



TEXAS TRANSPORTATION INSTITUTE

**GUIDELINES ON THE SELECTION
AND DESIGN OF MESSAGES FOR
CHANGEABLE MESSAGE SIGNS**

RESEARCH REPORT 1232-10

COOPERATIVE RESEARCH PROGRAM

**TEXAS TRANSPORTATION INSTITUTE
THE TEXAS A&M UNIVERSITY SYSTEM
COLLEGE STATION, TEXAS**

TEXAS DEPARTMENT OF TRANSPORTATION

in cooperation with the
Federal Highway Administration
Texas Department of Transportation



1. Report No. FHWA/TX-92/1232-10	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle GUIDELINES ON THE SELECTION AND DESIGN OF MESSAGES FOR CHANGEABLE MESSAGE SIGNS		5. Report Date June 1992; Revised November 1992	
7. Author(s) Conrad L. Dudek		6. Performing Organization Code	
9. Performing Organization Name and Address Texas Transportation Institute The Texas A&M University System College Station, Texas 77843-3135		8. Performing Organization Report No. Research Report 1232-10	
12. Sponsoring Agency and Address Texas Department of Transportation Transportation Planning Division P.O. Box 5051 Austin, TX 78763		10. Work unit No. (TRAINS)	
15. Supplementary Notes Research performed in cooperation with DOT, FHWA. Research Study Title: Urban Highway Operations Research and Implementation Program		11. Contract or Grant No. 2-18-90/4-1232	
		13. Type of Report and Period Covered Interim (September 1990-June 1992)	
		14. Sponsoring Agency Code	
16. Abstract This report presents guidelines on the design of changeable message sign (CMS) messages for use in freeway corridors for incident management and route diversion. It is a companion to Report No. FHWA/TX-92/1232-9, which is a primer on the characteristics that affect the design, use and operation of CMSs, and which provides guidelines on the selection of the appropriate type of CMS displays. Both reports are updates and consolidations of the following reports: <ol style="list-style-type: none"> 1. C.L. Dudek and R.D. Huchingson. Manual on Real-Time Motorist Information Displays. Report FHWA-IP-86-16. August 1986. 2. C.L. Dudek. Guidelines on the Use of Changeable Message Signs. Report FHWA-TS-90-043. May 1991. 3. C.L. Dudek. Portable Changeable Message Signs at Work Zones. Report FHWA/TX-85/07+292-4. July 1984. 			
17. Key Words Changeable message signs, freeway corridors, human factors, advanced traffic management systems, intelligent vehicle-highway systems		18. Distribution Statement No restrictions. This document is available to the public through the National Technical Information Service 4285 Port Royal Road Springfield, Virginia 22161	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 71	22. Price

**GUIDELINES ON THE SELECTION AND DESIGN
OF MESSAGES FOR CHANGEABLE MESSAGE SIGNS**

by

Conrad L. Dudek

Research Report 1232-10
Research Study 2-18-90/4-1232

Sponsored by

Texas Department of Transportation
In cooperation with
U.S. Department of Transportation, Federal Highway Administration

TEXAS TRANSPORTATION INSTITUTE
Texas A&M University System
College Station, TX 77843

June 1992

SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
--------	---------------	-------------	---------	--------

LENGTH

in	inches	25.4	millimetres	mm
ft	feet	0.305	metres	m
yd	yards	0.914	metres	m
mi	miles	1.61	kilometres	km

AREA

in ²	square inches	645.2	millimetres squared	mm ²
ft ²	square feet	0.093	metres squared	m ²
yd ²	square yards	0.836	metres squared	m ²
ac	acres	0.405	hectares	ha
mi ²	square miles	2.59	kilometres squared	km ²

VOLUME

fl oz	fluid ounces	29.57	millilitres	mL
gal	gallons	3.785	litres	L
ft ³	cubic feet	0.028	metres cubed	m ³
yd ³	cubic yards	0.765	metres cubed	m ³

NOTE: Volumes greater than 1000 L shall be shown in m³.

MASS

oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams	Mg

TEMPERATURE (exact)

°F	Fahrenheit temperature	$5(F-32)/9$	Celcius temperature	°C
----	------------------------	-------------	---------------------	----

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
--------	---------------	-------------	---------	--------

LENGTH

mm	millimetres	0.039	inches	in
m	metres	3.28	feet	ft
m	metres	1.09	yards	yd
km	kilometres	0.621	miles	mi

AREA

mm ²	millimetres squared	0.0016	square inches	in ²
m ²	metres squared	10.764	square feet	ft ²
ha	hectares	2.47	acres	ac
km ²	kilometres squared	0.386	square miles	mi ²

VOLUME

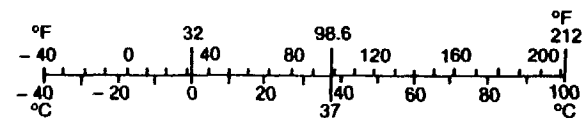
mL	millilitres	0.034	fluid ounces	fl oz
L	litres	0.264	gallons	gal
m ³	metres cubed	35.315	cubic feet	ft ³
m ³	metres cubed	1.308	cubic yards	yd ³

MASS

g	grams	0.035	ounces	oz
kg	kilograms	2.205	pounds	lb
Mg	megagrams	1.102	short tons (2000 lb)	T

TEMPERATURE (exact)

°C	Celcius temperature	$1.8C + 32$	Fahrenheit temperature	°F
----	---------------------	-------------	------------------------	----



* SI is the symbol for the International System of Measurement

(Revised April 1989)

SUMMARY

This report presents guidelines on the design of changeable message sign (CMS) messages for use in freeway corridors for incident management and route diversion. It is a companion to Report No. FHWA/TX-92/1232-9, which is a primer on the characteristics that affect the design, use and operation of CMSs, and which provides guidelines on the selection of the appropriate type of CMS displays. Both reports are updates and consolidations of the following reports:

1. C.L. Dudek and R.D. Huchingson. Manual on Real-Time Motorist Information Displays. Report FHWA-IP-86-16. August 1986.
2. C.L. Dudek. Guidelines on the Use of Changeable Message Signs. Report FHWA-TS-90-043. May 1991.
3. C.L. Dudek. Portable Changeable Message Signs at Work Zones. Report FHWA/TX-85/07 + 292-4. July 1984.

IMPLEMENTATION STATEMENT

The guidelines presented herein will be useful to TxDOT District personnel in designing and displaying the most appropriate and effective messages on changeable message signs.

DISCLAIMER

The contents of this report reflect the views of the author who is responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Federal Highway Administration or the State Department of Highways and Public Transportation. This report does not constitute a standard, specification, or regulation. This report is not intended for construction, bidding or permit purposes.

TABLE OF CONTENTS

		Page
1.	INTRODUCTION	1
	Objectives and Scope	1
2.	SIGNING ELEMENTS AND CHARACTERISTICS (2)	2
	Signing System Elements	2
	Message Content	3
	Message Load (Unit and Length)	5
	Message Format	5
	Message Redundancy..	9
	Guidelines for Message Length, Exposure Time and Display Format	11
3.	DESIGN OF ADVISORY SIGN PROBLEM AND EFFECT MESSAGE STATEMENTS (2)	12
	Incident Messages	12
	Location of Incidents	12
	Traffic State Messages During Non-Incident Conditions	13
	Lane Blockage (Closure)	14
	Location and Length of Congestion	15
	Delay and Time Saved Information	16
	Abbreviations	18
4.	DESIGN OF ADVISORY SIGN ATTENTION AND ACTION MESSAGE STATEMENTS (2)	22
	Attention Message Statement	22
	Action Message Statement	24
5.	LEVEL OF ADVISORY SIGN MESSAGES FOR INCIDENT MANAGEMENT	32
	Introduction	32
	General Messages	33
	Specific Diversion Message	36
	Arterial Bypass Messages - No Trailblazers on Arterial	39
6.	LEVELS OF ADVISORY SIGN MESSAGES FOR POINT DIVERSION TO MAJOR GENERATORS	41
	Introduction	41
	Relative Effectiveness of Messages	41
	Non-Incident Conditions	41
	Incident Conditions	43

7.	ADVANCE SIGNS	48
	Introduction	48
	Diversions to an Arterial Route - Several Possible	
	Alternate Routes	49
	Diversions to a Major Arterial - One Possible	
	Alternate Route	50
	Diversions of Thru Traffic to a Freeway Loop	50
8.	GUIDE SIGNS (TRAILBLAZERS) FOR ARTERIAL	
	ALTERNATE ROUTES	52
	Introduction	52
	Trailblazers for Diversions to a Major Generator	52
	Trailblazers for Diversions Around Incidents	57
	Situations Using Street Names	58
	Trailblazers for Intercity Diversions	58
	Forgiving Signing	59

LIST OF TABLES

	Page
Table 4-1 Connotations of Names for Diversion Routes	26

LIST OF FIGURES

	Page
Figure 2-1. Types of Discrete (Static) Formats	6
Figure 2-2. Illustration of Sequential and Run-On Display Format	7
Figure 8-1. Trailblazers Used in Dallas	54

1. INTRODUCTION

Objectives and Scope

This report presents guidelines on the design of changeable message sign (CMS) messages for use in freeway corridors for incident management and route diversion. It is a companion to Report No. FHWA/TX-92/1232-9 (1), which is a primer on the characteristics that affect the design, use and operation of CMSs, and which provides guidelines on the selection of the appropriate type of CMS displays. The reader is advised to read this latter report in order to acquire a better understanding of the rationale for the message designs recommended herein. In particular, the following chapters from Report No. FHWA/TX-92/1232-9 should be reviewed:

Chapter 3. Some General Considerations,
Chapter 4. Signing Elements and Characteristics,
Chapter 5. Guidelines for Message Length, Exposure Time and Display Format,
Chapter 6. Principles and Concepts of Visibility of Signs,
Chapter 7. Visibility and Legibility Criteria - Light-Emitting Signs, and
Chapter 8. Visibility and Legibility Criteria - Light-Reflecting Signs.

Both this report and Report No. FHWA/TX-92/1232-9 are updates and consolidations of the following reports:

1. C.L. Dudek and R.D. Huchingson. Manual on Real-Time Motorist Information Displays. Report FHWA-IP-86-16. August 1986.
2. C.L. Dudek. Guidelines on the Use of Changeable Message Signs. Report FHWA-TS-90-043. May 1991.
3. C.L. Dudek. Portable Changeable Message Signs at Work Zones. Report FHWA/TX-85/07 + 292-4. July 1984.

The reader may desire to reference these three reports for supplemental information relevant to the material contained herein. Also, the National Academy of Sciences has hired a consultant to prepare a Synthesis of Practice Report on Changeable Messages Signs. The Synthesis Report, scheduled for publication in late 1993, should provide useful insight as to the state-of-practice in the United States. A national survey will be conducted to solicit specific information relative to practices and standards, including messages, for both permanently mounted and transportable CMSs. A comprehensive survey of practices in Texas will be conducted as part of Study 1232.

2. SIGNING ELEMENTS AND CHARACTERISTICS (2)

This chapter describes the real-time signing system elements and their characteristics. Several message design issues are defined and explained. These include message content, load, unit, length, format, and redundancy.

Signing System Elements

Experience and research have shown that real-time signing systems, will consist of one or more of the following three elements:

- Advisory Signs
- Guide Signs
- Advance Signs

Advisory Signs

These signs display real-time information about the freeway status and advisories concerning the best course of action. Advisory signs can be located on the freeway, at the entrance ramps, or on arterial streets approaching the freeway.

Guide Signs

Occasionally, drivers are advised to take a specific alternate route to their destinations or to divert to another route to travel around an incident and associated congestion. If the affected drivers are not familiar with the route or area, guide signs along the alternate route are essential. Although the guide signs may in some cases be changeable displays, most often they are specially designated visual static trailblazer signs or standard route trailblazers.

Guide signs or trailblazers can be located along the alternate route for both incident management functions and freeway-to-arterial point diversion functions. In the special case of freeway-to-freeway point diversion, guidance along the alternate or bypass route can be provided by existing route markers or destination names trailblazed on existing freeway signs, or by innovative trailblazed symbols or codes.

Advance Signs

Sometimes it is necessary to inform the drivers that displays located farther downstream will provide them with up-to-date information concerning traffic conditions and advisories. These advance signs will always be visual displays.

Message Content

Message content refers to the specific words, numbers, symbols, and codes used on a display.

Advisory Sign Message Elements

Advisory sign messages consist of the following elements:

- A problem statement (accident, maintenance, construction, etc.)
- An effect statement (delay, heavy congestion, etc.)
- An attention statement (addressing a certain group or audience)
- An action statement (what to do)

The minimum information is the problem and action statements. The driver needs to know what to do and one reason for doing it. The location of the problem is also sometimes useful in a diversion decision. An example is as follows:

ACCIDENT AT MILFORD STREET	< Problem Statement
HEAVY CONGESTION	< Effect Statement
UTOPIA TRAFFIC	< Attention Statement
USE WILLIAMS STREET	< Action Statement

THE ESSENTIAL CHARACTERISTIC OF ADVISORY SIGN MESSAGES IS TO PROVIDE DRIVERS WITH ENOUGH INFORMATION TO MAKE DECISIONS.

The length of message and number of words displayed will be affected by the amount of available reading time and the information processing limits of drivers.

Guide Sign Message Elements

Guide signs provide the mechanism for drivers to follow a route other than the intended primary route to a specific destination, or to follow a diversion route to bypass an incident and associated congestion. As such, the signs must give drivers the assurance that they are traveling on the correct route and provide them with advance notice when turning movements are required. The essential message elements to accomplish this are:

- Destination affirmation
- Route affirmation and direction

Destination affirmation assures the drivers they will reach their destination. Route affirmation and direction information provide assurance that they are still on the correct route heading in the proper direction to their destination or to bypass the incident. Symbols, codes, and logos can be effectively used within the limits set forth in the Human Factors Manual on Real-Time Displays (2).

Advance Sign Message Elements

The message elements for an advance sign used in conjunction with an advisory visual display consist of the following four basic elements (not necessarily in the order shown):

- Information alert
- Nature of information (best route, traffic conditions, etc.)
- Destination for which information applies
- Location of the information (“ahead’ or specific distance)

For single point diversion signing situations where two known alternative major routes are available (such as a radial freeway and loop freeway for drivers traveling through the city), the following additional informational element is desirable:

- Route markers of the two major alternative routes

Message Load (Unit) and Length

The message load, as used herein, will refer to the informational “load” in the message expressed in terms of units of information. Message length refers to the number of words or characters in the message.

The informational unit refers to each separate data item given in a message which a motorist could recall and which could be a basis for making a decision. The following example of the message shown on page 3 serves to illustrate the concept of units of information:

<u>Question</u>	<u>Info. Unit Required</u>
1. What happened?	Accident
2. Where?	At Milford Street
3. What effect on traffic?	Heavy Congestion
4. Who is the advisory intended for?	Utopia Traffic
5. What is advised?	Use Williams Street

Hence, the above message contains five (5) units of information.

Typically, a unit of information is two words, but a unit could contain one to four words. A unit of information provides an answer to a question which a driver may pose. For example, **ACCIDENT** is one-word unit relative to a problem. **AT ROWLAND** is a two-word unit; **USE NEXT EXIT** is a three-word unit.

Message Format

Message **format** is the arrangement of the units of information on a sign to form the total message. Compatibility must be maintained between words within a line and between message units on a sign. Another usage of the term format is the manner in which word messages are arrayed on the CMS.

Discrete (Static) Formats

When the entire message is presented at one time, this is referred to as **discrete or static display**. Figure 2-1 presents four discrete formats: vertical, compact, chunk extended and message extended.

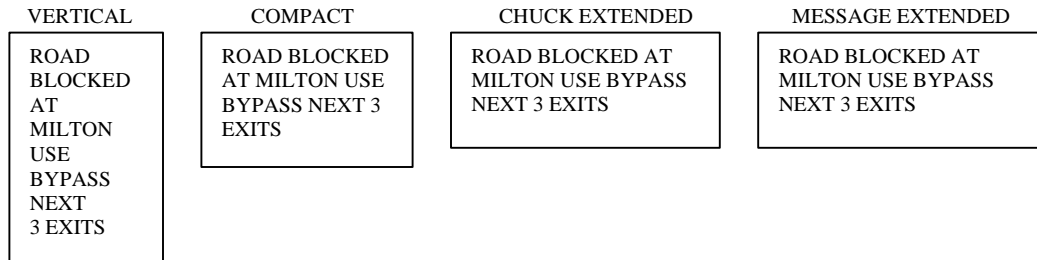


Figure 2-1. Types of Discrete (Static) Formats

THE COMPACT AND THE CHUCK EXTENDED ARE THE RECOMMENDED FORMATS FOR DISCRETE DISPLAYS.

For most freeway installations the compact and the chunk extended formats are the most effective discrete formats (3).

Modes of Movement

Certain types of matrix sign systems have automatic sequential or run-on capabilities. **Sequencing** refers to presenting in discrete manner two or more different message elements within the same signing space. **Running** messages do the same thing, but in a continuous manner so that the reading speed is paced by the speed of the running message.

Sequential formatting (sometimes referred to as message extended) is accomplished by dividing the message into parts. Each part is displayed or exposed in sequence for a set period of time. For example, the message **LEFT LANE CLOSED AHEAD, SPEED LIMIT 30 MPH** could be presented in a two-part sequence as **LEFT LANE CLOSED AHEAD** followed by the display of **SPEED LIMIT 30 MPH**. An illustration of a sequential message in compact format of this message is presented in Figure 2-2. The message format illustrated is an 8-word presentation using a sequence of two exposures to display the entire message. The message can be repeated several times by continuously cycling (in this case, alternating) through the parts of the message.

Run-on format sign displays present messages as a train of words moving continuously across a display from right to left. Run-on sign displays are also called moving message or continuous message displays. A common example of run-on messages is the special message bulletins frequently shown on television. An example of a run-on message is shown in Figure 2-2.

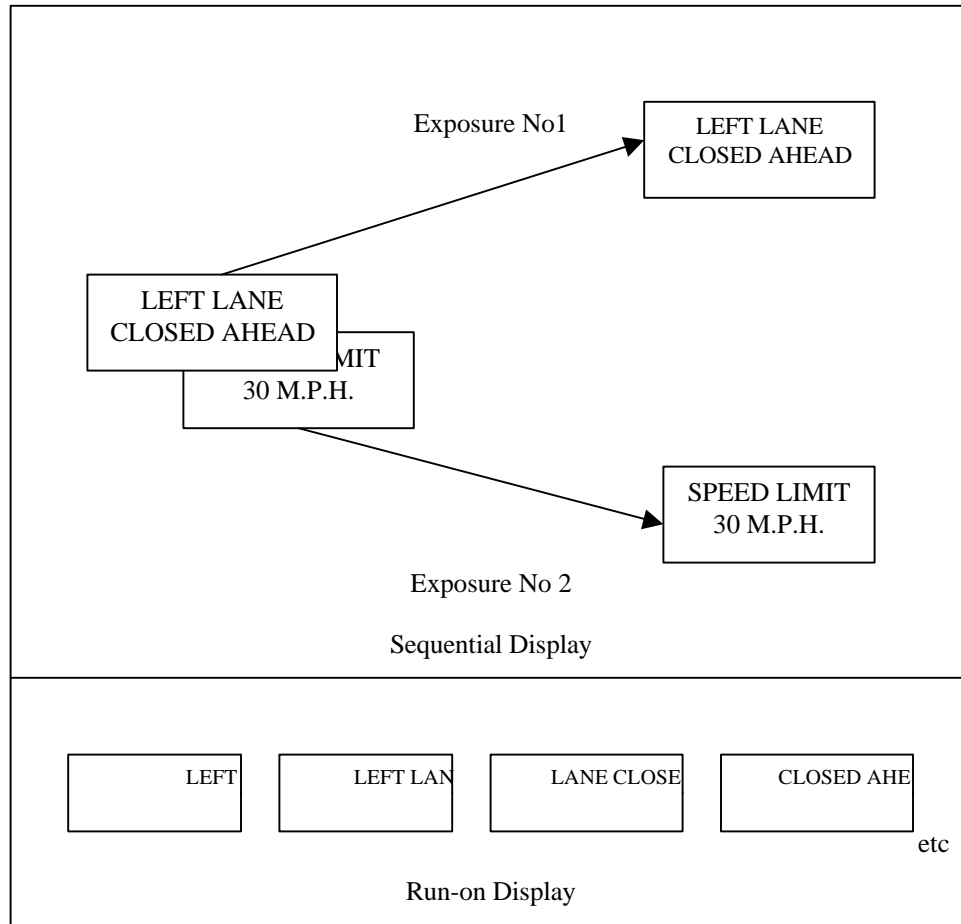


Figure 2-2. Illustration of Sequential and Run-On Display Format

RESEARCH HAS INDICATED THAT RUN-ON MESSAGES ARE NOT SUITABLE FOR DISPLAYING MESSAGES TO DRIVERS TRAVELING AT HIGH FREEWAY SPEEDS, AND ARE THEREFORE NOT RECOMMENDED FOR INCIDENT MANAGEMENT AND ROUTE DIVERSION SIGNING (4).

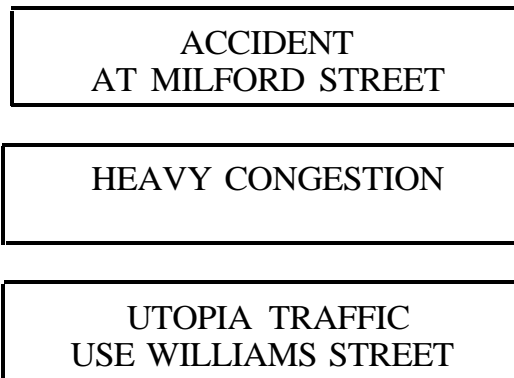
Typically, a sequencing or run-on message is repeated several times on a sign. The number of seconds allocated to display the complete message one time on a sign is called **message cycle**. A message cycle includes the blank time used to delineate the end of the message.

Splitting Messages(Chunking)

Quite frequently incident management or point diversion situations dictate the need for longer messages than can be processed by drivers viewing a CMS or placed on the CMS due to size limitations. Long messages displayed at one time on a CMS tend to overwhelm drivers to the extent that they are not able to read and process the information in the short time they are within the viewing distance of the message (3,4). This phenomenon has not been completely researched in the highway environment. However, there is evidence to indicate that drivers cannot efficiently scan long messages, and considerable time is lost in the scanning process. Laboratory studies, for example, have indicated that drivers can read and recall an 8-word message better when it is broken up into “chunks” of 2 to 4 words rather than if the 8 words were displayed all at one time (3,4). Message formats that display one word at a time should be avoided.

A message can be displayed by sequencing message chunks on a sign or, if necessary, displaying separate chunks of information on two signs.

Chunking must be accomplished by splitting the message into compatible units of information. For example, the advisory message shown on page 3 can be chunked into the following compatible phrases:



Note that HEAVY CONGESTION/UTOPIA TRAFFIC are not compatible phrases and therefore would not be chunked together. UTOPIA TRAFFIC/USE WILLIAMS STREET are compatible in the sense that the action statement refers to the destination group. Collectively, the message elements form a message that will stand alone like a sentence.

Sequential Message Formats

There are three ways in which a sequenced message can be displayed. It can be displayed at one word per sequence (word sequencing), two words per sequence (line sequencing), or four words per sequence (chunk sequencing) (3).

EITHER WORD, LINE OR CHUNK SEQUENCING CAN BE USED FOR MESSAGES UP TO 4 WORDS. FOR 8-WORD MESSAGES, BEST RESULTS ARE OBTAINED WITH EITHER CHUNK OR LINE SEQUENCING IN EITHER THE COMPACT OR CHUNK EXTENDED FORMATS.

Word sequencing of 8-word messages should be avoided. The message extended format should also be avoided.

Message Redundancy

Repetition

Redundancy is a concept which has been employed in several different ways. Sometimes it refers to repetition of the complete message or key words in the message. In this sense it provides assurance that all or nearly all drivers see the message at least once. If the information must be learned, such as a street name or trailblazer code, repetition gives drivers an additional learning trial. They will then be able to recognize these names or symbols when they appear later on other signs.

As discussed under “Message Format” on page 5, sometimes the length of the total message required for a visual display is too long to either be displayed on a single sign at one time or be read by drivers in the available reading time. It then becomes necessary to divide the message into parts and to use a sequential format, display separate parts of the message on two signs, or use a combination of the two. When sign space permits, it is recommended that key words be repeated which appear in the first part of a message sequence or on the first sign.

An example of a sequential format incorporating repetition of a key word is as follows:

ACCIDENT
AT KINGMAN

ACCIDENT
TAKE TEMP. BYPASS

The key word **ACCIDENT** is repeated in the second message, thus insuring that all drivers see the reason for taking the temporary bypass and, perhaps, stressing the urgency of doing so.

Redundancy in Coded Information

In addition to its usage as repetition, the word **redundancy** has been employed in the context of coded information. For example, the interstate shield is redundant in its shape, color, and route number. A driver viewing the route marker at a distance, or when it

appears with state route markers on a sign, may be able to distinguish the interstate marker either from the cue of its shape or from the red, white, and blue color pattern or from the number. These cues reduce the amount of visual search required and provide for quicker recognition.

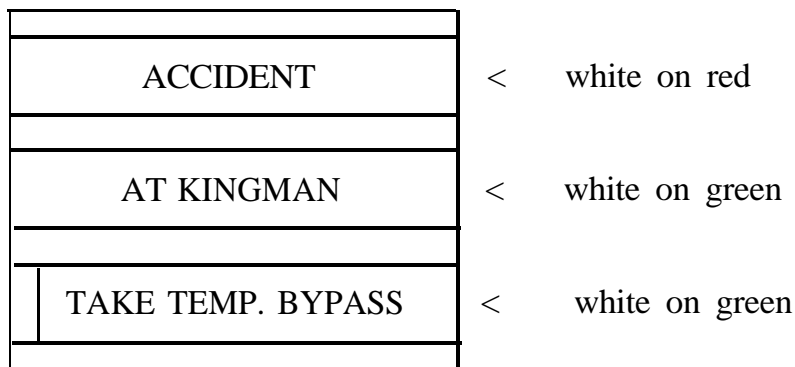
The following trailblazer shown below is another example of redundancy in the visual cues:



The trailblazer logo has redundancy in several respects: the distinctive shape and color of the “FP” logo; the background color of the sign; the shape of the sign; and in this instance, the word name explaining the code. Once the association between the logo and the generator name is made, the word name is unnecessary.

The distinctive coding of a critical message element has been used to enhance its probability of being read and also to stress its urgency.

An example on a rotating drum sign is as follows:



The red background of the word message ACCIDENT plus the fact that its background differs from that of the other two messages increased the probability that this message will be read first, and also may stress the urgency of the message. Thus, the red background is a redundant cue to the word message.

Redundancy in Word Messages

Redundancy has also a third meaning. It has been employed in a negative sense to imply unnecessary information or information which may be understood from the context and, hence, adds little new information for most drivers. For example, the fact that a familiar street name is an “avenue,” “boulevard,” or “lane,” may be well understood and redundant in this sense. The message **ACCIDENT AHEAD**, when it appears on a freeway sign, has a redundant word, since most certainly the accident is somewhere downstream of the drivers viewing the sign. Eliminating unnecessary words helps conserve space on limited capacity signs.

Guidelines for Message Length, Exposure Time and Display Format

Guidelines for message length, exposure time and display format are presented in the companion report, Report FHWA/TX-92/1232-9, “Guidelines on the Use and Operation of Changeable Message Signs” (1). The material is summarized below; however, the reader is encouraged to become familiar with the details presented in the companion report.

Reading time is the time it actually takes a driver to read a sign message. Exposure time or available viewing time is the length of time a driver is within the legibility distance of the message. That is, it is the maximum time available to the driver to read a message. Thus, exposure time must always be equal to or greater than the critical reading time for design purposes. Exposure time is directly related to message legibility distance and driving speed. A typical 18-inch CMS will provide approximately 8 seconds of exposure time when traffic is at normal off-peak freeway operating speeds (55 mph [88.6 km/hr]). As conditions change such that the driver has less time to read the CMS, then the message length must be reduced accordingly. Otherwise, the message displayed may be too long for the drivers to read at prevailing conditions. Specific guidelines presented in the companion report (1) are summarized as follows:

1. The message must be legible at a distance that allows sufficient exposure time for drivers to attend to the complex driving situation and glance at the CMS a sufficient number of times to read and comprehend the message.
2. A unit of information may be displayed on more than one line on the CMS. However, a sign line should not contain more than two units of information.
3. There is evidence that an 8-word message (about four to eight characters per word) excluding prepositions such as “to”, “for”, “at” etc., is approaching the processing limits of drivers traveling at high speeds.
4. Research has indicated that a minimum exposure time of one second per short word (excluding prepositions) or two seconds per unit of information, whichever is largest, should be used for unfamiliar drivers. On a CMS having 12 to 16 characters per line, this minimum exposure time will be two seconds per line.

3. DESIGN OF ADVISORY SIGN PROBLEM AND EFFECT MESSAGE STATEMENTS (2)

Incident Messages

Warnings of hazardous incidents should be displayed under all traffic conditions in peak or off-peak periods (5,6). Examples of incidents which should be displayed are:

Accident	Spilled Load
Minor or Major Accident	Roadwork
Ice (Icy Bridge)	Pavement Broken
Flooded	Snow or Fog

Do not display information on incidents off the roadway which can be readily seen and avoided by lane changing (3,4). Examples of minor off-roadway objects are grass cutters, stalled vehicles, trash, or small dead animals.

If an accident does block part of the roadway or slows down traffic, drivers want advance knowledge. The word **ACCIDENT** is preferred to more exact descriptions such as **VEHICLE OVERTURNED**. A large portion of traffic will voluntarily divert in response to the word **ACCIDENT**. General classification messages such as **ACCIDENT**, **ROADWORK**, or **SPILLED LOAD** are preferred and reduce the need for a library of messages for every conceivable incident. Also, credibility is weakened when overly precise messages are not later verified by the motorists.

Operations personnel disagree as to whether it is advantageous from a motorist diversion inducement standpoint to display descriptive incident messages. Some believe that the incident can be made too interesting, and many motorists might choose to see it rather than divert. Others believe that more precise incident descriptors such as **TRUCK ACCIDENT** or **CAR FIRE** would provide motorists with a better basis for judgement of estimated delays. Faced with this dilemma and the absence of a unanimous opinion, the Message Committee on the INFORM project in Long Island, recently took a conservative approach and decided to withhold specific incident descriptors (e.g., **TRUCK ACCIDENT**, **CAR FIRE**, etc.) from the signs (although it is shared with the media). (7)

Location of Incidents

When a majority of drivers would be unfamiliar with the names of local cross-streets, incident location should be described in distance to the nearest half-mile. Highway travelers are accustomed to seeing distances to cities. However, when a majority of drivers are commuters, incident location should be referenced to the nearest cross-street. When there are no cross-streets in the vicinity, a prominent landmark (factory, water tower, airport, etc.) may be substituted (8).

Examples of incident location messages are:

A rectangular traffic sign with a black background and white text. The text reads "ACCIDENT" on the top line and "2 MILES" on the bottom line.

Unfamiliar Driver

A rectangular traffic sign with a black background and white text. The text reads "ACCIDENT" on the top line and "AT VANCE AFB" on the bottom line.

Familiar Driver

The word **AHEAD** may be given after **MILES** although it is largely understood.

Traffic State Messages During Non-Incident Conditions

In describing downstream traffic states on a CMS (e.g., normal traffic, congestion, heavy congestion, etc.) during non-incident conditions, there is a large continuum of possible traffic conditions from nearly empty to totally jammed and stopped. While there are many points along the continuum, there is little value in signing for more traffic states than drivers can visualize. Laboratory studies (2) investigated the number of states and the words which most aptly described each state for driver understanding.

TRAFFIC STATE DESCRIPTOR MESSAGES SHOULD NOT ROUTINELY BE DISPLAYED IN THE COURSE OF TRAFFIC OPERATION DURING NON-INCIDENT CONDITIONS. THEY SHOULD BE RESERVED FOR WHEN FREEWAY CONGESTION IS NOT ANTICIPATED OR IS MORE SEVERE THAN EXPECTED.

Nevertheless, some agencies will elect to display traffic states. If this decision is made, the reader should refer to Chapter 4 of Reference 2.

It may be, in some cases, advisable to display messages during non-incident conditions. For example, personnel with the INFORM project in Long Island decided to display routine messages such as **NORMAL TRAFFIC** and **DELAYS**. This is an attempt to quiet motorists' displeasure with the system. The CMSs were installed about two years before the system became operational. Motorists traveling on the expressways viewed blank signs for about two years. The INFORM system became operational, project personnel found it desirable to display messages at all times in order to regain motorist confidence. Complaints that the signs "don't work" ceased after implementation of that strategy. The media and the public have struggled with the definition of **NORMAL TRAFFIC**, but have not complained about its use. (7)

Lane Blockage (Closure)

The overhead red “x” and green arrow, lane-use control signals have been used successfully and have been adopted by the MUTCD (9) to indicate lane blockage and availability on urban freeways (10-13). Since they are mounted above each lane, drivers readily associate them with the lane. Some agencies may desire to use side-of-the-road signs to inform drivers of blocked or closed lanes. When this is necessary, care in choice of words is essential to avoid ambiguity, as described below.

Two- and Three-lane Freeway Sections

When there are only two or three lanes, the word message may be either descriptive (**LEFT LANE BLOCKED** or **RIGHT LANE BLOCKED**) or it may be directive (**KEEP RIGHT** or **KEEP LEFT**).

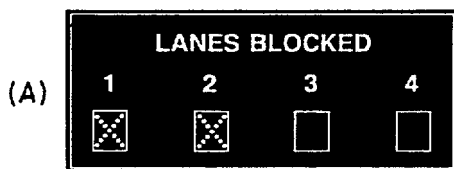
When the center lane is blocked or closed on a three-lane section, a directive message is not recommended. The preferable message is **CENTER LANE BLOCKED (CLOSED)**.

NEVER DISPLAY 'FREEWAY BLOCKED' WHEN AT LEAST ONE LANE IS OPEN TO TRAFFIC. DISPLAY IT ONLY WHEN ALL LANES ARE BLOCKED.

Drivers (5) felt that **LANE BLOCKED** indicated a temporary blockage due to an accident, stall, etc., whereas **LANE CLOSED** indicated a prolonged closure. Therefore, use **RIGHT (LEFT) LANE BLOCKED** when the obstruction is due to an incident.

Four or More Lanes

When the freeway section has four or more lanes in one direction, word descriptors like **LEFT**, **CENTER**, and **RIGHT** are ambiguous in designating specific lane blockages. Therefore, anchored displays shown below are recommended. Note that a design similar to Sign A below has been adopted by TxDOT for moving maintenance operations on multilane divided highways, and appears on Traffic Control Plan Sheet 3-2.



Both are acceptable methods for depicting that the first and second left-hand lanes are blocked.

Anchored signs with X's and "arrows" are correctly interpreted by drivers even when they are all white rather than coded red and green. Thus, they may also be used on matrix or rotating drum side-mounted signs. If the lanes are not numbered (Sign B), both Xs and arrows must be displayed to provide anchoring. If lanes are numbered (Sign A), only the blocked lanes need to be shown by Xs. For side-mounted CMSs, numbered lanes are recommended.

"LANE BLOCKED (CLOSED)" IS CLEARER THAN "LANE CONDITION" AS A TITLE.

Location Length of Congestion

As noted previously, familiar drivers are highly familiar with cross-street names or major intersecting freeways. Congestion locations should be referenced to these names, as follows:

CONGESTION
AT
ROWLAND AVE

TRAFFIC CLEARS
AT
OXFORD AVE

When a majority of drivers are unfamiliar with local cross-streets (for example, on a bypass, loop, beltway, or rural interstate), the locations should be given in odometer miles to the nearest half mile.

CONGESTION
BEGINS 1 MILE

TRAFFIC CLEARS
2 MILES

When drivers are approaching a queue, they wish to know when the queue will begin. When they are already engulfed in congestion, they desire to know when it will end. Therefore, use of the first or second message above depends upon where the drivers are located relative to congested traffic when they read the sign.

Operations personnel on the INFORM project in Long Island found it convenient to use exit numbers, rather than cross roads or distances in miles to indicate the limits of a congested section. According to INFORM personnel, most motorists have learned the exit number system. However, some motorists have suggested that actual roadway names used. (7).

NEVER DISPLAY THE OBVIOUS. TELLING DRIVERS THEY ARE IN CONGESTED TRAFFIC IS USELESS INFORMATION AND LESSENS CREDIBILITY OF THE SYSTEM.

Never display the word **CONGESTION** when drivers are engulfed in congestion. Drivers prefer **TRAFFIC CLEARS**. Also, measuring precise distances (to one-tenth of a mile) is difficult when queues change quickly and inaccuracies may weaken credibility. One-half mile is sufficiently precise for this application.

Queues will not likely begin exactly at a cross-street. Reference should be to the nearest cross-street. All that drivers want to know is that they may avoid being “caught up” in the queue if they exit at the first cross-street upstream of the referenced cross-street.

When there are no cross-streets in the vicinity of a queue onset or clearing, use a prominent landmark. (e.g., **TRAFFIC CLEARS AT JACKSON FIELD**).

Delay and Time Saved Information

In addition to congestion, another form of “effect” statement is to express the effect in terms of so-many minutes of delay. Typically, this statement will be followed by an action statement to use an alternative route. Thus, the statement should be to “avoid X minutes delay, use (facility).” An alternative approach is to express the advantage of taking the alternate route in terms of time saved in minutes.

Effect on Diversion

Surveys in three states revealed highly consistent results that the average (median) driver will divert to avoid a delay of about 20 minutes. It was also concluded that if a traffic engineer desired to induce various percentages of drivers to divert (5):

- Use no more than six levels of delay
- Do not display less than 5 minutes delay
- Do not display more than 1 hour delay

Field experience (14) found that **TIME SAVED** and **DELAY** were equally effective where both delay and time saved messages were presented with an advisory to a diversion route.

It is further cautioned that delays are easily checked by drivers and misrepresenting them to manipulate traffic demand is discouraged. The consequences could be loss of message credibility and confidence in the system.

Meaning: of Delay

Drivers interpret **DELAY** (shown in minutes) as being relative to their normal travel time to traverse the freeway and arrive at their destination. It will take that much longer than usual. **DELAY** does not necessarily mean they will be held up in traffic at one location for that long or that it will take that long to remove an accident.

Another study (2) found that the words **MAJOR ACCIDENT** and **MINOR ACCIDENT** were translatable into delay duration. To the average driver, **MAJOR ACCIDENT** implies at least 20-25 minutes delay, whereas **MINOR ACCIDENT** implies not more than 15 minutes delay.

Formats of Delay or Time Saved Messages

If the delay is expressed in the form of “X minutes delay,” it refers to travel time on the primary route and should appear immediately after the incident warning as illustrated:

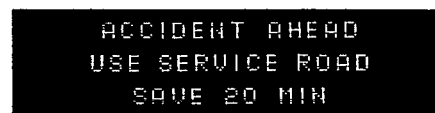


```
ACCIDENT AHEAD
20 MIN DELAY
USE SERVICE ROAD
```

If delay is expressed in terms of “Avoid X minutes delay” or “Save X minutes,” the reference is to an advantage of the temporary bypass and should appear after the advisory which mentions the bypass.



```
ACCIDENT AHEAD
USE SERVICE ROAD
AVOID 20 MIN DELAY
```



```
ACCIDENT AHEAD
USE SERVICE ROAD
SAVE 20 MIN
```

Note that the time saved message uses fewer characters, which is an advantage when line capacity is limited. Also, it offers a positive reason for taking the bypass.

Travel Time Messages

Some designers may also consider displaying comparative travel times along the primary and alternate routes. Problems with this approach are:

- Travel time information is easily disputed. If the sign says 10 minutes and they take 15 minutes, credibility is weakened. Delay is more difficult to refute.

- Travel times alone do not specify the best route to take. Also, when times are very similar on each route, the driver may question the usefulness.
- As noted, drivers must subtract to determine the time savings, which is really what they want to know anyway.

There is no need for a more complex system when delay and travel time information have proven effective.

Abbreviations

Highway agencies employing CMSs need an acceptable list of abbreviations for frequently used words in real-time traffic operations. The following are a set of abbreviations which at least 85% of the driving public would understand if they appeared on a road sign (3):

Word	Abbreviation	Word	Abbreviation
Boulevard	BLVD	Normal	NORM
Center	CNTR	Parking	PKING
Emergency	EMER	Road	RD
Entrance. Enter	ENT	Service	SERV
Expressway	EXPWY	Shoulder	SHLDR
Freeway	FRWY, FWY	Slippery	SLIP
Highway	HWY	Speed	SPD
Information	INFO	Traffic	TRAF
Left	LFT	Travelers	TRVLRS
Maintenance	MAINT (Use RDWK)	Warning	WARN

The above will likely be understood independent of the specific context of usage. Other words are easily understood (> 85%) whenever they appear in conjunction with a particular word commonly associated with it. These words and abbreviations are as follows:

Word	Abbreviation	Prompt Word	Word	Abbreviation	Prompt Word
Ahead	AHD	Fog •	Mile	MI	[Number] •
Blocked	BLKD	Lane •	Minute(s)	MIN	[Number] •
Access	ACCS	Road	Oversized	OVRSZ	Load
Bridge	BRDG	[Name] •	Prepare	PREP	To Stop
Chemical	CHEM	Spill	Pavement	PVMT	Wet •
Construction	CONST	Ahead	Quality	OLTY	Air •
Exit	EX, EXT	Next •	Route	RT	Best •
Express	EXP	Lane	Turnpike	TRNPK	[Name] •
Hazardous	HAZ	Driving	Vehicle	VEH	Stalled •
Interstate	I	[Number]	Cardinal Directions	N,E,S,W	[Street Name or Number]
Maior	MAJ	Accident			
Minor	MNR	Accident	Upper, Lower	UPR, LWR	Level

▪ = prompt word given first

The user should be cautious in employing these abbreviations with other prompt words since their high understanding has been established only with the words given in the table.

Certain abbreviations are prone to inviting confusion because another word is abbreviated or could be abbreviated in the same way. The following are the abbreviations, the word intended, and the word commonly given. **AVOID USING THESE ABBREVIATIONS** without prompt words and extensive public education.

Abbreviation	Intended Word	Word Erroneously Given
WRNG	Warning	Wrong
ACC	Accident	Access (Road)
DLY	Delay	Daily
LT	Light (Traffic)	Left
STAD	Stadium	Standard
L	Left	Lane (Merge)
PARK	Parking	Park
RED	Reduce	Red
POLL	Pollution (Index)	Poll
FDR	Feeder	Federal
LOC	Local	Location
TEMP	Temporary	Temperature
CLRS	Clears	Colors

There are many words for which traffic agencies sought an acceptable abbreviation. Many simply could not be abbreviated efficiently (i.e., by an abbreviation less than 67% of the word's length). Employing what may appear to be an obvious abbreviation runs the risk of misunderstanding since the drivers may not be thinking in the same vein as the highway agency.

The following abbreviations were understood with a prompt word by about 75% of the drivers. These abbreviations would require public education prior to usage.

Word	Abbreviation	Prompt Word	Word	Abbreviation	Prompt Word
Downtown	DWNTN	Traffic	Roadwork	RDWK	Ahead (Distance)
Northbound	N-BND	Traffic			
Congested	CONG	Traffic	Township	TWNSHP	Limits
Temporary	TEMP	Route	Frontage	FRNTG	Road
Condition	COND	Traffic •	Local	LOC	Traffic

- Prompt word given first

All other abbreviations should be tested prior to usage. When the length of an abbreviation exceeds 67% of the word's length the space savings by abbreviating may not be worth it.

4. DESIGN OF ADVISORY SIGN ATTENTION AND ACTION MESSAGE STATEMENTS (2)

Attention Message Statement

General

An attention statement is required only when the action statement applies to a portion of the drivers.

AN ATTENTION MESSAGE STATEMENT MUST ALWAYS BE ACCOMPANIED BY AN ACTION STATEMENT.

The attention message statement identifies the audience to whom the action message statement applies. In the absence of an attention statement, the action statement is understood to apply to all freeway drivers. When the action message is directed only to drivers traveling to a specific destination, however, that destination must be displayed on the advisory CMS.

Use of the Word "Traffic"

GENERALLY THE WORD "TRAFFIC" AFTER A DESTINATION NAME IS NOT NECESSARY.

When the location of the accident (or incident)--either in terms of the cross street, miles ahead, or simply AHEAD--is not displayed, it is frequently necessary to display TRAFFIC after the destination.

ACCIDENT AHEAD
KYLE STADIUM
USE
ROWLAND AVE

TRAFFIC not required

ACCIDENT
KYLE STADIUM TRAFFIC
USE
ROWLAND AVE

TRAFFIC required

City Destinations

NAMES USED FOR CITIES SHOULD BE IDENTICAL TO THOSE USED ON EXISTING STATIC SIGNING.

City destinations appearing on a CMS should be consistent with existing signing practices. Nicknames should be avoided. For example, **SAN ANTONIO** is recommended rather than the nickname **ALAMO CITY**.

Major Generator Destinations

NAMES USED FOR MAJOR GENERATORS MUST BE SPECIFIC AND ADDRESS THE EXACT PLACE WHERE AN ACTIVITY TAKES PLACE.

Many cities have large areas known locally by a single name, but which house smaller areas of wider general knowledge. An example is Fair Park in Dallas which contains the better known Cotton Bowl and Texas State Fairgrounds. Caution should be used by drivers. If the anticipated audience contains non-local, unfamiliar drivers, the more general, lesser known destination name (**Fair Park**) would be confusing if the activity was being held at a specific, more widely known destination (**Cotton Bowl or Fairgrounds**).

Special Activity Destinations

NAMES DESCRIBING CERTAIN SPECIAL ACTIVITIES SHOULD BE DISPLAYED RATHER THAN THE LOCATION WHERE THE ACTIVITY IS BEING HELD.

Frequently, special activities such as parades and fireworks displays on July 4th attract large audiences, part of which are non-local, unfamiliar drivers. For these events, it is preferred to display the event (such as **parade** or **fireworks**) rather than the location of the event (such as **downtown** or **Kyle Stadium**).

Action Message Statement

General

The action statement, which tells drivers what to do, must be remembered by drivers. Research found that only about two-thirds of drivers are able to recall completely four pieces of information (problem, effect, attention, and action). However, 80 to 90 percent recalled the action message (8). Obviously, the action message element is most important for diversion.

Drivers want certain reassurances before diverting to temporary bypass routes (15-18).

- They want to be assured that they won't become lost.
- They want to know that they will be returned to the freeway.
- They prefer to know in advance where they can return to the freeway.

The message devised should strive to provide as much of this information as is feasible within the constraints of the sign's presentation and the driver's viewing time.

Highway Names, Route Numbers, and Route Markers

USE OF A HIGHWAY ROUTE MARKER SUCH AS  IS PREFERRED TO A WRITTEN HIGHWAY NUMBER SUCH AS "I-10."*

Drivers have exhibited a strong preference for having the route marker displayed on the CMS in comparison to the written version (19). There is also evidence that the message is read more quickly and is generally easier to understand when the route marker is used. Unfortunately, several types of CMSs are incapable of displaying a route marker.

HIGHWAY ROUTE NUMBERS (PREFERABLY ROUTE MARKERS) SHOULD BE DISPLAYED WHEN REFERRING TO HIGHWAYS USED FOR INTERCITY TRIPS.

Intercity travel refers to those trips in which part of the primary highway is within a rural environment. A local name for a highway should not be displayed unless it is used in combination with the highway route number (19).

LOCAL HIGHWAYS NAMES CAN BE USED FOR INTRACITY TRIPS (TRIPS TO DESTINATIONS WITHIN A METROPOLITAN AREA) IF THE INTENT IS TO COMMUNICATE WITH LOCAL COMMUTERS PRIOR TO THEIR ENTERING THE FREEWAY.

Because existing static freeway guide signs display route markers and not local highway names, a CMS on the freeway should display the route number (preferably the route marker) to insure compatibility between the messages on the CMS and static freeway guide signs. Local names can be used in addition to the route number.

THERE ARE LOCAL WORD DESCRIPTOR PREFERENCES DRIVERS ASCRIBE TO THE FRONTAGE ROAD.

National studies revealed that the names used by drivers for frontage roads differ by locality. In some cities **Service Road** is more commonly used; other locations more commonly use **Frontage Road**, **Access Road**, or **Feeder Street**.

Diversion Route Name

In advising drivers to take an alternate route other than the frontage road for diversion around an incident, you may either tell them the sign names of roads to take, use trailblazers along the route, or assign a name to the route. Route names should aptly describe the type of facility and the likelihood of the driver being returned to the primary highway.

A survey was conducted in four U.S. cities (19) to determine whether certain names connote particular meanings. The results are shown in Table 4-1.

GIVING A DIVERSION ROUTE A NAME THAT IMPLIES CHARACTERISTICS WHICH THE FACILITY OR ROUTE DOES NOT POSSESS MAY WEAKEN CONFIDENCE IN THE SIGNING. IT IS BETTER TO USE EITHER AN APPROPRIATE NAME OR ONE WHICH CARRIES NO PARTICULAR CONNOTATIONS.

The results on the survey revealed that the name **TEMPORARY BYPASS** was the best overall name. The word **TEMPORARY** connotes a need to divert and **BYPASS** implies the driver will be returned. **TEMPORARY FREEWAY BYPASS**, although lengthy, implies a freeway and the other characteristics as well.

**Table 4-1
Connotations of Names for Diversion Routes**

Facilities Implied by Diversion Route Names	
<u>Name</u>	<u>Means</u>
FREEWAY BYPASS	FREEWAY
BYPASS	FREEWAY
BUSINESS ROUTE	MAJOR, DIVIDED ARTERIAL
TEMPORARY BYPASS	MAJOR, UNDIVIDED ARTERIAL (OR FACILITY OTHER THAN FREEWAY)
ALTERNATE, DETOUR, SIDE ROAD.	TWO-LANE FACILITY
Facilities Not Implied by Diversion Route Names	
<u>Name</u>	<u>Does Not Mean</u>
TEMPORARY BYPASS	FREEWAY
DETOUR, ALTERNATE, BUSINESS ROUTE	FREEWAY
FREEWAY BYPASS	MAJOR ARTERIAL
BYPASS	MAJOR ARTERIAL
FRONTAGE, ACCESS OR SIDE ROAD	MAJOR ARTERIAL
BUSINESS ROUTE, STREET BYPASS	TWO-LANE FACILITY
<u>High Connotation Motorist MUST DIVERT from Primary Route</u>	<u>Low Connotation Motorist MUST DIVERT</u>
DETOUR or DETOUR ROUTE TEMPORARY BYPASS	SIDE ROAD, ALTERNATE BUSINESS ROUTE
<u>High Connotation Motorist Will Eventually BE RETURNED to Primary</u>	<u>Low Connotation Motorist Will BE RETURNED</u>
TEMPORARY BYPASS DETOUR or DETOUR ROUTE BYPASS	SIDE ROAD ALTERNATE BUSINESS ROUTE
<u>High Connotation of Being BETTER OFF BY DIVERTING</u>	<u>Low Connotation of Being BETTER OFF Diverting</u>
DETOUR or DETOUR ROUTE TEMPORARY BYPASS	BUSINESS ROUTE SIDE ROAD
<u>High Connotation of Being Diverted a Mile or Less</u>	<u>High Connotation of Being Diverted a Mile to 10 Miles</u>
ACCESS ROAD STREET BYPASS	ALTERNATE/ALTERNATE ROUTE FREEWAY BYPASS

Note: Most names carry no connotation of distance

FREEWAY BYPASS may also be used. While a number of names are almost as effective, the value of standardizing or employing only a few names has been established. Drivers will soon learn to recognize and associate with standardized messages.

“USE.” “TAKE.” and “FOLLOW” - Verb Selection in Action Message Statements

In general, the three verbs use, take and follow are synonymous and no strong preference has been found. The verb use has been employed more often because it is slightly shorter. There are, however, fine shades of differences in meaning which make one verb preferable to another when used in a particular context,

The verb use should be selected whenever the advisory is to employ a route which will carry the motorist to his destination. The destination could be a major generator or a point of return to the freeway.

Examples: USE TEMPORARY BYPASS
 USE FITZHUGH [TO FIREWORKS]

The verb take should be selected whenever the advisory is a directive to begin taking the first street or “leg” of a route.

Examples: TAKE OXFORD AVE EAST
 TAKE NEXT EXIT

The verb follow, although somewhat synonymous, carries the additional connotation that the driver will be guided by references to signs or other cues. It should always be used whenever a trailblazer code is being explained. Follow should never be used when guidance is not available.

Examples: FOLLOW MARKED ROUTE
 FOLLOW [TRAILBLAZER SYMBOL]

The verb go is not used in visual signing for route guidance, but may be used in audio messages. It connotes initiation of action, but would be out of place in situations where use or take is appropriate.

Similarly, the verb turn is used frequently before left and right in audio messages, but in visual signing the directional arrow is briefer and well understood on road signs.

The word **exit** may also be used as a verb in advisory messages presented on a controlled access facility. When **exit** is employed as a verb, it should usually be followed by the name of the cross-street or highway associated with the exit ramp.

Example: EXIT AT OXFORD AVE

The only exception would be when several exits could be used successfully in diverting to a temporary bypass.

Example: EXIT AND USE GREENVILLE TO LOOP 12

Exit Designation

Whenever drivers are asked to “use” a certain type of facility to bypass an incident and ensuing congestion, it is desirable to tell them which exits to take. If the advisory sign is located a considerable distance upstream of the queue and it would not be advisable for the drivers to take the next few exits, then the message must be specific as to the exit ramps recommended.

Example:

USE SERVICE ROAD
EXIT AT MONROE
OR SHIRLEY

If the situation requires that the drivers exit at the next ramp(s), the following exit designation statements would apply:

USE SERVICE ROAD
NEXT EXIT

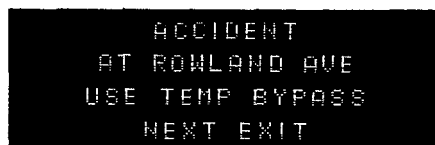
USE TEMPORARY
BYPASS NEXT 3 EXITS

Route Return Assurance Information for Incident Bypass

BEFORE DIVERTING, DRIVERS DESIRE TO KNOW THAT THE INCIDENT BYPASS ROUTE WILL EVENTUALLY RETURN TO THE PRIMARY ROUTE AND THE POINT (STREET, CITY) AT WHICH THEY WILL BE RETURNED.

Research has indicated that drivers want certain assurances prior to deciding to take a bypass route, given there is an option (25). Some signing situations may dictate the need for a second sign downstream of the primary CMS to provide this assurance.

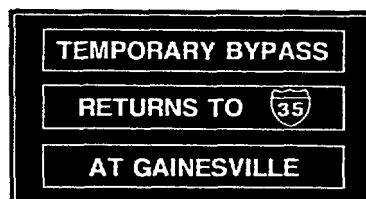
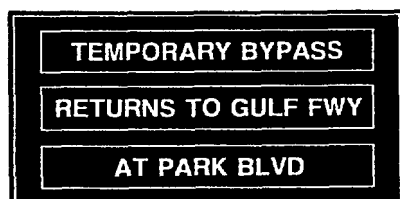
The following message is typical of those that might be displayed on the primary CMS:



Research has established that the ideal route return assurance message should contain the following information (19):

- The name of the alternate route (e.g., **Temporary Bypass**).
- The geographic point of return.
- The name of the primary route.

Examples of messages recommended for intracity and intercity situations are:



In situations where information requirements may dictate the need to reduce elements of certain message statements, the name of the primary route may be eliminated from the route return assurance messages. This is permitted because the primary route should be “understood” by drivers. The following are acceptable alternatives for the route assurance messages (19):



Intracitv Bypass Route Pattern

DRIVERS BEING DIVERTED FROM A FREEAY WILL EXPECT THE BYPASS ROUTE TO BE A LOGICAL "]" OR "[" PATTERN. A "]" PATTERN REFERS TO THE MORE COMMON DIVERSION ROUTE TO THE RIGHT, THEN PARALLEL TO THE FREEWAY, AND RETURNING BY TURNING LEFT. THE "[" PATTERN REFERS TO A DIVERSION TO THE LEFT, PARALLEL, AND RETURN ROUTE (22).

Local commuters may be able to recall and follow brief instructions presented on an advisory CMS describing a simple “]” or “[“ pattern bypass route. An example of such a message, assuming Greenville Avenue is the major parallel arterial, is as follows:

TAKE MOROE
TO GREENVILLE
TO ROWLAND

Commuters will know that the parallel arterial lies to the right or left and will not need a cardinal direction in the action message statement. An alternative message when more than one cross-street is satisfactory to take to Greenville would be:

USE GREENVILLE
TO ROWLAND

The appropriate cross-street to get to the parallel arterial (Greenville) is generally understood to be the next exit unless otherwise specified. In signing situations where another message line is available, the following format is recommended:

TO BYPASS ACCIDENT
TAKE MONROE
TO GREENVILLE
TO ROWLAND

or

TO BYPASS ACCIDENT
USE GREENVILLE
TO ROWLAND

The second message presumes the drivers know the following:

- They should exit as soon as possible and go right or left to Greenville.
- The idea of a “]” or “[“ is obvious.
- They may return to the freeway on Rowland Avenue, another well-know cross-street, or on any cross-street downstream of Rowland. They must not return on a cross-street upstream of Rowland.

Unfamiliar drivers may be aided by a sign, such as the one shown below, located at the first cross-street they encounter immediately after leaving the freeway which give the direction of turn to the parallel arterial.

TO
GREENVILLE >

Symbol and Logo Codes

Symbols and logos have a history of being effective means of trailblazing the alternate route to be followed.

SYMBOLS AND LOGOS, AS A RULE, SHOULD NOT BE DISPLAYED ON THE FREEWAY CMS.

Because of the large amount of information that is required to be displayed on the CMS for diversion situations, symbols and logos should not be displayed on a freeway CMS. The usual strategy is to limit the on-freeway message to that information necessary to help the drivers decide to get off and take the alternate route. The most effective way to incorporate symbols and logos into the diversion communication system is to direct drivers off the freeway with word messages, and to then transition into the symbol or logo trailblazer after the drivers leave the freeway and are in a somewhat unloaded driving situation.

Interstate Numbers and Designator Names for Loop Freeways

A loop freeway (beltway) in some cities offers a viable alternative route for thru drivers traveling on a radial freeway. Although many unfamiliar drivers use maps in preparing for long trips, a segment of the driving population relies solely on the highway signs for directions (18.19). The following considerations are important when designing CMS diversion systems for this latter segment of the driving population:

- 1. DRIVERS DO NOT UNDERSTAND THE SIGNIFICANCE OF THE THIRD DIGIT USED IN THE INTERSTATE NUMBERING SYSTEM.**
- 2. NO SINGLE DESCRIPTOR NAME COULD BE FOUND THAT DRIVERS THROUGHOUT THE NATION WOULD UNDERSTAND TO DESCRIBE A FREEWAY LOOP.**
- 3. CARDINAL DIRECTIONS ON LOOP FREEWAYS TEND TO CONFUSE DRIVERS.**

5. LEVELS OF ADVISORY SIGN MESSAGES FOR INCIDENT MANAGEMENT

Introduction

Two classes of advisory sign messages are presented (when applicable):

- General messages
- Specific diversionary messages

General messages are those which do not give specific diversion instructions. Some voluntary diversion would be expected by familiar drivers (20). This class of messages is necessary when:

- A “better” alternate route does not exist, or
- Surveillance data are not yet available to allow one to decide whether to divert traffic to another route.

It should be emphasized that most CMS operational systems in urban freeway corridors do not display messages that advise drivers to take a specific alternate route even during incident conditions. This is true because most systems do not have adequate surveillance of alternate routes. Therefore, at best, agencies currently tend to display incidents and the degree of congestion, and allow the drivers to decide whether to leave the freeway and seek an alternate route. Even on the INFORM project, specific diversion messages are seldom displayed, even though the alternate route is a highly-instrumented parallel expressway (7). The INFORM signing strategy is generally to provide as much information as possible on where delays exist so that each driver can make reasonably intelligent decisions on route choice given his or her current position and ultimate destination.

It is recognized that various types of sign hardware and sizes will be used to satisfy individual needs. However, in order to have a consistent form for illustrating the messages, the author has elected to use two combinations of message lines and alphanumeric character lengths. These are as follows:

- 4 lines per sign, 20 alphanumeric characters per line
- 2 lines per sign, 20 alphanumeric characters per line, sequencing capabilities

Most 4-line messages can be “chunked” into phrases that can be sequenced on 2- line signs having this capability.

The messages and considerations for diverting traffic along arterials around a freeway incident are essentially the same as for when a frontage road is used with two major exceptions:

- When drivers are diverted along an unknown route, the route should be given a name. The name found to be most commonly associated with this type of route is **TEMPORARY BYPASS**. The word **TEMPORARY** may be abbreviated **TEMP**.
- Since drivers are diverted away from the freeway and various diversion routes are possible (not all of these good), special consideration must be given to the use of trailblazers. The trailblazers can be dynamic (e.g., changeable arrows) in the sense that they can lead drivers back to the freeway at different ramps based on where the freeway incident might be located.

General Messages

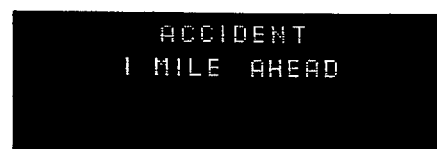
Incident Description

Other than the message warning drivers of slow traffic, the simplest message is to let the drivers know that an incident has occurred.



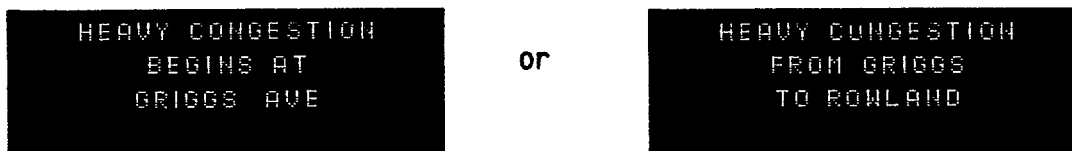
Incident Description and Location

A better message would include the location of the incident to aid the drivers in deciding where to leave the freeway if they decide to divert. Examples of messages for familiar and for unfamiliar drivers are as follows:



These messages are appropriate when the freeway is still the better route for the longer trips. The message is displayed to preserve system credibility and will result in significant voluntary diversion (20).

As a minimum, it is desirable to tell drivers the nature of the problem and the appropriate location of the incident. This requires specific visual surveillance capabilities. If television surveillance is available, the problem and location of the problem can be quickly identified. With other types of surveillance systems, there may be a considerable time interval after the incident occurs and before specific information about the incident is known. During this time lag it is desirable to display a message to preserve credibility--but the message displayed must be credible. One approach is to display traffic state information. It might also be desirable to present the location of the end of congestion so that drivers could estimate the length of the problem. (See page 15 for discussion of the use of exit numbers by INFORM project personnel.)

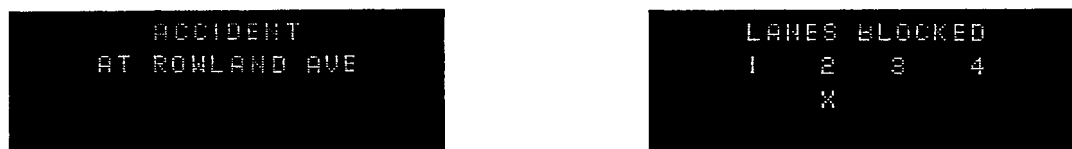


Incident Description, Location, and Lane Blockage

Although the previous incident message will elicit voluntary diversion, drivers remaining on the freeway indicate they desire information about which lanes are blocked (or open) (19). Thus, on 2- or 3-lane freeway sections, the following message format is recommended:



Freeway sections having four or more lanes require that either two signs or a single 3- or 4-line sign having message sequencing capabilities be used. **Note that the message cannot be sequenced on a 2-line sign.** An appropriate message combination is as follows:



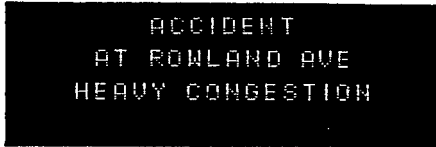
Sign 1 or first sequence

Sign 2 or second sequence

The reason is that it is difficult to describe in words when there are four or more lanes.

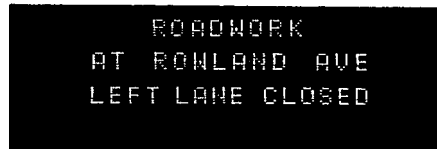
Incident Description, Location, and Traffic State

Another message that will encourage voluntary diversion by some familiar drivers is to include a traffic state descriptor. Examples are as follows:



Roadwork

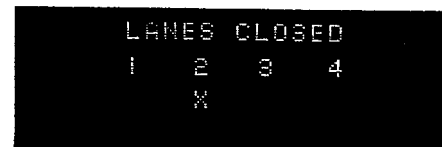
As a minimum, messages for maintenance operations should include the incident descriptor, the location of the closure, and the lane(s) affected. An example of the simplest message for 2- or 3-lane freeway sections is as follows:



For freeway sections with four or more lanes, the lane closure messages shown below are recommended:

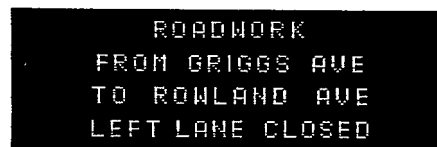


Sign 1 or first sequence



Sign 2 or second sequence

When the maintenance operation requires that the lane be closed for a considerable distance, the preferred method of signing is to tell the drivers the cross-streets between which the lane is closed. For example:



Specific Diversion Message

Incident and Diversion Route Description

The simplest message for communicating diversion instructions to drivers in incident management situations is one which briefly describes the problem and advises the drivers what action they should take initially to avoid the problem.

Example:

ACCIDENT AHEAD
USE SERVICE ROAD

DRIVERS NEED TO KNOW AS A MINIMUM WHAT THEY SHOULD DO AND ONE GOOD REASON FOR DOING IT.

The “action” is an essential message statement at all levels of diversion signing. It is the statement that drivers will most likely attempt to recall. In addition, field studies revealed that the messages with the action message statement **USE SERVICE ROAD** will result in greater diversion than those not displaying the action statement (20).

Basic Diversion Messages

Although the preceding “simplest” message can be used, the recommended simplest diversion message includes the following units of information: 1) incident description, 2) location of incident, and 3) action to be taken.

ACCIDENT
AT ROWLAND AVE
USE SERVICE ROAD

ACCIDENT
1 MILE AHEAD
USE SERVICE ROAD

Situation 1

These three units of information (incident description, incident location, and alternate route directive) form the base of recommended specific diversion messages. Other information units can be added to the base as needed.

Basic Diversion and Lane Blockage Messages

Lane blockage information can be added to the base diversion message without exceeding the maximum information unit criteria. The format for the message is as follows:



ACCIDENT
AT ROWLAND AVE CENTER
LANE BLOCKED

Sign 1



ACCIDENT
AT ROWLAND AVE USE
TEMP BYPASS
NEXT 2 EXITS

Sign 2

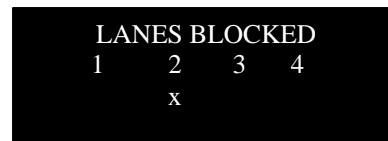
Situation 2

On freeway sections having four or more lanes, the following message formats are recommended and must be displayed on two signs or a sequencing sign having three or more lines.



ACCIDENT
AT ROWLAND AVE USE
SERVICE ROAD

Sign 1 or first sequence




LANES BLOCKED
1 2 3 4
x

Sign 2 or second sequence

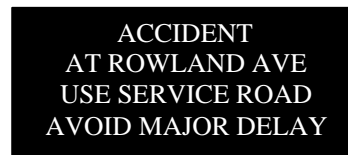
If the recommendation is to divert, this information takes priority over lane blockage or delay.

Basic Diversion and Traffic State Descriptor Messages

Traffic state descriptor messages can be incorporated into the display to convince drivers that using the frontage road will be better than remaining on the freeway. Many drivers have indicated a need to know about the conditions on the freeway (21-23). Two Alternative messages are:



ACCIDENT
AT ROWLAND AVE
MAJOR DELAY
USE SERVICE ROAD



ACCIDENT
AT ROWLAND AVE
USE SERVICE ROAD
AVOID MAJOR DELAY

Displaying traffic state descriptor messages for Situation 2 must be done at the expense of omitting information about the location of the incident when the entire message is displayed on one sign.

ACCIDENT
MAJOR DELAY
USE TEMP BYPASS
NEXT 2 EXITS

Traffic state descriptor messages may be displayed in terms such as minutes of delay. Field studies (20) indicate that these messages will not result in higher percentages of diversion than the qualitative descriptors shown previously. Examples of the quantitative traffic state descriptor messages for Situations 1 and 2 are follows:

ACCIDENT
AT ROWLAND AVE
USE SERVICE ROAD
AVOID 20 MIN DELAY

ACCIDENT
AT ROWLAND AVE USE
SERVICE ROAD
SAVE 20 MINUTES

Situation 1

ACCIDENT
USE TEMP BYPASS
NEXT 2 MILES
AVOID 20 MIN DELAY

ACCIDENT
USE TEMP BYPASS
NEXT 2 EXITS
SAVE 20 MINUTES

Situation 2

Basic Diversion and Diversion Route Return Messages

One major concern drivers have is whether the frontage road is continuous beyond the incident (23). Even commuters will not be familiar with frontage roads and will thus be concerned about getting trapped on a discontinuous road. Therefore, it is desirable to tell drivers the point of return to the freeway, and thereby imply a continuous frontage road at least to this point. An example is as follows:

ACCIDENT
AT ROWLAND AVE
USE SERVICE ROAD
TO CARTER CREEK

ACCIDENT
AT ROWLAND AVE
USE SERVICE ROAD
FOR BYPASS

Note that the point of return in the first message also indirectly communicates the length of the diversion route.

Diversion and Exit Designation Messages

Telling drivers to use the next exit or that they can use the next two or three exits prior to encountering congestion is desirable. Examples of this signing approach are given below:

ACCIDENT
AT ROWLAND AVE
USE SERVICE ROAD
NEXT EXIT

ACCIDENT
AT ROWLAND AVE
USE SERVICE ROAD
NEXT 2 EXITS

Message Combinations

Not all drivers require the same information to make diversion decisions. It is desirable, however, to satisfy the needs of as many drivers as possible to insure that sufficient number will divert to improve operations in the corridor. Obviously there are limitations on the amount of information displayed on a sign that drivers can read and recall. Note that the messages in the previous Sections, as a rule, approach the recommended 8-word, 4-information unit maximum. Thus, when combination messages are displayed, two CMSs will be necessary.

BECAUSE OF THE LIMITATIONS ON THE AMOUNT OF VISUAL INFORMATION DRIVERS CAN READ AND RECALL, IT IS PREFERRED TO EXCLUDE LAND BLOCKAGE INFORMATION AND INCLUDE DIVERSION INFORMATION WHEN COMBINATION MESSAGES ARE DISPLAYED.

Arterial Bypass Messages - No Trailblazers on Arterial

The previous sections dealt with freeway signing when the diversion route was an arterial bypass marked with trailblazers. There may be instances when it is necessary to divert traffic to arterial routes not previously marked with trailblazers. There is evidence from laboratory studies that unfamiliar motorists can follow simple arterial routes consisting of either “J” or “[“ patter (19).

The message for unfamiliar drivers from those in the preceding two described Sections in the following respects:

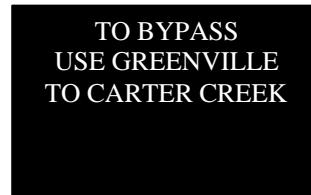
- The diversion route must be described in terms of the name of the parallel arterial which will be followed and the name of the return route. The name(s) of the street(s) leading to the parallel arterial are optional and may be omitted to meet signing space constraints.
- Since the critical information are the names of the streets, the message should not include traffic state descriptor messages which would compete with the critical information.

Basic Diversion Message

The simplest diversion message for this situation is one which consists of two signs. The message on the first sign will be identical to the basic diversion message for arterial diversion with trailblazers. The second sign will repeat the key word **BYPASS** and will include route guidance information.



Sign 1



Sign 2

Aid to the Unfamiliar Driver

There may be some unfamiliar drivers who do not know whether the parallel arterial (**GREENVILLE** in the above example) is to the right or to the left of the freeway. This information cannot easily be displayed on the CMS without risking overload (four or more units of information). One approach to aiding unfamiliar drivers would be to use a sign located at the first cross-street they encounter which points out the direction to the parallel arterial. An example of such a sign is as follows:



6. LEVELS OF ADVISORY SIGN MESSAGES FOR POINT DIVERSION TO MAJOR GENERATORS

Introduction

Major generators may be conveniently classified into those for:

- Special events (e.g., ballgames, parades, etc.), and
- Employment centers (e.g., downtown).

Special events attract many unfamiliar drivers, whereas commuters, who in many cases are familiar with the surrounding street system, are destined to the employment centers during the peak traffic periods. This distinction is important to recognize when designing messages for major generator traffic.

Relative Effectiveness of Messages

The relative effectiveness of the specific messages for special event traffic is, in part, dependent upon whether the activity at the major generator has a:

- Specific and set starting time, or
- Variable starting time.

Ballgames, parades, shows, etc., have specific scheduled starting times. The traffic demands are concentrated in a relatively short time period, and drivers are concerned with arriving on time. At the other extreme, events such as a state fair have no set starting times, so demands are distributed over a greater period of time (except for certain major special events at the fair), and as a rule, no set arrival time is required. One would expect greater driver response to messages displayed prior to events with set starting times (14).

Non-Incident Conditions

Simplest Diversion Message

For special events, the simplest approach to signing for diversion onto an indirect perpendicular arterial route is to use one CMS displaying the following elements:

- Best route (to)
- Audience or destination (location, special event, etc.)
- Action to be taken (use arterial given)

In this instance, the expression **BEST ROUTE** is intended to inform drivers that the traffic condition on the freeway route constitutes a “problem” (e.g., is degraded due to congestion); the simplest message attempts to imply this without actually stating it.

**BEST ROUTE TO
KYLE STADIUM
USE OXFORD AVE**

Diversion and Qualitative Traffic State Descriptor Messages

EXPERIENCE HAS SHOWN THAT FOR EVENTS AT MAJOR GENERATORS HAVING A VARIABLE STARTING TIME, DISPLAYING QUALITATIVE TRAFFIC STATE DESCRIPTOR MESSAGES (e.g., MAJOR DELAY, TRAFFIC JAM, ETC.) PRODUCES SLIGHTLY MORE DIVERSION THAN THE SIMPLEST DIVERSION MESSAGE SHOWN ABOVE (14).

Although the simplest diversion message shown above can be effective if properly used, some drivers will not divert. The primary reasons cited by non-diverting drivers in special research studies were:

- The drivers were not convinced the alternate was a better route. They believed that the alternate, because of the traffic signals and lower type facility, would not be as good as the primary freeway route. Many of these drivers wanted more specific information concerning the conditions on the primary freeway route.
- Several drivers were not certain that guidance was provided along the alternate, and they were afraid of getting lost.

Two alternative traffic state descriptor messages that address the first reason cited above and require minimum surveillance capabilities are:

**KYLE STADIUM
USE OXFORD AVE
AVOID
MAJOR DELAY**

**KYLE STADIUM
USE OXFOD AVE
AVOID
CONGESTION**

Diversion and Quantitative Traffic State Descriptor Messages

EXPERIENCE HAS SHOWN THAT FOR EVENTS AT MAJOR GENERATORS HAVING A VARIABLE STARTING TIME, DISPLAYING QUANTITATIVE TRAFFIC STATE DESCRIPTOR MESSAGES (TIME SAVED OR DELAY AVOIDED) PRODUCTS SLIGHTLY MORE DIVERSION THAN THE SIMPLEST DIVERSION MESSAGE SHOWN ON THE TOP OF PAGE 42. HOWEVER, THEY NO MORE EFFECTIVE THAN THE QUALITATIVE TRAFFIC STATE DESCRIPTOR MESSAGES SHOWN ON THE BOTTOM OF PAGE 42 (14).

Alternative approaches when adequate surveillance is available for predicting travel times along the primary and alternate route are:

KYLE STADIUM
USE OXFORD AVE
AVOID
15 MINUTES DELAY

KYLE STADIUM
USE OXFORD AVE
SAVE 15 MINUTES

Note: Time in 5- or 10-minute increments

Messages Concerning Guide Signs on Alternate Routes

Some non-diverting drivers in special field studies (14) stated they wanted assurance prior to leaving the freeway that guidance would be provided along the alternate route. The message shown below was therefore field tested but not produce any better results than the **BEST ROUTE** message shown on the top of page 42.

BEST ROUTE TO
KYLE STADIUM
USE OXFORD AVE
FOLLOW SIGNS

Incident Conditions

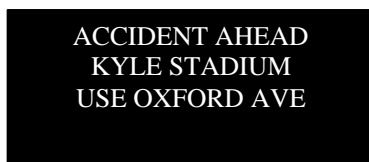
General

The messages suggested for non-incident conditions have been used successfully in diverting traffic for special events when heavy congestion due to demand-capacity imbalance adversely affected the primary freeway route. Drivers are aware that traffic accidents will

impair the operations even more, so it is advisable that “stand by” messages be available. No real-world data are available validating the success of accident messages specifically for special event traffic. However, it follows from research on the effects of incident messages (20) that accident messages will elicit a higher degree of diversion.

Simplest Diversion Message

The simplest diversion message includes an attention statement, an action statement, and one good reason for responding (problem statement). The simplest diversion messages for special events are as follows:



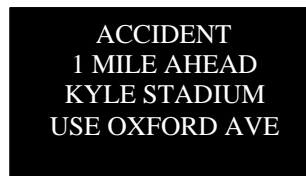
ACCIDENT AHEAD
KYLE STADIUM
USE OXFORD AVE



ACCIDENT
KYLE TRAFFIC
USE OXFORD AVE

Note: When AHEAD is omitted, the word TRAFFIC must follow KYLE (STADIUM).

Another variation to the previous messages is to include the location of the accident in terms of miles away from the sign. Four lines of message will be required to abide by the principle of having only one unit of information per line of message. An example is as follows:



ACCIDENT
1 MILE AHEAD
KYLE STADIUM
USE OXFORD AVE

For commuters:



ACCIDENT AHEAD
DOWNTOWN
USE CARSON AVE



ACCIDENT
DOWNTOWN TRAFFIC
USE CARSON AVE

The preferred method is to include the location of the incident. Familiar drivers are knowledgeable about major cross-streets and desire to know the location of the accident in these terms.

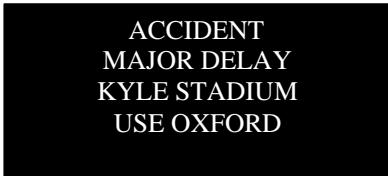


ACCIDENT
AT VILLA MARIA
DOWNTOWN
USE CARSON AVE


Note: In the above examples and in the examples that follow, the recommendation is that the destination name should appear before the action message statement so that drivers going to the destination will attend to the recommended action.

Diversion and Qualitative Traffic State Descriptor Messages

When the user desires to display qualitative traffic state descriptor information in addition to the basic diversion message for special event traffic, the following messages may be displayed on a 4-line sign:



ACCIDENT
MAJOR DELAY
KYLE STADIUM
USE OXFORD



ACCIDENT AHEAD
HEAVY CONGESTION
KYLE STADIUM
USE OXFORD AVE

Note: Four units of information displayed simultaneously may overload the drivers. Preferably, the message should appear on a 2-line, 2-sequence display or on two signs.

When the traffic condition descriptor—such as **MAJOR DELAY, TRAFFIC JAM, HEAVY CONGESTION**, etc—applies specifically to the primary facility, then this descriptor should immediately follow the problem message statement (as previously shown) since too applies to the primary facility.

Traffic state descriptors that imply a comparison between the primary and alternate route should follow the information about the alternate route. For example, the above general traffic state descriptors might be changed to read **AVOID MAJOR DELAY, AVOID TRAFFIC JAM, AVOID HEAVY CONGESTION**, etc. Thus, the message format would be as follows:

ACCIDENT
KYLE STADIUM
USE OXFORD
AVOID MAJOR DELAY

ACCIDENT AHEAD
KYLE STADIUM
USE OXFORD AVE
AVOID TRAFFIC JAM

When the user desires to display qualitative traffic state information for commuters on one sign, it must be done as the expense of omitting the location of the incident. Examples are as follows:

ACCIDENT
MAJOR DELAY
DOWNTOWN
USE CARSON

ACCIDENT AHEAD
HEAVY CONGESTION
DOWNTOWN
USE CARSON AVE

Note: Again, four units of information displayed simultaneously may overload the drivers. Preferably, the message should appear on a 2-line, 2-sequence display or on two signs.

One method is to include the accident location by using two signs. Examples of acceptable message formats are as follows:

ACCIDENT
AT VILLA MARIA

Sign 1

DOWNTOWN
USE CARSON AVE
AVOID MAJOR DELAY

Sign 2

ACCIDENT
AT VILLA MARIA

Sign 1

BEST ROUTE TO
DOWNTOWN
USE
CARSON AVE

Sign 2

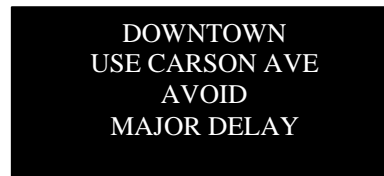
When the traffic condition descriptor--such as **MAJOR DELAY**, **TRAFFICJAM**, **HEAVY CONGESTION**, etc.—applies specifically to the primary facility, then this descriptor should immediately follow the **ACCIDENT** descriptor (as previously shown) since it too applies to the primary facility.

Traffic state descriptors that imply a comparison between the primary and alternate route should follow the information about the alternate route. For example, the above general traffic state descriptors might be changed to read **AVOID MAJOR DELAY**, **AVOID MAJOR TRAFFIC JAM**, **AVOID HEAVY CONGESTION**, etc. Thus, an example message format would be as follows:



ACCIDENT
AT VILLA MARIA

Sign 1

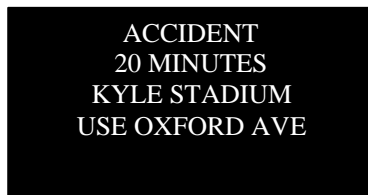


DOWNTOWN
USE CARSON AVE
AVOID
MAJOR DELAY

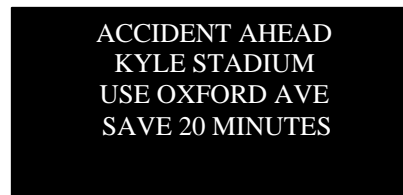
Sign 2

Diversion and Quantitative Traffic State Descriptor Messages

The descriptors **MAJOR DELAY**, **TRAFFIC JAM**, **HEAVY CONGESTION**, etc., may be replaced with more specific quantitative traffic state descriptors when surveillance and prediction capabilities are available. Examples are as follows:



ACCIDENT
20 MINUTES
KYLE STADIUM
USE OXFORD AVE

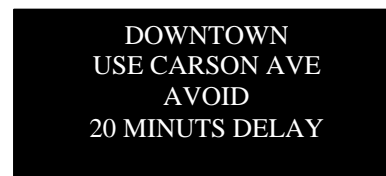


ACCIDENT AHEAD
KYLE STADIUM
USE OXFORD AVE
SAVE 20 MINUTES

And for commuters:



ACCIDENT
AT VILLA MARIA



DOWNTOWN
USE CARSON AVE
AVOID
20 MINUTS DELAY

7. ADVANCE SIGNS

Introduction

Some situations dictate the need to alert unfamiliar drivers about the existence of the advisory CMS so that they search for it, thus giving them more time to read the message. In such cases, an advance sign is advisable. Circumstances that might arise dictating the need for an advance sign include the following:

- The advisory CMS cannot be located such that optimum target value, legibility, and reading distances are possible because of geometric and/or physical design features of the freeway.
- Conditions upstream of the advisory CMS are such that drivers must devote considerable attention to traffic, thus increasing the probability that many will not notice the sign in ample time to read and comprehend the entire message.
- Some drivers may simply be inattentive and fail to see the advisory CMS in time, particularly if the sign has low target value.

The primary function of the advance sign is to prepare the driver to look for and read the upcoming CMS.

INFORMATION ON THE ADVANCE SIGN SHOULD NOT BE DISPLAYED EXCEPT WHEN THE ADVISORY CMS IS DISPLAYING A MESSAGE.

In the case of static signs with beacons, the beacons should only flash when the advisory CMS is in operation. Otherwise, the credibility of the system is compromised.

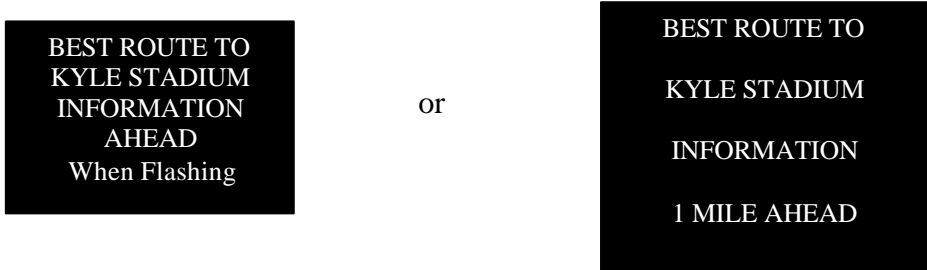
THE MESSAGE ON THE ADVANCE SIGN SHOULD PREPARE THE DRIVER FOR THE PARTICULAR KIND OF INFORMATION ON THE ADVISORY CMS.

If the advisory CMS presents a recommended “best route” to a specific destination, the advance sign should convey this information. When the advisory CMS presents traffic information and advisories to all the freeway drivers, an appropriate message should be displayed on the advance sign. If “best route” to a specific destination is amplified by traffic information, **BEST ROUTE TO (Destination)** should be presented on the advance sign.

WHENEVER AN ADVANCE SIGN DISPLAYS “BEST ROUTE,” THE ADVISORY CMS MUST CONTAIN AN ACTION MESSAGE STATEMENT TELLING DRIVERS WHICH ROUTE TO TAKE: EITHER REMAIN ON THE PRIMARY FREEWAY OR TAKE SOME ALTERNATE ROUTE.

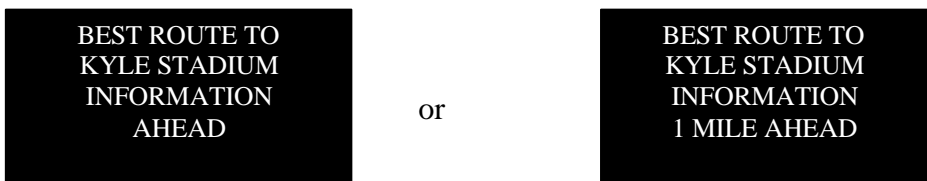
Diversion to an Arterial Route – Several Possible Alternate Routes

The advance sign can be a single message static sign with flashing beacons or other type of single message CMS. They may present the following type of messages (19):

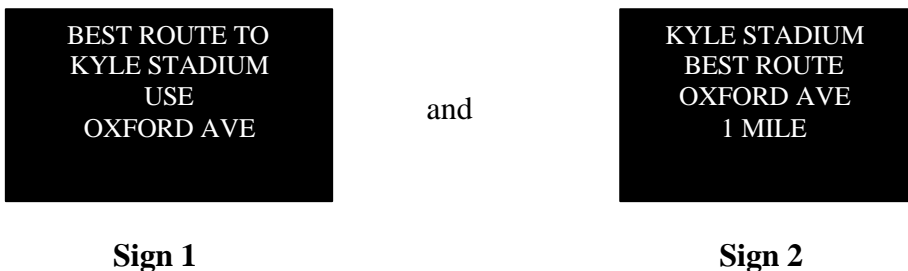


Incident management signing systems often require more than one CMS. When a second CMS is located upstream of the primary diversion CMS, it can be used to serve a similar function as the above single message advance sign.

The displayed message can simply be:



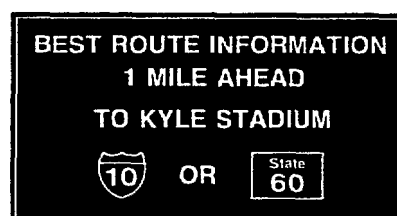
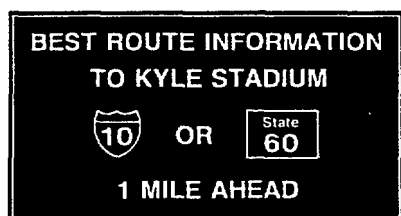
It should be noted that the advance sign can be used more effectively if selected message units are displayed on both the first and second sign. Repeating message units provides a degree of redundancy that increases the likelihood of all drivers heeding the message. An example of CMS messages for diversion to an arterial using two CMSs is as follows:



Diversion to a Major Arterial Route - One Possible Alternate Route

When drivers are advised on the CMS to take a cross-road which otherwise only a small percentage of drivers would take, then the recommended message designs for the advance sign are identical to those shown in the previous section.

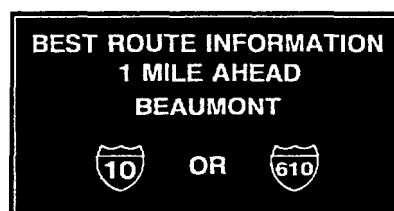
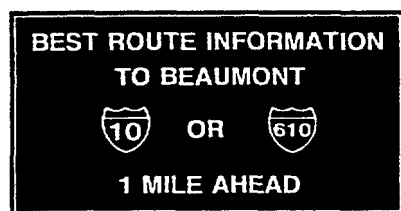
When the freeway and the cross-road are both plausible routes which a substantial number of drivers might take, the advance sign messages recommended in the previous section are acceptable. Special signing situations may dictate the need to include the route markers of the two plausible routes on the sign. The importance of including the route markers is that it gives drivers advance notice that they will be asked to take one of the two major highways to the destination. Laboratory studies indicate that the following formats for advance signs containing the route markers are acceptable (19).



Although conventional freeway guide signs display the distance on the bottom line, many drivers prefer to have the distances placed immediately following **BEST ROUTE INFORMATION** on advance signs (19).

Diversion of Thru Traffic to a Freeway Loop

As discussed in earlier Chapters, the advisory CMS should tell drivers which route to take. Thus, the advance sign should prepare them for the “best route” information. Laboratory studies indicate that the following messages and formats for the advance sign are acceptable (19):



Although conventional freeway guide signs display the distance on the bottom line, many drivers prefer to have the distance placed immediately followine **BEST ROUTE INFORMATION** on advance signs (19).

The following are some additional guidelines (19):

- The first message line should be the nature of the information--“Best Route” Information. This is more precise than “Traffic Information,” “Traffic Condition,” or “Traffic Advisory.”
- The second message line may be either the distance to the Advisory CMS, the destination (motorists who should observe the message), or the route markers of the alternate routes.
- The destination should be indicated by the first major city (preferably the control city) after the alternative routes reunite.
- If there is no major city immediately beyond the location where the routes reunite, then the cardinal direction may be used by itself in place of a destination city (e.g., FOR POINTS EAST).
- The cardinal direction may be included with the destination (e.g., BEAUMONT AND POINTS EAST).
- If the word INFORMATION is omitted from the sign, many drivers will feel that either route is acceptable and that the interchange is the distance shown on the advance sign (e.g., 1 MILE AHEAD).
- Use of the route markers is highly preferred over the written message “I-10” or “I-610.”

8. GUIDE SIGNS (TRAILBLAZERS) FOR ARTERIAL ALTERNATE ROUTES

Introduction

Trailblazers are used for three specific intracity incident management/route diversion cases:

- Diversion to major generators
- Diversion to a specific highway
- Diversion around incidents

In addition, trailblazers can be used for intercity diversion.

Trailblazer signing along an alternate route can take on several designs. The design objective for trailblazers is to insure high target value and ease of recognition. This is accomplished by employing colors, shapes, and sometimes logos and symbols. The message on trailblazer signs should be as simple as possible, providing two essential elements:

- Destination affirmation
- Route affirmation and direction

This chapter addresses static-type trailblazers, although it should be recognized that dynamic-type trailblazer CMSs are currently being considered by some cities. The dynamic trailblazers will have changeable arrows that will allow guidance along various alternative routes for different incident types and locations

Trailblazers for Diversion to a Major Generator

Designs

Because of the permanence of a route as a viable alternate, several effective message options are available. These include the use of:

- Destination name
- Logo
- Symbol
- Silhouettes

Examples are as follows:



Pictorial silhouettes are a useful technique for guiding unfamiliar drivers to special events. A baseball and bat, for example, is a self-explanatory symbol for a ball park.

Arrows

Trailblazers containing a destination name, logo, or symbol should be accompanied by an arrow. The arrow can be placed on a separate sign blank mounted below the trailblazer, or it may be incorporated on the same sign face. Examples are shown in Figure 8-1.

When an arrow assembly is used, the preference is to use the same color combinations as for the trailblazer (i.e., the arrow should be the same color as the trailblazer legend and the sign background colors should be the same).

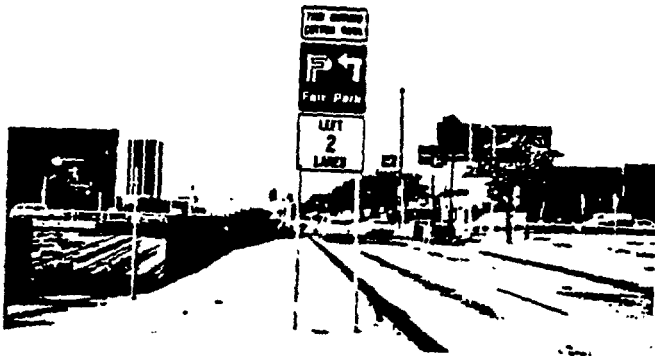
Ramp/Service Road Junction

Normally, as soon as drivers leave the freeway, they must maneuver through a major signalized intersection. Because of the relatively high exit speed and the loaded conditions of the drivers (due to high volume traffic and the short time available to make critical decisions as soon as they leave the freeway), good signing at the ramp/service road (or arterial street) junction is exceptionally important.

As soon as drivers leave the freeway they will be searching for information about the

- destination,
- turning movements, and
- lane assignments.

Since destination is of utmost importance, drivers will immediately be searching for information about the destination.



SIGN 1



SIGN 2



SIGN 3



SIGN 4



SIGN 1



SIGN 3



SIGN 4

Figure 8-1. Trailblazers Used in Dallas

THE FIRST TRAILBLAZER SIGN OR SIGN ASSEMBLY MUST CONTAIN THE DESTINATION NAME. THE DESTINATION NAME MUST BE IDENTICAL TO THAT USED ON THE FREEWAY CMS.

Trailblazers containing the destination name obviously satisfy the destination requirement. When logo or symbol trailblazer signs are used, an additional sign assembly containing the destination name must be placed above the trailblazer.

It is recommended that the upper destination panel be of a reverse color to the trailblazer. For example, if the trailblazer is white-on-brown, the destination assembly should be brown-on-white.

The sign should be located on the left side of the service road upstream of the intersection to allow adequate time for the drivers to read the sign and enter in the appropriate lane(s). Care must be exercised so that the sign is not placed too close to the ramp/service road intersection.

Because of the heavy driver work load, it may in some cases be necessary to enlarge the size of the sign, place an additional sign on the right, or both.

When a right turning movement is required, it is recommended that a minimum of two signs be used--one on the left and the other on the right side of the service road.

Sometimes it may be desirable to allow left (right) turns from two service road lanes. An additional sign panel will then be necessary for the service road sign assembly. One approach is to use the sign assembly shown in Figure 8-1, Sign 1.

Pull Thru Signs

DRIVERS MUST BE "PULLED THRU" THE BUSY SERVICE ROAD/ARTERIAL STREET INTERSECTIONS.

Because drivers are under considerable work load at the service road/arterial street intersection, they must be "pulled thru" the intersection with a trailblazer assembly that is easily recognized. It is recommended, therefore, that an additional sign with an arrow pointing in the direction of the turn movement should be placed at the intersection. (See Sign 2, Figure 8-1.)

If a left turn is necessary at the intersection, drivers will immediately be confronted with another busy intersection on the other side of the freeway. Again, a "pull thru" trailblazer is necessary. (See Sign 3, Figure 8-1.)

Trailblazer Code Explanation

Whenever a special type of trailblazer containing a logo or symbol code is used, the code must be explained to drivers. The code explanation should not be given when the driver is overloaded. After the drivers are pulled thru the busy intersections, they can be transitioned into following the trailblazer sign. At locations along the route where traffic conflicts are at a minimum, the transition can be made using the Sign 4 assembly shown in Figure 8-1. Two such signs should be used at successive locations.

The key factor to remember in transitioning from the freeway sign to any type of route guidance marking is that no doubt should be left in the driver's mind that the two signs go together. Whether the common elements are route names, destinations, or events, they should be easily detectable and recognizable.

Route Confirmation

Following this transition, the remaining signs would merely use the trailblazer with an arrow.

Advance turn signs are advisable upstream of intersections where turning movements are required.

Forks or Y-intersections along the alternate route are particularly confusing to unfamiliar drivers (14). At such locations, special attention should be given to sign placement and number. A slanted arrow (left or right) should be used.

Location of Trailblazer Signs

TRAILBLAZERS SHOULD BE LOCATED AT EVERY POINT WHERE DRIVERS MAY BECOME CONFUSED.

The important point to remember is that many drivers will be taking the alternate route for the first time. Also, drivers expect that turning movements, if required, will be made at a major cross-street or highway as a potential leg on the alternate route, and must decide on the appropriate course of action.

A general rule of thumb to follow is that a trailblazer is needed at intersections where drivers have to make decisions. Thus, trailblazers should be located at every major intersection where the alternate route traffic is controlled by a traffic signal or stop sign, in addition to locations where the road forks.

Where a wide major road (particularly a freeway) passes over or under the alternate route, trailblazers are recommended both in advance of and just beyond the interchange. The second trailblazer provides reassurance to drivers that they have not missed a turn and are headed in the proper direction.

It is recommended that at least one supplementary trailblazer be installed between major intersections whenever the major intersections are spaced 1 mile (1.6 km) or more apart (14).

Adequate visibility of the trailblazers is important. Trailblazers may be mounted either on the near or far side of the intersections depending upon where best visibility is achieved. Be consistent along the entire stretch of the alternate route. Experience has indicated that placement within 100 feet (30.4 m) of the intersection is satisfactory (14).

Supplementary Information

Distance to Generator--Questionnaire studies (14) conducted to evaluate a trailblazer system in Dallas on an alternate route over four miles (6.44 km) long indicated that some drivers became concerned and would have liked to know how much farther they had to travel to reach the major generator. Although not necessary for route following, consider the possible addition of a mileage sign panel mounted below one or more trailblazers located at intermediate points. When used, these mileage and trailblazer sign assemblies should be placed at locations away from major intersections.

Parking--One major concern of drivers will be the availability and location of parking facilities (14). Where public off-street parking is available, supplementary panels similar to sign D4-1 shown in the MUTCD should be mounted below the trailblazers near the parking facility. The arrows on the Parking Sign Panel must be in concert with those on the trailblazer.

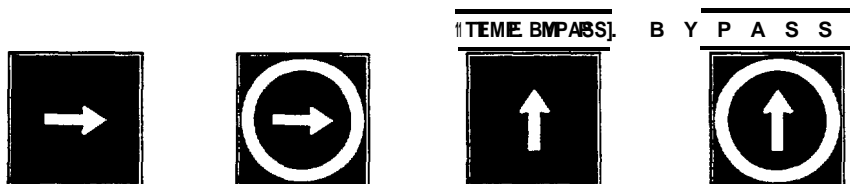
Generally, drivers begin to seek parking facilities, either on- or off- street, well before reaching the major generator. Therefore, it is advisable that Parking sign panels be used with the alternate route trailblazers well in advance of the major generator parking area to assist the drivers. The parking panels should be used with each subsequent trailblazer leading to the parking area.

Trailblazers for Diversion Around Incidents

Situations Using: Diversion Route Names

When the freeway CMS displays a name for the alternate route such as **TEMPORARY BYPASS**, then the alternate route must be trailblazed using a design that will be quickly read and understood by diverting drivers, yet will not confuse other drivers traveling on the arterial. These conditions must be met regardless of whether the trailblazers are permanently installed or are placed in position by an incident response team only during major incidents.

Simple designs for the basic trailblazer could be an arrow on a rectangular sign similar to those shown below:



One important feature is that drivers not destined for the freeway are not likely to become confused because the sign does not present any contradictory information. In fact, it presents no information at all to those drivers not in the diversion population. The sign will be meaningful to diverting drivers, however, once they are “transitioned” into it.

Situations Using Street Names

When the freeway driver is told before leaving the freeway the exact sequence of streets to use to bypass the incident--such as TAKE BERRY/TO RIVERSIDE/TO ROSEDALE or USE RIVERSIDE/TO ROSEDALE--then the designs shown above would not be applicable.

Normally, street names are given only when the audience is primarily familiar drivers who would know the approximate location of the streets used for diversion. Although trailblazers along the alternate route are not essential, it is recommended that a street (road) name sign pointing the direction to the parallel street be placed at the intersection of the ramp or frontage road and the cross-street that drivers should take to the parallel street. An example is illustrated below:



Trailblazers for Intercity Diversion

Designs

The trailblazer for intercity diversion should be different from that used for intracity diversion. The diversion route should be given a name depending upon the type of facility.

As indicated previously, the name given the diversion route on the freeway advisory CMS should be used consistently along the bypass route. Thus, if the CMS advises to USE I-95 TEMP. BYPASS, then the trailblazer signs should use the same language.

Example:

TEMP. BYPASS

Route Assurance

Drivers expect that the bypass route will rejoin the primary route eventually, and it may be desirable to use a route assurance sign at intervals along a lengthy bypass route. The point of return in this situation may be given in miles ahead.

The route assurance message: **TEMP. BYPASS RETURNS TO I-95 AT (Return City)** is a clearer explanation than would be signs indicating **TO 95 NORTH** or **TO (Destination City)** when in fact the bypass route involves traveling in a direction away from I-95 or perpendicular to I-95 (19).

Forgiving Signing

Wherever traffic is traveling on a temporary bypass and a left- or right- hand turn to another intersecting roadway is required to return drivers to the original route, some drivers may inadvertently fail to see or comprehend the return signs. To prevent them from traveling a considerable distance before discovering their error, a “forgiving sign system” may be employed. Missing a turn-off is especially troublesome when the route leads away from the bypass route so that the only solution is to turn around and drive back to the correct turn-off.

Erring drivers require three sets of information:

- An advisory that they have gone past the correct route for return to the interstate.
- An advance guide sign which informs them that there is a designated return route and that the next exit or turn will lead them to the route.
- A set of guide signs at intersections which trailblaze the route.

Designs for signs to supply the above information are provided in the next three subsections.

Forgiving Advisory Sign--Although seldom used in traditional signs, use of an active tense, rather than a passive tense, may attract the driver's attention better, especially in static signs. Research findings (19) support the following advisory message:



DO NOT: USE THE WORD TURN-AROUND INSTEAD OF RETURN" (19).

If the temporary bypass was marked by a trailblazer symbol which motorists had been keying on, the symbol would be used instead of the interstate shield and number.

Forgiving Advance Guide Signs--The second message should be as follows:



USE AN ARROW WHICH RESEMBLES A "U" TURN ARROW. (THE RETURN ROUTE MAY NOT INVOLVE GOING BACK ON THE OPPOSITE LANE OF THE PRESENT ROUTE AS WOULD BE IMPLIED. THE RETURN ROUTE COULD INVOLVE TAKING A FRONTAGE ROAD OR EVEN AN ARTERIAL AS THE SITUATION DICTATES.)

This message should convey three kinds of information:

- The driver is being led to a return route.
- The driver must reverse his direction to get back to the bypass route.
- The next exit (or turn) will get him started on the route, so he must transition into the appropriate lane.

Forgiving Guide Signs-The guide signs should be simple trailblazers at each intersection along the return route. They should carry the same message as the forgiving advance guide sign with an appropriate set of left, right, or forward directional arrows. An example is shown below:



9. REFERENCES

1. C.L. Dudek. Guidelines on the Use and Operations of Changeable Message Signs. Texas Transportation Institute. Report No. FHWA/TX-92/1232-9. June 1992
2. C.L. Dudek and R.D. Huchingson. Manual on Real-Time Motorist Information Displays. Report No. FHWA-IP-86-16. August 1986.
3. C.L. Dudek, R.D. Huchingson, R.D. Williams and R.J. Koppa. Human Factors Design of Dynamic Visual and Auditory Displays for Metropolitan Traffic Management, Vol. 2: Dynamic Visual Displays. Texas Transportation Institute. Report No. FHWA-RD-81/040. January 1981.
4. C.J. Messer, W.R. Stockton and J.M. Mounce. Human Factors Requirements for Real-Time Motorist Information Displays, Vol. 9: A Study of Physical Design Requirements for Motorist Information Matrix Signs. Texas Transportation Institute. Report No. FHWA-RD-78-13. February 1978.
5. C.L. Dudek, R.D. Huchingson, R.J. Koppa, and M.L. Edwards. Human Factors Requirements for Real-Time Motorist Information Displays, Vol. 10--Human Factors Evaluation of Traffic State Variables. Texas Transportation Institute. Report No. FHWA-RD-78-14. February 1978.
6. T.M. Mast and J.A. Ballas. Diversionary Content & Behavior. Transportation Research Board 600, 1976.
7. S.A. Smith. Inform Evaluation, Volume 1: Technical Report. JHK & Associates. Report No. FHWA-RD-91-075. January 1992.
8. R.D. Huchingson, R.J. Koppa and C.L. Dudek. Human Factors Requirements for Real-Time Motorist Information Displays, Vol. 13: Human Factors Evaluation of Audio and Mixed Modal Variables. Texas Transportation Institute. Report No. FHWA-RD-78-17. August 1978.
9. Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD). Federal Highway Administration, 1988.
10. T.W. Forbes, E.R. Gervais, and T. Allen. Effectiveness of Symbols for Lane Control Signals. Highway Research Board Bulletin 244. 1963.
11. C.L. Dudek. Effects of Incidents on Freeway Traffic. John C. Lodge Freeway Traffic Surveillance and control Project, 1962.
12. E.R. Gervais. Report on Project Activities. National Proving Ground for Freeway Surveillance, Control and Electronic Aids. August 1966.

13. J.A. Wattleworth, K.G. Courage, and J.D. Carvell. An Evaluation of Two Types of Freeway Control Systems. Texas Transportation Institute Research Report 388-6. April 1968.
14. G.D. Weaver, S.H. Richards, D.R. Hatcher and C.L. Dudek. Human Factors Requirements for Real-Time Motorist Information Displays, Vol. 14: Point Diversion for Special Events Field Studies. Texas Transportation Institute. Report No. FHWA-RD-78-18. August 1978.
15. R.W. McNeas and R.D. Huchingson. Human Factors Requirements for Real-Time Motorist Information Displays, Vol. 6: Questionnaire Survey of Motorist Route Selection Criteria. Texas Transportation Institute. Report No. FHWA-RD-78-10. February 1978.
16. C.L. Dudek, R.D. Huchingson, R.H. Ratcliff, and G.J. Mayer. Human Factors Requirements for Real-Time Information Displays, Vol. 7--Analysis of Driver Information Requirements for Intercity Trips. Texas Transportation Institute. Report No, FHWA-RD-78-11. February 1978.
17. J.D. Carvell and R.H. Whitson. Human Factors Requirements for Real-Time Motorist Information Displays, Vol. 8--Analysis of Driver Information Requirements for Intracity Trips. Texas Transportation Institute. Report FHWA-RD-78-12. February 1978.
18. G.F. King and H. Lunenfeld. Urban Guidance: Perceived Needs and Problems. Transportation Research Board 503, 1974.
19. R.D. Huchingson, C.L. Dudek, M.L. Edwards, and R.J. Koppa. Human Factors Requirements for Real-Time Motorist Information Displays, Vol. 11--Human Factors Evaluation of Route Diversion and Guidance Variables. Texas Transportation Institute. Report FHWA-RD-78-15. February 1978.
20. J.D. Carvell, J.M. Turner and C.L. Dudek. Human Factors Requirements for Real-Time Motorist Information Displays, Vol. 15: Freeway Incident Management Studies. Texas Transportation Institute. Report No. FHWA-RD-78-19. August 1978.
21. C.L. Dudek, C.J. Messer and H.B. Jones. A Study of Design Considerations for Real-Time Freeway Information Systems. Highway Research Record 363, 1971.
22. R.L. Pretty and D.E. Cleveland. Evaluation of Dynamic Freeway Ramp Entry Guidance System. University of Michigan. HRSI Report TrS-3, 1970.
23. M.A. Bogdanoff and R.P. Thompson. Evaluation of Warning and Information Systems, Part I, Changeable Message Signs. Freeway Operations Branch Report No. 75-5. Los Angeles Area Freeway Surveillance and Control Project, California Department of Transportation. July 1976.