs or with sloping curbs, adjacent shoulders should match the type and cross section of the approaches.

If roadside barriers are present, shoulder widths should be measured to the face of barrier with a graded width of 2.0 feet.

For other than low-volume roadways, right shoulders should be stabilized a minimum of 4.0 feet.

Purchase this course to see the remainder of the technical materials.