

APPROVED BY NCUTCD COUNCIL ON JANUARY 19, 2007

National Committee on Uniform Traffic Control Devices
TECHNICAL COMMITTEE RECOMMENDATIONS TO SPONSORS

TECHNICAL COMMITTEE: Regulatory/Warning Signs Technical Committee

DATE OF ACTION: To Sponsors 3/10/06, NCUTCD Council denial 06/30/06

Final Revised Draft to RWSTC 08/19/06, 8/21/06, 8/25/06, 9/01/06

Draft to Sponsors 9/11/06, Revisions 12/20/06 and 1/18/07 by RWSTC based on Sponsors comments.

TOPIC: Horizontal Alignment and Advisory Speed Warning Signs

**AFFECTED PORTIONS OF MUTCD: Sections 2C.06 Thru 2C.11, 2C.36 and 2C.46;
Table 2C-5; Figures 2C-1, 2C-5 and 2C-7**

DISCUSSION:

The 2003 MUTCD included optional requirements for determining Advisory Speeds that were inconsistent with existing MUTCD guidance, inconsistent with other policies such as AASHTO's Greenbook and unsupported by most documented research. A letter to ITE published in the March 2004 ITE Journal raised several questions about the MUTCD Advisory Speed provisions. After discussion, the Regulatory/Warning Signs Technical Committee appointed a Task Force to study the available research on warning signs for horizontal alignment including advisory speed determination to develop new MUTCD provisions designed to meet the road user's requirements.

The NCHRP Report 500, Volume 7, A Guide for Reducing Collisions on Horizontal Curves, identified that approximately 25% of the highway system fatalities are occurring along horizontal curves directly related to two-lane highways in rural areas. The first strategy recommended therein was to provide Advance Warning of Unexpected Changes in Horizontal Alignment. Several research projects have noted the current MUTCD provisions fail to inform the road users adequately communicate and effectively of the change in horizontal alignment. to the road users. It has long been recognized that the ball bank criteria for curve advisory speeds is too conservative and receives only limited driver compliance. Therefore, a significant change in the signing for horizontal alignment is being recommended.

The major MUTCD revisions and the rationale' for these recommendations are as follows;

1. Engineering Study

It is recommended that Advisory Speeds be determined on the basis of an engineering study following recommended traffic engineering practices. The Advisory Speed procedures will include ball bank criteria, accelerometer readings and calculations using equivalent side friction values.

2. Increase Ball Bank criteria for Advisory Speed

The Ball Bank criteria will be increased 2 degrees from 10/12/14 to 12/14/16 which represents the approximate 8 to 10 mph that the average driver are presently exceeding the existing posted advisory speed for curves. The new values are comparable to the AASHTO 2003 Greenbook design values and represent conservative values based on the research.

3. Adjust Side Friction Factors

A small adjustment will be made in the side friction factors to provide comparable values and the appropriate relationship between lateral acceleration, side friction factors and ball bank indications based on research by Carlson and Mason, TRB, January 1999. To be consistent, it is recommended that the curve advisory speed can be determined by either an accelerometer, ball bank determination or the design formula using the modified side friction factors.

4. Truck Advisory Speed

A ball bank indication of 12 degrees or side friction factor of 0.21 is being recommended for Truck Advisory Speed determinations on Truck Rollover signs, Truck Exit Speeds and Ramp Advisory Speeds. The measured and documented truck rollover side friction factor is 0.35 or a 19.5 degree ball bank indication so there would be a reasonable margin of safety between the advisory speed signing and truck rollover factors.

5. Chevron Alignment Signs

The new MUTCD provisions indicate that Chevrons may be used as an alternate or to supplement standard delineation and pavement markings on the curve. No changes are recommended to the existing MUTCD criteria for delineation and pavement markings on curves. Spacing criteria have been added for Chevron Alignment signs on curves and turns based on TTI Report FHWA/TX-04/0-4052-1, Modifying Delineator and Chevron Applications for Horizontal Curves. NCHRP 440 found that delineators reduced night accidents on sharp curves and were cost justified at 1,000 AADT or more. The new MUTCD provisions would provide edge-lines, delineators, chevrons or combinations thereof for all functionally classified arterials and collectors over 1,000 AADT where there is a significant speed differential.

6. Installation Requirements

A new Table 2C-5, Selection of Horizontal Alignment Traffic Control Devices Signs, has been provided to define the required, recommended and optional warning signs. The requirements have been limited to freeways, expressways, and functionally classified arterials and collectors over 1,000 AADT with the option for use on other roadways ~~also~~. This road classification represents the higher volume roadways, a larger percentage of unfamiliar drivers, and has the potential to yield the largest safety benefits at modest costs. The categories of functionally classified arterials and collectors represent a very specific portion of the roadway network which are designated and periodically reported by the States and local jurisdictions. Average Annual Daily Traffic (AADT) is used in lieu of ADT because it is a specific term in traffic volume terminology whereas ADT may represent only a single traffic count or estimate. Note, that roadway classification and traffic volumes are presently used as criteria for pavement markings. It is surmised that most of these roadways are currently signed and it would only be necessary to upgrade the signing to the new provisions. It should be noted that there is step process for signing, ie. initially a Curve sign, then add an Advisory Speed, and finally include Chevrons as the speed differential increases. Previously, the use of horizontal alignment signing has been an option based on engineering judgment. It has been a consideration

that the new MUTCD text should move carefully into the required and recommended provisions, hence, the limitation to arterials and collectors. These provisions can be expanded to other roadways if a jurisdiction so desires or in the future when it is appropriate.

7. Curve Speed Sign (W13-5)

The optional Curve Speed sign used at or beyond the curve has been deleted because of limited usage. The expanded usage of Chevron Alignment, Large Arrow, and Combination Horizontal Alignment/Advisory Speed signs has decreased the need for this sign. It is desirable to broaden the consistent usage of a few signs providing better driver communications than adding potential driver confusion with a mixed application of several signing options.

8. Reorganization of the MUTCD

The MUTCD Sections relating to horizontal alignment have been consolidated in one location from Section 2C.06 through Section 2C.14 for ease of reference and consistency. That includes relocation of the Advisory Speed Plaque to Section 2C.08 because of its predominant application with horizontal alignment warning signs, the application of Table 2C-5 and it was preferred to cover all the horizontal alignment warning signs in one group of MUTCD provisions. The relocation of the Advisory Speed plaque to the horizontal alignment provisions was preferred because of the applications covered in Table 2C-5 and advisory speed plaques should be part of this coverage not moved to the back of this Part.

9. Implementation

It is recommended that a ten or fifteen year Compliance Date be provided for implementation of these new MUTCD provisions. The ten years This long compliance period will provide the necessary time frame to perform a new engineering study of the horizontal alignment signing on existing roadways, advise the public of the changes being implemented, and ~~revising~~ revise the existing signing.

These MUTCD revisions were transmitted to Sponsors in March 2006 with Sponsor comments considered by the RWSTC in June 2006. Those recommendations were denied by the NCUTCD Council on June 30, 2006. The provisions have been edited and clarified based on the Sponsor comments and are going through the process one more time for consideration. were resubmitted, fall 2006, for Sponsor comments.

Figure 2C-1, Horizontal Alignment Signs has been expanded to include the signs from Figure 2C.05 plus illustration of an Intersection/Turn Warning sign (W1-9).

Figure 2C-X has been added to provide an example of signing and markings for a turn including clarification of optional provisions.

Figure 2C-7 has been revised to provide a better example of Exit Speed, Ramp Speed and Truck Rollover Warning signs.

RECOMMENDED WORDING:

Replace Sections 2C.06 through 2C.11 with the following revised Sections 2C.06 through 2C.14, delete existing Sections 2C.36 and 2C.46, and renumber the remaining existing Chapter 2C Sections consecutively starting with Section 2C.15.

Changes to the MUTCD shown in red (new text underlined) Revisions made to text based on latest Sponsor comments and RWSTC consideration are highlighted in yellow.

Section 2C.06 Horizontal Alignment Warning Signs

Support:

A variety of traffic control signs (See Figure 2C-1), pavement markings (See Chapter 3B) and delineation (See Chapter 3D) can be used to advise motorists of a change in the roadway alignment. Uniform application of these traffic control devices with respect to the amount of change in the roadway alignment conveys a consistent message establishing driver expectancy and promoting effective roadway operations. The design and application of warning signs to meet those requirements are addressed below.

Standard:

Horizontal Alignment Warning signs on freeways, expressways and roadways functionally classified as arterial or collector with more than 1,000 AADT shall be in accordance with Table 2C-5 based on the speed differential between the roadway posted or statutory speed limit and the horizontal curve advisory speed.

Option:

Horizontal Alignment Warning signs may be used on other roadways or on arterial and collector roadways with less than 1,000 AADT based on engineering judgment.

Replace Table 2C-5 Horizontal Alignment Sign Usage with the following Table.

Table 2C-5. Selection of Horizontal Alignment Traffic Control Signs

Traffic Control Signs	<10 km/h (≤5 mph)	10 km/h (10 mph)	20 km/h (15 mph)	30 km/h (20 mph)	≥ 40 km/h (≥ 25 mph)
Turn (W1-1), Curve (W1-2), Reverse Turn (W1-3), Reverse Curve (W1-4), or Winding Road (W1-5)	Option	Guidance	Standard	Standard	Standard
Advisory Speed (W13-1) Plaque	Option	Guidance	Standard	Standard	Standard
Chevrons (W1-8) and/or One Direction Large Arrow (W1-6)	Option	Option	Guidance	Guidance	Standard
Combination Horizontal Alignment/Advisory Speed (W1-1a, W1-2a)	N/A	N/A	Option	Option	Guidance
One Direction Large Arrow (W1-6)	Option	Option	Option	Option	Option
INTERCHANGE RAMP SIGNING					
Truck Rollover Warning (W1-13) & Advisory Speed (W13-1) Plaque	N/A	Option	Guidance	Guidance	Standard
Advisory Exit Speed (W13-2) & Ramp Speed (W13-3)	N/A	Option	Guidance	Standard Guidance	Standard

NOTE: References to Standard, Guidance, and Option in the above Table shall have the same meanings as contained in the Introduction for this publication.

Section 2C.06. 2C.07 Horizontal Alignment Signs (W1-1 through W1-5, W1-11, W1-15)
Standard:

A Curve (W1-2) sign (See Figure 2C-1) shall be used in accordance with Table 2C-5 to advise road users of a change in roadway alignment except as specified below.

Option

The horizontal alignment Turn (W1-1), Curve (W1-2), Reverse Turn (W1-3), Reverse Curve (W1-4), or Winding Road (W1-5) signs (see Figure 2C-1) may be used in advance of situations where the horizontal roadway alignment changes. A One Direction Large Arrow (W1-6) sign (see Figure 2C-1) and Section 2C.09) may be used on the outside of the turn or curve.

If the change in horizontal alignment is 135 degrees or more, the Hairpin Curve (W1-11) sign (see Figure 2C-1) may be used.

If the change in horizontal alignment is approximately 270 degrees, such as on a cloverleaf interchange ramp, the 270-degree Loop (W1-15) sign (see Figure 2C-1) may be used.

Guidance:

A Turn (W1-1) sign (See Figure 2C-1 and 2C-X) should be used in advance of curves with a change in roadway alignment of approximately 90 degrees and an Advisory Speed (W13-1) of 50 km/h (30 mph) or less.

The Reverse Turn (W1-3) or Reverse Curve (W1-4) sign (See Figure 2C-1) should be used in place of multiple Turn (W1-1) or Curve (W1-3) (W1-2) signs where there are two changes in roadway alignment that are separated by a tangent distance less than 180 m (600 ft.).

Option:

A Winding Road (W1-5) sign (See Figure 2C-1) is may be used where there are three or more changes in roadway alignment separated by a tangent distance less than 180 m (600 ft.). The supplemental distance plaque NEXT XX km (NEXT XX MILES) (W7-3a) may be installed below the Winding Road sign where continuous roadway curves exist (see Section 2C.45).

The Hairpin Curve (W1-11) sign (see Figure 2C-1) may be used in advance of the curve if the curve has a change of direction of 135 degrees or more.

The 270-Degree Loop (W1-15) sign (see Figure 2C-1) may be used in advance of the curve if the curve has a change of direction of approximately 270 degrees such as on a cloverleaf interchange ramp.

Guidance:

~~The application of these signs should conform to Table 2C-5.~~

When the Hairpin Curve sign or the 270-degree Loop sign is installed, either a One-Direction Large Arrow (W1-6) sign or Chevron Alignment (W1-8) signs (See Figure 2C-1) should be installed on the outside of the turn or curve.

Option:

~~An Advisory Speed (W13-1) plaque (see Section 2C.46) may be used to indicate the speed for the change in horizontal alignment. The combination Horizontal Alignment/Advisory Speed sign (see Section 2C.07), combination Horizontal Alignment/Intersection sign (see Section 2C.08), or the Curve Speed sign (see Section 2C.36) may also be used.~~

Standard:

~~When engineering judgment determines the need for a horizontal alignment sign, one of the W1-1 through W1-5, W1-10, W1-11, or W1-15 signs shall be used.~~

Option:

~~If the reduction in speed is 20 km/h (15 mph) or greater, a supplemental combination Horizontal Alignment/Advisory Speed sign or Curve Speed (W13-5) sign may be installed as near as practical to the point of curvature. If the reduction in speed is 40 km/h (25 mph) or greater, one or more additional Curve Speed signs may be installed along the curve.~~

Section 2C.46 2C.08 Advisory Speed Plaque (W13-1)

Option:

The Advisory Speed (W13-1) plaque (see Figure ~~2C-5~~ 2C-1) may be used to supplement any warning sign to indicate the advisory speed for a condition.

Standard:

The Advisory Speed plaque shall be used where an engineering study indicates a need to advise road users of the advisory speed for horizontal alignment signing in accordance with Table 2C-5 and a or other roadway conditions

~~If~~ Where used, the Advisory Speed plaque shall carry the message XX km/h (XXMPH). The speed shown shall be a multiple of 10 km/h or 5 mph.

Except in emergencies or when the condition is temporary, an Advisory Speed plaque shall not be installed until the advisory speed has been determined by an engineering study.

The Advisory Speed plaque shall only be used to supplement a warning sign and shall not be installed as a separate sign installation.

Guidance:

The advisory speed should be determined for free-flowing traffic conditions.

Because changes in conditions, such as roadway geometrics, surface characteristics, or sight distance might affect the advisory speed, each location should be periodically evaluated when the conditions change, and the Advisory Speed plaque changed if necessary.

Option:

~~The advisory speed may be the 85th percentile speed of free-flowing traffic, the speed corresponding to a 16-degree ball bank indicator reading, or the speed otherwise determined by an engineering study because of unusual circumstances.~~

Support:

~~A 10-degree ball bank indicator reading, formerly used in determining advisory speeds, is based on research from the 1930's. In modern vehicles, the 85th percentile speed on curves approximates a 16-degree reading. This is the speed at which most drivers' judgment recognizes incipient instability along a ramp or curve.~~

Section 2C.10 2C.09 Chevron Alignment Sign (W1-8)

Option: **Standard:**

The Chevron Alignment (W1-8) sign (see Figure 2C-1 and Figure 2C-X) may shall be **used** in accordance with Table 2C-5 used to provide additional emphasis and guidance for a change in horizontal alignment.

Option:

A Chevron Alignment sign may be used as an alternate or supplement to standard delineators and pavement markings (See Part 3) on curves. ~~or to the One Direction Large Arrow (W1-6) sign.~~

Standard:

The Chevron Alignment sign shall be a vertical rectangle. No border shall be used on the Chevron Alignment sign. ~~If **Where** used,~~ Chevron Alignment signs shall be installed on the outside of a turn or curve, in line with and at approximately a right angle to approaching traffic. Chevron Alignment signs shall be installed at not less than 1.2 m (4 feet) mounting height measured from the bottom of the sign to the nearest edge of pavement.

Option:

~~A Chevron Alignment sign may be used on the far side of an intersection to inform drivers of a change of horizontal alignment for through traffic.~~

Guidance:

~~Spacing of Chevron Alignment signs should be such that the road user always has at least two in view, until the change in alignment eliminates the need for the signs.~~

The Chevron Alignment sign approximate spacing on the turn or curve measured from the point of curvature (PC) should be as shown in Table 2C-6.

Table 2C-6. Approximate Spacing for Chevron Alignment Signs on Horizontal Curves

<u>Curve Advisory Speed (km/h)</u>	<u>Curve Radii (Meters)</u>	<u>Approximate Chevron Alignment Sign Spacing (meters)</u>	<u>Curve Advisory Speed (mph)</u>	<u>Curve Radii (feet)</u>	<u>Approximate Chevron Alignment Sign Spacing (feet)</u>
<u>≤ 20</u>	<u>< 60</u>	<u>12</u>	<u>≤ 15</u>	<u>< 200</u>	<u>40</u>
<u>30 to 50</u>	<u>60 – 120</u>	<u>24</u>	<u>20 to 30</u>	<u>200 – 400</u>	<u>80</u>
<u>60 to 70</u>	<u>120 – 210</u>	<u>36</u>	<u>35 to 45</u>	<u>400 – 700</u>	<u>120</u>
<u>80 to 100</u>	<u>210 – 380</u>	<u>48</u>	<u>50 to 60</u>	<u>700 – 1250</u>	<u>160</u>
<u>> 100</u>	<u>> 380</u>	<u>60</u>	<u>> 60</u>	<u>> 1250</u>	<u>200</u>

Note: The curve radii criteria shown in this table should not be used to set Advisory Speeds.

Chevron Alignment signs should be visible for a sufficient distance to provide the road user with adequate time to react to the change in alignment.

Section 2C.07-2C.10 Combination Horizontal Alignment/Advisory Speed Signs (W1-1a, W1-2a)

Option:

The Turn (W1-1) sign or the Curve (W1-2) may be combined with the Advisory Speed (W13-1) plaque (see Section 2C.46-2C.08) to create a Combination Turn/Advisory Speed (W1-1a) sign (see Figure 2C-1) or Combination Curve/Advisory Speed (W1-2a) sign (see Figure 2C-1).

Standard:

~~When~~ **Where** used, the combination Horizontal Alignment/ Advisory Speed sign shall be used to supplement other advance horizontal alignment warning signs in accordance with Table 2C-5. The sign shall not be used alone. ~~supplement other advance warning signs, and~~ **Where used, the sign** shall be installed at the beginning of the turn or curve (See Figure 2C-X).

Section ~~2C.08~~ 2C.11 Combination Horizontal Alignment/Intersection Sign (W1-9, W1-10)

Option:

The Turn (W1-1) sign or the Curve (W1-2) sign may be combined with the Cross Road (W2-1) sign or the Side Road (W2-2 or W2-3) sign to create a combination Horizontal Alignment/Intersection (W1-9 or W1-10) sign (see Figure 2C-1) that depicts the condition where an intersection occurs within or immediately adjacent to a turn or curve.

Guidance:

Elements of the combination Horizontal Alignment/Intersection sign related to horizontal alignment should conform to Section ~~2C.06~~ 2C.07 and elements related to intersection configuration should conform to Section 2C.37. The sign symbol design should approximate the configuration of the roadway. No more than one Cross Road or two Side Road symbols should be shown on any one combination Horizontal Alignment/Intersection sign.

Section ~~2C.09~~ 2C.12 One-Direction Large Arrow Sign (W1-6)

Option:

~~A One-Direction Large Arrow (W1-6) sign (see Figure 2C-1) may be used to delineate a change in horizontal alignment.~~

Standard:

The One-Direction Large Arrow sign shall be a horizontal rectangle with an arrow pointing to the left or right.

Option:

A One-Direction Large Arrow (W1-6) sign (see Figure 2C-1) may be used either as a supplement or an alternate to Chevron Alignment signs in order to delineate a change in horizontal alignment of approximately 90 degrees or more. (See Figures 2C-X and 2C-7).

Guidance:

The One-Direction Large Arrow sign should may be used to supplement a Turn or Reverse Turn sign (See Figure 2C-X) to emphasize the abrupt curvature.

Guidance:

The One-Direction Large Arrow sign should be visible for a sufficient distance to provide the road user with adequate time to react to the change in alignment.

Standard:

If Where used, the One-Direction Large Arrow sign shall be installed on the outside of a turn or curve in line with and at approximately a right angle to approaching traffic.

The One-Direction Large Arrow shall not be used where there is no alignment change in the direction of travel, such as at the beginning and ends of medians or at center piers.

Section ~~2C.11~~ **2C.13** Truck Rollover Warning Sign (W1-13)

Standard:

~~The use of the~~ **Truck Rollover Warning sign (W1-13) shall be used on freeway and expressway ramps in accordance with Table 2C-5.**

~~Option~~ **Guidance:**

A Truck Rollover Warning (W1-13) sign (see Figure 2C-1 ~~and 2C-7~~) ~~may~~ **should** be used to warn drivers of vehicles with a high center of gravity, such as trucks, tankers, and recreational vehicles, of a curve or turn having geometric conditions that are prone to cause such vehicles to lose control and overturn. ~~may contribute to loss of control and rollover.~~ **Such locations may include Interchange ramps, turn lanes or other separate turning roadways.**

~~The engineering study to determine the truck advisory speed should use~~ **recommended established traffic engineering practices for truck advisory speeds**

Standard:

~~When~~ **The Truck Rollover Warning (W1-13) sign is used, it shall be accompanied by an Advisory Speed (W13-1) plaque indicating the recommended speed for vehicles with a higher center of gravity.**

Option:

The Truck Rollover Warning sign may be displayed either as a static sign, a static sign supplemented by a flashing beacon, or as a changeable message sign activated by the detection of an approaching vehicle with a high center of gravity that is traveling in excess of the recommended speed for the condition.

Support:

The curved arrow on the Truck Rollover Warning sign shows the direction of roadway curvature. The truck tips in the opposite direction.

Section ~~2C.36~~ **2C.14** Advisory Exit, and Ramp, and Curve Speed Signs (W13-2, W13-3, W13-5)

Standard:

~~Advisory Exit, and Ramp, and Curve Speed signs (See Figure 2C-1) shall be vertical rectangles. The advisory Exit Speed (W13-2), Ramp Speed (W13-3), or Curve Speed (W13-5) signs (see Figure 2C-5) shall be used where engineering judgement indicates the need to advise road users of the recommended speed on an exit, a ramp, or a curve.~~ **The use of the Advisory Exit (W13-2) and Ramp Speed (W13-3) signs shall be in accordance with Table 2C-5.**

Guidance:

~~When~~ **Where** used, the **Advisory** Exit Speed (W13-2) sign should be installed along the deceleration lane ~~and the advisory exit speed should be based on an engineering study.~~ **When a Truck Rollover (W1-13) sign (Section 2C.13) is installed, the Advisory Exit speed should be based on the truck advisory speed for the horizontal alignment using recommended engineering practices**

The **Advisory** Exit Speed sign should be visible in time for the road user to ~~make a~~ **reasonably safe slowing** ~~slow~~ and **make an** exiting maneuver.

The Ramp Speed sign should be visible in time for the road user to reduce to the recommended speed.

The Ramp Speed (W13-3) sign should be used on a ramp to confirm the ramp advisory speed.

Chevron Alignment (W1-6) (W1-8) signs and/or One-Direction Large Arrow (W1-6) signs should be used on the outside of the exit curve in accordance with the applications noted in Sections 2C.09 and 2C.12.

Option:

A Combination Horizontal Alignment/Advisory Speed (W1-1a) or Hairpin Curve (W1-11) sign with Advisory Speed plaque or a Loop (W1-15) sign with Advisory Speed plaque may be installed at or beyond the beginning of the exit curve or on the outside of the curve, provided that it is apparent that the sign applies only to the exit curve or where there is a need to remind road users of the recommended advisory speed. These signs may also be used at intermediate points along the ramp if the ramp curvature changes and for any second curve on the ramp where the advisory speed is different from that on the initial ramp curve.

One or more Ramp Speed signs may be used along the deceleration lane, beyond the gore, or along the ramp (see Figure 2C-7). Based on engineering judgment, the Ramp Speed sign may be installed on the inside or outside of the curve to enhance its visibility.

A Turn (W1-1) or Curve (W1-2) sign with an Advisory Speed (W13-1) plaque may be used in place of a Ramp Speed sign if it is located such that it clearly does not apply to drivers on the main roadway.

A Curve Speed sign may be used at and beyond the beginning of a curve following a Horizontal Alignment and Advisory Speed sign combination, or when there is need to remind road users of the recommended speed, or where the recommended speed changes because of a change in curvature (see Section 2C.06). Based on engineering judgment, the Curve Speed sign may be installed on the inside or outside of the curve to enhance its visibility.

The advisory speed may be the 85th percentile of free flowing traffic, the speed corresponding to a 16-degree ballbank indicator reading, or the speed otherwise determined by an engineering study because of unusual circumstances.

Support:

A 10-degree ball bank indicator reading, formerly used in determining advisory speeds, is based on research from the 1930s. In modern vehicles, the 85th percentile speed on curves approximates a 16-degree reading. This is the speed at which most drivers' judgment recognizes incipient instability along a ramp or curve.

Change Section 5C.02 as follows:

Section 5C.02 Horizontal Alignment Signs (W1-1 through W1-8)

Support

Horizontal Alignment signs (see Figure 5C-1) include turn, curve, reverse turn, reverse curve, winding road, large arrow, and chevron alignment signs. For guidance in the design and application of horizontal alignment warning signs refer to Section 2C.06 through Section 2C.12.

Option:

Horizontal Alignment signs may be used where engineering judgment indicates a need to inform the road user of a change in the horizontal alignment of the roadway.

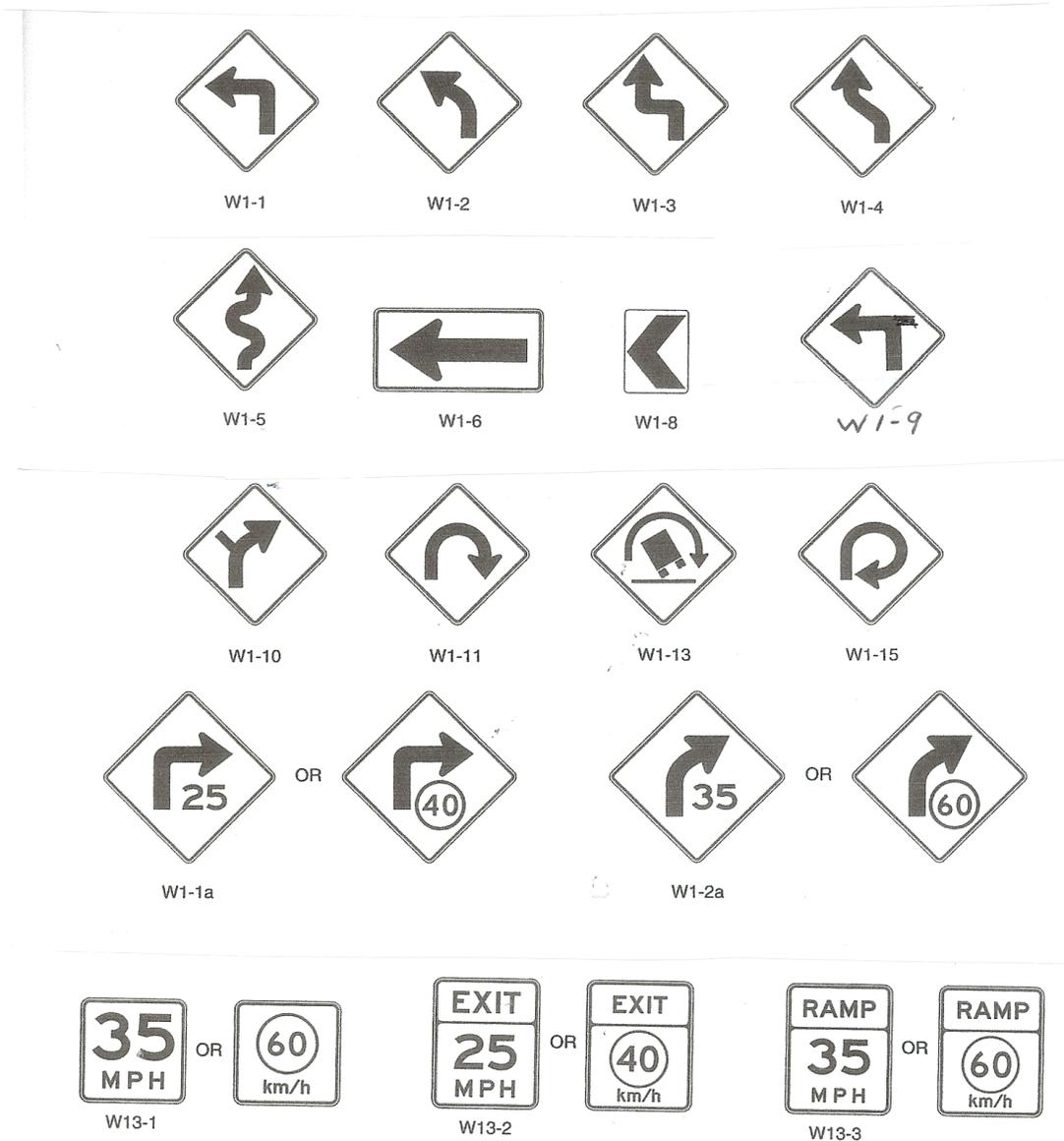
Section 1A.13 Definition of Words and Phrases in This Manual.

Add the following definition:

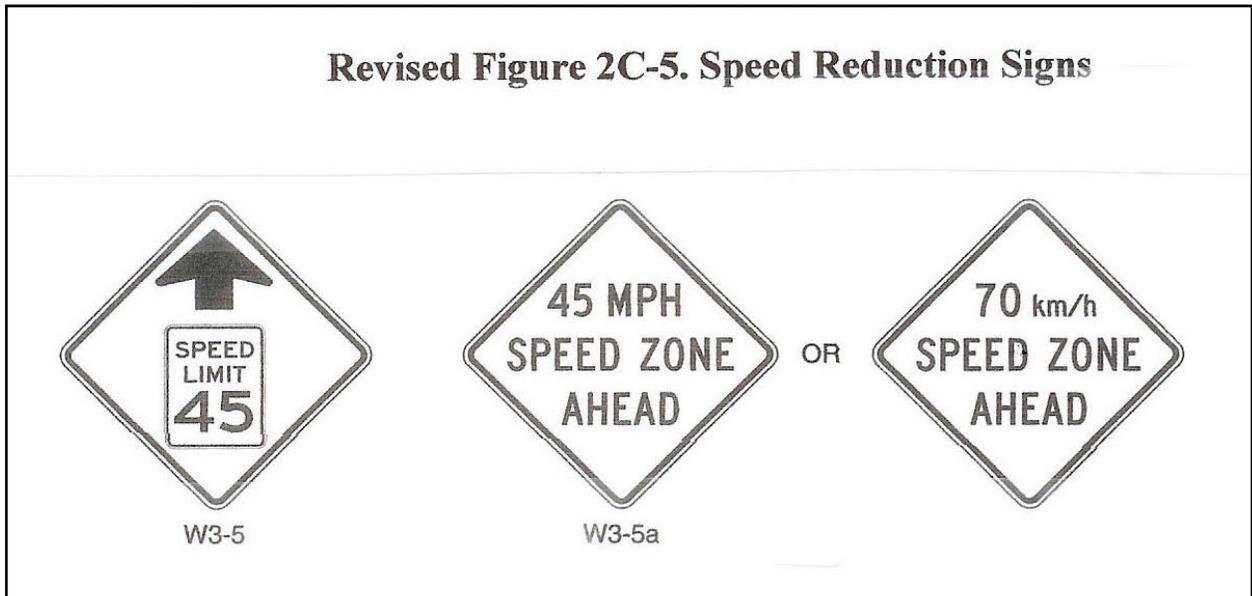
Average Annual Daily Traffic (AADT) – The total volume of traffic passing a point or segment of a highway facility in both directions for one year divided by the number of days in the year. Normally, periodic daily traffic volume figures are adjusted for hours of the day counted, days of the week and seasons of the year to arrive at average annual daily traffic.

Revise Figure 2C-1, Horizontal Alignment Signs, page 2C-7, by adding the Combination Turn/ Intersection (W1-9) sign and relocating the Advisory Speed (W13-1) plaque, Exit Speed (W13-2), and Ramp Speed (W13-3) from Figure 2C-5 to Figure 2C-1 so that all the Horizontal Alignment signs are shown in one figure. (Also change the name of the figure)

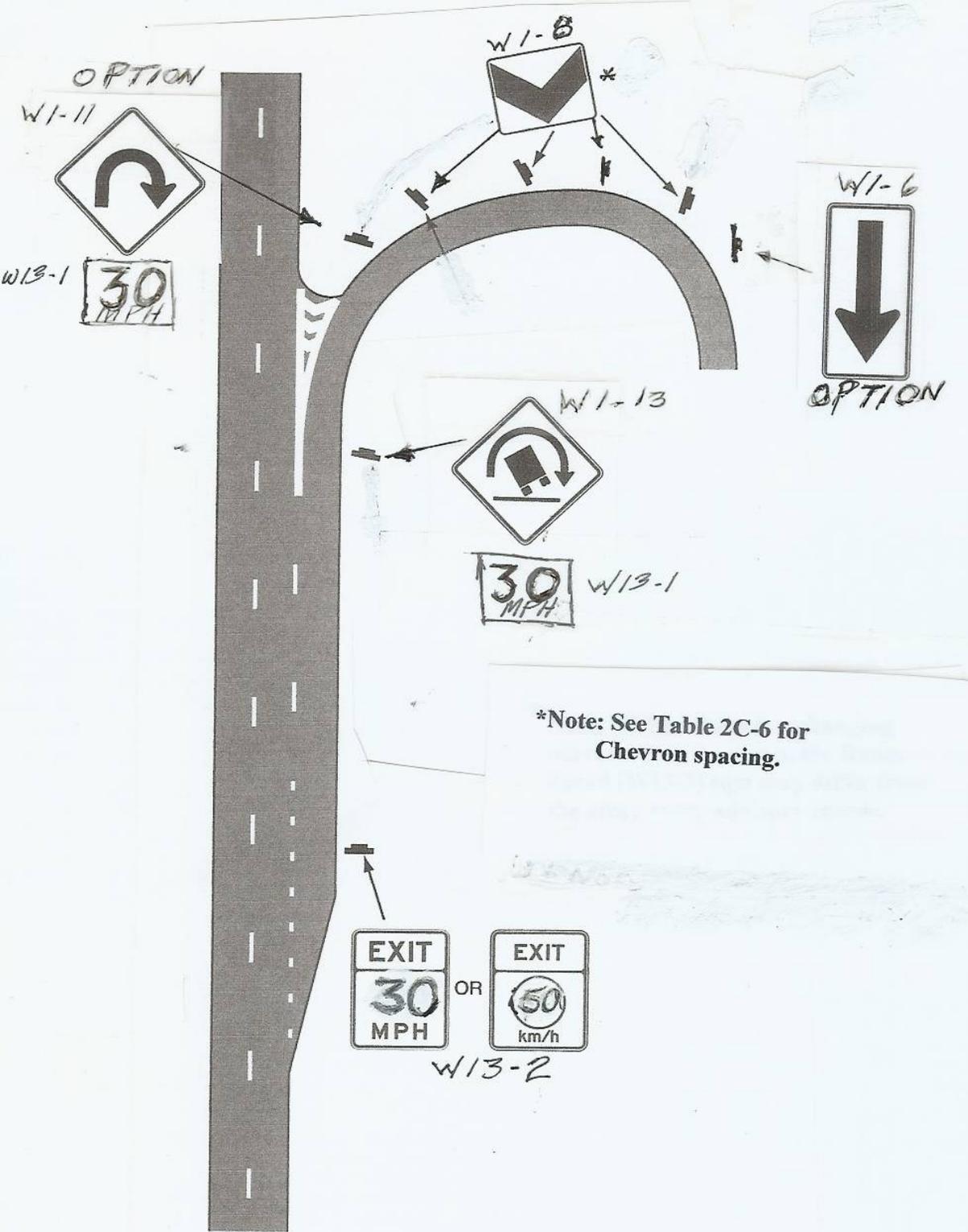
Revised Figure 2C-1. Horizontal Alignment Signs



Revise Figure 2C-5, ~~Advisory Speed and Speed Reduction Signs~~, by relocating the Advisory Speed signs to Figure 2C-1. Note that the Advisory Curve Speed (W13-5) sign has been deleted.



Revise Figure 2C-7. Example of Advisory Speed Signing for an Exit Ramp, to illustrate the signing addressed in Section 2C.13 and 2C.14.



Add a new Figure 2C-X. Example of Signing for a Turn to illustrate the application of optional signing addressed in Sections 2C.07, 2C.09, 2C.10 and 2C.12.

Figure 2C-X. Example of Warning Signs for a Turn

Replace with Revised Figure

