

Session 57

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FL. Dept. of Transportation D7

Guide Signing for Multilane Freeway Exits with an Optional Lane

Topic Description

Discussing the FHWA Notice of Proposed Amendment (NPA) on guide signing of two lane exits with optional lane on freeways to be printed in the 2008 edition of MUTCD.

Speaker Biography

Mr. Behzadi has over 23 years of experience in civil, traffic & transportation engineering. He is the District Traffic Design engineer and has been employed by the Department since 1987.

Mr. Behzadi is a licensed professional engineer, and a professional traffic operations engineer. He is also an adjunct faculty at USF teaching a graduate level course, Advanced Geometric Design of Highways. He is a member of the National Committee on Uniform Traffic Control Devices, serving in the Guide & Motorists Information subcommittee.

Guide Signing for Two-Lane Exits with Option Lane



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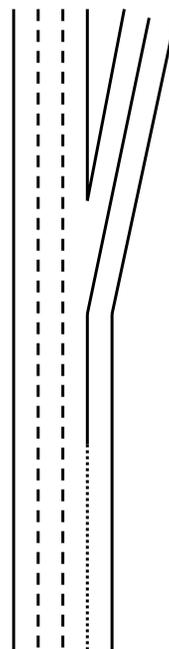
August 2006

Important Note To Audience:

- ❑ Interim Approvals are considered by the Office of Transportation Operations based on the results of successful experimentation, studies, or research, and an intention to place the new or revised device into a future rulemaking process for MUTCD revisions
- ❑ Interim approval has not been issued on the subject of Guide-Signing for Two-Lane Exits with Option Lane by FHWA
- ❑ Once approval is recommended by the technical committee on Guide & Motorists Information, an interim approval will be issued by FHWA
- ❑ The notice of final rulemaking will then be issued and printed in the 2008 edition of MUTCD

Guide Signing for Two-Lane Exits with Option Lane on Freeways

Although previous editions of the MUTCD have covered the signing requirements for multi-lane exits with an option lane, there is a tremendous lack of uniformity in sign design for this application throughout the United States, from state to state, and even within individual states, a wide variety of sign designs are in use.



**TWO-LANE EXIT
RAMP
WITH AN OPTION
LANE**









Guide Signing for Two-Lane Exits with Option Lane on Freeways

In 2002, a project was initiated in the National Cooperative Highway Research Program to objectively evaluate a variety of guide sign designs.

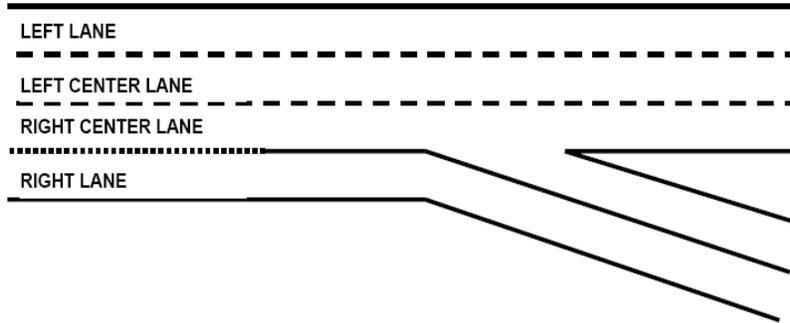
Project Panel: 4 State Traffic Engineers , 18 Members of Guide & Motorists Information Signs Technical committee, & 7 members of NCHRP panel.

Guide Signing for Two-Lane Exits with Option Lane on Freeways

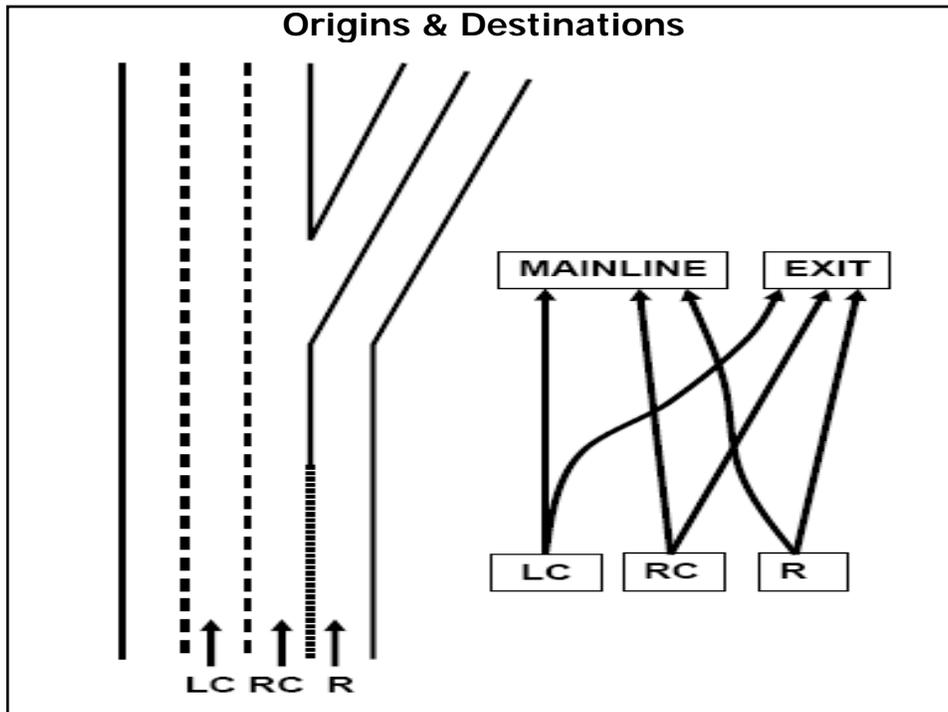
Challenges: sign design should communicate the following types of information to the motorist:

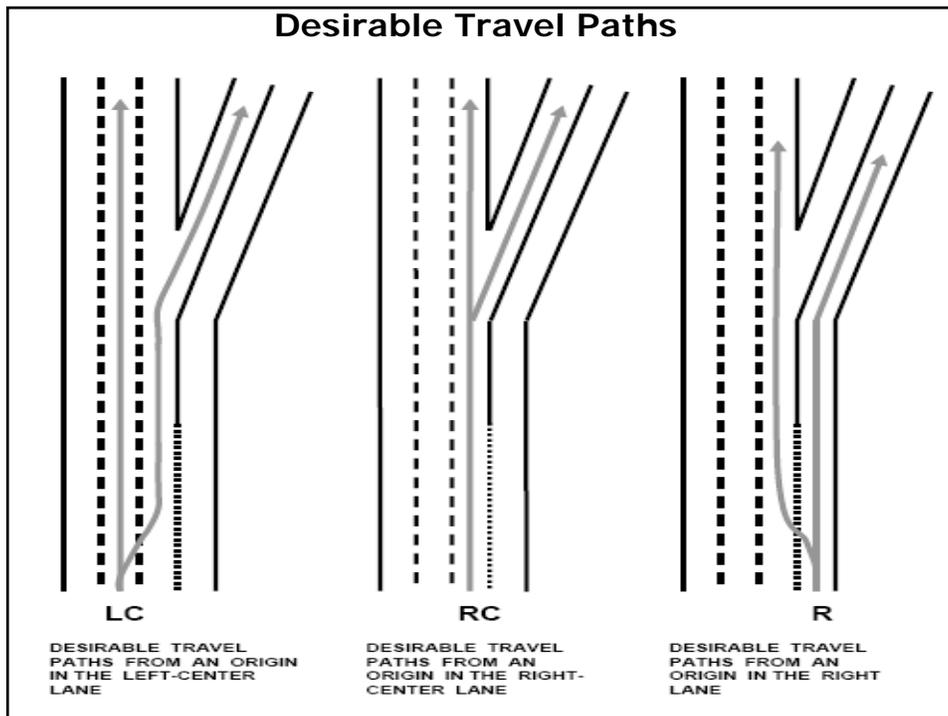
- 1) The concept that a vehicle in the option lane is able to either exit the freeway or continue on the mainline
- 2) The concept that a vehicle in the option lane does not have to change lanes to the left to continue on the mainline
- 3) The concept that a vehicle in the option lane does not have to change lanes to the right in order to exit; and
- 4) The provision of identifying information about each destination (mainline and exit), such as street name, route number, or destination name

Guide Signing for Two-Lane Exits with Option Lane on Freeways



Origins & Destinations





Guide Signing for Two-Lane Exits with Option Lane on Freeways

Four different sign configurations were tested in NCHRP study by the University of Massachusetts in Amherst, Jonathan Upchurch, PhD, PE, PTOE :

The term "Advance Guide Sign" is used to describe the signs displayed at the locations 1 mile and 1/2 mile before the gore.

The term "Lane Designation Sign" is used to describe the signs displayed at, or near, the gore.

EXISTING MUTCD SIGN CONFIGURATION

Lane Designation Signs (Longitudinally located at the theoretical gore, i.e., at a point where the right edgeline for the mainline and the left edgeline for the ramp begin at a common point and then diverge. Laterally located so that arrows are centered above the lanes to which each applies.)



34.0 x 15.0 ft



22.0 x 15.0 ft

Advance Guide Sign (Located approximately ½ mile in advance of exit and centered over the four approach lanes)



32.5 x 8 ft

Advance Guide Sign (1 mile in advance of exit and centered over the the four approach lanes)



32.5 x 8 ft

Guide Signing for Two-Lane Exits with Option Lane on Freeways

The Existing MUTCD Sign Configuration is based upon the design for Diagrammatic Signs for Two-Lane Exit with Optional Lane, as shown in Figure 2E-7, page 2E-18.

Some traffic engineers have commented that this diagrammatic type of sign has traditionally been used only for major forks and for locations at which the exiting roadway carries a major route and / or a relatively large volume.

In this regard, past use of this diagrammatic type of sign has been for a different situation than that which this study was designed to address.

Guide Signing for Two-Lane Exits with Option Lane on Freeways

This study is oriented toward two-lane exits (with an option lane) to arterial cross streets – a situation in which the exiting volume is smaller, relative to the mainline volume.

Configuration Type I-B

Lane Designation Sign (Longitudinally located slightly upstream of the theoretical gore; located before the point where the option lane begins to diverge. Laterally located so that arrows are centered above the lanes to which they apply)



22.5 x 10.5 ft

Advance Guide Sign (Located approximately ½ mile in advance of exit. Laterally located so that arrows are centered above the lanes to which they apply)

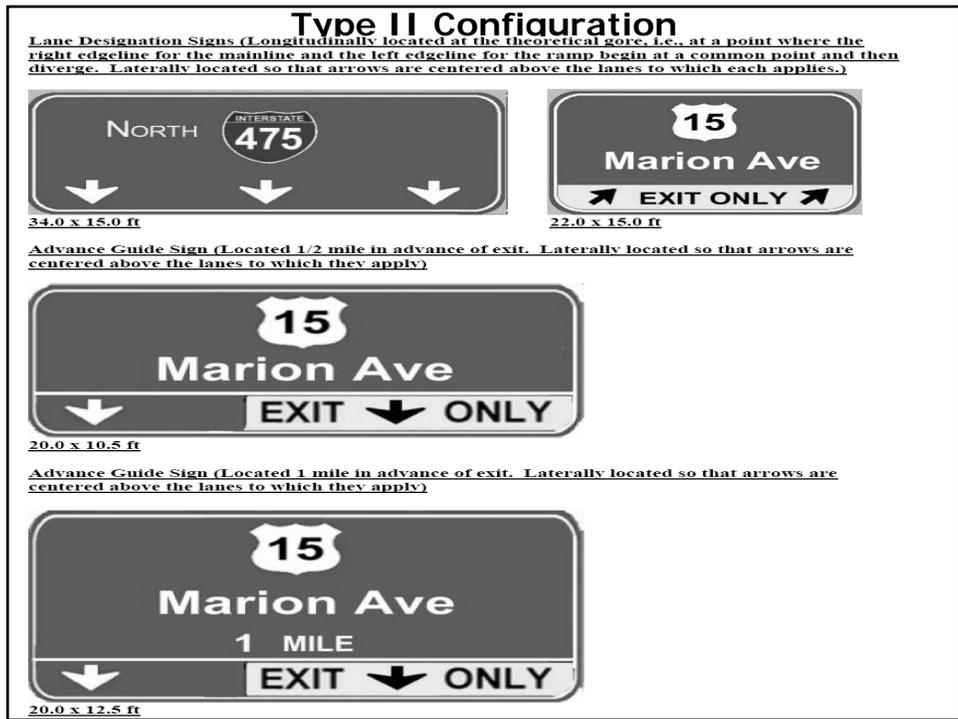
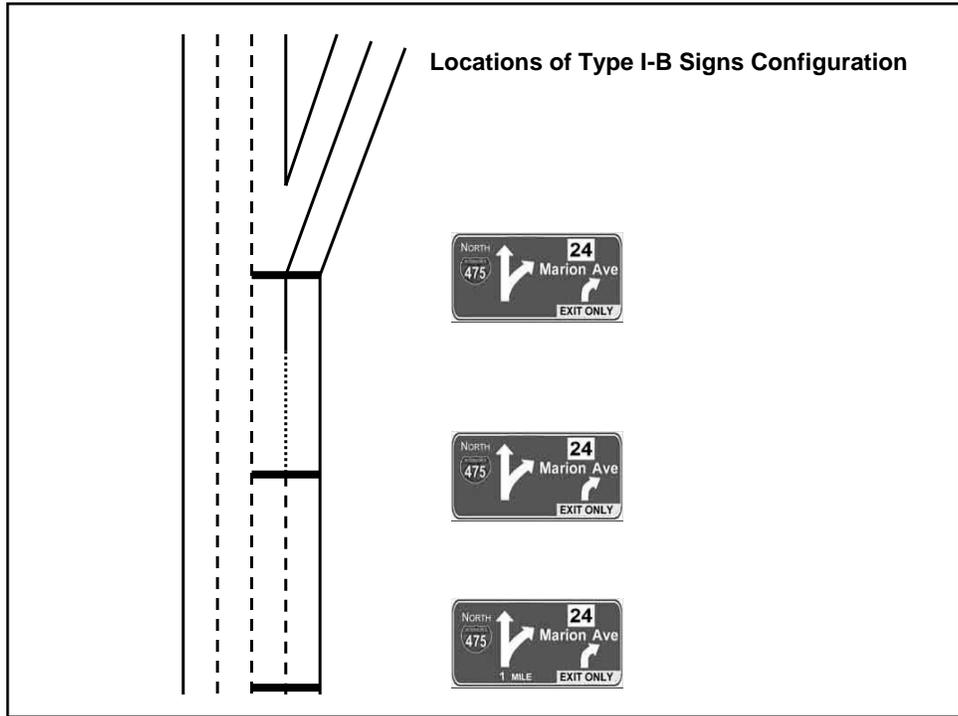


22.5 x 10.5 ft

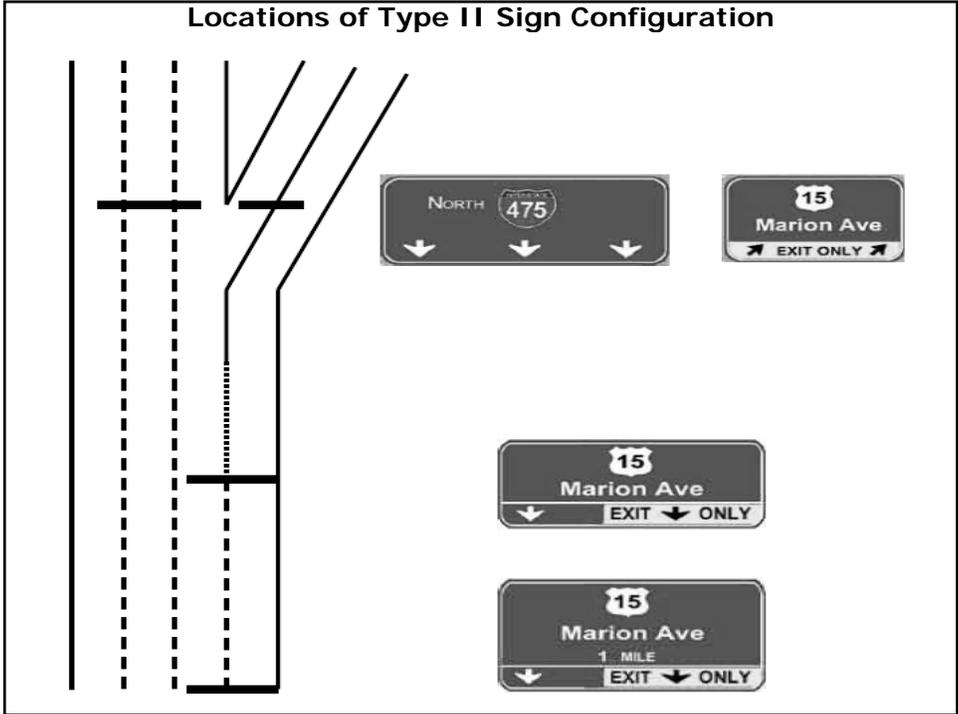
Advance Guide Sign (Located 1 mile in advance of exit. Laterally located so that arrows are centered above the lanes to which they apply)



22.5 x 10.5 ft



Locations of Type II Sign Configuration



Type III Configuration

Lane Designation Sign (Longitudinally located slightly upstream of the theoretical gore; located before the point where the option lane begins to diverge. Laterally located so that arrows are centered above the lanes to which they apply.)



20.0 x 11.0 ft

Advance Guide Sign (Located 1/2 mile in advance of exit. Laterally located so that arrows are centered above the lanes to which they apply.)

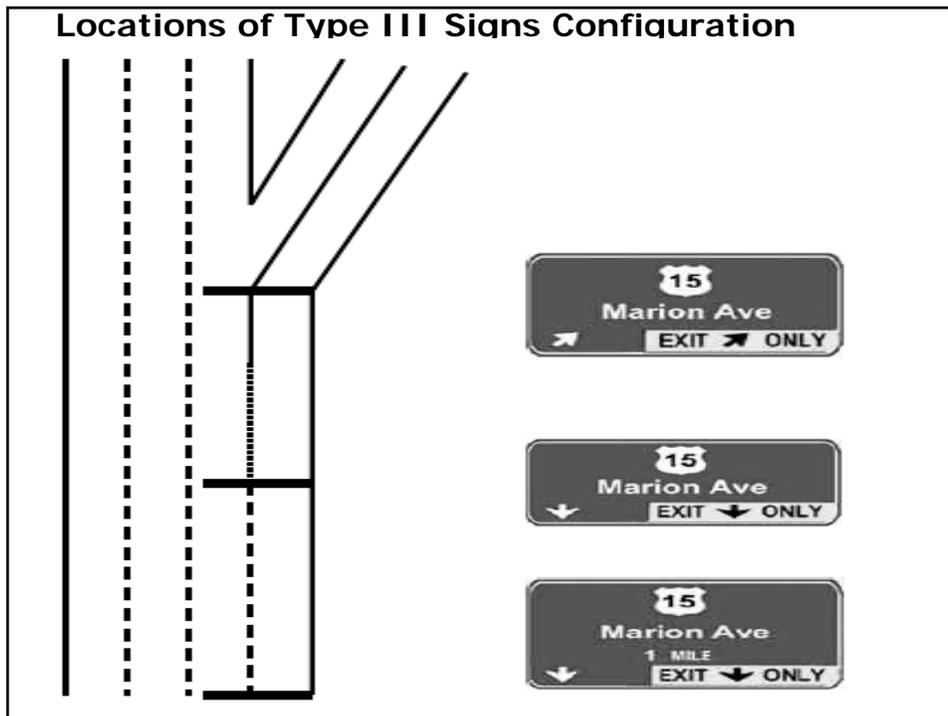


20.0 x 10.5 ft

Advance Guide Sign (Located 1 mile in advance of exit. Laterally located so that arrows are centered above the lanes to which they apply.)



20.0 x 12.5 ft



Experimental Design

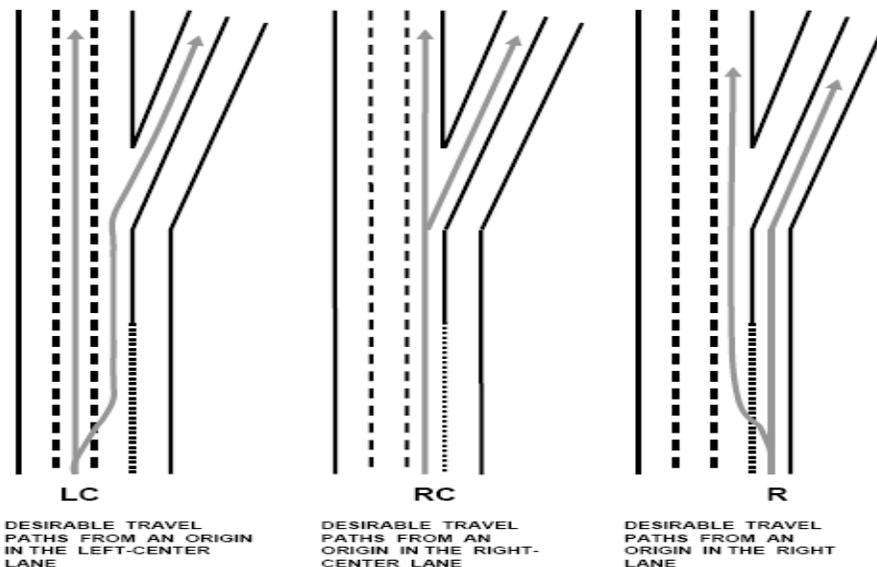
- ❑ Ninety-six (96) test subjects were hired to participate in an experiment in a driving simulator
- ❑ The 96 subjects were divided into four groups of 24 individuals w/valid driver licenses
- ❑ Each group participated in an experiment in which they were exposed to one of the four sign configurations

Experimental Design

- ❑ Each group of 24 subjects included 18 younger subjects and 6 older subjects (age 65 and older)
- ❑ Each subject drove in a driving simulator for about one hour
- ❑ During this time each subject drove on 23 segments of freeway
- ❑ Each segment included about 1 1/4 to 2 1/4 miles of freeway approaching an exit
- ❑ One segment was a practice segment, ten segments included exits that were not two-lane exits, and 12 segments included two-lane exits with an option lane

Measures of Effectiveness

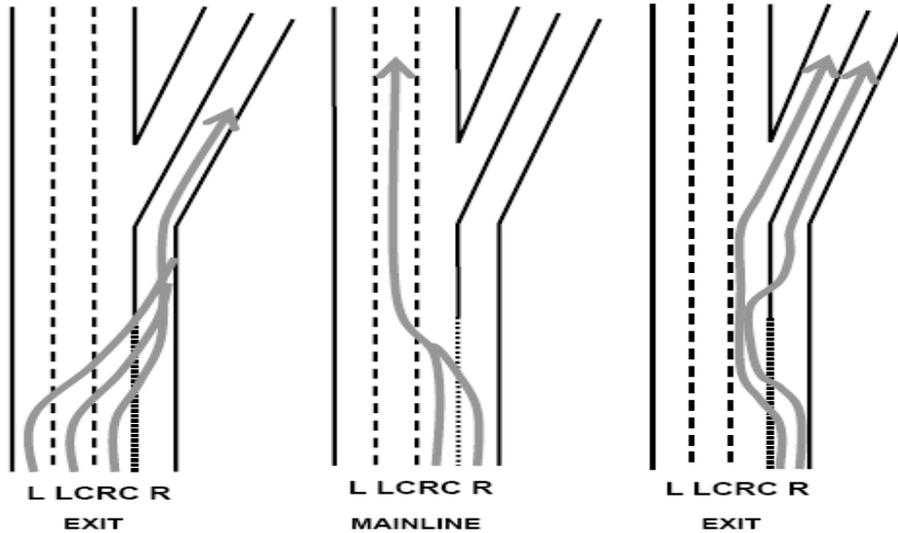
- ❑ A sign can be considered effective if drivers follow the ideal path for a given origin lane and destination.



Measures of Effectiveness

- A second measure of effectiveness for ideal travel paths is, how many unnecessary lane changes do subjects make to reach their destination (for example, move out of an option lane when they do not have to do so)

(Note that originating lane of each path is labeled immediately below the lane schematic and the destination is shown below the origin)



Other Measures of Effectiveness

- The number of lane changes are made within a short distance of the gore
- Lane changes near, at, or beyond the painted gore are presumably more hazardous, especially when it is a needed lane change
- A needed lane change is a lane change that is necessary for a subject to successfully reach his/her destination

Other Measures of Effectiveness

- ❑ A distance of 88 feet (1 second of travel time at 60 mph) was tentatively selected for this study as the criterion
- ❑ Because no lane changes were observed this close to the gore, a second criterion distance of 450 feet (about five seconds of travel time at 60 mph) was added

Other Measures of Effectiveness

The distribution of lane changes is an indication of how well subjects understand the message conveyed by a sign or signs.

A lane change that is made when the subject views the 1 MILE sign implies a rapid understanding of the message and is preferable to a lane change made at the 1/2 mile point.

Similarly, a change made at the 1/2 mile point is preferable to a lane change made near the gore.

Relative Importance of MOEs

To determine the relative importance of the 10 measures of effectiveness, plus cost of installation, a questionnaire survey was sent to about 40 transportation professionals. These were all individuals who have professional experience in traffic control devices. Responses were received from 29 individuals, comprised of:

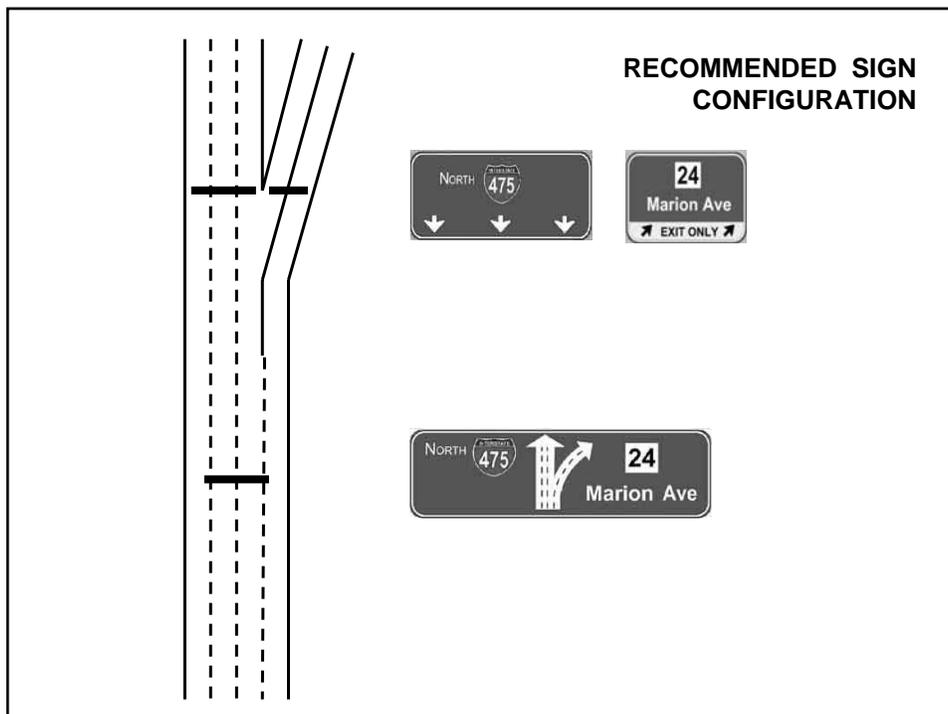
- ❑ 7 members of the NCHRP panel for this project
- ❑ 18 members of the Guide and Motorist Information Signs Technical Committee of the National Committee on Uniform Traffic Control Devices
- ❑ 4 State Traffic Engineers

Relative Importance of MOEs

- Respondents assigned a weight to each of the items
- They were to select the measure that they thought was most important and assign a weight of 10 to that item
- They assigned weights to the other items based upon their relative importance to the most important item

Relative Importance of MOEs

- For each measure, the mathematical average of the weights assigned by the 29 respondents was calculated.
- This is the value shown in the "WEIGHT" column in Table
- These values represent the consensus Judgment of 29 transportation professionals on the relative importance of the 10 measures of effectiveness, plus installation cost



Relative Scores for each Sign Type

| MEASURE NUMBER | MEASURE DESCRIPTION | RAW DATA | | | | RELATIVE SCORE | | | | | WEIGHT | RELATIVE SCORE X WEIGHT | | | | |
|--------------------|--|------------------------|------------------------|------------------------|------------------------|----------------|---------|---------|----------|----------|---------------|-------------------------|---------------|---------------|---------------|----------|
| | | MUTCD | TYPE IB | TYPE II | TYPE III | MUTCD | TYPE IB | TYPE II | TYPE III | MUTCD/II | | MUTCD | TYPE IB | TYPE II | TYPE III | MUTCD/II |
| 1 | Number of failures to reach assigned destination | 2 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 4.31 | 4.31 | 4.31 | 4.31 | 4.31 | |
| 2 | Number of unnecessary lane changes to reach assigned destination | 105 | 101 | 100 | 92 | 4 | 5 | 5 | 6 | 4.5 | 6.76 | 23.04 | 28.80 | 28.80 | 34.68 | 25.92 |
| 3 | Number of last needed lane changes made less than 88 feet from painted gore | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 3.56 | 3.56 | 3.56 | 3.56 | 3.56 | 3.56 |
| 4 | Number of last needed lane changes made less than 450 feet from painted gore | 3 | 3 | 5 | 8 | 10 | 10 | 6 | 1 | 10 | 6.14 | 61.40 | 61.40 | 36.84 | 6.14 | 61.40 |
| 5 | Number of last lane changes made less than 450 feet from painted gore | 13 | 4 | 9 | 11 | 1 | 10 | 5 | 3 | 1 | 6.48 | 6.48 | 64.80 | 32.40 | 19.44 | 6.48 |
| 6 | Location of last needed lane change | | | | | 10 | 6 | 3 | 1 | 10 | 7.79 | 77.90 | 46.74 | 23.37 | 7.79 | 77.90 |
| 7 | Certainty of lane to reach destination - advance guide sign | 3.45 | 3.27 | 3 | 3.04 | 10 | 6 | 1 | 1 | 10 | 6.66 | 66.60 | 39.96 | 6.66 | 6.66 | 66.60 |
| 8 | Certainty of lane to reach destination - lane designation sign | 3.36 | 3.14 | 3.74 | 3.21 | 4 | 1 | 10 | 2 | 10 | 7.03 | 28.12 | 7.03 | 70.30 | 14.06 | 70.30 |
| 9 | Difficulty in understanding - advance guide sign | 4.45 | 4.13 | 3.77 | 3.5 | 10 | 7 | 3 | 1 | 10 | 6.52 | 65.20 | 45.64 | 19.56 | 6.52 | 65.20 |
| 10 | Difficulty in understanding - lane designation sign | 4.18 | 3.86 | 4.39 | 3.75 | 7 | 2 | 10 | 1 | 10 | 6.52 | 45.64 | 13.04 | 65.20 | 6.52 | 65.20 |
| 11 | Cost of installation | \$251,000 \$171,000 | \$151,000 \$101,000 | \$191,000 \$140,000 | \$151,000 \$100,000 | 1 | 10 | 5 | 10 | 1 | 4.14 | 4.14 | 41.40 | 20.70 | 41.40 | 4.14 |
| POINT TOTAL | | | | | | | | | | | 386.38 | 356.67 | 311.69 | 150.95 | 451.00 | |

Additional Findings:

- ❑ The Type III sign yields the lowest point total (150.95) and is clearly surpassed in performance by other sign types
- ❑ The Type II sign has a point total (311.69) that is much higher than the Type III sign and this is attributed to the points earned for Measures 4, 5, 6, 8, 9, and 10
- ❑ For all other measures, the MUTCD sign performs better.
- ❑ It could be argued that the Type IB sign is competitive with the MUTCD sign
- ❑ The hybrid sign – the combination of the MUTCD and Type II sign configurations – takes advantage of the strengths of both sign configurations. The MUTCD / II point total of 451.00 exceeds the MUTCD sign type by 65 points. This is due almost exclusively to the points earned for Measures 8 and 10

Additional Findings (cont'd)

- ❑ It is also clear that the hybrid sign outperforms the Type IB sign. The Type IB sign has slightly better points earned for Measure 2.
- ❑ The Type IB has much higher points earned for Measure 5 and has a lower cost of installation.
- ❑ Overall, however, the hybrid sign has a point total 95 points better than the Type IB sign.
- ❑ Based upon the experimental results and the analysis of the measures of effectiveness, a hybrid sign configuration is recommended. It consists of the Advance Guide signs in the MUTCD sign configuration and the Lane Designation Signs in the Type II sign configuration



RECOMMENDED SIGN CONFIGURATION



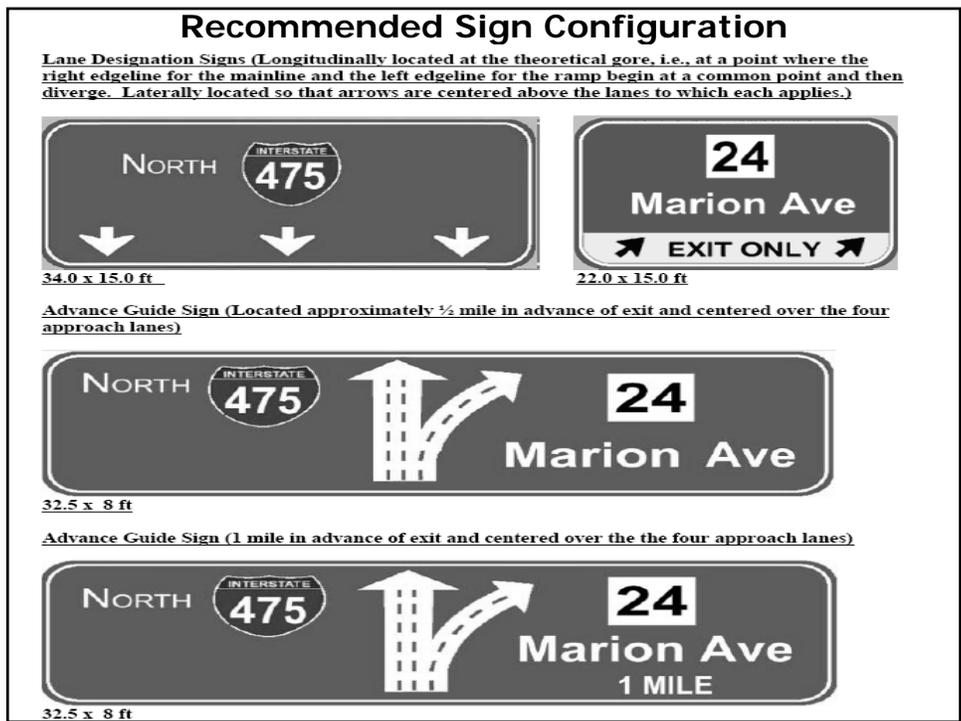
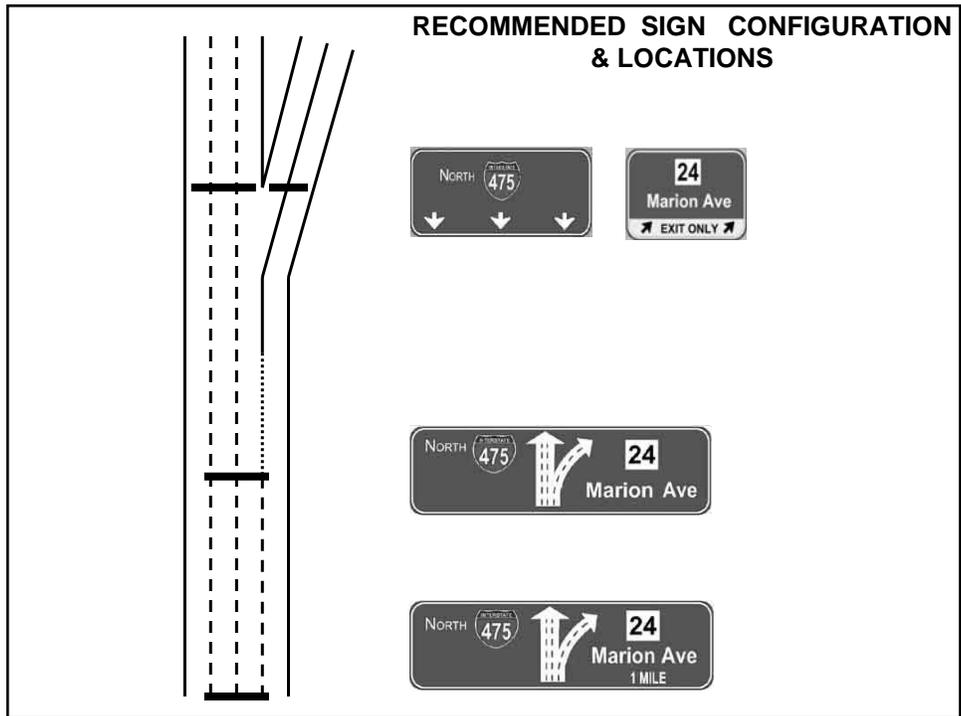
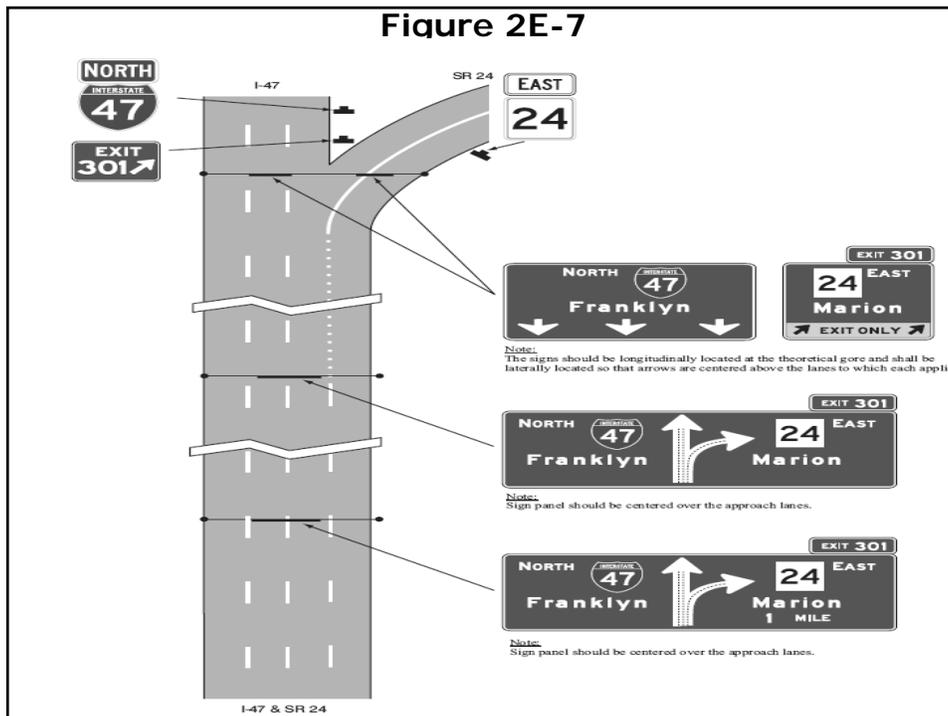


Figure 2E-7



Recommended Wording Changes to MUTCD For the 2008 Edition

□ Section 2E.11 Pull-Through Signs

Guidance:

Modify the last sentence to read as follows:

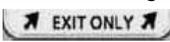
- Pull-Through signs with down arrows should be used where the alignment of the through lanes is curved and the exit direction is straight ahead, where the number of through lanes is not readily evident, and at multi-lane exits where there is a reduction in the number of through lanes or where a through lane becomes an option lane for through or exiting traffic.

Recommended Wording Changes to MUTCD For the 2008 Edition

- Section 2E.18 Arrows for Interchange Guide Signs

Standard:

Modify the 1st paragraph to read as follows:

- On all Exit Direction signs for single lane exits, both overhead and ground mounted, arrows shall be upward slanting and shall be located on the side of the sign consistent with the direction of the exiting movement. For multi-lane exits, upward slanting arrows shall be located on the bottom of the overhead mounted sign with each arrow positioned near the center of each exiting lane. Upward slanting arrows on the bottom of an Exit Direction sign shall be at the same angle as the arrow on Exit Direction Signs (see Figure 2E-20 ). 

The size of upward slanting arrows on the bottom of the sign panel shall be based on the EXIT ONLY letter size in accordance with the "Standard Highway Signs" book.

Recommended Wording Changes to MUTCD For the 2008 Edition

- Section 2E.19 Diagrammatic Signs

1st Guidance:

- Diagrammatic signs should be designed in accordance with the following additional criteria: *Delete Item G in its entirety replace with new text and add a new Item H as follows:*
- G. For splits or other exits leading in a single cardinal direction, the cardinal direction For splits or other exits leading in a single cardinal direction, the cardinal direction should be placed adjacent to the route shield.
- H. The destination should be placed below and justified with the route shield.
- Diagrammatic signs should be used at the Advance Guide sign location(s) for the following: *Modify Item D as follows:*

D. Where a multi-lane exit has an optional lane that carries the through route (see Figures 2E-6 and 2E-7). These interchanges create serious expectancy problems for drivers who are unfamiliar with the interchange.

Recommended Wording Changes to MUTCD For the 2008 Edition

Modify Figure 2E-6 and Figure 2E-7 to reflect the Recommended Sign Configuration from the NCHRP Project 20-7 (155),

- The diagrammatic arrows should be wider with heavier lane lines to emphasize the auxiliary and option lanes.

Adjacent to the 1 mile and ½ mile advance guide signs add the following:

- "Sign should be centered over the approach lanes"

Adjacent to the gore sign add the following:

- "The signs should be longitudinally located at the theoretical gore, i.e. at a point where the right edge line for the mainline and the left edge line for the ramp begin at a common point and then diverge. The signs shall be laterally located so that arrows are centered above the lanes to which each applies."

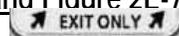
In addition the appropriate pavement markings should be shown on the roadway for the right hand lane that is required to exit, i.e. elephant tracks, followed by a solid lane line, approaching the gore.

Recommended Wording Changes to MUTCD For the 2008 Edition

- *Section 2E.20 Signing for Interchange Lane Drops*

1st Guidance:

-  The EXIT ONLY (down arrow) (E11-1) panel (see Figure 2E-9) should be used on all signing of lane drops on all Advance Guide signs for right exits (see Figure 2E-10). For lane drops on the left side, diagrammatic signing with the EXIT ONLY (E11-1c) 
- panel (see Figure 2E-9) should be used without a down arrow for Advance Guide signs (see Figure 2E-8). When diagrammatic Advance Guide signs are used for multi-lane exits with an option lane, EXIT ONLY panels should not be used on the Advance Guide signs. For multi-lane exits with an option lane the sign designating the exiting lanes and the E11-1d panel should be of the format shown in Figure 2E-6 and Figure 2E-7.



Recommended Wording Changes to MUTCD For the 2008 Edition

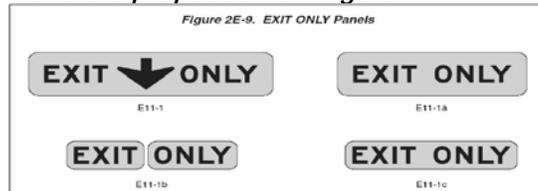
2nd Standard:

The Exit Direction sign (see Figure 2E-20) and E11-1a panel (see Figure 2E-9) shall be of the format shown in Figures 2E-8 and 2E-20 for all single lane lane drops. The standard slanted up arrow (left or right side) shall be included on the Exit Direction sign.



Recommended Wording Changes to MUTCD For the 2008 Edition

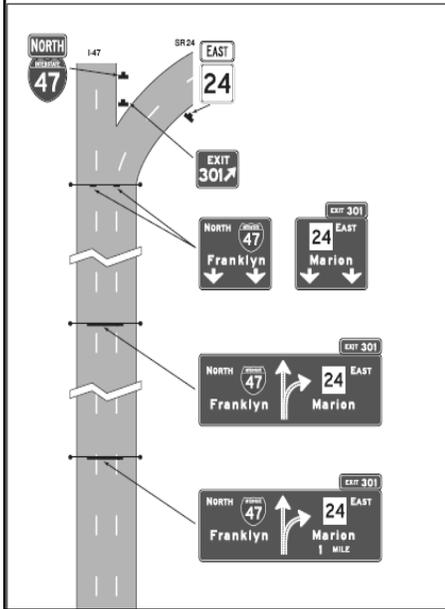
Modify Figure 2E-9 to include Exit Only panel E11-1d (new) which shows the Exit Only message between two upward slanting arrows. See below graphic showing a comparison of existing Figure 2E-9 and the proposed new Figure 2E-9



Comparison:

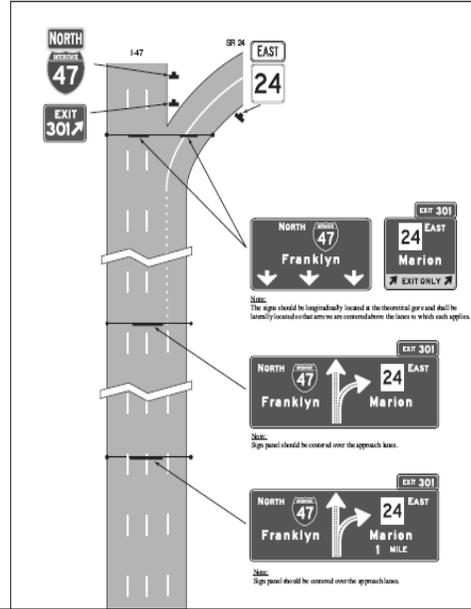
EXISTING FIGURE 2E-7

Figure 2E-7. Diagrammatic Signs for Two-Lane Exit with Optional Lane

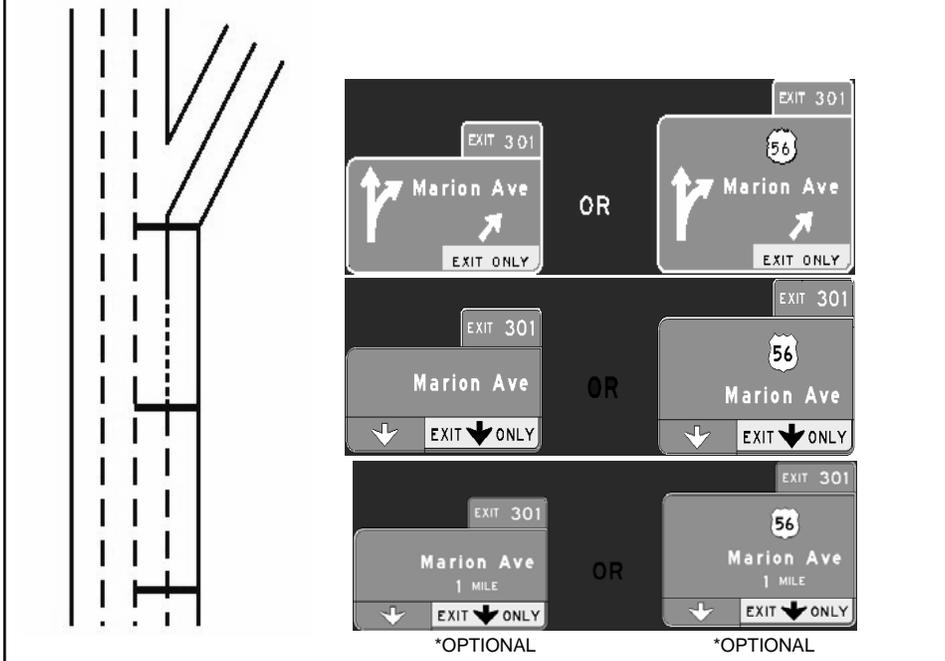


RECOMMENDED FIGURE 2E-7

Figure 2E-7. Diagrammatic Signs for Two-Lane Exit with Optional Lane



In June 2006, this configuration was submitted to the NCUTCD for consideration



References:

- ❑ MUTCD , 2003 Edition
- ❑ NCHRP Project 20 – 7 (155)
- ❑ G & MI Meeting Notes From 2002 to 2006