

<b>Curve Safety and Signing Study</b>	
<b>Street Name</b>	
<b>Curve Location</b>	
<b>Municipality</b>	
<b>County</b>	
<b>Vehicle</b>	
<b>Date</b>	
<b>Posted Speed</b>	
<b>Driver/Recorder</b>	
<b>Weather</b>	
<b>Pavement Condition</b>	
<b>Comments</b>	

<b>Curve Safety Study References</b>	
<b>PennDOT Publication 46, Traffic Engineering Manual</b>	Page 2-17. Information on how to conduct the ball bank study and signing options
<b>Manual on Uniform Traffic Control Devices</b>	Section 2C.05-2C.12, resource for signing and pavement marking standards
<b>PennDOT Publication 33, Shoulder/Guide Rail Field Guide</b>	For review of shoulders, edge drop-offs, and guide rail
<b>PennDOT Publication 111, Signing Standards</b>	For installation details of signs/pavement markings
<b>PennDOT Publication 236, Handbook of Approved Signs</b>	For sign sheets/sign details
<b>Low Cost Treatments for Curve Safety 2016, FHWA SA-15-084</b>	Resource for mitigation measures
<b>PennDOT Publication 638, Safety Manual</b>	Section 5.5.5, resource for mitigation measures
<b>Highway Safety Manual</b>	Resource for predicting crashes and crash reductions
<b>FHWA Roadway Departure Safety</b>	Resource for studies, crash data, and mitigation measures <a href="http://safety.fhwa.dot.gov/roadway_dept/">http://safety.fhwa.dot.gov/roadway_dept/</a>

<b>Curve Study Field Examination</b>	
<b>Type of Curve/Degree of Curve (refer to Appendix B of Pub 638)</b>	
<b>Fixed Objects</b>	
<b>Curve Super-elevation</b>	
<b>Curve shoulder and edge drop-offs (refer to Pub 33)</b>	
<b>Pavement condition</b>	
<b>Pavement skid resistance</b>	
<b>Sight distance to and around curve</b>	
<b>Visibility/lighting at curve (vegetation encroachment)</b>	
<b>Drainage</b>	
<b>Pavement Markings</b>	
<b>Guide Rail</b>	
<b>Existing Signs</b>	
<b>Comments</b>	

# Crash Analysis/Diagram (refer to Pub 638)

Draw sketch of curve and crash locations/types:

<b>Ball Bank Study Readings</b>			
<b>Speed</b>	<b>Direction</b>	<b>Reading 1</b>	<b>Reading 2 (if needed)</b>
10			
10			
15			
15			
20			
20			
25			
25			
30			
30			
35			
35			

<b>Advisory Speed Determination</b>		
<b>Direction of Travel</b>	<b>Reading that exceeds MUTCD chart value</b>	<b>Recommended Advisory Speed</b>

- C. A traditional ball-bank indicator using the following criteria:
1. 16 degrees of ball-bank for speeds of 20 mph or less
  2. 14 degrees of ball-bank for speeds of 25 to 30 mph
  3. 12 degrees of ball-bank for speeds of 35 mph and higher

<h1>Horizontal Alignment Sign Determination</h1>			
Direction	Speed Limit	Advisory Speed	Sign Selection (MUTCD Table 2C-5)

Per MUTCD Section 2C.07, for advisory speeds of 30 mph or lower, use the Turn W1-1 sign. For speeds of 35 mph or more, use the Curve W1-2 sign.

**Table 2C-5. Horizontal Alignment Sign Selection**

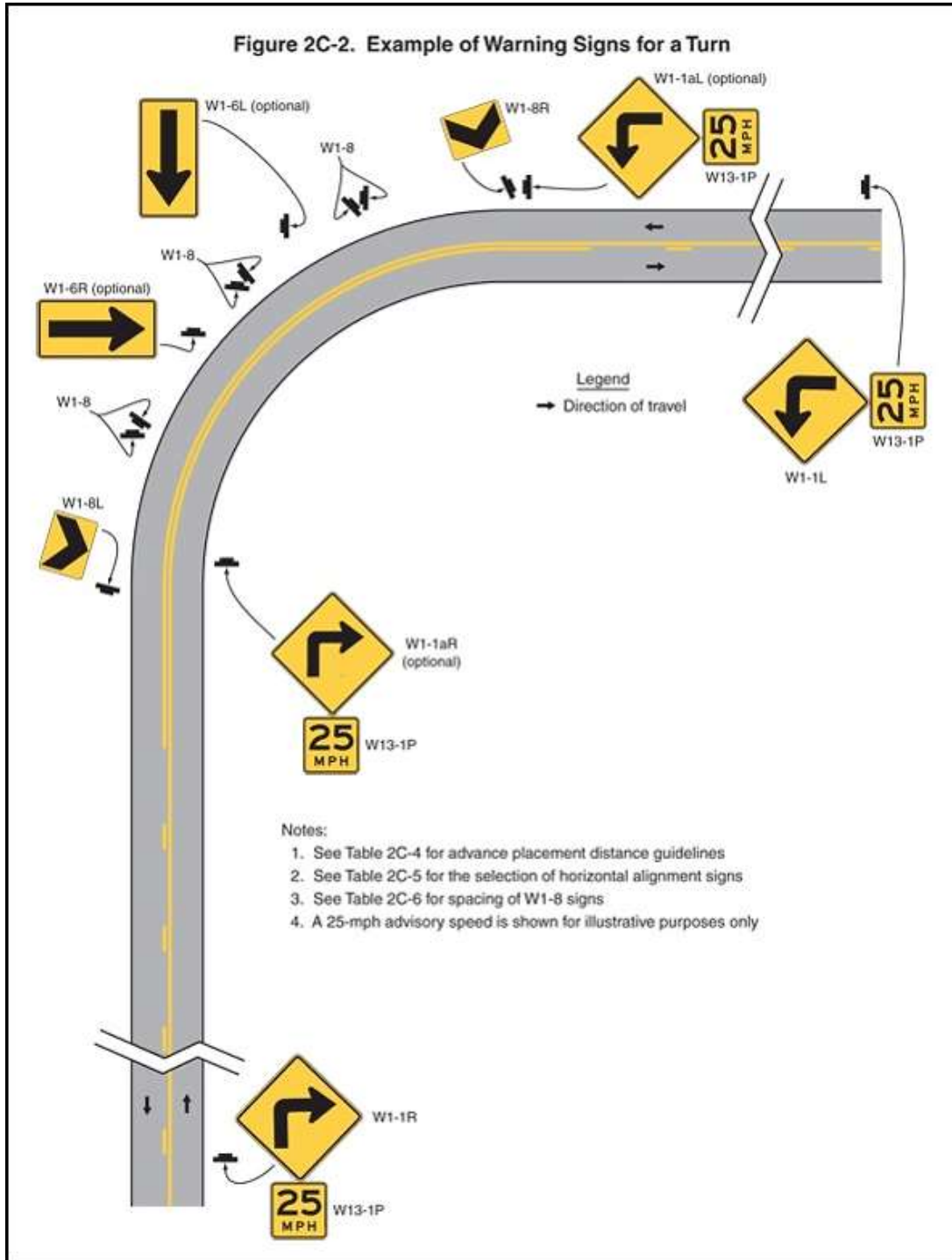
Type of Horizontal Alignment Sign	Difference Between Speed Limit and Advisory Speed				
	5 mph	10 mph	15 mph	20 mph	25 mph or more
Turn (W1-1), Curve (W1-2), Reverse Turn (W1-3), Reverse Curve (W1-4), Winding Road (W1-5), and Combination Horizontal Alignment/Intersection (W10-1) (see Section 2C.07 to determine which sign to use)	Recommended	Required	Required	Required	Required
Advisory Speed Plaque (W13-1P)	Recommended	Required	Required	Required	Required
Chevrons (W1-8) and/or One-Direction Large Arrow (W1-6)	Optional	Recommended	Required	Required	Required
Exit Speed (W13-2) and Ramp Speed (W13-3) on exit ramp	Optional	Optional	Recommended	Required	Required

Note: Required means that the sign and/or plaque shall be used, recommended means that the sign and/or plaque should be used, and optional means that the sign and/or plaque may be used.

## Reverse Curve Determination (MUTCD 2C.07)

*03 Where there are two changes in roadway alignment in opposite directions that are separated by a tangent distance of less than 600 feet, the Reverse Turn (W1-3) sign should be used instead of multiple Turn (W1-1) signs and the Reverse Curve (W1-4) sign should be used instead of multiple Curve (W1-2) signs.*

## Example of Typical Sign Placement



# Horizontal Sign Placement Chart (MUTCD Table 2C-4)

**Table 2C-4. Guidelines for Advance Placement of Warning Signs**

Posted or 85th-Percentile Speed	Advance Placement Distance <sup>1</sup>								
	Condition A: Speed reduction and lane changing in heavy traffic <sup>2</sup>	Condition B: Deceleration to the listed advisory speed (mph) for the condition							
		0 <sup>3</sup>	10 <sup>4</sup>	20 <sup>4</sup>	30 <sup>4</sup>	40 <sup>4</sup>	50 <sup>4</sup>	60 <sup>4</sup>	70 <sup>4</sup>
20 mph	225 ft	100 ft <sup>5</sup>	N/A <sup>6</sup>	—	—	—	—	—	—
25 mph	325 ft	100 ft <sup>5</sup>	N/A <sup>6</sup>	N/A <sup>6</sup>	—	—	—	—	—
30 mph	460 ft	100 ft <sup>5</sup>	N/A <sup>6</sup>	N/A <sup>6</sup>	—	—	—	—	—
35 mph	565 ft	100 ft <sup>5</sup>	N/A <sup>6</sup>	N/A <sup>6</sup>	N/A <sup>6</sup>	—	—	—	—
40 mph	670 ft	125 ft	100 ft <sup>5</sup>	100 ft <sup>5</sup>	N/A <sup>6</sup>	—	—	—	—
45 mph	775 ft	175 ft	125 ft	100 ft <sup>5</sup>	100 ft <sup>5</sup>	N/A <sup>6</sup>	—	—	—
50 mph	885 ft	250 ft	200 ft	175 ft	125 ft	100 ft <sup>5</sup>	—	—	—
55 mph	990 ft	325 ft	275 ft	225 ft	200 ft	125 ft	N/A <sup>6</sup>	—	—
60 mph	1,100 ft	400 ft	350 ft	325 ft	275 ft	200 ft	100 ft <sup>5</sup>	—	—
65 mph	1,200 ft	475 ft	450 ft	400 ft	350 ft	275 ft	200 ft	100 ft <sup>5</sup>	—
70 mph	1,250 ft	550 ft	525 ft	500 ft	450 ft	375 ft	275 ft	150 ft	—
75 mph	1,350 ft	650 ft	625 ft	600 ft	550 ft	475 ft	375 ft	250 ft	100 ft <sup>5</sup>

<sup>1</sup> The distances are adjusted for a sign legibility distance of 180 feet for Condition A. The distances for Condition B have been adjusted for a sign legibility distance of 250 feet, which is appropriate for an alignment warning symbol sign. For Conditions A and B, warning signs with less than 8-inch legend or more than four words, a minimum of 100 feet should be added to the advance placement distance to provide adequate legibility of the warning sign.

<sup>2</sup> Typical conditions are locations where the road user must use extra time to adjust speed and change lanes in heavy traffic because of a complex driving situation. Typical signs are Merge and Right Lane Ends. The distances are determined by providing the driver a PRT of 14.0 to 14.5 seconds for vehicle maneuvers (2005 AASHTO Policy, Exhibit 3-3, Decision Sight Distance, Avoidance Maneuver E) minus the legibility distance of 180 feet for the appropriate sign.

<sup>3</sup> Typical condition is the warning of a potential stop situation. Typical signs are Stop Ahead, Yield Ahead, Signal Ahead, and Intersection Warning signs. The distances are based on the 2005 AASHTO Policy, Exhibit 3-1, Stopping Sight Distance, providing a PRT of 2.5 seconds, a deceleration rate of 11.2 feet/second<sup>2</sup>, minus the sign legibility distance of 180 feet.

<sup>4</sup> Typical conditions are locations where the road user must decrease speed to maneuver through the warned condition. Typical signs are Turn, Curve, Reverse Turn, or Reverse Curve. The distance is determined by providing a 2.5 second PRT, a vehicle deceleration rate of 10 feet/second<sup>2</sup>, minus the sign legibility distance of 250 feet.

<sup>5</sup> No suggested distances are provided for these speeds, as the placement location is dependent on site conditions and other signing. An alignment warning sign may be placed anywhere from the point of curvature up to 100 feet in advance of the curve. However, the alignment warning sign should be installed in advance of the curve and at least 100 feet from any other signs.

<sup>6</sup> The minimum advance placement distance is listed as 100 feet to provide adequate spacing between signs.