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16. Abstract

This report describes the tasks conducted during the second year of a three-year study evaluating the use of guide signs on conventional highways in rural areas. Some of the major tasks conducted during the second year of the study include: a survey of signing practices in other states, a survey of driver information needs, a laboratory evaluation of alternative designs for the F.M. route marker, a laboratory evaluation of alternative designs for combination signing, and a field study of driver responses to guide signing. The second-year findings were used to develop a series of preliminary recommendations that primarily address the design and placement of conventional guide signs. In general, the recommendations indicate the need for larger state route markers and taller numbers in the route markers, adoption of a new design for the F.M./R.M. route marker, moving guide signing further from the intersection, and reducing the number of unique highway classifications in Texas.

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EVALUATION OF RURAL GUIDE SIGNING:

SECOND YEAR ACTIVITIES AND

PRELIMINARY RECOMMENDATIONS

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IMPLEMENTATION STATEMENT

This report describes the activities conducted during the second year of a three-year study evaluating guide signing on rural, or conventional, highways. This report also contains some preliminary recommendations which have been developed from the study activities to date. This study of guide signing does not include guide signing on access-controlled highways. The research results will be used to evaluate the effectiveness of current guide signing practices and to identify areas where the effectiveness could be improved. In the third year of the study, the results will be used to develop and evaluate the final recommendations for guide signing strategies on conventional highways. Implementation of the recommendations may be instituted through the revision of the *Texas Manual on Uniform Traffic Control Devices*, TxDOT Typical Sheets, or TxDOT practices.

DISCLAIMER

The contents of this report reflect the views of the authors who are responsible for the opinions, findings, and conclusions presented herein. The contents do not necessarily reflect the official views or policies of the Federal Highway Administration or the Texas Department of Transportation. This report does not constitute a standard, specification, or regulation, nor is it intended for construction, bidding, or permit purposes. The engineer in charge of the project was H. Gene Hawkins, Jr., P.E. #61509.

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At the initiation of this study, TxDOT formed a Technical Panel (TP) for consultation, review, and approval of the research activities encompassed by this study. The members of the TP were able to provide the researchers with valuable insights related to many different aspects of traffic control devices. The research team met with the TP several times throughout the study, and the assistance and comments received from the TP were instrumental in conducting the study activities. The researchers would like to acknowledge the following members of the TP for their time, efforts, and contributions:

Technical Panel Chairman

- Mr. Lewis Rhodes, Traffic Operations Division, Texas Department of Transportation.

Technical Panel

- Mr. Rick Collins, Traffic Operations Division, Texas Department of Transportation.
- Mr. Paul Frerich, Yoakum District, Texas Department of Transportation.
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- Mr. Richard Rogers, Transportation Planning and Programming Division, Texas Department of Transportation.
- Mr. Bill Tucker, San Antonio District, Texas Department of Transportation.
- Ms. Mary Ulrich, Travel and Information Division, Texas Department of Transportation.

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- Mr. Bob Musselman, Division Office, Federal Highway Administration.
- Mr. Mark Olson, Division Office, Federal Highway Administration.

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SUMMARY

This report describes the second-year activities of a three-year study evaluating guide signing for rural (or conventional) highways. There were six major activities in the second year: 1) a survey of signing practices in other states, 2) surveys of drivers to assess information needs, 3) the development and evaluation of alternative route markers for Farm-to-Market (F.M.) highways, 4) the development and evaluation of combination signs which combine route and destination information into a single sign, 5) in-vehicle field evaluations of driver use of conventional guide signing, and 6) the development of preliminary recommendations for the use of conventional guide signing. Table S-1 summarizes the key points of the second-year activities.

Table S-1. Summary of Second-Year Activities

Activity	Description	Chapter
Survey of Signing Practices in Other States	The state traffic engineer in each state was surveyed to determine the form of MUTCD used, the design of the state route marker(s), and the number of highway classifications in the state system.	II
Driver Survey	A follow-up to the first year driver survey was conducted to determine the potential effectiveness of changes in conventional guide signing practices.	III
Evaluation of Alternative F.M. Route Markers	Six alternative F.M. route markers were developed and evaluated in a laboratory setting. The current F.M. route marker was also evaluated. The laboratory evaluation used four different tests to assess the route markers.	IV
Evaluation of Combination Signing	Combination signing, which combines route and destination information into a single sign, was developed and evaluated in a laboratory setting.	V
Field Evaluations of Driver Use of Guide Signs	In-vehicle interviews were conducted as drivers navigated through a 50+ mile course of rural highways. The field study was intended to assess driver recognition, comprehension, and use of various conventional guide signs.	VI
Development of Preliminary Recommendations	The results of all first- and second-year research activities were used to develop a series of preliminary recommendations.	VII

The results of the second-year activities have been combined with those of the first year to develop a series of preliminary recommendations to improve the effectiveness of conventional guide signing. Some of the most significant of the preliminary recommendations include:

- **Preliminary Recommendations for Sign Design and Layout** - preliminary recommended changes to the standard design, layout, or appearance of specific signs and a determination of information to include in a sign.
  - Adopt the 762×610 mm (30×24 in) route markers for use when there are three or four digits in the highway number.
  - Reduce the width of the border on state route markers to be consistent with the border design of standard regulatory signs.
  - Increase the height of the highway number in state route markers.
  - Adopt a new design for the F.M. and similar route markers.
  - Develop a system of control cities for destination signs on conventional highways.
  - Use supplemental plaques below Junction signs in some applications.
- **Preliminary Recommendations for Sign Placement** - preliminary recommendations regarding the location where guide signs should be placed.
  - Locate all guide signs further from the intersection.
  - Use a redundant Junction marker in some applications.
  - Adopt the sign spreading concept for conventional highway intersections.
  - Develop a minimum separation distance for signs on conventional highways.
- **Preliminary Recommendations for Highway Classification** - preliminary recommendations related to the various highway classifications in the state system and the manner in which they should be signed.
  - Reduce the ACTUAL number of unique highway classifications to three (Interstate Highways, U.S. Highways, and Texas Highways).
  - As an alternative, reduce the APPARENT number of unique highway classifications to three (Interstate Highways, U.S. Highways, and Texas Highways) by using an essentially similar route marker for all highways on the state system.

CHAPTER I
INTRODUCTION

In 1927, the American Association of State Highway Officials (AASHO) published a manual for signing the newly designated system of U.S. Highways (1). This manual presented guidelines for the use of highway guide signs. It also illustrated and described the use of newly created signs used to provide drivers with directional information. Some of the new signs in the manual included the U.S. Highway route marker, junction signing, arrow markers, destination signing, and distance signing. One of the signing illustrations from this manual is reproduced in Figure I-1. This figure also indicates the placement of the guide signs. It is interesting to compare this figure to one in the 1988 national *Manual on Uniform Traffic Control Devices* (2) for a similar situation. Figure I-2 illustrates the figure from the current manual. Table I-1 compares the guide sign placement distances for the two manuals. As this table shows, the placement of guide signs on conventional highways has not changed much over the last 67 years. This can be contributed in part to a lack of research devoted specifically to guide signing for conventional highways.

Table I-1. Comparison of Guide Sign Placement Distances

Sign	Distance from Intersection	
	1927 AASHO[1]	1988 MUTCD[2]
Junction Marker	105 m (350 ft)	Not less than 120 m (400 ft)
Advance Turn Assembly	90 m (300 ft)	Not less than 60 m (200 ft)
Destination	Not Shown	Not less than 60 m (200 ft)
Reassurance	15-38 m (50-125 ft)	8-60 m (25-200 ft)
Distance	Not Shown	90 m (300 ft)

Notes: [1]From center of intersection.
[2]From near or far side curb line.

This three-year research study, sponsored by the Texas Department of Transportation (TxDOT) and conducted by the Texas Transportation Institute (TTI), was initiated in order to assess the guidance information needs of drivers on rural conventional highways and develop guidelines for improving conventional guide signing. Conventional highways are highways where access is not controlled or limited. Rural highways are located in areas outside of cities/towns or in towns with a population less than 5,000. The terms "rural highway" and "conventional highway" are used interchangeably in this report.

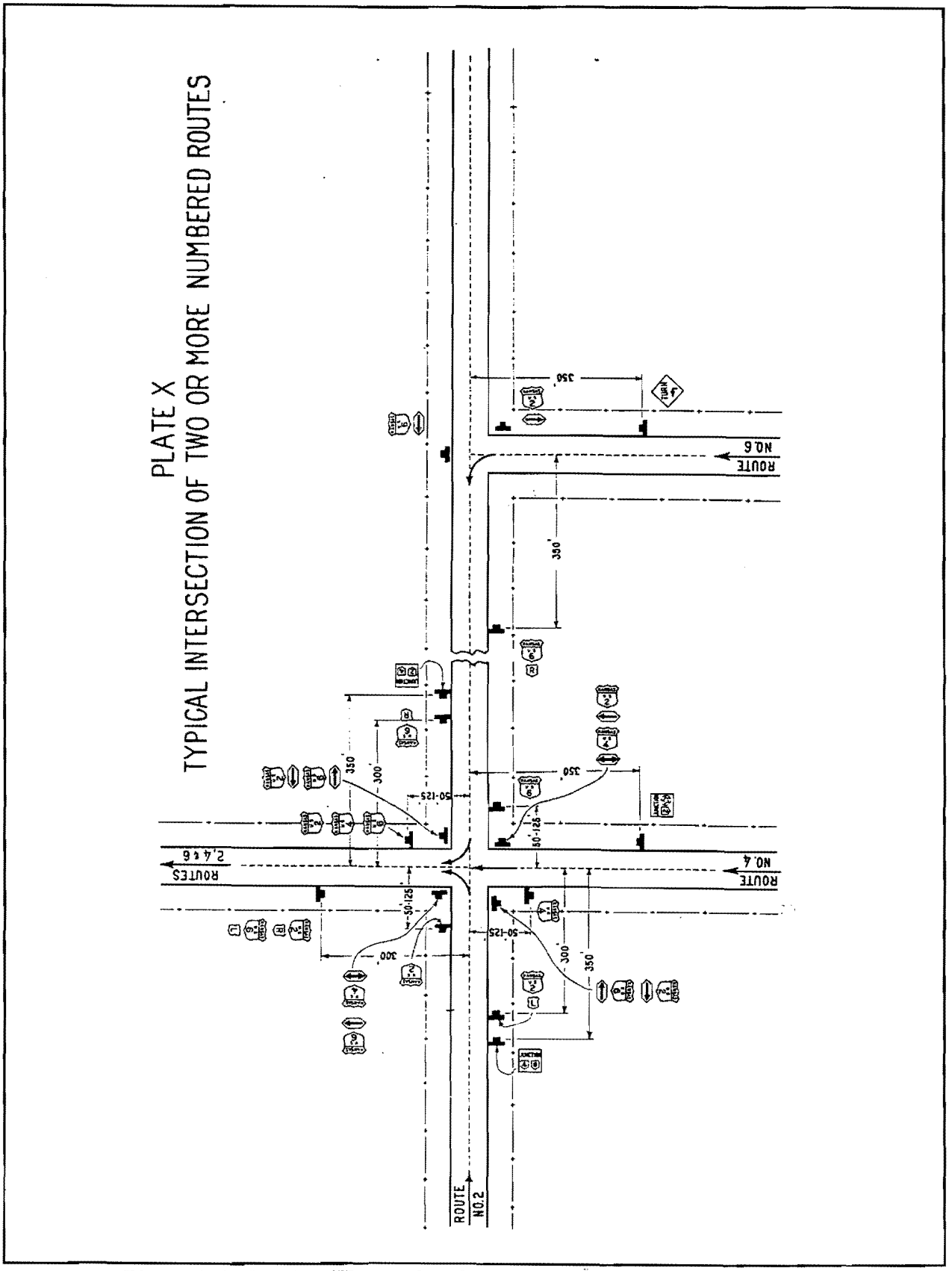


Figure I-1. Signing Illustration from the 1927 AASHO Manual (1)

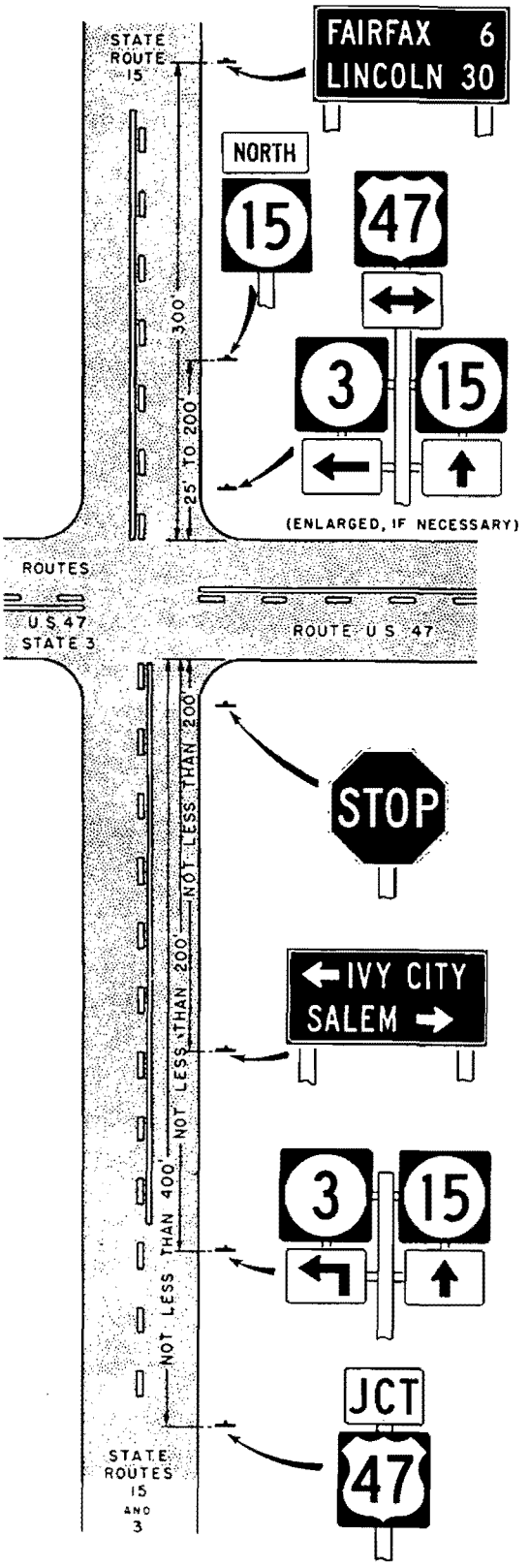


Figure I-2. Signing Illustration from the 1988 MUTCD (2)

STUDY OBJECTIVES

The purpose of this study is to develop improved guidelines for the use of guide signs on conventional highways in rural areas. The following objectives have been established for this research:

- Identify current state practices for rural guide signing;
- Identify rural guide sign practices which confuse drivers;
- Coordinate research activities with TxDOT Highway Signing Task Force;
- Evaluate rural highway classification schemes;
- Evaluate guide sign legibility;
- Develop alternative rural guide signing practices;
- Evaluate alternative practices in field and laboratory tests;
- Develop recommended practices for rural guide signing in Texas; and
- Develop recommendations for the use of motorist services signing and other related signs.

These objectives are being met through the many different tasks conducted throughout the three-year study. This report describes the activities conducted during the second year of the study and the resulting findings. The first-year activities are described in a previous report (3).

FIRST-YEAR ACTIVITIES

The first year of this study was intended to identify and evaluate existing practices for, and understanding of, conventional guide signs. During the first year, there were four major areas of activity: assessment of current practices, identification of driver information needs, evaluation of guide sign legibility, and identification of potential study sites. The most significant of the first-year research tasks included a survey of TxDOT guide signing practices, a driver survey administered at four locations, focus groups conducted at three locations, an extensive evaluation of route marker legibility, and the identification of potential study sites. The results obtained from these tasks identified a number of areas where potential recommendations could improve the quality of rural guide signing. The most significant of the first-year findings indicated the need to improve the design of the State Highway (S.H.) and Farm-to-Market Highway (F.M.) route markers, the need to move information further from the intersection, and the need to provide city name information together with highway number information at the intersection.

SECOND-YEAR ACTIVITIES

The second year of this study was intended to develop and evaluate alternative signing strategies for the use of guide signs on rural highways. The key tasks of the second year included a survey of practices in other states, another driver survey, laboratory evaluations of route markers and intersection signing, field studies of guide signing, and the development of preliminary recommendations. These activities are summarized below and are described in more detail in the following chapters of this report.

Survey of Other States' Practices

A major concern related to the effectiveness of route markers and other conventional guide signs is consistency from one state to another. Observations have indicated that there are visible differences from state to state. A survey was conducted to identify some of these differences and identify where changes to Texas route markers could improve nationwide consistency in conventional guide signing. The survey was distributed to all 50 states. The portion of the survey related to this research consisted of five questions. These questions ranged from the identification of the form of MUTCD used in each state to the identification of key design elements of the state route markers. Responses were received from 42 states over a period of 5 months. The results indicate that most states use the 762×610 mm (30×24 in) route marker for highway numbers with three or more digits. In addition, the highway numbers in most state route markers are taller than those in Texas route markers. Chapter II provides a more detailed description of the research activities and findings of this task.

Driver Survey

Another driver survey was developed to provide information on the effectiveness of conventional guide signs and to obtain driver input for improving these signs. The second-year driver survey was intended to follow-up on the findings of the first-year driver survey and focus groups. The survey investigated several important aspects of conventional guide signs including opinions about the F.M. and Ranch-to-Market (R.M.) route markers, the importance and location of key navigational information, and the placement of junction assemblies. The survey contained eight questions about conventional guide signing, and seven additional demographic questions to gain information on the survey sample. The survey was given to a total of 432 drivers at two small-town festivals. The

findings of the survey confirmed many of the findings of the first-year survey. The most significant findings include: junction signing should be further from the intersection, highway class is of little concern to drivers, and drivers prefer to see destination and highway information in advance of the intersection. Chapter III describes the survey administration and analysis in more detail.

Laboratory Evaluations

Some of the first-year findings indicated the need to improve the design of the F.M. route marker and the possible benefit of presenting destination information along with the highway information. Because of the many alternatives that required testing, a laboratory evaluation format was utilized to test the effectiveness of the alternatives. The laboratory experiment used a slide project and a tachistoscope to project sign images for precisely controlled durations of exposure. Two different evaluations were conducted in the laboratory experiment: an evaluation of seven different designs for the F.M. route marker, and an evaluation of three basic designs for combining destination and highway information into a single intersection sign. The route marker evaluation tested the alternatives for glance legibility, filtered identification, reaction time, and preference. The intersection sign evaluation only tested the reaction time. A total of 72 drivers took part in the route marker evaluation and 67 drivers took part in the evaluation of intersection signing. The results of the route marker evaluations clearly identified one design as the most effective route marker and found the current standard design for the F.M. route marker to be the least effective. The evaluation also found one of the intersection signs to be more effective than the other two. Chapter IV describes the laboratory evaluation of the F.M. route marker and Chapter V describes the laboratory evaluation of the intersection signing.

Field Evaluations

A field evaluation was conducted to assess driver recognition, comprehension, interpretation, and response to actual conventional guide signs. Ten subjects evaluated conventional guide signs and sign assemblies on a 58-mile predetermined route that included 17 intersections. The route was set up to include intersection signing situations common to those encountered by drivers on conventional rural highways. The purpose of the study was to make observations regarding all types of conventional highway guide signs and signing procedures common to those used throughout the state. The subjects were given navigational instructions concerning the route that they should take

before beginning the trip. Along the route, an interviewer would ask the subjects questions concerning the signs that they saw. Periodically, the subject would be asked to pull over and answer questions on a particular sign, or a picture of a sign. Chapter VI describes the field evaluation and its results.

Preliminary Recommendations

The research activities conducted in the first two years of this study have produced a number of useful findings pertaining to the use of conventional guide signs. These findings have been used to develop a series of preliminary recommendations for improving the effectiveness of conventional guide signs. The most significant of the guidelines affect the design of Texas route markers, junction markers, sign placement, and a few other items. Chapter VII describes the preliminary recommendations that have been developed to date.

USE OF METRIC UNITS

The United States (U.S.) is currently in the process of transitioning to the International System (SI) of metric units. One of the major concerns associated with the change to metric units is the conversion of traffic signs to metric units. At the present time, however, traffic signs have not been converted to metric units, nor have standard metric legends been developed. In fact, traffic sign legends have been exempted from the September 30, 1996 FHWA deadline for transitioning to metric units. Therefore, this research used U.S. customary units in all guide signs evaluations, including both surveys and legibility experiments. It was particularly important to use familiar units in the driver surveys in order to reduce the potential for driver confusion in responding to the sign. Had metric units been included in the survey guide signs, driver confusion might have undermined the measurement of driver comprehension.

In this report, both metric and U.S. units are provided when dimensions are given. Because of the uncertainty over the conversion of highway signs to metric units, all of the research activities for this study were conducted using U.S. units. The metric units shown in this report for sign sizes have been determined from the U.S. units through the use of a soft (exact) conversion with rounding to reflect the same accuracy implied in the original numbers. As such, the actual size of signs has not changed.

Both soft and hard metric equivalencies for letter heights, sign sizes, and speeds used in this report are shown in Tables I-2 to I-5. The hard equivalencies were obtained from American Association of State Highway and Transportation Officials (AASHTO) metric conversion publications (4, 5). Once the transition to the metric system has been completed, sign layout and other dimensions will use the hard equivalencies shown in the table. As mentioned previously, this report uses soft conversions for sign sizes, which are equally acceptable during the transition period.

Table I-2. Metric Equivalents for Letter Height

System	Unit	Letter Heights								
U.S.	inch (in)	4	5	6	7	8	9	10	11	12
Soft Metric (SI)	millimeter (mm)	102	127	152	178	203	229	254	279	305
Hard Metric* (SI)	millimeter (mm)	100	125	150	175	200	225	250	275	300

Note: *Based on 1 inch equal 25 mm conversion factor.

Table I-3. Metric Equivalents for Sign Size

System	Unit	Sign Sizes		
U.S.	inch (in)	24×12	24×24	30×24
Soft Metric (SI)	millimeter (mm)	610×305	610×610	762×610
Hard Metric* (SI)	millimeter (mm)	600×300	600×600	750×600

Note: *Based on 1 inch equal 25 mm conversion factor.

Table I-4. Metric Equivalents for Speed

System	Unit	Speeds										
U.S.	miles per hour (mph)	15	20	25	30	35	40	45	50	55	60	65
Soft Metric (SI)	kilometers per hour (km/h)	24	32	40	48	56	64	72	81	89	97	105
Hard Metric[1] (SI)	kilometers per hour (km/h)	20	30	40	50	60	60	70	80	90	100	105[2]

Note: [1]Based on AASHTO Traffic Engineering Metric Conversion Factors (5).
[2]FHWA has determined that the 65 mph equivalency should be 105 km/h instead of the AASHTO equivalency of 110 km/h.

Table I-5. Metric Equivalents for Distance

System	Unit	Distance												
U.S.	feet (ft)	50	100	300	500	528	660	750	1000	1320	1500	2000	2500	2640
U.S.	miles (mi)					1/10	1/8			1/4				½
Soft Metric (SI)	meters (m)	15	31	92	153	161	201	229	305	403	458	610	763	805
Hard Metric (SI)	meters (m)	15	30	90	150	160	200	230	300	400	450	600	750	800

Note: Based on AASHTO Traffic Engineering Metric Conversion Factors (5). Distances between 1 km and 300 m will be displayed to the nearest 100 meters, distances between 50 and 300 m will be converted to the nearest 10 m, distances between 10 m and 50 m will be converted to the nearest meter, and distances less than 10 m will be converted to the nearest tenth of a meter.

CHAPTER II
SURVEY OF OTHER STATES' PRACTICES

One of the major concerns associated with the effectiveness of a route marker and other conventional guide signs is the consistency in signing from one state to another. General observations have indicated that there are some visible differences in the conventional guide signing practices of many states. Therefore, a survey was developed to identify some of these differences and determine potential recommendations which could lead to more effective conventional guide signing in Texas.

SURVEY DESCRIPTION

The survey instrument was developed to obtain information for several other TTI research studies in addition to this study. The survey contained a total of eleven questions, five of which were related to conventional guide signing issues. Appendix A contains the complete survey instrument. The five questions on conventional guide signing were contained in Part I (State Manual for Traffic Control Devices) and Part II (Conventional Guide Signing). These five questions were developed to meet the following objectives with respect to conventional guide signing:

- Identify the form of MUTCD used by each state,
- Obtain a copy of each state's MUTCD or equivalent where possible to gain insight into the signing practices of individual states,
- Determine the number of different classifications of state highways for each state,
- Identify the key design elements of the state route markers used in each state, and
- Determine the extent to which color is used in route markers.

The survey was sent to the state traffic engineer of all 50 states in December 1993. Responses were received from 42 states over a period of 5 months. Table II-1 indicates those states that responded to the survey.

Table II-1. Summary of Responding States and Form of State Manuals

State	Response Received	Form of State Manual[1]	State	Response Received	Form of State Manual[1]
Alabama	Yes	State*	Montana	No	N/A
Alaska	Yes	Supplement*	Nebraska	Yes	Supplement*.
Arizona	No	N/A	Nevada	No	N/A
Arkansas	Yes	National	New Hampshire	Yes	National
California	Yes	State*	New Jersey	Yes	National
Colorado	Yes	Supplement*	New Mexico	Yes	National
Connecticut	Yes	Supplement*	New York	Yes	State*
Delaware	Yes	State*	North Carolina	Yes	Supplement*
Florida	Yes	National[2]	North Dakota	Yes	National
Georgia	Yes	National	Ohio	Yes	State*
Hawaii	No	N/A	Oklahoma	Yes	National
Idaho	Yes	National	Oregon	Yes	National
Illinois	Yes	Supplement*	Pennsylvania	No	N/A
Indiana	Yes	State*	Rhode Island	No	N/A
Iowa	Yes	National	South Carolina	Yes	State*
Kansas	Yes	National	South Dakota	Yes	National
Kentucky	Yes	Supplement	Tennessee	Yes	Supplement*
Louisiana	No	N/A	Texas	Yes	State*
Maine	Yes	National	Utah	Yes	National
Maryland	No	N/A	Vermont	Yes	Supplement
Massachusetts	Yes	Supplement	Virginia	Yes	Supplement
Michigan	Yes	State	Washington	Yes	Supplement
Minnesota	Yes	State*	West Virginia	Yes	Supplement*
Mississippi	Yes	National	Wisconsin	Yes	Supplement
Missouri	Yes	Supplement*	Wyoming	Yes	National

Notes: [1]Forms of Manuals: National - 1988 National MUTCD; Supplement - 1988 National MUTCD with state supplement; State - State manual or state MUTCD; N/A - information not available.
[2]Florida is developing a state supplement.
*A copy of the state manual or supplement was obtained for review.

FORM OF STATE MANUAL

One of the objectives of the survey was to identify the version of the *Manual on Uniform Traffic Control Devices*, or equivalent manual, used by each state to establish standards for traffic control devices. Three questions addressed this objective. The first asked respondents to indicate the form of manual used in the state. Three choices were provided. The summary below provides the number of states which use each form of manual. Table II-1 indicates the form of state manual used in each state.

- 17 states use the 1988 National MUTCD without a state supplement.
- 15 states use the 1988 National MUTCD with a state supplement.
- 10 states use a state MUTCD or state manual.
- 8 states did not provide information.

The second and third questions asked respondents to provide the name of the person responsible for the manual in that state and information on ordering the state manual or supplement. This information was used to obtain copies of the state manual or supplement where feasible. An asterisk (*) is used in Table II-1 to indicate those states for which a manual or supplement was obtained.

CONVENTIONAL GUIDE SIGNING

Part II of the survey contained three questions which specifically addressed conventional guide signing. The first question addressed the number of different highway classifications within each state. The second question asked for the standard design for the state route marker. The final question addressed the use of colors in route markers.

Number of Highway Classifications

The Texas MUTCD (6) identifies ten different classifications of state highways. These include: Texas (State Highway), Loop, Spur, Park Road, Ranch Road, Farm Road, Recreational Road, Beltway, State Business, and Farm Road Business. Such a large number of classifications creates the potential for driver confusion. Therefore, the survey included one question intended to identify the number of different state highway route markers (highway classifications) used in the responding

states. The question asked for the number of different classifications on the state highway system, not including U.S. Highways and Interstate Highways. Of the 42 responding states, 36 indicated that there were 1 or 2 different classifications in their system. Five states indicated that there were 3 or 4 classifications (Alaska, Maine, Missouri, Nebraska, and Utah). Texas has 10 different classifications. The large number of highway classifications in Texas, particularly in comparison to those of other states, indicates that consideration should be given to reducing the distinctions between the different classifications.

Several states indicated that they have different administrative classifications, but use the same route marker design for all of them. It should also be noted that the highway system in several states includes the county roads. However, county road classifications are not included in the summary described in the preceding paragraph.

State Route Marker Design

The second question of Part II asked respondents to provide copies of the standard sign design for the state route marker or markers used in the state. This question was intended to identify: the height of the numbers in the route markers, the size of the route markers, how the different states accommodate highway numbers with three or four digits, and other general design characteristics. Tables II-2 to II-4 summarize the key elements of the state responses.

The information provided by the states and summarized in Tables II-2 through II-4 yields some interesting insights on the design elements of route markers in various states. In general, the route marker information received from the states confirmed the appearance of the route markers as shown in a 1979 pamphlet prepared by the Federal Highway Administration (7). Figures II-1 and II-2 show the state highway route markers contained in that pamphlet. Only the Connecticut, Michigan, and Tennessee route markers appear to be different from those shown in Figures II-1 and II-2. It should be noted that the route markers in these figures are for one- or two-digit highway numbers; therefore, they do not illustrate whether states use larger route markers or smaller letters to accommodate three- or four-digit numbers. The general appearance of the route markers obtained from the survey and Figures II-1 and II-2 can be classified into the following categories:

Table II-2. Summary of State Route Marker Designs (Alabama-Kentucky)

State	Response Received	General Description of Route Marker	3-Digit Highways in State	Use of Route Marker Sizes - in[1]		Height of Numbers - in[1]		Number Series		Color in Route Marker[2]
				24×24	30×24	1 or 2 digits	3 or 4 digits	1 or 2 digits	3 or 4 digits	
Alabama	Yes	state shape	Yes	Yes	Yes	NR	NR	NR	NR	No[3]
Alaska	Yes	state name w/ stars	No	Yes	N/A	10	N/A	E	N/A	No
Arizona	No	state shape & state name[3]	No Response							No[3]
Arkansas	Yes	state shape	Yes	Yes	No	12	12	C	B	No
California	Yes	unique shield shape	Yes	24×25	28×25	10	10	D	D	Yes
Colorado	Yes	state flag	Yes	Yes	No	8	8	E	D	Yes
Connecticut	Yes	rectangle	Yes	Yes	No	12	12	D/C	B/A	No
Delaware	Yes	standard circle[4]	NR	Yes	Yes	12	12	D	D	No
Florida	Yes	state shape	Yes	Yes	Yes[5]	12	8	C	B	No
Georgia	Yes	state shape	No Response							No
Hawaii	No	unique shape[3]	No Response							No[3]
Idaho	Yes	state shape w/ name	NR	Yes	No	No Response				No
Illinois	Yes	rectangle w/ state name	NR	Yes	Yes	10	10	D	D	No
Indiana	Yes	rectangle w/ state name	Yes	Yes	Yes	No Response				No
Iowa	Yes	standard circle[4]	NR	Yes	Yes	12	12	D	D	No
Kansas	Yes	sunflower shape	NR	Yes	No	12	NR	D	NR	Yes
Kentucky	Yes	standard circle[4]	NR	Yes	Yes	12	12	D	D	No

Notes: [1]None of the states provided metric dimensions for the route marker designs, therefore, metric units are not reported in this table.
[2]Other than black and white.
[3]Information obtained from route marker illustrations in FHWA pamphlet (7).
[4]FHWA design for standard state route marker.
[5]For 4-digit highway number only.
NR - no response.
N/A - not applicable.

Table II-3. Summary of State Route Marker Designs (Louisiana-North Dakota)

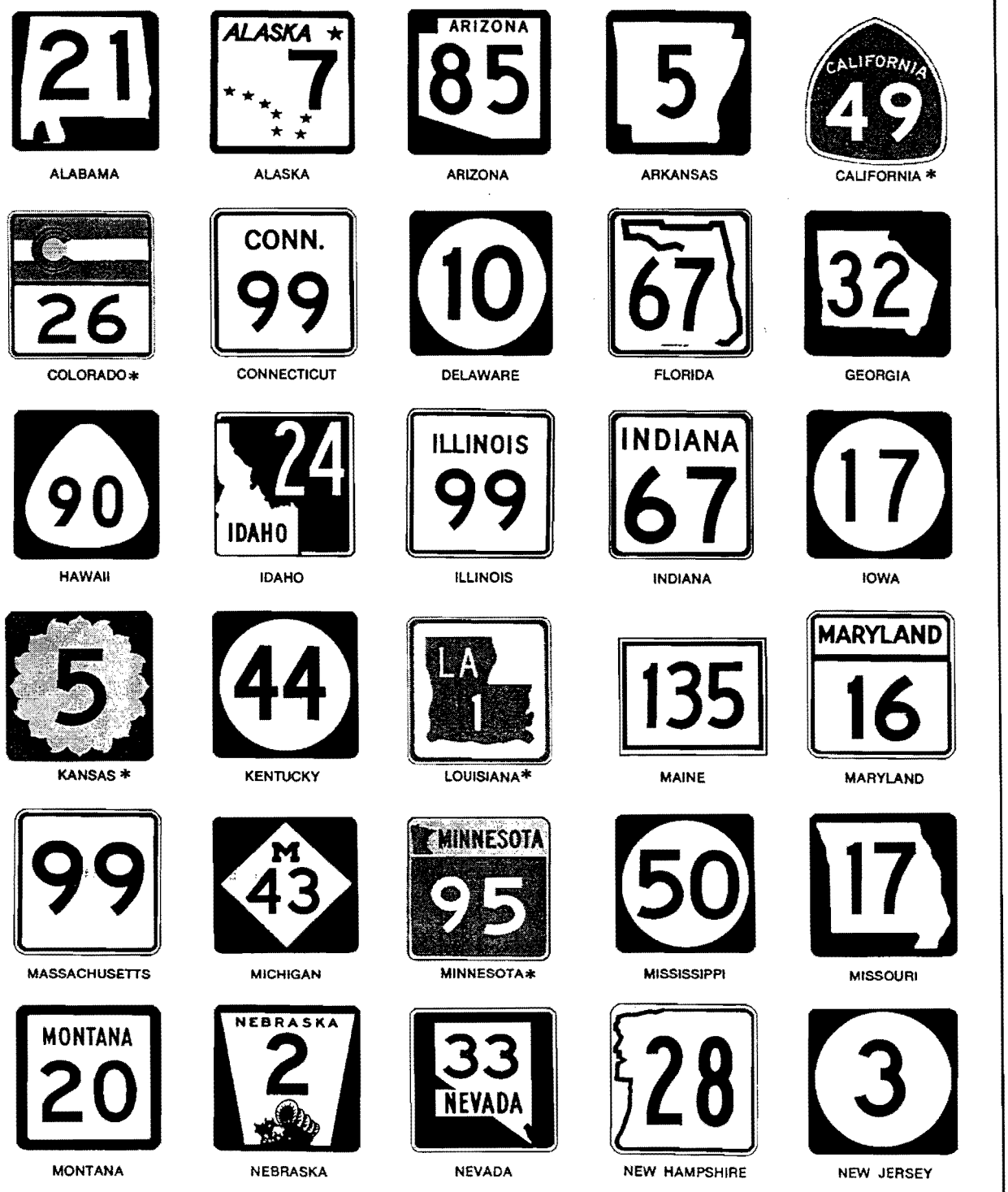
State	Response Received	General Description of Route Marker	3-Digit Highways in State	Use of Route Marker Sizes - in[1]		Height of Numbers - in[1]		Number Series		Color in Route Marker[2]
				24×24	30×24	1 or 2 digits	3 or 4 digits	1 or 2 digits	3 or 4 digits	
Louisiana	No	state shape[3]	No Response							Yes[3]
Maine	Yes	rectangle	No Response							No
Maryland	No	rectangle w/ state name[3]	No Response							No[3]
Massachusetts	Yes	rectangle	Yes	Yes	Yes	12	12	D	D	No
Michigan	Yes	diamond sign shape	Yes	30×30	45×34	12	12	D	C/B	No
Minnesota	Yes	rectangle w/ state name	NR	Yes	Yes	NR	NR	NR	NR	Yes
Mississippi	Yes	standard circle[4]	Yes	Yes	Yes	12	12	D	D	No
Missouri	Yes	state shape	Yes	Yes	No	12	10	D/C	C/B	No
Montana	No	rectangle w/ state name[3]	No Response							No[3]
Nebraska	Yes	unique image in sign	NR	Yes	No	No Response				No
Nevada	No	state name & shape[3]	No Response							No[3]
New Hampshire	Yes	state shape	No Response							No
New Jersey	Yes	standard circle[4]	NR	Yes	Yes	12	12	D	D	No
New Mexico	Yes	number in red circle	NR	Yes	No	8	NR	D	NR	Yes
New York	Yes	unique shape	Yes	Yes	Yes	12	10	D	D	No
North Carolina	Yes	diamond shape	Yes	Yes	No	12/10	8/7	D/C	D/C	No
North Dakota	Yes	indian head shape w/ ND	Yes	Yes	Yes	12	12	D	D	No

Notes: [1]None of the states provided metric dimensions for the route marker designs, therefore, metric units are not reported in this table.
[2]Other than black and white.
[3]Information obtained from route marker illustrations in FHWA pamphlet (7).
[4]FHWA design for standard state route marker.
NR - no response.

Table II-4. Summary of State Route Marker Designs (Ohio-Wyoming)

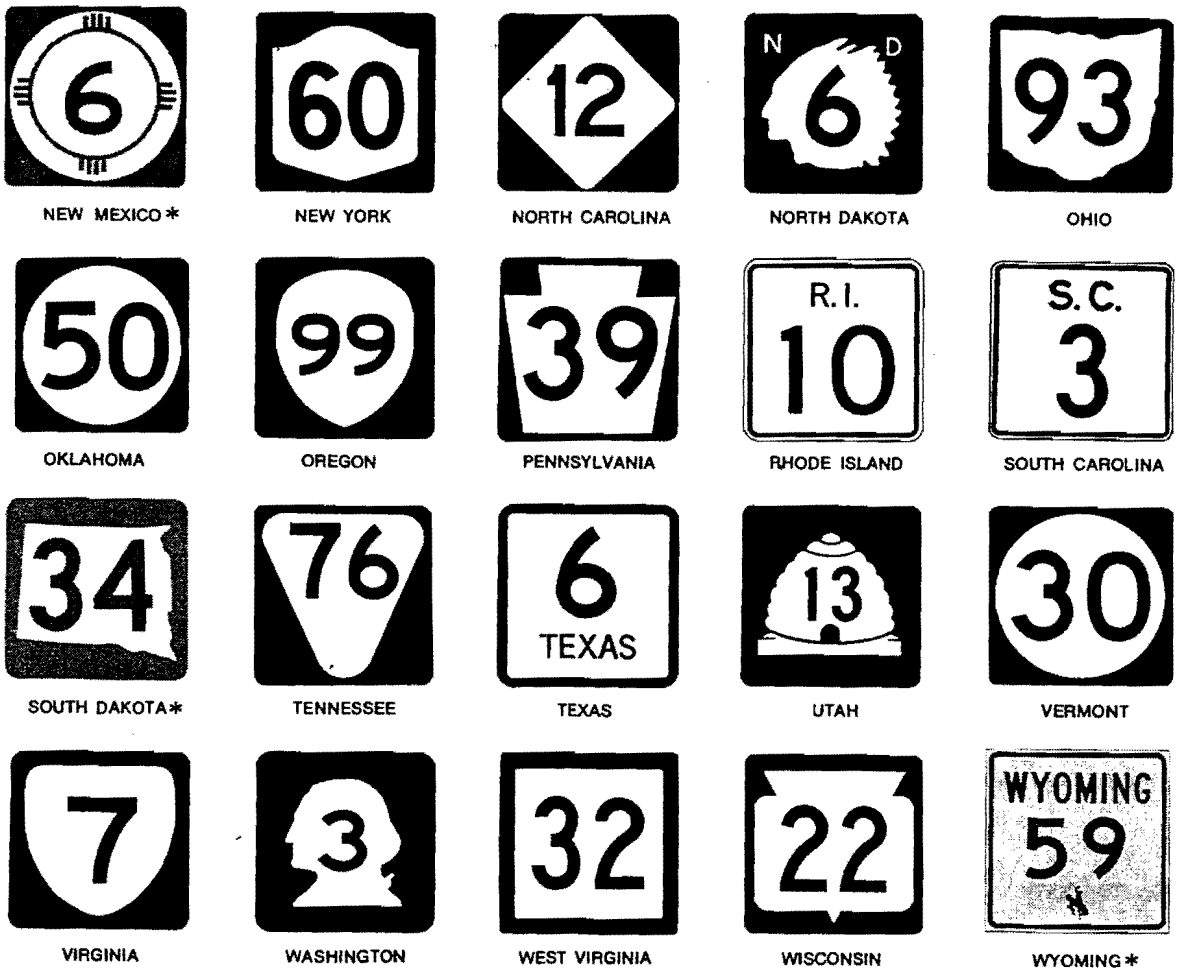
State	Response Received	General Description of Route Marker	3-Digit Highways in State	Use of Route Marker Sizes - in[1]		Height of Numbers - in[1]		Number Series		Color in Route Marker[2]
				24×24	30×24	1 or 2 digits	3 or 4 digits	1 or 2 digits	3 or 4 digits	
Ohio	Yes	state shape	Yes	Yes	Yes	12	10	D	D	No
Oklahoma	Yes	standard circle[4]	Yes	Yes	Yes	12	12	D	D	No
Oregon	Yes	unique shape	Yes	Yes	Yes	12	11	C	C	No
Pennsylvania	No	unique shape[3]	No Response							No[3]
Rhode Island	No	rectangle w/ R.I.[3]	No Response							No[3]
South Carolina	Yes	rectangle w/ S.C.	Yes	Yes	Yes	No Response				No
South Dakota	Yes	state shape	NR	Yes	Yes	No Response				Yes
Tennessee	Yes	state shape	Yes	No	Yes	12	12	D	D	No
Texas	Yes	square w/ state name	Yes	Yes	No	9	7	D	D	No
Utah	Yes	unique shape	Yes	Yes	No	8	8	D/C	B	No
Vermont	Yes	standard circle[4]	Yes	Yes	Yes	12	12	D	D	No
Virginia	Yes	unique shape	Yes	Yes	Yes	12	12	C	C	No
Washington	Yes	unique shape	Yes	Yes	No	12/10	7	C	C	No
West Virginia	Yes	rectangle	Yes	Yes	Yes	12	12	D	C	No
Wisconsin	Yes	unique shape	No	Yes	No	12	12	E/D	C	No
Wyoming	Yes	rectangle w/ state name	Yes	Yes	No	No Response				Yes

Notes: [1]None of the states provided metric dimensions for the route marker designs, therefore, metric units are not reported in this table.
[2]Other than black and white.
[3]Information obtained from route marker illustrations in FHWA pamphlet (7).
[4]FHWA design for standard state route marker.
NR - no response.



Note: * indicates a route marker which uses colors in addition to, or instead of, black and white.

Figure II-1. State Route Markers (Alabama-New Jersey)



Note: * indicates a route marker which uses colors in addition to, or instead of, black and white.

Figure II-2. State Route Markers (New Mexico-Wyoming)

- **FHWA Standard State Route Marker.** Seven states place the highway number within a circle: Delaware, Iowa, Kentucky, Mississippi, New Jersey, Oklahoma, and Vermont.
- **State Shape in Route Marker.** Twelve states place the number within the shape of the state in the route marker or show the state shape somewhere else in the route marker.
  - ▸ **Number within State Shape with State Name or Initials** - 3 states: Arizona, Louisiana, and Nevada.
  - ▸ **Number within or upon State Shape without State Name** - 7 states: Alabama, Arkansas, Florida, Georgia, Missouri, New Hampshire, and South Dakota.
  - ▸ **Number outside of State Shape.** - 2 states: Idaho and Minnesota.

- **Rectangular Shape.** Fifteen states place the number within the rectangular or square border of the route marker.
  - **Number with State Name or State Initials** - 9 states: Illinois, Indiana, Maryland, Montana, Rhode Island, South Carolina, Tennessee, Texas, and Wyoming.
  - **Number without State Name** - 5 states: Connecticut, Maine, Massachusetts, New Mexico, and West Virginia.
- **Unique Shape or Symbol.** Seventeen states use a unique shape or design for their route marker: Alaska, California, Colorado, Hawaii, Kansas, Michigan, Nebraska, New York, North Carolina, North Dakota, Ohio, Oregon, Pennsylvania, Utah, Virginia, Washington, and Wisconsin.
- **Color in Route Marker.** Eight states use a color other than black or white in their route marker: California, Colorado, Kansas, Louisiana, Minnesota, New Mexico, South Dakota, and Wyoming.

Overall, a total of 17 states include the state name or state initials as part of the route marker. Twelve states place the highway number within or on top of the shape of the state. Eight states use one or more colors, other than black and white, in the state route marker.

The majority of states responding to the survey have highway numbers with three or more digits. The survey results indicated that there are four basic methods for accommodating a highway number within the route marker as the number of digits increases. Thirteen states maintain the same height and series of highway number. This is accomplished by increasing the width of the route marker to 762×610 mm (30×24 in). Seven states maintain the same number height, but use a narrower series. Except for Michigan and West Virginia, all seven states retain the 610×610 mm (24×24 in) route marker. Five states (including Texas) reduce the height of the number as the digits increase, but retain the same series for all heights. Three of these use the 762×610 mm (30×24 in) route marker for some numbers and two (including Texas) use the 610×610 mm (24×24 in) route marker for all numbers. Finally, three states reduce the number height and use a narrower stroke width. Two use the 610×610 mm (24×24 in) route marker for all numbers. Florida uses the 610×610 mm (24×24 in) for numbers up to three digits and the 762×610 mm (30×24 in) route marker for four-digit numbers. In all, 24 of the 39 states which provided information about the size of route markers use a 762×610 mm (30×24 in) route marker.

The survey results indicate that for 24 of 31 states that provided information about their route marker design, a 305 mm (12 in) height is used for highway numbers with one or two digits. Three states use 254 mm (10 in), the Texas S.H. route marker uses 229 mm (9 in), and three states use 203 mm (8 in). Of the 28 states that provided information for three- or four-digit highway numbers, 16 use 305 mm (12 in), one uses 279 mm (11 in), five use 254 mm (10 in), four use 203 mm (8 in), and two (including Texas), use 178 mm (7 in).

Colors in Route Markers

The third question in the survey addressed the use of color in, or in combination with, route markers. The results indicated that eight states use one or more colors (other than black and white) in their state route markers. These states include California, Colorado, Kansas, Louisiana, Minnesota, New Mexico, South Dakota, and Wyoming. Two states, Missouri and Oregon, indicated that they are experimenting with the use of colors in route markers and assemblies to provide directional information. A similar concept has been used previously in Florida, where a unique color is used for a specific highway throughout the state. For example, U.S. Highway 1 in Florida used a red and white (instead of black and white) route marker throughout the length of U.S. 1 in Florida. The Florida practice has since been abandoned.

SUMMARY OF SURVEY OF STATES' PRACTICES

The results of the survey of signing practices in other states yielded some useful information regarding conventional guide signing practices. The survey results addressing the design of the state route marker indicate that the Texas S.H. route marker has design features (route marker size, number height, and number series) that are lower than those for most other states. When the Texas F.M. route marker is compared to those of other states, the differences become even more dramatic. These findings indicate that Texas could improve the interstate consistency of state route markers by increasing the width of the route marker as the number of digits increases. This change would allow the height of the highway number to be maintained regardless of the number of digits.

The use of color in conventional guide signing and route markers is not a widespread practice and does not appear to merit further attention. Information obtained from the various states about their state MUTCD or equivalent will be used to identify conventional signing practices which will be reviewed in the third year of the study as the final signing recommendations are developed.

CHAPTER III
DRIVER SURVEY

A key focus of this research study was to evaluate the relationship between drivers and guide signs for conventional highways. This included the assessment of driver information needs, driver use of and dependence on guide signs, and driver understanding of these guide signs. The driver surveys and focus groups conducted during the first year of the study provided some useful insight into the driver-guide sign relationship. However, the first-year activities did not fully answer all of the questions and the results of those evaluations also created a few additional questions. Therefore, a second driver survey was conducted during the second year of the study in order to further evaluate the remaining issues.

The second-year driver survey investigated the following aspects of conventional guide signs: the importance of key navigational information, the relative importance of destination signing and highway number/direction signing, understanding of the F.M. and R.M. initials on route markers, selection of destination names for destination signs, opinions about the F.M. route marker, the preferred placement distance of junction assemblies, and the location of key navigation information at highway intersections.

DRIVER SURVEY METHODOLOGY

The driver survey contained eight questions about conventional highway guide signing. Seven additional questions provided demographic and background information about the survey sample. Appendix B contains the survey instrument.

A pilot test of the survey instrument was performed at the Balloon Festival in Bryan, Texas. Twenty-five subjects participated in the pilot test. After completing the survey, each subject was asked to comment on the survey and to identify problems or difficulties which they may have encountered. The results of the pilot test were used to revise the survey instrument.

The driver survey was administered at two events in small Texas communities. The two events included:

- **The Riesel Fair; Riesel, Texas** - The Riesel Fair is a Thursday-through-Saturday event sponsored by the Riesel Lions Club. The Fair attracts about 20,000 people annually. Riesel is located 24 kilometers (15 miles) southeast of Waco on State Highway 6.
- **The Great Texas Mosquito Festival; Clute, Texas** - The Great Texas Mosquito Festival is a Thursday-through-Saturday event sponsored by the City of Clute Parks and Recreation Department. The Festival attracts about 35,000 people annually. Clute is located 72 kilometers (45 miles) south of Houston and 16 kilometers (10 miles) north of Freeport on State Highway 288.

A similar driver survey was conducted at these events during the first year of this study. Based on the high degree of public participation in the 1993 surveys, a decision was made to administer the 1994 survey at these same events.

DRIVER SURVEY RESULTS

A total of 432 surveys were completed at the two events: 194 in Riesel and 238 in Clute. The following paragraphs summarize the results and major findings of the driver survey. Appendix C provides the response percentages for the total survey sample.

Seven background questions assessed the demographic characteristics of the survey sample. The demographic categories included age, gender, ethnic background, educational background, driving experience, types of vehicles driven, and size of city of residence. The typical survey respondent was an Anglo between the ages of 25 and 54, with at least a high school education and at least five years of driving experience. The typical survey respondent drove a car or pick-up and resided in a medium-size city (5,000 to 50,000 population). Table C-1 in Appendix C details the demographic composition of the survey sample.

The survey responses were analyzed according to seven demographic groupings. Questions characterized by unique demographic trends are identified, and the trends are described. The survey sample included nearly equal representation of males and females, and good representation in each of the four city of residence size categories. The numbers of subjects within each of the age, gender, level of education, and size of city of residence categories were sufficient to permit reasonably reliable statistical comparisons. Under ethnic background, the numbers of African-American subjects (7) and

Asian subjects (4) were insufficient for developing statistically reliable comparisons between these and other ethnic groups. It was possible, however, to perform comparisons between Anglo and Hispanic drivers. Also, a majority of the subjects claimed more than five years of driving experience. The number of subjects with less than one year of driving experience (3) or one to five years of experience (16) was insufficient to allow a reasonable comparison.

Question 1: Relative Importance of Number/Direction and Destination Signing

The first question dealt with the relative importance of two key types of information presented by conventional guide signs: the *number and direction* of the intersecting highway compared to the *destinations* (city names) on the intersecting highway. Drivers were shown pictures of a directional assembly and a destination sign (Figure III-1), and then asked which of the two types of information was most important to them. Sixty-one percent indicated that highway number and direction are most important. This result conflicted with the expectations of the researchers. Most drivers in the state are accustomed to urban driving, and urban guide signing (freeway and expressway signing) emphasizes destinations over route numbers and cardinal directions at the decision point. Guide signing in rural areas, however, emphasizes highway route numbers and cardinal directions at the intersection. It was hypothesized that drivers develop expectancies based on their experiences with urban guide signing, and that these expectancies predispose them to prefer destination information. The responses to Question 1 do not support this argument. One in ten drivers considered the two types of information to be of equal importance. This view was expressed frequently in both written and casual comments made by the drivers to the survey administrators. Other comments indicated that the relative importance of the two types of information varies with driver familiarity and the length of the trip.

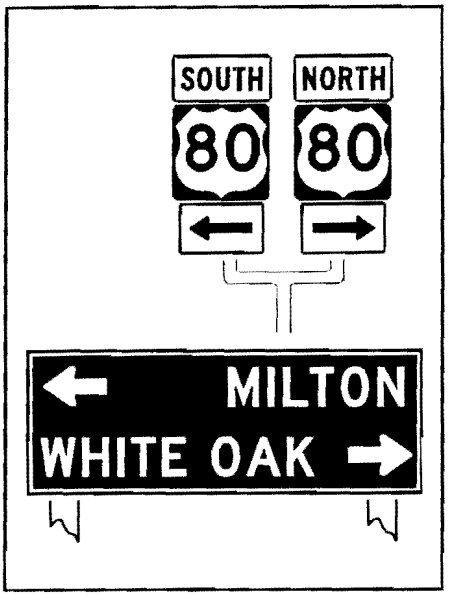


Figure III-1. Question 1 Signs

Approximately equal proportions of drivers in each of the four age categories selected the *highway number and direction* response to the first question. Younger drivers appear to assign greater value to the destination city name than older drivers. Thirty-one percent of drivers age 16 to 24 and 29 percent of drivers age 25 to 54 selected *the name of the next city on the highway,* versus

23 percent of drivers age 55 to 64 and about 20 percent of drivers 65 and older. Drivers age 65 and older exhibited a greater tendency to prefer both types of information. Twenty-four percent of drivers age 65 and older selected both responses, as opposed to 9 percent of drivers in all other age categories combined. Male drivers showed more of a preference for destination name information (32 percent) than did female drivers (23 percent).

All size of residence categories indicated a preference for highway number and direction information. Some interesting trends were noted, however, for the individual responses. The proportion of persons from large- and medium-size communities that answered *highway number and direction* (65 percent) was greater than the percentage of drivers from small communities and rural areas that gave the same response (55 percent). The proportion of drivers from small communities and rural areas that responded *name of the next city on the highway* (32 percent) was greater than the percentage of subjects from larger communities that responded the same (24 percent). In other words, of all drivers preferring highway number and direction, most (on a proportional basis) are urban drivers. Of all drivers that prefer destination name, most (again on a proportional basis) are rural drivers.

Questions 2 and 3: R.M. and F.M. Initials

Two questions addressed the meaning of the *R.M.* and *F.M.* initials used to denote Ranch-to-Market and Farm-to-Market Highways. These two classes of highways are equivalent; the only difference is the area of Texas in which they are located. R.M. Highways are generally located in the western part of the state where ranches are more prevalent. F.M. Highways are generally located in the eastern part of the state where farms are more common. It should be noted that the survey was administered where F.M. Highways are used.

The drivers were shown pictures of the R.M. and F.M. route markers for expressway and freeway guide signs (Figure III-2), then presented a list of eight possible meanings, which included the response *Not Sure*. Forty-one percent of the drivers correctly identified R.M. as a *Ranch-to-Market Highway*. Thirty-seven percent responded *Not Sure* to this question, and the remainder either

guessed or selected an incorrect response. *Restricted Maintenance Highway* and *Rural Mail Highway* were the most frequently chosen incorrect responses. Many drivers commented that they had never seen or heard of a ranch-to-market highway. More than half (55 percent) of the drivers age 55 to 64 responded correctly, while less than half of the drivers in each of the other age categories gave the correct response. Younger drivers in the 16 to 24 and 25 to 54 age categories were more inclined to answer *Not Sure* than older drivers. Equal proportions of male and female drivers (41 and 40 percent, respectively) responded correctly, and nearly equal proportions (37 and 39 percent respectively) responded *Not Sure*. The proportion of Anglo drivers answering correctly (44 percent) was about twice that of Hispanics (23 percent). *Rural Mail Highway* was the most frequent incorrect response for both Anglos and Hispanics; however the proportion of Hispanics that gave this response (15 percent) was about double the proportion of Anglos (7 percent). High percentages of Anglos and Hispanics responded *Not Sure* (36 and 45 percent, respectively). There were no identifiable trends for the education and size of place of residence categories.

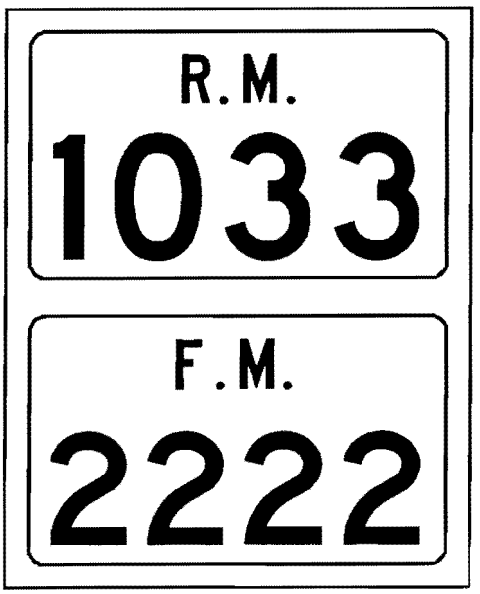


Figure III-2. Questions 2 and 3 Signs

Eighty-nine percent of the survey participants selected the correct response *Farm-to-Market Highway* for the initials F.M. The most frequently chosen incorrect response was *Farm Machinery Highway*. Considering that the survey was administered in the part of the state that uses the F.M. route marker, these results are not surprising. The *Not Sure* and other incorrect responses for the F.M. route marker can probably be attributed primarily to out-of-state visitors or drivers who recently moved to Texas and are not yet familiar with Texas highway designations. The level of understanding of the F.M. initials appeared to increase with age. For the four age categories (16 to 24 years, 25 to 54 years, 55 to 64 years, and 65 years and older), the proportion of drivers answering correctly was 71 percent, 90 percent, 92 percent, and 93 percent, respectively. Ninety-three percent of Anglo drivers gave the correct response, versus 68 percent of Hispanic drivers. Again, the number of subjects in both the Asian and African-American categories was not adequate for comparison purposes.

Question 4: Name of Destination Cities

Question 4 investigated the selection of names of cities and towns for display on destination guide signs. Drivers were asked to indicate which names would be the most helpful in deciding which way to turn at an intersection: *a major city regardless of its distance from the intersection, the next county seat, the next city or town that is shown on the Texas state map,* or *the next city or town regardless of whether it is shown on the Texas state map.* A majority of drivers (54 percent) indicated that they prefer to be told the name of the next city or town that is shown on the state map. *A major city regardless of its distance from the intersection* (23 percent) and *the next city or town regardless of whether it is shown on the map* (20 percent) performed nearly the same. Only 2 percent selected *the next county seat* response. Forty-four percent of drivers age 65 and older prefer the name of the next city or town, versus 56 percent of drivers of all other ages. Similarly, 27 percent of older drivers prefer a major city and 23 percent responded *the next city or town regardless of whether it is on the state map,* versus 22 percent and 19 percent of drivers age 64 or younger. There were no identifiable trends within the other demographic categories.

Question 5: F.M. Route Marker Design

The fifth question assessed drivers' opinions of the Farm-to-Market/Ranch-to-Market Highway route markers. Four statements were listed, and the subjects were asked to indicate their level of agreement with each statement: *agree, uncertain,* or *disagree.* The statements dealt with daytime sign legibility, nighttime sign legibility, the size of the route marker, and the importance of showing the shape of Texas in the route marker.

Most of the subjects (71 percent) indicated that they have no difficulty reading the F.M. route marker during the day. Only 47 percent, however, responded that they do not have a problem reading the sign at night, and 28 percent indicated that it is difficult to read at night. About three-fourths of the drivers age 54 or younger disagreed with the statement *I have trouble reading the sign during the day.* By comparison, 67 percent of drivers age 55 to 64 and only 39 percent of drivers over age 65 disagreed with the same statement. It should be noted, however, that over half of the drivers over age 65 either did not respond or were uncertain. When asked about the nighttime legibility of the route marker, the results were very similar. About half of all drivers below age 65 indicated that they have no trouble reading the sign at night, opposed to only 13 percent of drivers

age 65 or older. Once again, nearly half (46 percent) of the older drivers did not respond to this question, and another 15 percent were uncertain.

Drivers were evenly split on the subject of sign size. Thirty-seven percent believed the F.M. route marker needs to be bigger, while 35 percent disagreed with this statement. Older drivers showed some tendency to prefer a larger size sign. Forty-three percent of drivers over age 65 responded affirmatively to the statement *the sign needs to be bigger*, compared to one-fourth of the drivers in the youngest age category. Alternatively, 15 percent of the age 65 and older drivers disagreed with the same statement, versus 37 percent of all remaining drivers. Females may prefer the larger sign slightly more than males, although not by a large margin. Forty-one percent of females indicated agreement with the statement while 32 percent disagreed. For males, 33 percent agreed while 37 percent disagreed. Anglos were evenly split on the issue of sign size, with 38 percent favoring a larger sign and 37 percent opposed; one-fourth of the Anglo drivers were uncertain or did not respond. Hispanics were split nearly evenly, with 30 percent favoring a larger sign, 30 percent uncertain, and 26 percent opposed; 15 percent did not respond. Drivers from rural areas and small communities appeared to favor a larger sign more than drivers from urban areas (41 percent versus 35 percent, respectively). Furthermore, only 30 percent of rural drivers disagreed with the statement about sign size (that it should be larger).

Fifty-five percent of the drivers indicated agreement with the statement *it is important to show Texas in this sign.* Twenty percent disagreed, and 17 percent were uncertain. Older drivers appeared to favor including the shape of Texas more than younger drivers. Sixty-five percent of drivers over age 65 agreed with the statement, while 53 percent of all drivers younger than 65 years of age agreed. Male and female drivers responded in equal proportions that it is important to show Texas in the sign; 54 percent of males and 56 percent of females thought it important, while 20 percent of males and 19 percent of females said it is not important.

Question 6: Placement of Junction Assembly

One question asked for drivers' preferences for placement of the Junction Assembly in advance of intersections. A table of possible placement distances expressed the placement in increments of time (1, 2, 3, 4, 7, 10 and 15 seconds) and distance for an assumed 55 mph approach speed (75, 150, 250, 325, 550, 800 and 1200 feet, respectively). Metric units were not presented to the drivers. In

rural areas, the Texas MUTCD specifies a placement of not less than 120 meters (400 feet) from the intersection. The responses indicated drivers prefer to see the junction sign placed farther from the intersection; 78 percent indicated a placement distance of 7 seconds (550 feet at 55 mph) or greater, and nearly 40 percent responded 15 seconds (¼-mile at 55 mph). Interestingly, although a simple majority of drivers preferred the 15-second placement distance, more drivers preferred 7-second placement distance to 10 seconds. One possible explanation is that 10 seconds at 55 mph is about 1/7-mile, whereas 7 seconds at 55 mph converts to 1/10-mile, a number which is probably much easier for a driver to visualize. Some of the written comments on this question emphasized the importance of multiple or redundant Junction signs and of increasing placement distances at congested intersections. Considering differences between age groups, the only identifiable trend was an overwhelming preference by drivers of all ages for moving the junction sign to at least seven seconds (550 feet). The most frequent response amongst Anglo drivers was 15 seconds (42 percent), followed by 7 seconds (24 percent). By comparison, the most frequent response given by Hispanic drivers was 10 seconds (32 percent), followed by 15 seconds (28 percent). Nearly 40 percent of drivers with less than a high school education marked one second or two seconds as their response; the response did not exceed 10 percent in any of the other education categories.

Question 7: Ranking of Guide Sign Information

The seventh question asked drivers to state the relative importance of various types of navigational information using a ranking procedure. The five types of information are shown in Figure III-3 and included: *name of the next city in each direction* (destination sign), *directions in which the highway goes* (cardinal direction marker), *highway number* (route marker), *class of highway* (route marker), and *direction to turn to go in the indicated direction* (arrow marker). The survey illustrated each type of information as it is shown in conventional guide signs. Drivers used scores of 1, 2 and 3 to rank the relative importance of the three most important types of information.

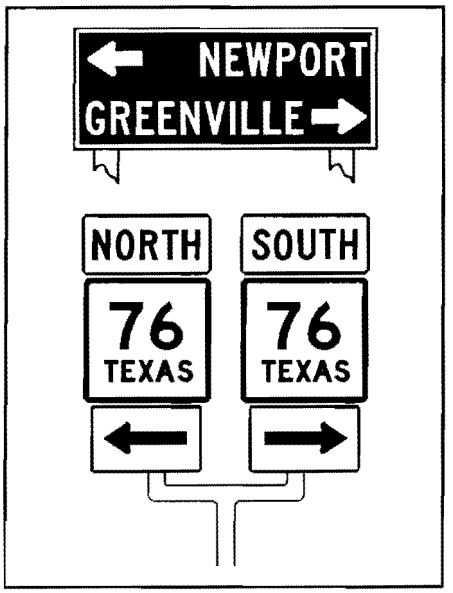


Figure III-3. Question 7 Signs

An indexing procedure was devised to analyze the relative importance of the five types of guide sign information. This procedure required the calculation of an overall score for each type of information. The overall score was a weighted average, determined by multiplying the rank by the number of drivers that assigned that rank, summing the products for each rank, and then dividing by the total number of respondents. On the basis of the overall score, the five types of information were ranked from most important to least important, as indicated in Table III-1.

Table III-1. Summary of Sign Information Ranking for All Subjects

Rank	Type of Information	Overall Score
1	Name of the next city in each direction	1.64
2	Highway number	1.80
3	Directions in which the highway goes	1.91
4	Direction to turn to go in the indicated direction	2.04
5	Class of highway	2.23

Notes: Lowest score indicates the most important.

The results of the ranking procedure were analyzed by age category. The analysis determined if any single age group considers a given type of sign information more or less important than all other age brackets. An overall score was calculated for each information type and for each age category. The signs were ranked in order from most to least important for each age category. Each ranking was compared to the overall ranking shown in Table III-1 to determine which, if any, changed by two or more places. Table III-2 summarizes the results of this procedure. Three were identified: *class of highway* for age 16 to 24, *directions in which the highway goes* for age 55 to 64, and *direction to turn to go in the indicated direction* for age 65 and older. The survey results indicated that young drivers placed considerably greater importance on the class of highway than do older drivers. On average, drivers between the ages of 16 and 24 scored this information at 1.92; all other drivers combined gave it a 2.28. Older drivers placed significance on directional arrows. Drivers in the age 65 and older bracket ranked this second overall with an average score of 1.62; all other age groups combined gave this information an average score of 2.11. There is also evidence that some older drivers preferred to see cardinal direction information. Drivers in the 55 to 64 bracket ranked this information first overall with a score of 1.62; drivers in the two youngest brackets, 16 to 24 and 25 to 54, gave an average score of 1.97.

Table III-2. Summary of Sign Information Ranking by Age Category (Rank/Score)

Type of Information	Overall Rank (Score)	Rank and Score for Age Categories			
		16-24	25-54	55-64	65+
Name of the next city in each direction	1 (1.64)	1 (1.70)	1 (1.64)	2 (1.64)	1 (1.53)
Highway number	2 (1.80)	3 (1.97)	2 (1.79)	3 (1.79)	3 (1.64)
Directions in which the highway goes	3 (1.91)	4 (2.03)	3 (1.96)	1 (1.62)*	4 (1.79)
Direction to turn to go in the indicated direction	4 (2.04)	5 (2.25)	4 (2.06)	5 (2.19)	2 (1.62)*
Class of highway	5 (2.23)	2 (1.92)*	5 (2.35)	4 (2.13)	5 (2.13)

Note: Rankings which differ from the overall rank by two or more are indicated by an asterisk (*).

The results were analyzed by gender to determine if male and female drivers differ significantly in their opinions of the importance of guide sign information. The average scores given by male and female drivers for each type of information were calculated, then the signs were ranked accordingly in order of importance. Both male and female rankings were in the same order. The average scores differed by less than one-tenth of a point for most signs, with the exception of the cardinal direction markers. The average scores for these signs differed by 0.14 point. Table III-3 summarizes the results of this analysis.

Table III-3. Summary of Sign Information Ranking by Gender Category (Rank/Score)

Type of Information	Overall Rank (Score)	Gender Category	
		Male	Female
Name of the next city in each direction	1 (1.64)	1 (1.66)	1 (1.62)
Highway number	2 (1.80)	2 (1.77)	2 (1.84)
Directions in which the highway goes	3 (1.91)	3 (1.85)	3 (1.99)
Direction to turn to go in the indicated direction	4 (2.04)	4 (2.07)	4 (2.02)
Class of highway	5 (2.23)	5 (2.22)	5 (2.24)

Similar analyses to those described above investigated potential differences between drivers with different educational backgrounds, between rural and urban drivers, and between drivers from different ethnic groups. In all cases, the average scores yielded the same or nearly the same rank order for the five signs. Where differences in ranking did exist, these were not significant (rank differed by less than one position).

The relative importance of the highest- and lowest-ranked signs within each demographic category was studied by examining the range of average scores for each category and comparing it to the range of scores averaged over all drivers that took the survey. If the difference between the highest and lowest average scores for a given category was relatively large compared to the overall average, this was evidence that drivers in that category considered the most important signs to be much more important than the least important signs. Alternatively, if the range of values was relatively small compared to the overall average, there was an indication that while some signs were more important than others, they were not much more important.

The range of high and low average scores was determined for each sign and each demographic category. For the scores averaged over all survey participants, the difference between the high value of 2.23 and the low value of 1.64 was 0.59. This value was the benchmark for comparisons. Table III-4 reports the results of the analysis.

Table III-4. Range of Question 4 Average Scores by Demographic Category

Demographic Category	Demographic Sub-Category	Average Score		Range	Percent Difference
		High	Low		
All Subjects	-----	2.23	1.64	0.59	-----
Age	16-24 years	2.25	1.70	0.55	-6.8
	25-54 years	2.35	1.64	0.71	+20.3
	55-64 years	2.19	1.62	0.57	-3.4
	65+ years	2.13	1.53	0.60	+1.7
Gender	Male	2.22	1.66	0.56	-5.1
	Female	2.24	1.62	0.62	+5.1
Educational Background	Less than high school	2.20	1.00	1.20	+103.4
	High school graduate	2.21	1.62	0.59	0.00
	Trade school graduate	2.17	1.80	0.37	-37.3
	Some college	2.13	1.70	0.43	-27.1
	College graduate	2.50	1.67	0.83	40.7
	Advanced college degree	2.57	1.62	0.95	+61.0
Residence	Large community	2.30	1.70	0.60	+1.7
	Medium community	2.15	1.54	0.61	+3.4
	Small community	2.47	1.63	0.84	+42.4
	Rural area	2.16	1.78	0.38	-35.6
Ethnic Background	Anglo	2.25	1.64	0.61	+3.4
	Hispanic	2.17	1.69	0.48	-18.6

A discrepancy was noted in the responses to Questions 1 and 7. On the first question, 61 percent of the drivers indicated that *highway number and direction* was the most important information, while 27 percent responded *the name of the next city on the highway.* In answering the second question, 42 percent ranked *name of the next city in each direction* as most important and 35 percent ranked *highway number* as most important. The results pose an apparent contradiction which is difficult to explain. One set of results seemed to indicate a strong preference on the part of most drivers for emphasis on the highway route number. The second set of results supported emphasis on destination information, or at least suggested the equal importance of these two types of information.

Question 8: Placement of Directional and Destination Signing

The final survey question determined drivers' preferences for placement of the destination sign and directional assembly. Drivers were shown a picture of both signs and a sketch of an intersection. Figure III-4 presents the signs and intersection shown to the drivers. Four locations were labeled on the sketch: in advance of the intersection (A), near right side (B), far right side (C), and far left side (D). A distance was not provided for the advance location. The subjects were asked to indicate at which of the four specified locations they would prefer to see each of the two signs. Two-thirds (67 percent) indicated a preference for placing the destination information in advance of the intersection. This result confirms current signing practice, which places this sign a minimum distance

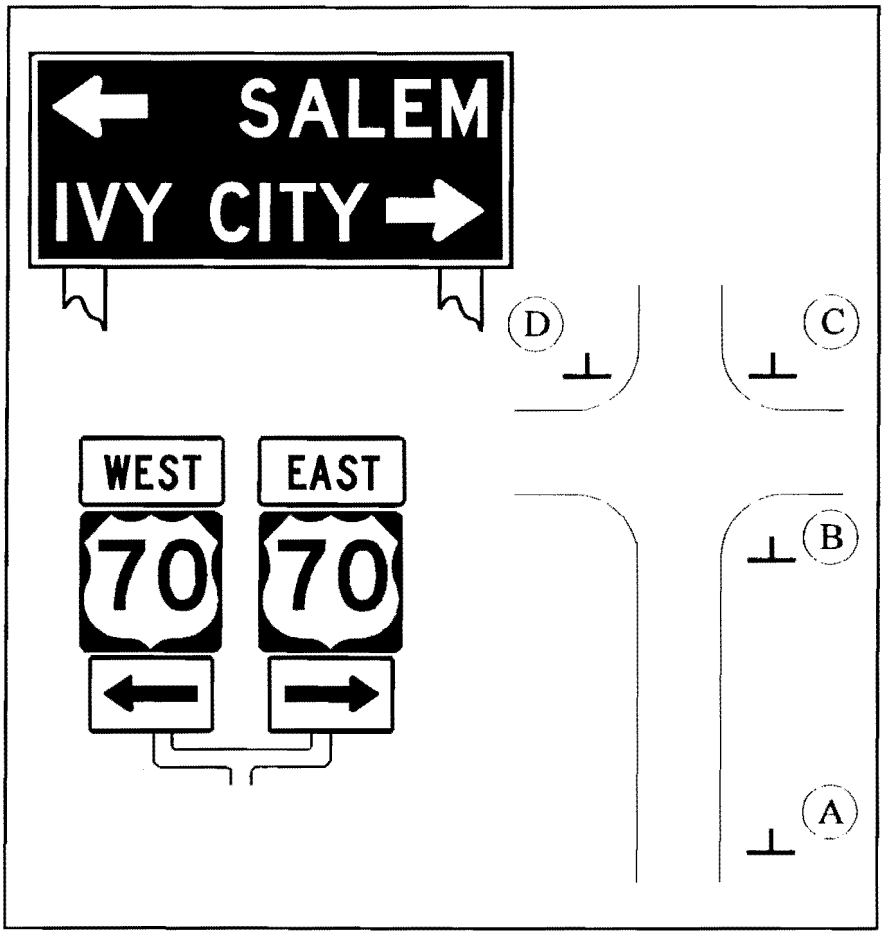


Figure III-4. Question 8 Signs and Intersection

of 60 meters (200 feet) from the intersection. Over half (56 percent) of the subjects preferred to see the directional assembly in advance of the intersection, and another 30 percent preferred the near right side of the intersection. Only one in ten indicated a preference for seeing this assembly at the far right side of the intersection. This result supports providing more directional information in advance of the intersection.

The results indicated that older drivers prefer to see the destination sign farther in advance of the intersection. In fact, the percentage of drivers favoring Location A increased steadily over the range of ages, from 56 percent for drivers between 16 and 24 years of age to 85 percent for drivers over age 65. Likewise, the percentage of drivers that would prefer placement of this same sign on the near right side of the intersection decreased steadily, from 31 percent for the youngest drivers to only 4 percent for the oldest drivers. Seventy percent of females indicated a preference for Location A versus 64 percent of males; for Location B, the proportions were 20 and 27 percent for females and males, respectively. Sixty-nine percent of Anglo drivers favor Location A versus 57 percent of Hispanic drivers; 23 percent and 28 percent of Anglo and Hispanic subjects, respectively, preferred Location B.

The results gave some indication that older drivers are more prone than younger drivers to prefer moving the directional assembly farther away from the intersection. Forty-four percent of the age 16 to 24 drivers and 56 percent of the age 25 to 54 drivers preferred Location A, compared to 66 percent of drivers age 55 to 64 and 59 percent of drivers age 65 and older. This alone does not constitute strong evidence in favor of moving the directional assembly. Taken together with the results for Location B, however, the evidence is somewhat stronger. The proportion of survey subjects favoring Location B decreased steadily over the full range of ages, from 42 percent of the youngest drivers to 17 percent of the oldest drivers. Sixty-one percent of females and 53 percent of male drivers preferred Location A, compared to 28 percent of female drivers and 34 percent of males indicating preference for Location B.

SUMMARY OF DRIVER SURVEY FINDINGS

The driver survey provided much useful information about drivers' use of and opinions about various aspects of conventional highway guide signing. These findings will be valuable in evaluating new signing concepts and designs and in the development of recommended guidelines.

- The typical survey respondent was an Anglo between the ages of 25 and 54, with at least a high school education and five years of driving experience minimum. The typical survey respondent drove a car or pick-up and resided in a community of approximately 5,000 to 50,000 population.
- Drivers considered destination information and highway route number information the most important types of guide sign information. The class of highway was relatively unimportant.
- It is uncertain whether drivers consider destination or highway route number information the most important type of guide sign information. The reasons for the discrepancy are not well understood.
- The initials *R.M.* were poorly understood by the drivers participating in the survey. Many drivers commented that they had never seen nor heard of Ranch-to-Market Highways. This result may, however, be a consequence of geographic bias in the survey sample.
- The initials *F.M.* were well understood by the drivers participating in the survey. This finding, however, may also be a consequence of geographic bias in the survey sample. Younger, less experienced drivers did not understand this sign as well as older drivers with more driving experience.
- Most drivers preferred to see the name of the next city or town that is shown on the state map when they must decide which way to turn at an intersection. Showing the name of the next county seat was of little or no help to most drivers.
- Daytime legibility of the F.M. route marker was thought to be adequate by most drivers. Nighttime legibility may be a problem for a significant portion of the driving population. Not surprisingly, there was some evidence that the legibility of this sign, during both day and night, was considerably worse for older drivers than for younger drivers.
- It is uncertain whether drivers would prefer a larger F.M. route marker. The survey results were inconclusive on this point.
- Just over half of the survey participants agreed that it is important to display the shape of Texas on the F.M. route marker. No strong opinions in favor of, or opposed to, the display were expressed by the survey participants.
- Placement of the junction assembly well in advance of the intersection, perhaps 500 feet or more, would be well received by most drivers. An overwhelming majority indicated that providing this information further in advance is preferred. More than three-fourths of the drivers favored at least seven seconds or 550 feet at 55 mph, and almost two out of every five drivers preferred at least 15 seconds or ¼-mile at 55 mph.

- Young drivers placed greater importance on the class of highway than the older drivers.
- Older drivers may have more of a need for directional arrows to indicate the direction to turn to travel on a specified route. There is also some evidence that cardinal direction information was comparatively more important to older drivers than to their younger counterparts.
- Drivers preferred to see destination information in advance of the intersection, as currently provided in the MUTCD.

CHAPTER IV
EVALUATION OF F.M. ROUTE MARKERS

A major concern of this research study is the legibility of Texas route markers, particularly with respect to the older driver population. A legibility study of the existing State Highway (S.H.) and Farm-to-Market Highway (F.M.) route markers was carried out in the first year of this study (3). These legibility evaluations were conducted with full size signs viewed by drivers from a stopped position and while driving at 60 km/h (35 mph). The results of the first-year legibility evaluation indicated a need to improve the legibility of the F.M. route marker. A major activity conducted in the second year of this study was to develop and evaluate alternative designs for the Farm-to-Market route marker.

DEVELOPMENT OF ALTERNATIVE F.M. ROUTE MARKER DESIGNS

The objective in redesigning the F.M. route marker was to provide alternative designs which offer improved legibility. The legibility of a sign is predominantly a function of the height of the letters and numbers used in the sign. To increase the legibility of the F.M. route marker, the heights of the letters and numbers must be increased. However, there are several other design features which impact the overall effectiveness of a sign. In order to develop effective alternative route marker designs, a number of primary and secondary design parameters were identified to establish the relationship between the various design features. The design parameters and the basis for their use are described below.

- **Primary Design Parameters** - Parameters which should be satisfied to the greatest extent possible in all alternative designs.
  - **The marker should meet the needs of older drivers** - The increasing proportion of older drivers, combined with their diminished driving capabilities, requires more generous signing features. Signs which meet the needs of older drivers will most likely meet the needs of any other population subgroup.
  - **The marker should meet the needs of 85 percent of drivers** - The legibility of the route markers should be such that it provides at least 85 percent of the target population with adequate time to perform the appropriate driving response.

- **The highway number should be the primary sign element** - Results of this research indicate that the highway number is the primary feature in a route marker. As such, it should receive the primary emphasis in any design.
- **The height of the number should not decrease as the number of digits is increased** - In the current design of the F.M. route marker, the height of the number decreases 25 mm (1 in) for each digit that is added. This means that the size of the information decreases and the amount of information increases.
- **The designs should conform to standard sign dimensions, 610×610 mm (24×24 in) or 762×610 mm (30×24 in)** - For economic reasons, the route marker design should be based on readily available sign blanks.
- **Route marker designs should be based on a four-digit highway number** - There are approximately 3,544 F.M./R.M. numbered highways in Texas. Of these, approximately 70 percent use a four-digit highway number.
- **Numeral heights should be consistent with the State Highway route marker** - F.M./R.M. Highways are currently built to the same geometric standards as State Highways and have many of the same operating characteristics. As a result, the basic design elements of the two route markers should be equivalent.
- **The designs should use Series D or wider numerals and letters** - The Series D alphabet is the most commonly used series in traffic signs.

- **Secondary Design Parameters** - Parameters which may be satisfied in some, but not all, alternative designs.
  - **An attempt should be made to identify the route marker design with the state of Texas** - The current F.M. route marker displays the number within the shape of Texas. The continued use of the Texas shape may be a useful identification tool.
  - **The width of the route marker should increase as the number of digits increases** - Increasing the width of the route marker is necessary in order to accommodate an increase in the number of digits without decreasing the height of the number.
  - **The height of the number should be consistent with the design of route markers in other states** - Drivers should be able to read the F.M. route marker as easily as they would a state route marker in any other state.

Twelve alternative designs were developed based on the design parameters. Three designs were developed to explore the improvements in legibility that could be made if the current 610×610 mm (24×24 in) sign blank dimensions are retained. The greatest improvement in legibility, however, is

associated with the larger 762×610 mm (30×24 in) sign blank dimensions. Nine designs used this size sign blank. The current F.M. route marker and the 12 alternative designs can be seen in Figure IV-1.

TxDOT SURVEY OF ALTERNATIVE F.M. ROUTE MARKER DESIGNS

In order to obtain input from TxDOT personnel regarding the development of alternative designs, a technical memorandum describing the factors justifying the consideration of alternative designs for the F.M. route marker was prepared and distributed to 17 administrative, division, and district personnel within TxDOT. The technical memorandum addressed the standard design of the current route marker, its legibility, consistency with other route marker designs, driver information needs, previous changes in the F.M. route marker, and its design requirements. The technical memorandum also included a survey intended to solicit input concerning several aspects of Farm-to-Market highway signing. A copy of the technical memorandum and survey is provided in Appendix D. TxDOT personnel were asked to read the technical memorandum and then complete the survey form. The objectives of this survey were to:

- Solicit general opinions about a new F.M. route marker design.
- Solicit opinions regarding the pertinence of the design parameters used in developing the alternative designs.
- Solicit opinions as to which alternative designs should be tested as well as any comments on the individual designs.

Survey Methodology

The survey consisted of three parts. The first part contained four statements pertaining to general opinions about a new F.M. route marker design. The respondents were asked to indicate their opinion by checking the appropriate box: *strongly agree, agree, neutral, disagree, or strongly disagree*. The second section of the survey included the seven primary requirements and three secondary requirements considered in the development of the alternative F.M. route markers. Again, the respondents were asked to indicate their opinion by checking the appropriate box: *strongly agree, agree, neutral, disagree, or strongly disagree*. The third section of the survey presented the 12 alternative designs. The respondents were asked to indicate which designs they would prefer to see included in or excluded from future testing. This section also gave the respondents an opportunity to offer specific or general comments on the signs.

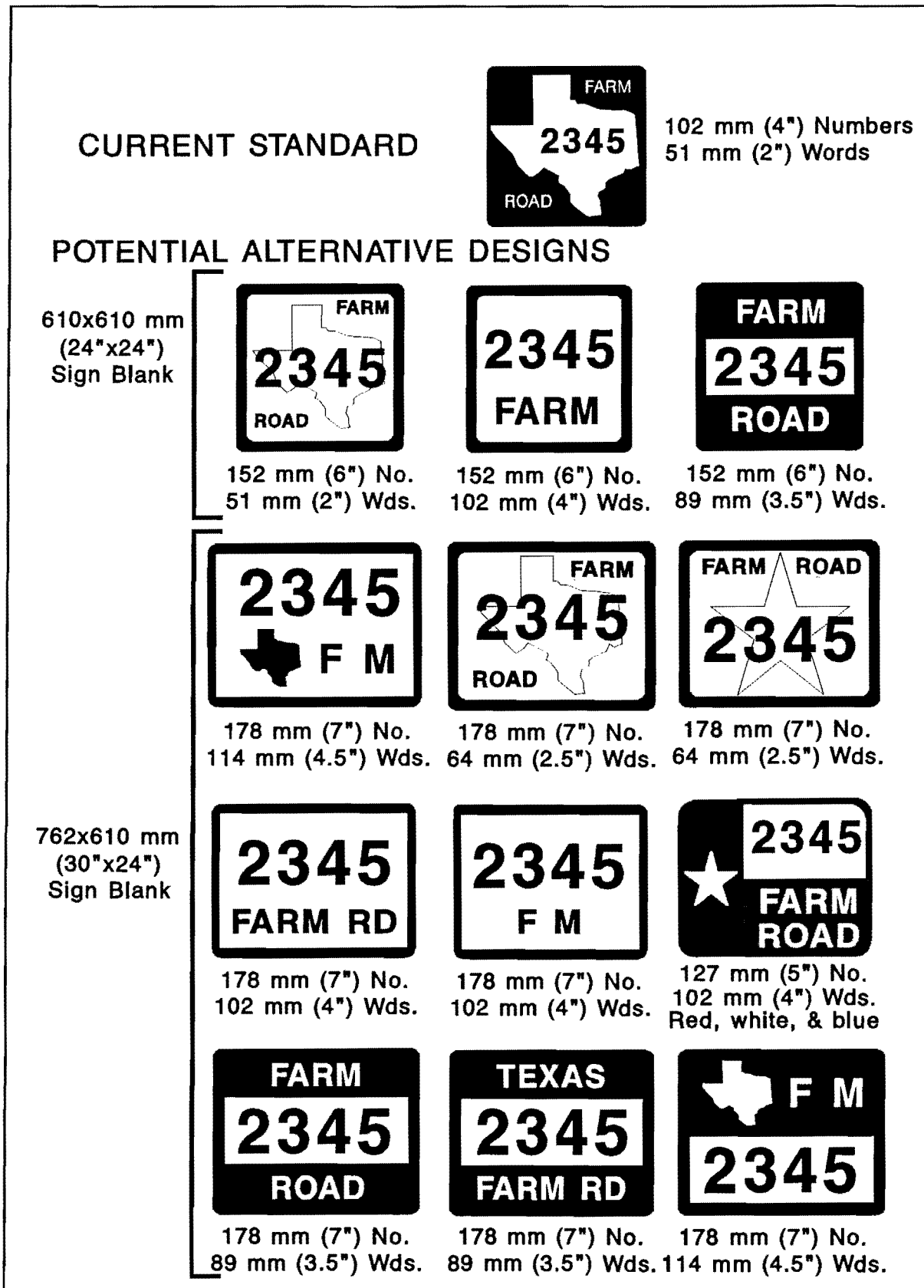


Figure IV-1. Alternative F.M. Route Marker Designs

Survey Results

A total of 12 individuals responded to the survey. Table IV-1 summarizes the results for the first section of the survey regarding general opinions about a new F.M. route marker design. Seventy-five percent of the TxDOT personnel responding to the survey believed that the current F.M. route marker design is inadequate. Furthermore, 75 percent of the respondents also felt that there is sufficient justification to consider alternative F.M. route marker designs, and 83 percent stated that if an alternative F.M. route marker design is found to be more effective, it should be implemented. It is interesting to note that only 8 percent of the respondents felt there would be institutional barriers to implementing a new F.M. route marker.

Table IV-1. Summary of General Opinions About a New F.M. Route Marker Design

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The design of the existing F.M. route marker is adequate.	8%	8%	8%	58%	17%
There is sufficient justification to consider alternative F.M. route marker designs.	42%	33%	8%	0%	17%
If a new F.M. route marker design is found to be better, it should be implemented.	58%	25%	0%	0%	17%
There are institutional barriers to implementing a new F.M. route marker.	8%	0%	42%	33%	8%

Note: Based on 12 responses.

Table IV-2 summarizes the results for the second section of the survey regarding the pertinence of the design requirements for the alternative F.M. route marker designs. In general, those surveyed strongly agreed with the design requirements. The only two design requirements that were not widely supported were the requirements for the number height to be consistent with those used on the state highway route marker and for the design to have a feature which identifies the marker with Texas.

Table IV-2. Summary of Design Requirements for Alternative F.M. Route Markers

Design Requirements	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Primary					
Meets the needs of older drivers	55%	45%	0%	0%	0%
Accommodates the needs of 85 percent of drivers	73%	27%	0%	0%	0%
Highway number should be the primary feature	55%	45%	0%	0%	0%
Number height doesn't decrease as no. of digits increase	55%	45%	0%	0%	0%
Fits on standard size sign blanks: 610×610 mm (24×24 in) or 762×610 mm (30×24 in)	73%	18%	9%	0%	0%
Sign design based on four-digit highway number	73%	18%	9%	0%	0%
Number height consistent with S.H. route marker	55%	18%	9%	9%	0%
Secondary					
Has design feature which identifies it with Texas	64%	18%	9%	9%	0%
A 762×610 mm (30×24 in) sign blank is used for three- or four-digit numbers	36%	55%	9%	0%	0%
Number height consistent with other states	18%	36%	45%	0%	0%

Note: Based on 11 responses.

The recommendations for the inclusion/exclusion of alternative designs for further testing were tabulated from the third section of the survey. Based on these recommendations, the 6 alternative designs shown in Figure IV-2 were chosen for further testing. The designs will be referenced in the text of this report by the names listed above each design. The third section of the survey allowed respondents to make general comments about the designs. A sample of the comments received are listed below:

- The 610×610 mm (24×24 in) designs are too small and would have the same number height limitations as the current design.
- The RD on the FARM RD design could be confusing.
- Prefer that we don't consider predominantly black backgrounds.
- The red-white-blue sign will require multiple screening, will be expensive to manufacture.
- The predominantly black signs will cause a flashlight effect when made with high-intensity sheeting. This will probably drastically reduce the legibility distance.
- There is a possible problem with the adhesion of the stick-on letters to the screened areas (number superimposed over the Lone Star or Texas outlines).

CURRENT STANDARD

SM-BLK

102 mm (4") Numbers
51 mm (2") Words

ALTERNATIVE DESIGNS

610x610 mm
(24"x24")
Sign Blank

SM-WH

127 mm (5") Numbers
51 mm (2") Words

762x610 mm
(30"x24")
Sign Blank

WH-FMTX

178 mm (7") Numbers
114 mm (4.5") Words

WH-FMRD

178 mm (7") Numbers
102 mm (4") Words

WH-FM

178 mm (7") Numbers
102 mm (4") Words

W/B-FMRD

178 mm (7") Numbers
89 mm (3.5") Words

W/B-TXFM

178 mm (7") Numbers
114 mm (4.5") Words

Figure IV-2. Alternative Designs Selected for Further Testing

- Most of the alternative signs seem to have a broad 38 mm (1½ in) border. We would prefer that guide signs and regulatory signs of the same size have the same size border. The 15 mm (⅝ in) border shown on the 610×610 mm (24×24 in) and 762×610 mm (30×24 in) regulatory signs will provide you with an extra 25 mm (1 in) of width and height for the sign message.
- We need to give the Texas Department of Criminal Justice about 6 months notice if we are going to change the size of the three-digit and four-digit F.M. signs.
- The predominantly black background signs are not as visible as the predominantly white background signs.

Summary of Survey Findings

- Seventeen TxDOT personnel were surveyed to obtain input for the evaluation of alternative F.M. route marker designs. A total of 12 responded to the survey.
- Seventy-three percent believed the current F.M. route marker is inadequate.
- Seventy-three percent believed there is sufficient justification to consider alternative F.M. route marker designs.
- Eighty-two percent believed that if an alternative F.M. route marker design is found to be more effective, it should be implemented.
- The design requirements for alternative F.M. route markers were considered appropriate by the majority of respondents.
- Comments received about the alternative designs were used to select the 6 alternative designs shown in Figure IV-2 for further testing.

EVALUATION OF ALTERNATIVE F.M. ROUTE MARKER DESIGNS

The evaluation of the current and alternative F.M. route marker designs was conducted in College Station. Four laboratory tests were designed to ensure that adequate data were collected to assess the effectiveness of the F.M. route marker designs. A total of 70 drivers from the Bryan/College Station community participated in this study. Subjects were compensated for their participation.

Evaluation Methodology

The four laboratory tests utilized in this study were the glance legibility test, filtered identification test, reaction time test and preference test. A combination of different evaluation procedures was used in order to obtain a more useful measure of the overall effectiveness of the alternative route marker designs. In addition to taking the four tests conducted in this research, each subject was asked to fill out a survey form dealing with their experience with F.M. route markers. The four questions along with the subjects' possible responses can be seen in Figure IV-3. The purpose of these questions was to gain an understanding of whether or not drivers were having difficulty reading the current F.M. route marker and whether or not they would support the idea of redesigning the F.M. route marker so that it is easier to read.

1) Do you find Farm-to-Market highway signs difficult to read when driving in daylight?
☐ no ☐ somewhat difficult ☐ difficult ☐ very difficult

2) Do you find Farm-to-Market highway signs difficult to read when driving at night?
☐ no ☐ somewhat difficult ☐ difficult ☐ very difficult

3) Have you ever missed a turn onto a Farm-to-Market highway because you couldn't read the route marker in time to slow down and turn?
☐ no ☐ once or twice ☐ occasionally ☐ often

4) Do you think the Farm-to-Market route marker should be redesigned so it is easier to read?
☐ strongly against ☐ against ☐ neutral ☐ agree ☐ strongly agree

Figure IV-3. Questions Dealing with Subject Experience with F.M. Route Markers

Glance Legibility Test

The glance legibility test determined the minimum duration of time required by subjects to perceive and identify the numbers, words, and symbols on the various route marker designs. The stimuli in this test were slides of the 7 route marker designs. Each route marker presented a different highway number. The highway numbers used were actual F.M. highway numbers, but were not located in the county that the participants lived in or any surrounding county. These numbers were selected to avoid familiarity with the highway numbers, which would allow for recognition as opposed to identification. A tachistoscope controlled the length of time the slides were presented on the screen. Each slide was shown at observations of 5, 10, 20, 50, 100, 200, 500, 1000, and 2000

milliseconds (.005 to 2 seconds). The order in which the slides were presented was varied so that the participant would not see the same number repeated in successive route markers. The task of the subject was to write down the highway numbers, words, and symbols present on the route marker design.

Filtered Identification Test

The filtered identification test provided an understanding of the relationships between the legibility of the various sign elements and gave an indication of the level of performance of each design under adverse viewing conditions. A computer program digitally filtered the sign images. This process degraded the legibility of the designs through a number of quantifiable steps to the point of being blurred beyond recognition. The stimuli in this test were the slides of the route markers shown at the various levels of legibility at durations of 1 second. Appendix E shows the series of slides prepared for two of the route markers evaluated in the test. The task of the subject was to identify the highway number, words, and symbols present on the route marker designs.

Reaction Time Test

The reaction time test measured the time required by subjects to discriminate a prespecified highway number from a sign assembly. The stimuli in this test were 7 slides of sign assemblies. Each sign assembly consisted of 3 F.M. route markers of the same design, but with different highway numbers, and 1 U.S. highway route marker. Figure IV-4 illustrates the sign assembly featuring the current F.M. route marker. The slides were shown to the subjects with the aid of the tachistoscope at times of 5, 10, 20, 50, 100, 200, 500, 1000, and 2000 milliseconds (.005 to 2 seconds). The subject's task was to indicate the position of a prespecified highway number in the assembly: upper left, lower left, upper right, or lower right.

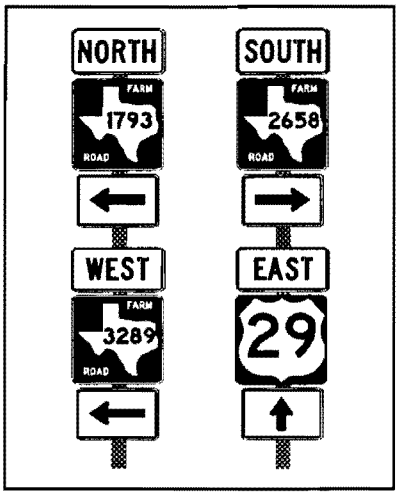


Figure IV-4. Reaction Time Test Assembly

Preference Test

The importance of preference testing is generally viewed as relatively low compared with other measures of effectiveness such as glance legibility and reaction time. It does, however, provide an additional evaluation technique in the event that several designs perform equally well under the other evaluation tests. The preference test gives an indication of public acceptance of each design should it be implemented. The preference test was administered after the other tests had been completed. Each subject was given a sheet of paper which showed the 7 F.M. route marker designs side by side. The task of the subject was to rank the designs from 1 to 7 in order of preference, with 1 being the most preferred design and 7 being the least preferred.

Results of Evaluation Tests

The selection of subjects for this study focused on the needs of the older driver. An older driver was defined in this study as being age 60 and older, while younger drivers were defined as being under the age of 60. Of the 70 subjects who participated in this research, 52 were classified as being older drivers and 18 were classified as being younger drivers. The mean age in the older group was 71.8 (standard deviation = 6.3) and the mean age in the younger group was 28.4 (standard deviation = 8.9). The selection of subjects attempted to create a balanced sample with respect to gender. The younger driver group consisted of 9 men and 9 women, while the older driver group consisted of 25 men and 27 women. All of the subjects were licensed drivers.

F.M. Route Marker Experience Survey

Figure IV-5 summarizes the results of the survey regarding driver experience with F.M. route markers. Although the majority of subjects reported that they did not have any trouble reading F.M. route markers in daylight (Question 1), a majority indicated that they did have trouble reading the markers when driving at night (Question 2). The third question on the survey sought information on whether drivers had difficulty reading the current F.M. route marker. If the marker provided adequate legibility, it would be expected that there would be few responses to missing turns because of inadequate distance to decelerate and turn. However, 74 percent of the subjects in this research reported they had missed turns onto F.M. highways because they could not slow down in time to make the turn. The fact that such a high percentage of subjects missed turns because they did not

have enough time to slow down and turn is evidence that the current F.M. route marker does not provide adequate legibility for a large percentage of drivers. The last question on the survey sought public opinion as to whether or not drivers felt that the current F.M. route marker should be redesigned so that it is easier to read. Although 35 percent of the subjects were neutral, only 2 percent were against the redesign and a majority of 63 percent were in favor of the redesign. Forty-nine percent of the subjects who responded that they did not have any trouble reading the F.M. route marker were in favor of redesigning the F.M. route marker so that it is easier to read.

1) Do you find Farm-to-Market highway signs difficult to read when driving in daylight?
   - 73% No
   - 26% Somewhat Difficult
   - 1% Difficult
   - 0% Very Difficult

2) Do you find Farm-to-Market highway signs difficult to read when driving at night?
   - 29% No
   - 38% Somewhat Difficult
   - 19% Difficult
   - 14% Very Difficult

3) Have you ever missed a turn onto a Farm-to-Market highway because you couldn't read the route marker in time to slow down and turn?
   - 26% No
   - 41% Once or Twice
   - 30% Occasionally
   - 3% Often

4) Do you think the Farm-to-Market route marker should be redesigned so it is easier to read?
   - 1% Strongly Against
   - 1% Against
   - 35% Neutral
   - 46% Agree
   - 17% Strongly Agree

Figure IV-5. Results from Driver Experience with F.M. Route Marker Survey

Glance Legibility Test

Each subject's responses were graded as either correct or incorrect for each of the durations of exposure. A response was rated as correct if the highway number, words, and symbol of Texas were all correctly identified. Because each subject made observations on the same images at 9 different durations of exposure, it was possible for subjects to make a correct response at one duration of exposure, but then make an incorrect response at the next duration of exposure. This phenomena was

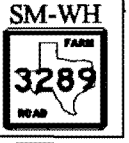
noted to occur with a large percentage of subjects. Therefore, two different glance legibility times were reported for each subject and each design. The term "best" glance legibility time was used to indicate the duration of exposure at which the subject first made a correct response. The term "certain" glance legibility time was used to indicate the duration of exposure from which the subject made only correct responses on the remainder of the durations of exposure. For subjects failing to make either a best or certain correct response at any of the durations of exposure for a design, an artificial value of 2500 ms was assigned as their glance legibility time.

A one-way analysis of variance (ANOVA) test was used to analyze the glance legibility data. Duncan's multiple range test was used to make paired comparisons of the mean reaction times for each design. This analysis was performed separately for the best and certain glance legibility times. The mean best and certain glance legibility times for the sign designs can be seen in Table IV-3 and Table IV-4 respectively.

Table IV-3. Mean Best Glance Legibility Times (ms)

WH-FM	WH-FMRD	W/B-FMRD	W/B-TXFM	WH-FMTX	SM-BLK	SM-WH
						
625.4	845.6	957.7	1285.9	1289.4	1658.0	1737.1

Table IV-4. Mean Certain Glance Legibility Times (ms)

WH-FM	W/B-FMRD	WH-FMRD	W/B-TXFM	WH-FMTX	SM-BLK	SM-WH
						
893.0	1044.7	1048.2	1539.3	1565.6	1729.4	1782.9

The results of the best and certain glance legibility tests were very similar with respect to the ranking of designs by mean legibility times. The WH-FM design performed the best in both best and certain glance legibility measurements. Designs without symbols of Texas performed significantly better than designs with symbols of Texas in both the best and certain measurements. Less time is required to perceive the designs which are less complex and present less information than the designs which are more complex and present a greater amount of information. The SM-BLK design, which is the current route marker, performed poorly in comparison with the alternative designs.

The results of this analysis are represented schematically in Figures IV-6 and IV-7. In these representations, designs connected with lines were not significantly different in terms of best or certain glance legibility times, whereas designs not connected by lines were significantly different. For example, the WH-FM design in Figure IV-6 did not have significantly lower best glance legibility times than the WH-FMRD design. However, the WH-FM design did have significantly lower best glance legibility times than the remaining designs. Likewise the WH-FMRD design did not have significantly different best glance legibility times from the WH-FM or W/B-FMRD designs, but did have significantly different best glance legibility times than the remaining designs.

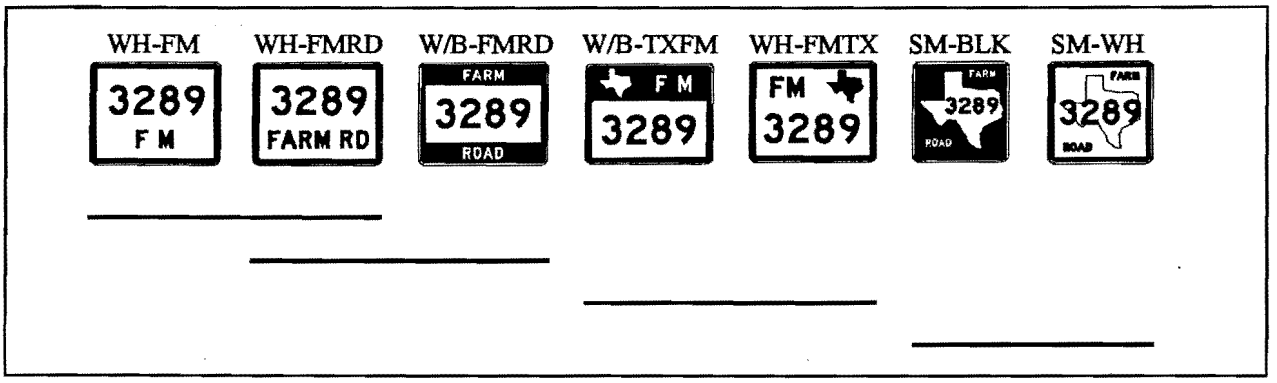


Figure IV-6. Schematic Representation of the Statistical Analysis of Best Glance Legibility Times

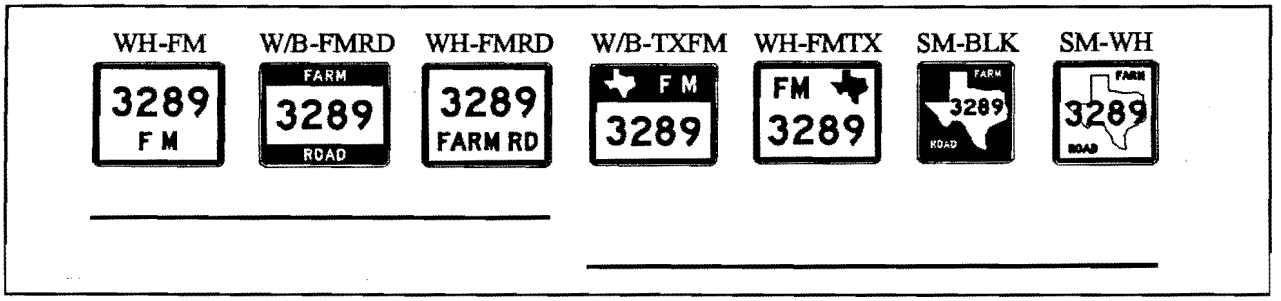


Figure IV-7. Schematic Representation of the Statistical Analysis of Certain Glance Legibility Times

Filtered Identification Test

Each subject's response was rated as correct or incorrect independently for each of the three sign elements, i.e. highway number, words, and symbol of Texas. The data were reduced by recording the filter level that each element first became correct for each subject and each sign design. A separate analysis was performed for each of the three sign elements. The Friedman two-way analysis

of variance test was used to analyze the filtered identification data. This test is a nonparametric rank-based test and was performed separately for the three sign elements. The Friedman test statistic was compared with the F distribution.

The analysis of the highway numbers indicates that there are statistical differences among the designs with respect to the legibility of the highway numbers. The results of this analysis are represented schematically in Figure IV-8. Route markers connected by horizontal lines are not statistically different from each other in terms of the filtered identification of the highway numbers, whereas route markers not connected by lines are significantly different.

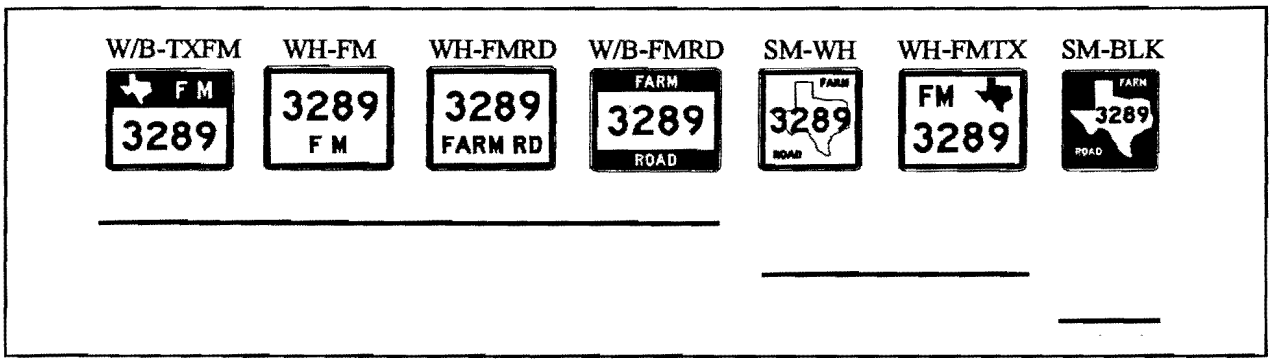


Figure IV-8. Schematic Representation of the Statistical Analysis of the Filtered Identification of the Highway Numbers

The results from the analysis of the presentation of highway number on the designs are consistent with predicted results with one exception. It was expected that the highway numbers on the designs with 178 mm (7 in) numbers would be significantly more legible than the other two designs with smaller numbers. This was true with the exception that the 178 mm (7 in) highway numbers on the WH-FMTX design were significantly less legible than the other 178 mm (7 in) numbers and not significantly different from the legibility of the highway number on the SM-WH design, which only featured 127 mm (5 in) highway numbers. In general, with this exception, the 178 mm (7 in) highway numbers were found to be significantly more legible than the 127 mm (5 in) highway numbers, which in turn were found to be significantly more legible than the 102 mm (4 in) highway numbers.

The analysis of the words in the route markers indicates that there are statistical differences among the designs with respect to the legibility of the words denoting the classification of the highway as an FM Highway. The results of this analysis are represented schematically in Figure IV-9.

The letters "FM" on the WH-FM design were significantly more legible than the methods used on the other designs. Also, the presentation of "FM" with black letters on a white background was significantly more legible than the presentation of "FM" with white letters on a black background. However, no significant difference in legibility existed in the comparison of the presentation of "Farm Road" with black letters on a white background versus white letters on a black background.

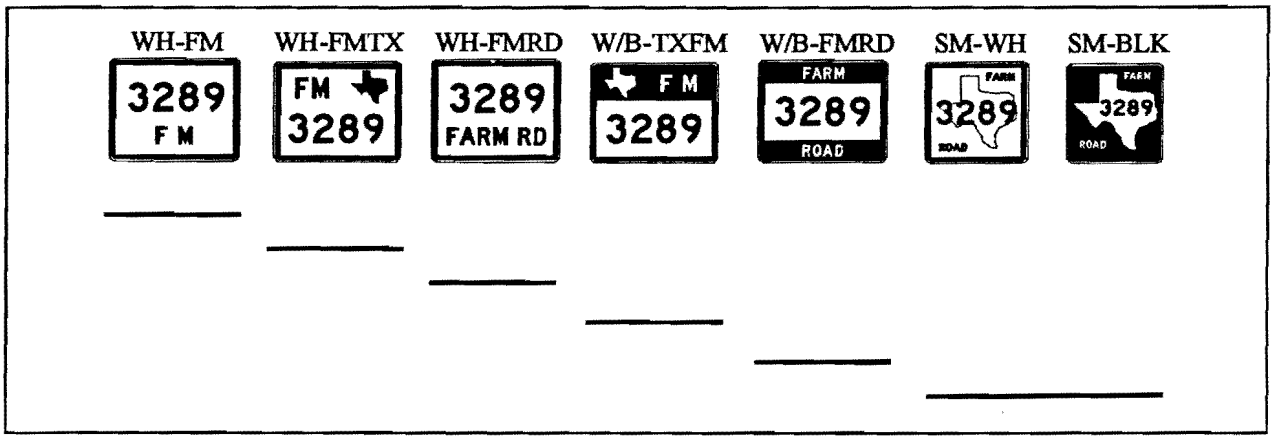


Figure IV-9. Schematic Representation of the Statistical Analysis of the Filtered Identification of Words

The analysis of the Texas shape indicates that there are statistical differences among the designs with respect to the manner in which the route marker was identified with the state of Texas. The results of this analysis are represented schematically in Figure IV-10.

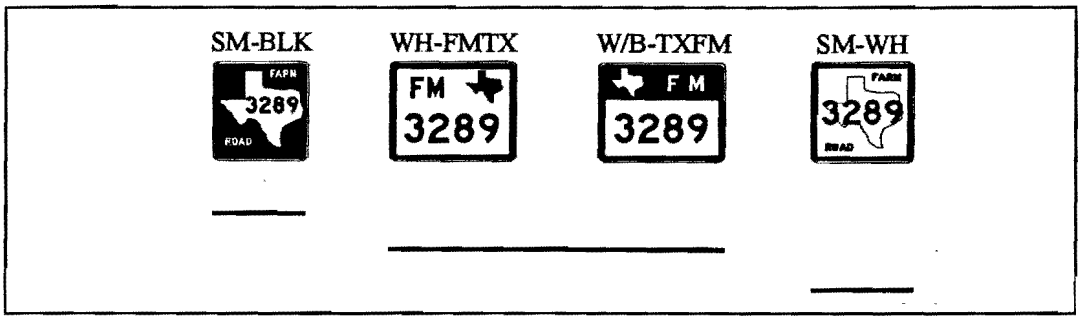


Figure IV-10. Schematic Representation of the Statistical Analysis of the Filtered Identification of the Texas Shape

The large shape of Texas on the current F.M. route marker was significantly more legible than the symbols of Texas presented on the other designs. No significant difference existed in a comparison of the legibility of equal size symbols of Texas with a black symbol on a white

background on the WH-FMTX design versus a white symbol on a black background on the W/B-TXFM design. The thin outline of Texas on the SM-WH design was significantly less legible than the symbols of Texas on the other designs. Furthermore, this design has the potential to detract from the legibility of the highway number, as the highway numbers overlay the border of Texas.

Reaction Time Test

Each subject's response was rated as either correct or incorrect for each duration of exposure. Because each subject made observations on the same images at 9 different durations of exposure, it was possible for subjects to make a correct observation at one duration of exposure, but then make an incorrect response at the next duration of exposure. This phenomena was noted to occur with the majority of subjects. Therefore, two different reaction times were reported for each subject and each design. The term "best" reaction time was used to indicate the duration of exposure at which the subject first made a correct response. The term "certain" reaction time was used to indicate the duration of exposure from which the subject made only correct responses on the remainder of the durations of exposure. For subjects failing to make either a best or certain correct response at any of the durations of exposure for a design, an artificial value of 2500 ms was assigned as their reaction time.

A one-way analysis of variance (ANOVA) test was used to analyze the reaction time data. Duncan's multiple range test was used to make paired comparisons of the mean reaction times for each design. This analysis was performed separately for the best and certain reaction times. Tables IV-5 and IV-6, respectively, illustrate the mean best and certain reaction times for the sign designs.

Table IV-5. Mean Best Reaction Times (ms)

WH-FM	WH-FMRD	W/B-FMRD	WH-FMTX	SM-WH	W/B-TXFM	SM-BLK
						
641.2	668.4	744.1	865.2	893.6	909.1	1572.6

Table IV-6. Mean Certain Reaction Times (ms)

WH-FM	W/B-FMRD	WH-FMRD	WH-FMTX	SM-WH	W/B-TXFM	SM-BLK
						
1033.9	1085.0	1113.6	1166.0	1196.4	1268.6	1860.0

The statistical analysis of the results of the reaction time evaluation are schematically represented in Figures IV-11 and IV-12. The results of the best and certain reaction time tests were very similar with respect to the ranking of sign designs by mean reaction times. The WH-FM design performed the best in both best and certain reaction time measurements. No significant differences existed among the alternative designs, however, all of the alternative designs displayed significantly lower reaction times that the SM-BLK design, which is the current route marker.

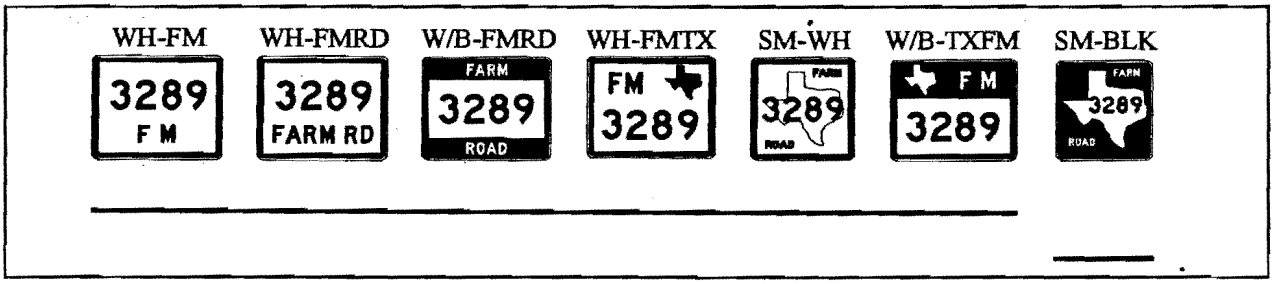


Figure IV-11. Schematic Representation of the Statistical Analysis of the Best Reaction Time

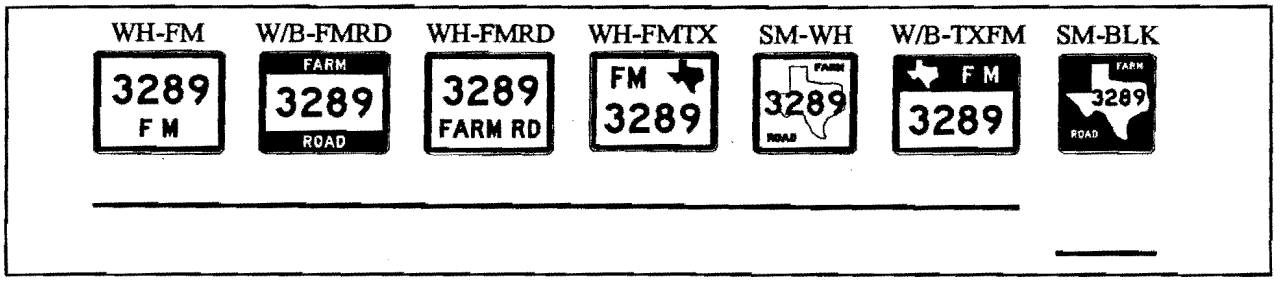


Figure IV-12. Schematic Representation of the Statistical Analysis of the Certain Reaction Time

Preference Test

Each subject ranked the F.M. route marker designs from 1 to 7, with 1 being the most preferred sign design and 7 being the least preferred sign design. A preference rating was determined by summing the ranks for each design. As a sign rating of 1 is the most preferred, low preference rankings indicate high preference designs. The preference ratings of the F.M. route marker designs can be seen in Table IV-7. The Friedman two-way analysis of variance test was used to analyze the preference data.

Table IV-7. Preference Ratings for the F.M. Route Marker Designs

WH-FM	WH-FMRD	WH-FMTX	W/B-FMRD	W/B-TXFM	SM-BLK	SM-WH
						
178	185	211	260	276	376	446

The analysis of the preference test data indicates that there are significant differences among the preference rankings of the route marker designs. Figure IV-13 provides a schematic representation of the results of this analysis. The results of the preference test indicated that the most preferred design was the WH-FM design. It was also found to be preferred significantly more than all of the designs except the WH-FMRD design which was the second most preferred design. As shown in Table IV-7, the subjects participating in this research preferred the designs with all white backgrounds as opposed to designs containing a significant amount of black background. The SM-BLK design, which is the current route marker, performed poorly in the preference test and was only preferred over one of the alternative designs.

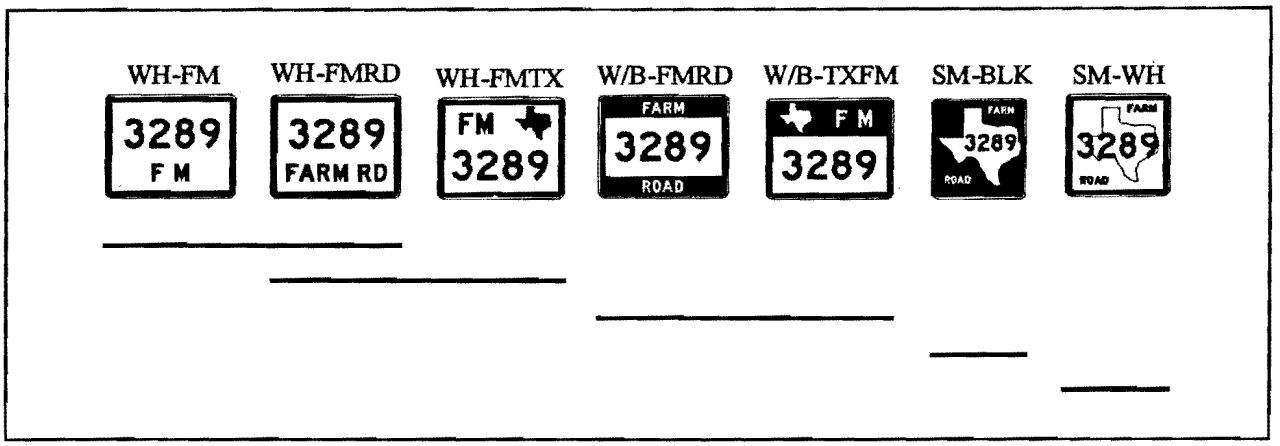


Figure IV-13. Schematic Representation of the Statistical Analysis of the Preference Ratings

SUMMARY OF EVALUATION FINDINGS

The four laboratory tests used in this study allowed evaluation of alternative F.M. route marker designs and comparison with the current F.M. route marker. An assessment of the effectiveness of the 7 designs was performed.

- Twenty-seven percent of the subjects indicated that they had some difficulty reading F.M. route marker designs when driving in daylight.
- Seventy-one percent of the subjects indicated that they had some difficulty reading F.M. route markers when driving at night.
- Seventy-four percent of the subjects reported that they had missed turns onto F.M. highways before because they could not read the F.M. route marker in time to slow down and turn.
- Sixty-three percent of the subjects favored redesigning the F.M. route marker so that it is easier to read.
- The WH-FM design performed the best in both the best and certain glance legibility measurements.
- The WH-FM design performed the best in the filtered identification test in the analysis of the words used to indicate the highway classification.
- The WH-FM design performed the best in both the best and certain reaction time measurements.
- The WH-FM design was the most preferred design in the preference test.

- The current F.M. route marker consistently performed poorly, usually coming in sixth or seventh place out of the 7 F.M. route marker designs.
- The designs without symbols of Texas consistently performed better in the glance legibility test, reaction time test, and preference test than designs with symbols of Texas.
- Some subjects commented that the symbol of Texas clutters the route marker and makes it more difficult to read.
- The 762×610 mm (30×24 in) designs consistently performed better than the 610×610 mm (24×24 in) designs.

The alternative F.M. route marker design shown in Figure IV-14 was found to be the most effective design in all four of the evaluation procedures. However, before this design can be recommended for replacement of the existing design, controlled field testing should be conducted to evaluate the actual effectiveness of the alternative design.

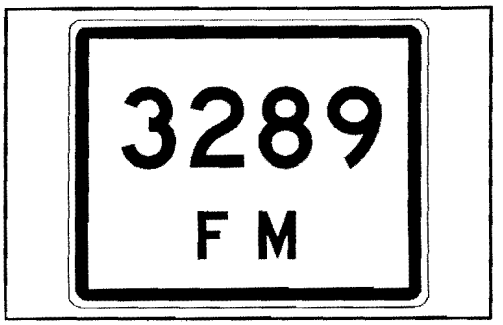


Figure IV-14. Recommended Design for F.M. Route Marker

CHAPTER V
EVALUATION OF COMBINATION SIGNS

The first-year report for this study (3) pointed out that different philosophies are used for guide signing on conventional highways and freeways. The major emphasis of conventional highway guide signing is on route number and cardinal directions. This information is provided at the intersection where the maneuver is completed. Destination information (city names) is provided in advance of an intersection/interchange, but following the Junction marker (route number information). The major emphasis of freeway signing is on destinations. Control cities and street names are used in all guide signs to provide the primary exiting and advance information for drivers. Route shields and cardinal directions are used to support the destination information in freeway signs.

The driver survey administered during the first year of this study evaluated several aspects of conventional guide signing, including the navigational information needs of drivers, how drivers use navigational information, and driver understanding of conventional guide signs (3). One question investigated the sequence of guide signs at conventional highway intersections. The correct sequence was generally recognized; however, the positions of the destination sign and directional assembly were frequently reversed. The directional assembly was placed in advance of the intersection more often than the destination sign. A second question asked drivers to identify the most important types of information provided by guide signs. The highway number and the name of the next city or town were ranked highest in this evaluation. A third question asked drivers to indicate the relative importance of several different types of guide signs. The signs considered most important included the destination sign, route markers, and arrow markers.

The widespread use of freeway-type guide signing, combined with the results of the first-year survey, indicate that signing which combines both highway number and destination information into the same sign may be useful to drivers. The combination of all this information into a single conventional guide sign, however, significantly increases the amount of information that the driver must process. Therefore, several different methods for combining this information into a single sign were developed and evaluated. These signs have been labeled as "combination signs" because of the amount of information that has been combined into a single sign. Although this type of signing may have some application at intersections, the large amount of information presented in the sign leads

to the use of these signs in advance of an intersection where the demand for driver attention is reduced. This chapter describes the development, testing, and evaluation of these combination guide signs.

DESCRIPTION OF COMBINATION SIGN DESIGNS

In order to convey both destination and highway route number information to drivers at highway intersections, several concepts were devised for combination signing. These signs combine the functions of the destination sign and the directional assembly. Each combination sign provides four types of information:

- destination name (city or town name),
- highway route number (route marker),
- direction of travel on the designated highway route (cardinal direction marker), and
- direction to turn to go in the indicated direction on the designated highway route (directional arrow marker).

Three unique systems of combination signs were developed: blended assembly, horizontal display, and vertical display. The signs vary in the presentation of the four types of information. Two- and three-destination combination signs were developed for each of the three sign systems corresponding to the use of the sign at both three-leg (two destination names) and four-leg intersections (three destination names).

Blended Assembly (Group I Signs)

The blended assembly combination sign integrates the standard destination sign and the standard directional assembly into a single sign assembly. The resulting assembly consists of route markers, directional arrows, cardinal direction markers, and destination signs. The cardinal direction markers, route markers, and directional arrows are arranged at the top of the sign assembly. Destinations are grouped at the bottom of the assembly, and directional arrows are displayed to the left or right of the city or town name as appropriate. For the purposes of this evaluation, this sign system is designated "Group I." Three variations of the blended combination assembly were developed for the following intersection types:

- Three-leg intersection to the left (two destinations),
- Three-leg intersection to the right (two destinations), and
- Four-leg intersection (three destinations).

The blended assembly for both left and right turns at three-leg intersections was not evaluated. Figure V-1 illustrates a typical blended combination assembly for a three-leg intersection to the left. Figure V-2 depicts a typical blended sign for a four-leg intersection.

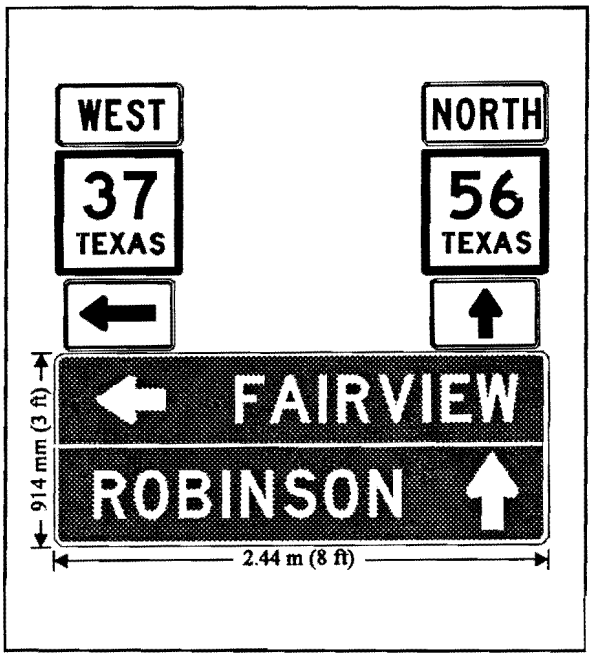


Figure V-1. Combination Assembly (Group I), Three-Leg Intersection to the Left

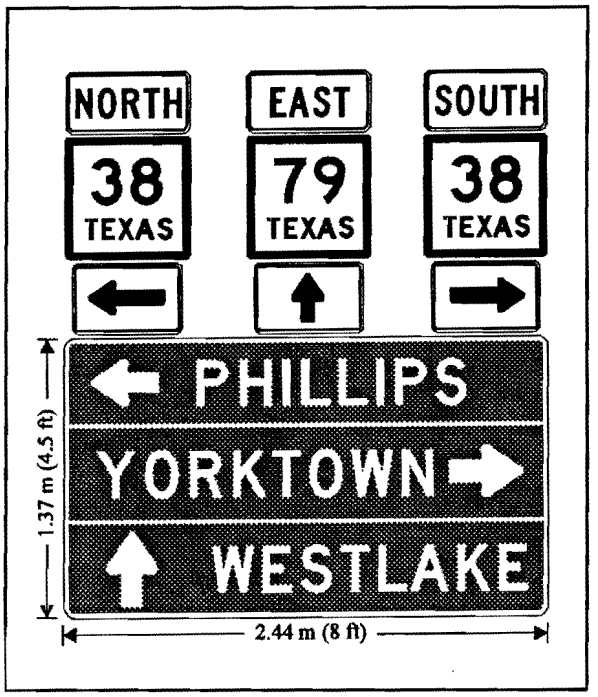


Figure V-2. Combination Assembly (Group I), Four-Leg Intersection

Horizontal Display (Group II Signs)

The horizontal display combination sign presents the navigational information for each direction (departure leg) on a long panel (horizontal axis). The individual panels are stacked on top of each other to comprise an assembly. Each panel includes a cardinal direction marker, a highway route marker, a destination name, and a directional arrow. Either two or three separate panels comprise each sign, depending on the type of intersection or the number of destinations. At minor intersections, the through route signing may be omitted. Three panels are used at four-leg intersections, two for the turning movements and one for the through movement. Signs for three-leg

intersections utilize two panels, one for the through and one for the turning movement, or one for each turning movement to the right and to the left, as may be the case. For the purposes of this evaluation, this sign system is designated "Group II."

Three sign types were studied. Horizontal display combination signs address four specific types of highway intersection:

- Three-leg with turns to the left (two destinations),
- Three-leg with turns to the right (two destinations),
- Three-leg with turns to the left and right (two destinations), and
- Four-leg intersection with left and right turns plus through movements (three destinations).

Two variations of the two-destination signs for three-leg intersections were investigated. The third option for three-leg intersections was not evaluated by this study. Figure V-3 illustrates a typical horizontal display combination guide sign for application at a three-leg intersection to the right. Figure V-4 shows a typical horizontal display sign for a four-leg intersection.

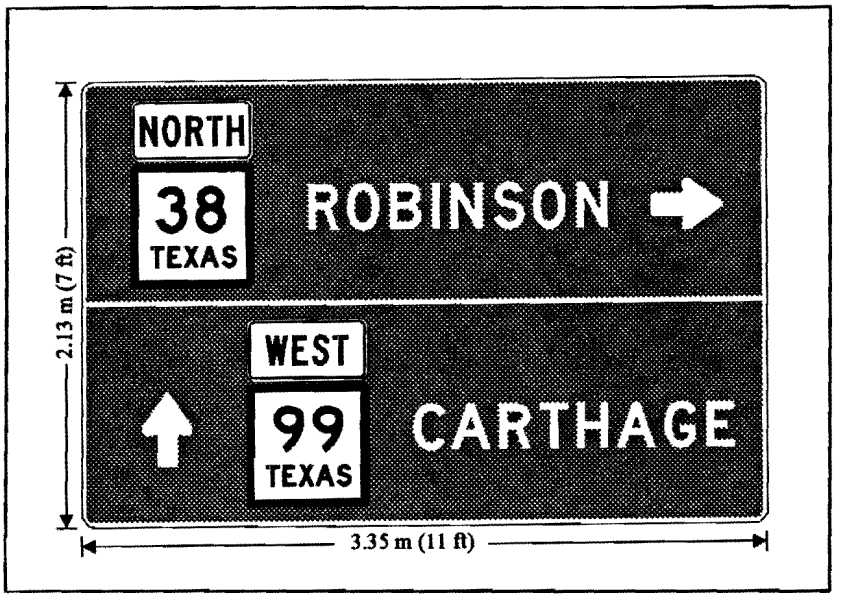


Figure V-3. Horizontal Display Sign (Group II), Three-Leg Intersection to the Right

Navigational information is presented in the order of cardinal direction and highway route number first, followed by the destination name. When a left turn must be made to reach the indicated destination or to travel on a given highway, the left directional arrow is positioned at the far left of the sign, preceding the navigational (route number and destination) information. Similarly, for highway routes or destinations requiring a turn to the right, the right directional arrow is positioned at the far right of the sign, after the navigational information. The panel containing the navigation

information and directional arrow for the through movement is located at the bottom of the sign assembly. At four-leg intersections, the vertical arrow for the through movement is placed at the far left of the panel.

At three-leg intersections, the position of the directional arrow and navigational information for the through movement varies, depending on whether it is a left or right three-leg intersection. The directional arrow for the through movement is always placed on the opposite side of the sign from the directional arrow for the turning movement. If the intersection is a T to the left, the vertical directional arrow is located at the far right of the sign panel containing the through movement navigational information. The highway route number and destination name for the through movement are at the left of the sign panel. If the intersection is a T to the right, the vertical arrow is placed at the far left of the sign panel, and the navigational information goes to the right of the arrow.

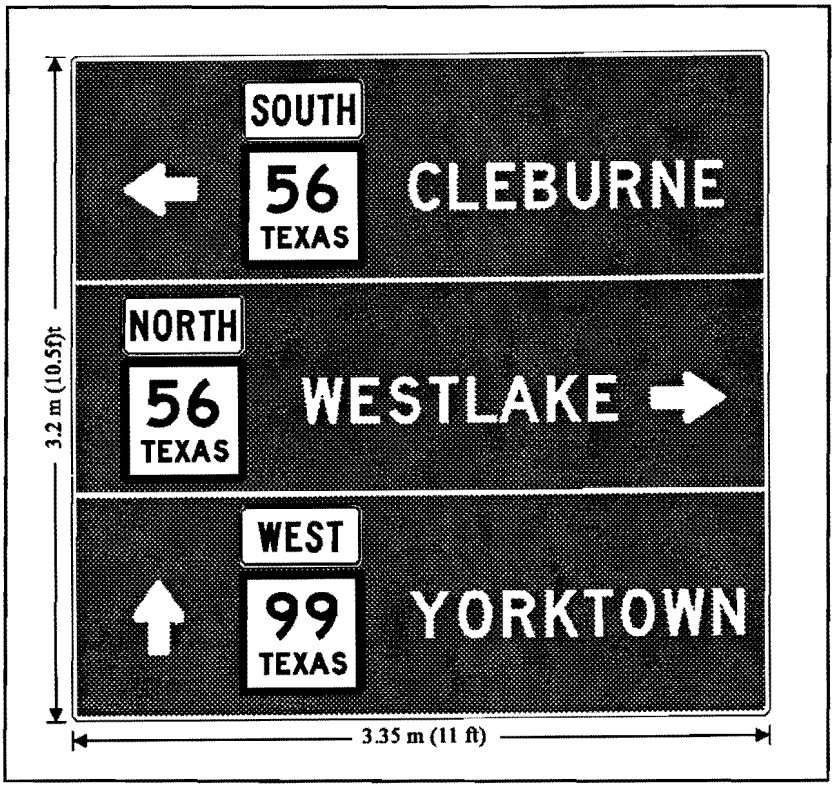


Figure V-4. Horizontal Display Sign (Group II), Four-Leg Intersection

Vertical Display (Group III Signs)

The vertical display combination sign presents the navigational information for each direction (departure leg) on a tall panel (vertical axis). The individual panels are arranged side-by-side to comprise an assembly. Each panel includes a cardinal direction marker, a highway route marker, a destination name, and a directional arrow. The vertical display sign format is very similar to standard freeway and expressway guide signs. Either two or three separate panels comprise each sign, with two panels used at three-leg intersections and three panels used when three destination names must

be shown at four-leg intersections. For the purposes of this evaluation, this sign system is designated "Group III."

Three sign types were studied. The vertical display combination guide signs address four specific types of highway intersection:

- Three-leg with turns to the left (two destinations),
- Three-leg with turns to the right (two destinations),
- Three-leg with turns to the left and right (two destinations), and
- Four-leg intersection with turns to the left and right plus through movements (three destinations).

Three-leg intersections with turns to the left and right and no through movement were not evaluated. Figure V-5 illustrates a typical vertical display combination guide sign for a three-leg intersection to the left. A vertical display combination guide sign for use at a four-leg intersection with left and right turns and through movements is shown in Figure V-6.

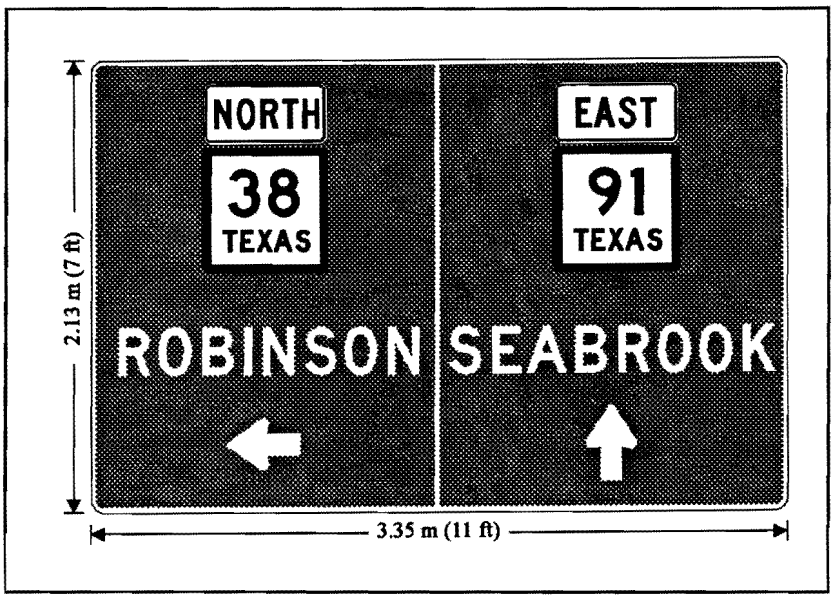


Figure V-5. Vertical Display Sign (Group III), Three-Leg Intersection to the Left

Navigational information is presented from the top to the bottom of the sign, in the order: cardinal direction, highway route number, destination name, and directional turn arrow. At three-leg intersections to the left, the left turn information is in the left panel, and the navigational information for the straight or through movement is in the right panel. The reverse is true for three-leg intersections to the right. The right turn information is in the right panel and the through movement information is in the left panel. At four-leg intersections, the center panel shows the navigational

information for the through movement. The left and right panels display information for the left and right turns, respectively.

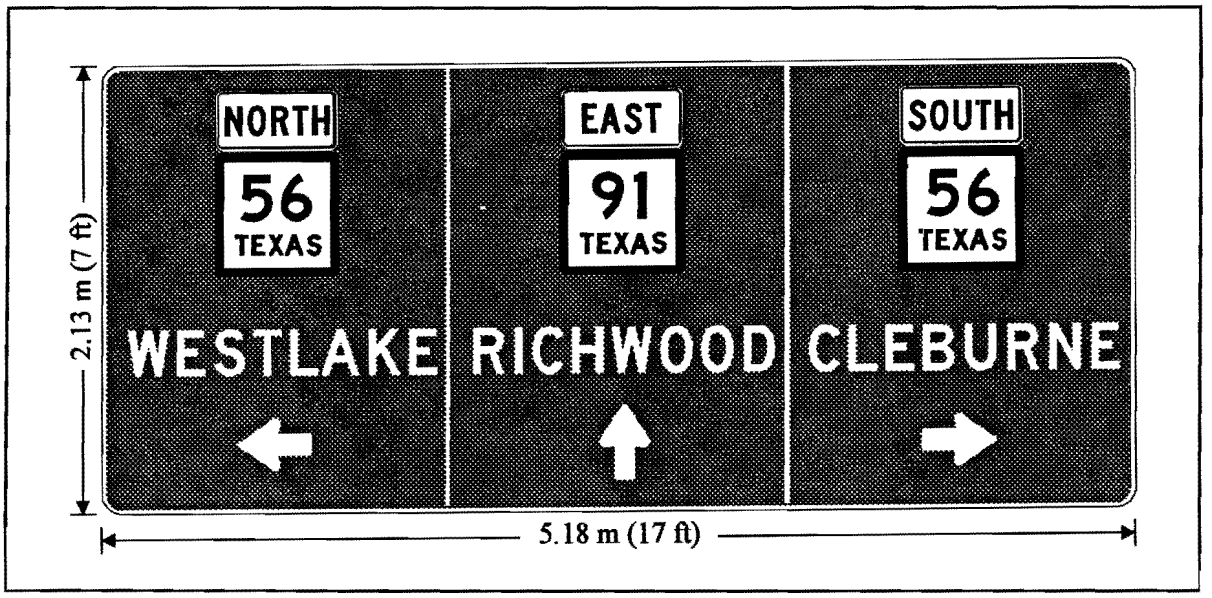


Figure V-6. Vertical Display Sign (Group III), Four-Leg Intersection

STUDY METHODOLOGY

A laboratory reaction time test evaluated the effectiveness of the new combination guide signs. The evaluation procedure was similar to the reaction time test used to evaluate alternative designs for the F.M. route marker (see Chapter IV). This sub-section describes the fifteen signs that were evaluated and discusses the equipment requirements, measures of effectiveness, and study procedures.

Description of Signs

Fifteen combination signs were evaluated during this evaluation: four Group I blended assemblies, seven Group II horizontal displays, and four Group III vertical display combination signs. The signs were numbered to facilitate collection and processing of the test data. The following descriptions provide descriptions of each of the signs. Appendix F illustrates the signs used in the evaluations.

Group I Blended Assemblies - Signs 4, 7, 12, and 13

Four signs were evaluated, including two for use at three-leg intersections and two for application at four-leg intersections. Two signs were evaluated for each type in order to have two data points for evaluating the results of the evaluation.

- Sign 4 (Figure F-1) is for a three-leg intersection to the right. West State Highway (S.H.) 38 turns right to go to Robinson. South S.H. 43 goes straight to Seabrook.
- Sign 13 (Figure F-2) illustrates a blended guide sign for a three-leg intersection to the left. West S.H. 37 turns left towards Fairview. In the through direction, North S.H. 56 goes toward Robinson.
- Sign 12 (Figure F-3) is for use at a four-leg intersection. West S.H. 91 turns left in the direction of Yorktown. East S.H. 91 turns right to go to Richwood. North S.H. 56, the through movement, goes to Westlake.
- Sign 7 (Figure F-4) is also for use at a four-leg intersection. North S.H. 38 turns left toward Phillips. South S.H. 38 turns right in the direction of Yorktown. East S.H. 79 is the through route and goes to Westlake.

Group II Horizontal Displays - Signs 6, 9, 11, 14, 1, 10, and 15

Seven signs were evaluated, including five for application at a three-leg intersection and two for use at four-leg intersections. Three of the three-leg intersection signs used variations on the order of placement for the individual navigational information elements, such as the directional arrow and the highway route marker. Where the order of information is described, it is assumed that the driver reads the sign panel from left to right.

- Sign 6 (Figure F-5) is the standard horizontal display sign for three-leg intersections to the right. North S.H. 38 turns right to Robinson. The information is in the order: cardinal direction marker plus highway route marker, destination name, and right arrow. West S.H. 99 goes straight to Carthage. The order of information is: vertical directional arrow, cardinal direction marker plus highway route marker, and destination name.
- Sign 10 (Figure F-6) is a variation of Sign 6. The positions of the destination name and the cardinal direction marker/highway route marker for the right turn are reversed, such that the

order of the navigational information becomes: destination name, cardinal direction marker plus highway route marker, and directional arrow.

- Sign 11 (Figure F-7) is the standard horizontal display sign for a three-leg intersection to the left. West S.H. 37 turns left in the direction of Robinson. The order of information is: left directional arrow, cardinal direction marker plus highway route marker, and destination name. North S.H. 56 goes straight to Bellaire. The information is in the order: cardinal direction marker plus highway route marker, destination name, and vertical directional arrow.
- Sign 15 (Figure F-8) is a variation of Sign 11. The positions of the destination name and the cardinal direction marker/highway route marker for the through movement are reversed, such that the order of the navigational information becomes: destination name, cardinal direction marker plus highway route marker, and directional arrow.
- Sign 1 (Figure F-9) is a variation of Sign 11. The vertical directional arrow for North S.H. 56 to Bellaire is moved to the left side of the sign panel. This is the practice described in the MUTCD. All other aspects of the sign remain unchanged.
- Sign 14 (Figure F-10) is a standard horizontal display sign for four-leg intersections. South S.H. 38 turns to the left to Yorktown. North S.H. 38 turns to the right toward Phillips. West S.H. 79 goes straight in the direction of Bartlett.
- Sign 9 (Figure F-11) is a standard horizontal display sign for four-leg intersections. South S.H. 56 turns to the left to Cleburne. North S.H. 56 turns to the right toward Westlake. West S.H. 99 goes straight in the direction of Yorktown.

Group III Vertical Displays - Signs 2, 3, 5, and 8

Four signs were evaluated: two for application at three-leg intersections and two for use at four-leg intersections.

- Sign 8 (Figure F-12) is the standard vertical display sign for a three-leg intersection to the left. North S.H. 38 to Robinson is to the left. Seabrook on East S.H. 91 is the through movement.
- Sign 3 (Figure F-13) is the standard vertical display sign for a three-leg intersection to the right. North S.H. 38 is the through movement and goes to Yorktown. East S.H. 91 to the right goes to Fairview.

- Sign 5 (Figure F-14) is a standard vertical display sign for use at four-leg intersections. North S.H. 56 to the left goes to Westlake. Straight ahead, East S.H. 91 goes to Richwood. A right turn on South S.H. 56 goes to Cleburne.
- Sign 2 (Figure F-15) is a standard vertical display sign for use at four-leg intersections. East S.H. 79 turns left to go to Westlake. South S.H. 38 goes straight to Yorktown. A right turn on West S.H. 79 goes to Bartlett.

Equipment Requirements

The laboratory evaluation measured the performance of the proposed combination signs. The study design allowed evaluation of the individual signs and each of the three sign systems. The laboratory evaluation required the following equipment:

- Slides of alternative signs;
- Tachistoscope;
- Slide projector;
- Projection screen;
- Response form; and
- Writing instrument to record responses.

The evaluation was conducted in a conference room at TTI's offices in College Station. The test administrator was present at all times during the evaluation. The test administrator's responsibilities included: introducing the evaluation and providing instructions, distributing response forms and writing utensils, operating the tachistoscope and slide projector, reading turn instructions for each sign at each time setting, and collecting the completed response forms at the end of the evaluation.

Measures of Effectiveness (MOEs)

Reaction time served as the basic measure-of-effectiveness (MOE) for the signs. A simulated reaction time test measured the time required by each test subject to process the sign information and give a correct response. The tachistoscope allowed nine possible exposure settings: 5, 10, 20, 50, 100, 200, 500, 1000, and 2000 ms (0.005 to 2.0 seconds). Two reaction time MOEs were examined: best reaction time (BRT) and certain reaction time (CRT). The best reaction time was the exposure

setting on the tachistoscope corresponding to the first correct response for a given slide. The certain reaction time was defined as the exposure setting on the tachistoscope corresponding to the first correct response for which there were no subsequent incorrect responses. To illustrate the concept of best and certain reaction times, consider the following example. Table V-1 presents hypothetical responses for a test subject.

Table V-1. Example of Best and Certain Reaction Times

Tachistoscope Setting	Exposure (ms)	Subject Response
1	5	left
2	10	not sure
3	20	**RIGHT***
4	50	left
5	100	straight
6	200	left
7	500	**RIGHT+**
8	1000	**RIGHT**
9	2000	**RIGHT**

Notes: *Indicates best response time (BRT).
+Indicates certain response time (CRT).

Assume that the correct response for the slide is "right" (the correct responses are highlighted). In this hypothetical case, the first correct response registered by the subject is at 20 ms; therefore, this is the subject's BRT. The certain reaction time is 500 ms, since incorrect responses were given at the fourth, fifth and sixth tachistoscope settings, but correct responses were recorded for all subsequent trials (settings 7 through 9).

Some subjects were unable to provide at least one correct response for a given slide. In other words, it was not possible to measure a BRT or CRT for these slides for these individuals. Similarly, some subjects responded correctly to a slide at one or more tachistoscope settings, however, the last response (at 2000 ms) was incorrect. In these cases, it was possible to identify a BRT but not a CRT. Under these circumstances, an arbitrary BRT or CRT value of 2500 ms was assigned to facilitate the statistical analysis. (2500 ms is one-half sec greater than the highest setting on the tachistoscope.)

Study Procedures

The test administrator stated the name of a destination and the highway to travel to reach that destination. A slide of one of the alternative signs was then flashed on the projection screen. The test subject indicated on the response form the maneuver required at the intersection to reach the destination, based upon the information presented by the sign. There were four possible responses: *turn left*, indicated on the response form by a left arrow or an L; *turn right*, indicated on the response form by a right arrow or an R; *go straight*, indicated on the response form by a vertical arrow or an S; and *not sure/did not see*, indicated on the response form by a dash (-) or an X. A total of 135 observations were recorded for each test subject, determined by fifteen signs tested and nine exposure settings for each sign.

Sixty-seven subjects participated in the evaluation. The subjects were divided into Group A and Group B. Group A contained a total of 37 subjects, while group B contained a total of 30 subjects. During the sign evaluations, both groups were shown the same signs, but were tested over different aspects of those signs. Two questions were developed for signs displaying two destinations, one question pertaining to each destination. One question was asked of the Group A subjects, and the other was asked of the Group B subjects. Two questions were developed for three-destination signs (three questions are possible). Again, one question was asked of the Group A subjects and the other was asked of the Group B subjects.

The two groups were each subdivided into two sub-groups, with designations of A1, A2, B1, or B2. This subdivision of groups was used to account for the possible influence of information presentation order upon the subjects' responses. The number of subjects in each sub-group was as follows: sub-group A1, 20 subjects; sub-group A2, 17 subjects; sub-group B1, 14 subjects; and sub-group B2, 16 subjects. The test administrator made a statement before showing each slide presenting three types of information: the destination, the highway number, and the cardinal direction of the highway. The A1 and B1 sub-groups were provided the navigational information in the following order: destination name, highway route number, cardinal direction. The A2 and B2 sub-groups were provided the navigational information in a different order: highway route number, cardinal direction, destination name.

The Statistical Analysis System (SAS) program was used to calculate the mean and standard deviation of the BRTs and CRTs for individual signs, each sign group, two-name signs, and three-name signs. An analysis of variance procedure (Duncan's multiple range test) was used to analyze the statistical significance of the data. These statistical measures were used to evaluate the performance of the signs and each sign group.

RESULTS OF EVALUATION

Mean BRTs and CRTs for each sign were calculated by sub-group, group, and total sample. Tables V-2 and V-3 illustrate the mean and standard deviation of BRT and CRT, respectively, for each individual sign. The signs are listed in order of performance, from smallest to largest mean reaction time.

Table V-2. Analysis of Best Reaction Times (BRTs) for Individual Signs

Sign	Description	Mean BRT (ms)	Standard Deviation (ms)
13	Blended Assembly, Left T	119	205
11	Horizontal Display, Left T	124	186
3	Vertical Display, Right T	134	226
4	Blended Assembly, Right T	151	237
10	Horizontal Display, Right T	205	412
6	Horizontal Display, Right T	209	268
8	Vertical Display, Left T	219	392
12	Blended Assembly, Four-Leg	233	357
15	Horizontal Display, Left T	239	336
1	Horizontal Display, Left T	249	427
2	Vertical Display, Four-Leg	282	433
7	Blended Assembly, Four-Leg	334	548
14	Horizontal Display, Four-Leg	412	532
9	Horizontal Display, Four-Leg	467	588
5	Vertical Display, Four-Leg	513	624

Table V-3. Analysis of Certain Reaction Times (CRTs) for Individual Signs

Sign	Description	Mean CRT (ms)	Standard Deviation (ms)
11	Horizontal Display, Left T	310	355
4	Blended Assembly, Right T	317	413
13	Blended Assembly, Left T	325	373
3	Vertical Display, Right T	330	434
6	Horizontal Display, Right T	365	402
15	Horizontal Display, Left T	376	412
10	Horizontal Display, Right T	404	546
8	Vertical Display, Left T	428	519
1	Horizontal Display, Left T	488	523
12	Blended Assembly, Four-Leg	534	483
7	Blended Assembly, Four-Leg	535	578
14	Horizontal Display, Four-Leg	684	605
2	Vertical Display, Four-Leg	689	654
9	Horizontal Display, Four-Leg	728	659
5	Vertical Display, Four-Leg	898	638

As described previously, the Group II signs display navigational information for each departure leg on a horizontal panel. In the experiment development stage, the research team proposed three variations of the basic horizontal layout for three-leg intersections. The variations involved changing the order of presentation of the navigational information (cardinal direction, route marker, destination, and arrow). Due to the variability of the three layouts, it would not have been appropriate to include all five three-leg signs in Group II when evaluating the evaluation results. The research team determined that Signs 6 and 11 were preferable to Signs 1, 5, and 10 due to the consistency between panels in the presentation of information. Furthermore, the layout of Signs 6 and 11 were comparable to and consistent with the three-leg signs in Groups I and III. Therefore Signs 6 and 11 were the only three-leg horizontal signs included in the comparisons between the three sign groups.

The mean and standard deviation of BRTs and CRTs for each sign group were calculated. For this procedure, Signs 1, 10, and 15 were eliminated from the Group II signs. Therefore, two two-destination and two three-destination signs comprised each of the three test groups. Table V-4 lists the mean BRT and mean CRT for each sign group. Note that the Group I signs displayed the lowest

mean best and mean certain reaction times. The Group II signs were ranked second for mean CRT, but third for mean BRT. The Group III signs ranked second for mean BRT and third for mean CRT. The Group I mean BRT was significantly less than the Group III and Group II mean BRTs. The Group III mean and Group II mean were not significantly different. Examining the mean CRTs, the Group I mean was significantly less than the Group II and Group III means. Once again, the means for Groups II and III were not significantly different from each other.

Table V-4. Analysis of Best and Certain Reaction Times by Sign Group

Sign Group	Description	Best Response Time		Certain Response Time	
		Mean (ms)	Rank	Mean (ms)	Rank
I	Blended Assembly	209	1	428	1
II	Horizontal Display	303	3	522	2
III	Vertical Display	287	2	586	3

Mean BRTs and CRTs for two-name and three-name destination signs were calculated. Table V-5 lists the mean BRT and mean CRT for two-destination signs. For both mean BRT and mean CRT, the Group I signs exhibited the best performance (the lowest mean reaction times) and the Group III signs performed the worst (the greatest mean reaction times). However, no significant difference existed between the mean BRTs or the mean CRTs for the three sign groups. In other words, while the Group I signs outperformed the Group II and III signs, in statistical terms, the differences were not significant.

Table V-5. Analysis of Reaction Times for Two-Destination Guide Signs

Sign Group	Description	Best Response Time		Certain Response Time	
		Mean (ms)	Rank	Mean (ms)	Rank
I	Blended Assembly	135	1	321	1
II	Horizontal Display	167	2	337	2
III	Vertical Display	176	3	379	3

Table V-6 provides the mean BRT and mean CRT of three-destination signs. As with the other two tests, the Group I signs performed better than either the Group II or the Group III combination guide signs. The Group II signs ranked second for mean CRT and third for mean BRT. The Group III signs ranked third for mean CRT and second for mean BRT. The Group I and Group II mean

BRTs were significantly different; however, the mean BRT for Group III was not significantly different from either the Group I or the Group II means. The Group I mean CRT was significantly different, while the Group II and Group III means were not significantly different.

Table V-6. Analysis of Reaction Times for Three-Destination Guide Signs

Sign Group	Description	Best Response Time		Certain Response Time	
		Mean (ms)	Rank	Mean (ms)	Rank
I	Blended Assembly	283	1	535	1
II	Horizontal Display	440	3	706	2
III	Vertical Display	397	2	793	3

SUMMARY OF FINDINGS

A laboratory evaluation was used to assess the relative performance of three new systems of combination guide signs. The basic measure of effectiveness was reaction time. This variable was examined in terms of the best reaction time (BRT) and the certain reaction time (CRT) for each individual sign. Given this data, it was possible to determine BRTs and CRTs for each of the three sign systems. Mean BRT and mean CRT were used to describe the performance of each sign and each sign system.

Six comparisons were performed on the reaction time data. The first two tests compared the mean BRTs and mean CRTs of sign groups. The third and fourth comparisons were between the mean BRTs and mean CRTs of two-destination (three-leg intersection) signs from each group. The final two comparisons were between the mean BRTs and mean CRTs of three-destination signs from each group.

In each of the six comparisons, the Group I blended assemblies performed the best. The Group I signs exhibited the smallest mean BRT and mean CRT in each comparison. In three of the six comparisons, the difference in performance between the Group I signs and the signs from Groups II and III was statistically significant. In one of the six comparisons, the difference between the performance of the Group I signs and the Group II signs was statistically significant, but not between the Group I and Group III signs.

On the basis of the reaction time testing, it may be concluded that the blended assembly is the more effective means of communicating highway route number, cardinal direction, destination, and turn information to drivers in a single sign assembly. This conclusion is based on very limited laboratory evaluations of the three sign systems. Additional testing, including field testing, would be required to state definitively that any of the three systems is optimal. The results of this limited laboratory investigation, however, provide evidence that the blended assembly is preferred.

It should also be noted that of the three combination sign systems that were tested, the blended assembly was the most similar to standard conventional highway guide signing. Signs very similar to Group II signs are in limited use at some locations in the state. Group III signs are similar in their design and layout to standard expressway and freeway guide signs. The fact that the Group I signs performed better than the two alternative systems may be attributed to the similarity between the blended assembly and standard conventional highway guide signing.

CHAPTER VI
FIELD EVALUATIONS

The survey, laboratory, and controlled field evaluations utilized in other portions of this research effort provided some useful information about the manner in which drivers use conventional guide signing and their information needs. However, none of these evaluations involved a driver behind the wheel on the open highway. In order to assess the information needs and information processing actions of drivers in actual highway conditions, a field evaluation procedure was developed. The field evaluations provided useful information about how drivers use highway signs to navigate on rural conventional highways. The field evaluations also provided some insight into drivers' opinions concerning conventional highway guide signs. This chapter describes the objectives, methodology, results, and significant findings of the field evaluations.

OBJECTIVES

The field evaluation was developed to find out how drivers use highway signs to navigate on conventional highways in rural areas. The primary objectives of the field study included:

- Assess guide sign placement distances;
- Evaluate relative importance of junction, destination, directional, confirmation, and distance information;
- Assess driver understanding of different types of guide signs and markers;
- Evaluate current designs for presentation of sign information; and
- Determine what, if any, difficulties drivers experience when using conventional guide signs.

EVALUATION METHODOLOGY

Conventional guide signs and sign assemblies were evaluated along a 58-mile test course in Burleson County. The intent in selecting a test course was to include intersections and signing situations commonly encountered by drivers on rural conventional highways. The test course included at least one highway from each of the following classifications: State Highway (S.H.), Farm-

to-Market Highway (F.M.), Loop, and Spur. The heavy line in Figure VI-1 illustrates the Burleson County test course. The course traveled in a counterclockwise direction.

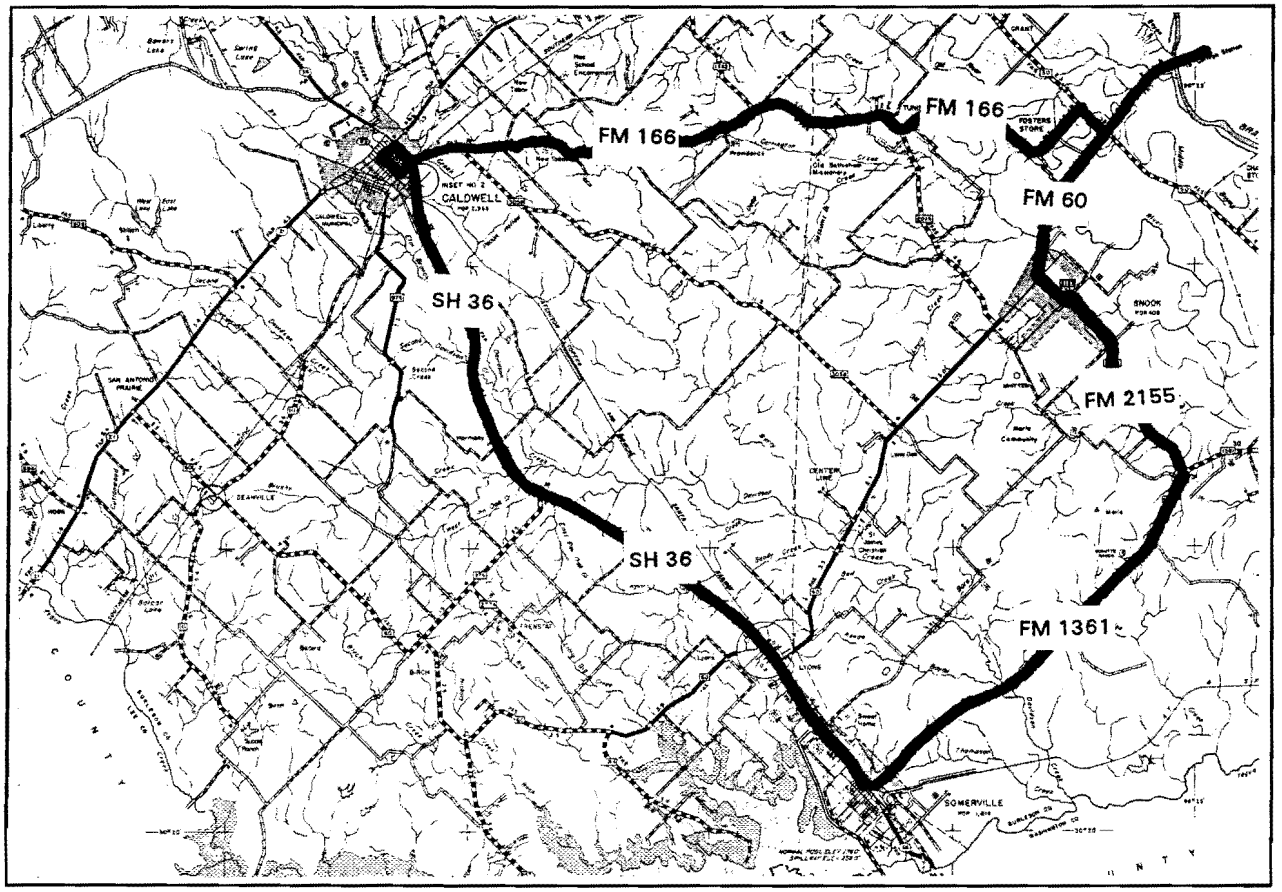


Figure VI-1. Test Course for Field Evaluation

The test course provided an opportunity to ask questions about conventional guide signs at 17 intersections. The course included at least one of each of the following sign types:

- Junction assembly;
- Advance route turn assembly;
- Destination sign;
- Directional assembly;
- Confirmation assembly;
- Distance sign; and
- Recreational destination sign.

Not all signs along the test course were evaluated. The researchers selected specific signs, sign assemblies, or sign sequences beforehand to evaluate. The intent of the study was not to develop conclusions about the specific signs or sign assemblies along the test route. Rather, the intent was to make some observations regarding the signs along the test route which could be generalized to conventional guide signs statewide.

An in-vehicle, open-ended driver interview technique was used. The purpose of this technique is to engage the test subjects, in this case licensed drivers, in discussion focusing on a particular subject. The information provided by this technique is somewhat different from the data obtained by most scientific evaluations. An open-ended driver interview provides very little, if any, quantitative data to describe the effectiveness of the various signs and sign assemblies being evaluated. The information received in this type of a study is mainly subjective or qualitative observations about the subject matter. Drivers' opinions and comments can be a good source of information in such a study.

During the field test, a volunteer driver and a member of the research team drove the test course. The volunteer drove at all times and the researcher rode as a passenger. The driver's private vehicle was used. Subjects were compensated $20 for their time and $20 for gas expenses. The test subject and researcher met at a pre-arranged location to begin the test. Prior to testing, the researcher described the testing procedure, provided instructions, obtained written consent from the driver, and answered any questions.

The driver was provided with a set of navigational instructions. The instructions included highway route number, cardinal direction, and destination information only. The instructions did not include information pertaining to distances, which way to turn at intersections (left, straight, or right), or any other information which might be useful in negotiating the test course. An official state highway map was also made available to the driver before the test began. The subjects were allowed to develop any kind of navigational aids they desired using the state highway map and instructions. For example, the driver could locate the highways on the map and identify where to turn left, turn right, or go straight. Or they could revise the instructions into a format more consistent with the directions they would normally use. Some test subjects elected to use the instructions provided without preparing additional navigational aids. After preparing the navigational aids, the subject proceeded to drive the test course. As mentioned previously, some of the highways in the field

evaluation were not shown on the map. This forced the driver to rely upon the instructions that they prepared or were given.

At various times during the evaluation, the researcher posed questions to the driver about certain aspects of the different guide signs that were encountered. At some locations, the driver was asked to pull to the side of the roadway to observe a sign, guide sign assembly, or photograph or drawing of a sign. The researcher recorded written observations about the subjects' responses on a data collection form. The drivers' responses and comments were also recorded on tape to allow further analysis in the office. The following subsections briefly describe each of the fifteen questions posed to the drivers during the field evaluations.

FIELD STUDY RESULTS

Ten drivers participated in the field evaluation of conventional guide signs. Each interview consisted of fifteen questions or series of questions. Each question or series related to a specific guide sign or sequence of guide signs. This section summarizes the responses and other comments received from the drivers during the field evaluations.

Question 1: Driver Use of Guide Signs

The first intersection was encountered at the junction of F.M. 60 and F.M. 50 between College Station and Snook. As they approached the intersection, the drivers were instructed to pay careful attention to the guide signs present at this location. In order to remain on the course, the drivers needed to make a right turn from F.M. 60 West onto F.M. 50 North and travel in the direction of Mumford. The sequence of guide signs at the intersection included:

- A junction assembly, consisting of a JCT marker and an F.M. 50 route marker;
- A destination sign, displaying the names SNOOK, INDEPENDENCE, and MUMFORD with appropriate directional arrows;
- A directional assembly, consisting of an F.M. 50 route marker with a SOUTH cardinal direction marker and left arrow marker, and F.M. 60 route marker with a WEST cardinal direction marker and a vertical arrow marker, and an F.M. 50 route marker with a NORTH cardinal direction marker and a right arrow marker;

- A confirmation assembly, including an F.M. 50 route marker with a NORTH cardinal direction marker; and
- A distance sign with the message "MUMFORD 17 HEARNE 28."

After executing the correct turn, the drivers were asked if any of the signs were difficult or problematic. If any of the signs did present a problem, the interviewer asked the driver to identify the problematic signs and the reasons why they were troublesome.

Nine of the ten drivers indicated that they had driven through this intersection previously. Therefore, these nine drivers could be expected to have some familiarity with the route and the signs. Additional results and observations included:

- Six of the test subjects responded "yes" when asked if any of the guide signs at the intersection presented a problem.
- Two subjects identified the destination sign as presenting some difficulty, while two others identified "the signs at the intersection" as difficult.
- Four drivers stated that the signs were too close to the intersection.
- Two drivers indicated that three destination names is too much information to display on a single sign, and that they were easily confused by too much information.
- Two of the drivers failed to execute the correct maneuver to remain on course at the intersection; one driver continued straight on F.M. 60 and one turned left instead of right at F.M. 50.

Question 2: Recall of Sign Information

The second question was also asked after the driver had negotiated the turn from F.M. 60 West onto F.M. 50 North. The drivers were asked to recall the names of the towns shown on the destination sign. Three destinations were displayed: Snook, Independence, and Mumford.

- Of the ten drivers, two recalled seeing Snook, four recalled seeing Independence, and eight recalled seeing Mumford.
- Two drivers recalled seeing Lyons, which was not shown.

- Overall, two drivers recalled no destinations correctly, three drivers correctly recalled one destination, two drivers correctly recalled two destinations, two drivers recalled two destinations correctly and one incorrectly, and only one driver recalled all three destinations correctly.

Question 3: Recall of Sign Information and Placement of Signs

The second intersection on the test course was at the junction of F.M. 50 and F.M. 166. This intersection is a T-intersection. To remain on the course, the driver needed to execute a left turn from F.M. 50 North onto F.M. 166 West and go toward Caldwell. The sequence of guide signs at this location included:

- A junction assembly, consisting of an F.M. 60 route marker and a JCT marker;
- A destination sign, with two destinations indicated (CALDWELL and MUMFORD) and appropriate directional arrows;
- A directional assembly, including an F.M. 50 route marker with a vertical arrow marker and an F.M. 166 route marker with a left arrow marker;
- A confirmation assembly, displaying an F.M. 166 route marker with a WEST cardinal direction marker; and
- A distance sign, reading "TUNIS 5, CALDWELL 16."

After passing the distance sign, drivers were asked to pull over to the side of the road. They were then asked if they had seen the two signs immediately after the intersection. The correct signs included the confirmation assembly and the distance sign. If the drivers remembered seeing one or both signs, they were then asked to recall the sign message. If they could not recall one of the signs, the interviewer tried to determine why the signs were missed through further questioning.

The key information on the confirmation assembly was the highway route number; therefore, the response was considered correct if the driver correctly recalled the route number. Similarly, the key information in the distance sign was the destination names; therefore the response was correct if the driver remembered the two destination names correctly. Only two of the drivers indicated that they had driven this roadway before, and thus would be considered familiar drivers. Five drivers indicated

that they had not driven this way before, and three were uncertain whether they had or not. The following results and observations were recorded:

- Five drivers correctly recalled the information on both the confirmation and the distance signs.
- One driver recalled the highway route number only, and one recalled only the distance information.
- One driver remembered the highway route number and the distance to Caldwell, but failed to mention the distance to Tunis.
- One driver reported missing the distance sign because the driver was reading the confirmation sign.
- Three drivers indicated that the confirmation sign was too close to the intersection.

Question 4: Comprehension of Advance Turn Arrow Marker

The third intersection on the test course was at the junction of F.M. 166 and F.M. 2039. This intersection is also a T-intersection, and a right turn is required for westbound traffic to remain on F.M. 166. The sequence of guide signs at this intersection included:

- A junction assembly, displaying an F.M. 2039 route marker and a JCT marker;
- An advance turn assembly, consisting of an F.M. 166 route marker and a bent right turn arrow marker;
- A directional assembly, including route markers for F.M. 2039 and F.M. 166, and left and right arrow markers;
- A confirmation assembly, comprised of an F.M. 166 route marker with a WEST cardinal direction marker; and
- A distance sign, with the message "CALDWELL 11."

As they approached the advance turn assembly, the drivers were asked to explain the meaning of the bent arrow marker and to identify when it is used.

- Nine of the ten drivers provided responses which could be considered "correct," including "F.M. 166 goes right" and "the highway I am on turns 90 degrees to the right," or some variation thereof.
- One driver stated that the bent arrow means "no thru traffic," which is incorrect.

In general, the meaning of the advance turn arrow marker appeared to be well understood by the drivers participating in the field study.

Question 5: Placement of Confirmation Assembly and Distance Signs

The fifth question also addressed the sequence of guide signs at the intersection of F.M. 166 and F.M. 2039. While stopped at the intersection, the drivers were asked to look at the confirmation assembly and distance signs and instructed to pay careful attention to them as they drove past them. After passing the signs, the interviewer asked if the signs were too far, too near, or about the right distance from the intersection. If the driver answered "too far" or "too near," the interviewer asked questions to determine what distance the driver would consider appropriate for each of these signs.

The question addressed the placement distance of the confirmation assembly and distance sign just beyond the intersection. Two of the drivers were familiar with this section of the test course. The remaining eight drivers had not driven it before, or could not recall driving this route before. The following results and observations were recorded:

- Two individuals stated that the signs were too close to the intersection.
- Five drivers said that only the confirmation sign was too close, and that the distance sign was fine in its present location.
- Two drivers responded that both signs were in about the right place.

The subjects that thought the confirmation sign was too close were asked to explain where it should be placed. A diamond-shaped yellow curve warning sign several hundred feet down F.M. 166 was used as a reference point. Four drivers preferred before the curve sign, while one responded after the curve sign.

Question 6: Recall of Guide Sign Information

The next intersection on the test course was at the junction of F.M. 166 and F.M. 1362. This intersection is a T-intersection; F.M. 166 is the through route and F.M. 1362 is the terminating route. The driver had to remain on F.M. 166 to follow the designated course. The sequence of guide signs at this location included:

- A junction assembly, with an F.M. 1362 route marker and a JCT marker;
- A destination sign, with directions indicated to CALDWELL and COOKS POINT;
- A directional assembly, consisting of an F.M. 166 route marker with a vertical arrow marker and an F.M. 1362 route marker with a right arrow marker;
- A confirmation assembly, comprised of an F.M. 166 route marker and WEST cardinal direction marker; and
- A distance sign, reading "CALDWELL 8."

After driving through this intersection, the driver was asked to pull to the side of the road. The interviewer showed the driver a page with reproductions of the various guide signs used at the intersection along with some distractor signs. Figure VI-2 contains the page of signs that was presented to the drivers. Note that the five signs or sign assemblies listed above were included. Distractor signs, including guide signs for the other approaches to the intersection and a HIGHWAY INTERSECTION 1000 FT warning sign, were also included. The driver's task was to mark each of the signs they remembered seeing as they drove through the intersection of F.M. 166 and F.M. 1362. Table VI-1 illustrates the results of this experiment.

In general, the drivers did not recall seeing signs that were not present at the intersection. A total of four incorrect responses were marked. None of the drivers, however, could correctly recall all five of the signs, although two were able to recall four of the signs correctly. One driver was unable to recall any of the signs correctly. The average number of signs recalled correctly was 2.3.

The destination sign and directional assembly were each recalled correctly five times. The confirmation assembly and distance sign were each recalled correctly four times. Note that the destination and directional signs are the second and third signs, respectively, in the guide sign sequence. The confirmation and distance signs are the fourth and fifth signs in the sequence. The results are interesting because the last two signs passed by the driver were recalled less often than signs which occur earlier in the sequence. The junction assembly was recalled correctly a total of three times.

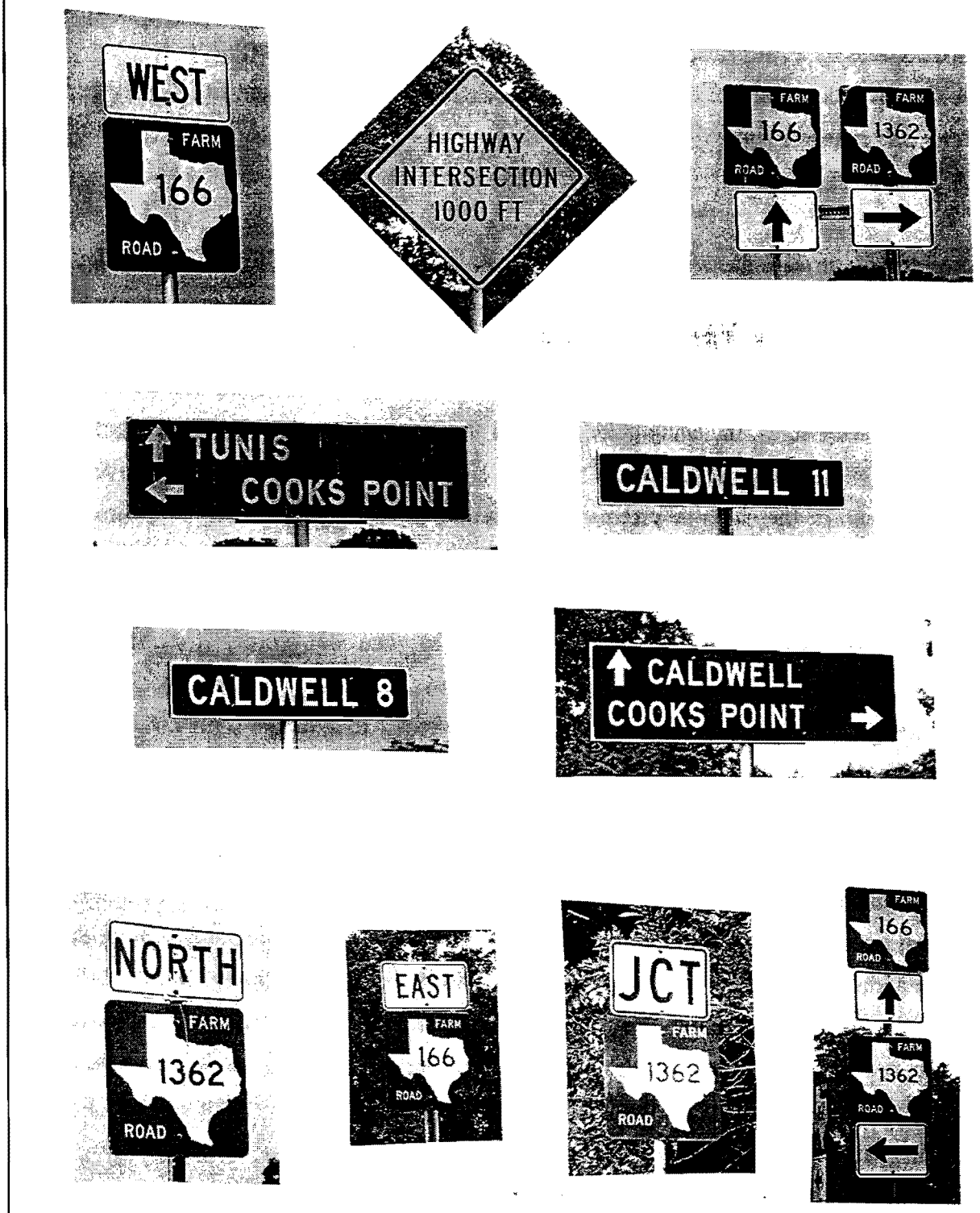


Figure VI-2. Signs for Sign Recall Test

Table VI-1. Results of Sign Recall Test

Guide Sign	Subject Number									
	1	2	3	4	5	6	7	8[1]	9	10
West F.M. 166 Confirmation Assembly				✓	✓	✓	✓	--		
Highway Intersection 1000 Feet	X							--		
F.M. 166 ↑ / F.M. 1362 → Directional Assembly	✓	✓			✓	✓		--	✓	
Tunis/Cooks Point Destination Sign		X	X					--		
Caldwell 11 Distance Sign							X	--		
Caldwell 8 Distance Sign	✓	✓		✓	✓			--		
Caldwell/Cooks Point Destination Sign	✓	✓			✓			--	✓	✓
North F.M. 1362 Confirmation Assembly								--		
East F.M. 166 Confirmation Assembly								--		
Junction F.M. 1362	✓			✓				--		✓
F.M. 166 ↑ / F.M. 1362 ← Directional Assembly								--		
Total Correct Responses	4	3	0	3	4	2	1	--	2	2
Total Incorrect Responses	1	1	1	0	0	0	1	--	0	0

Notes: A ✓ denotes a correct response (driver recognized an existing sign).
An X denotes an incorrect response (driver recognized an nonexistent sign).
[1]Data for Subject 8 are unavailable.

Question 7: Adequacy of Guide Sign Information

The next intersection was a T-intersection with F.M. 3058 east of Caldwell. At this location, F.M. 166 is the through route and F.M. 3058 is the terminating route. The driver had to remain on F.M. 166 to complete the course. The sequence of guide signs included:

- A junction assembly, displaying an F.M. 166 route marker and a JCT marker; and
- A directional assembly, comprised of an F.M. 3058 route marker and a left arrow marker.

This location was slightly different in that no destination signs were displayed in advance of the intersection. After executing the proper maneuver at this intersection, the drivers were asked to pull to the side of the road to answer some questions about the signing for F.M. 3058. The first question asked was, "Where does F.M. 3058 go?" After the driver responded, the interviewer informed the driver that F.M. 3058 does not go to a city or town, but instead it connects to F.M. 60. The interviewer then asked the driver if he or she considered the existing signing to be adequate or if it

was confusing that no destination was shown. Finally, the interviewer asked the driver to look at a drawing of a possible destination guide sign for use at this intersection. The sign displays the message "JCT F.M. 60" and a left directional arrow, as Figure VI-3 depicts. The drivers were asked if this type of sign needed to be shown at this location.

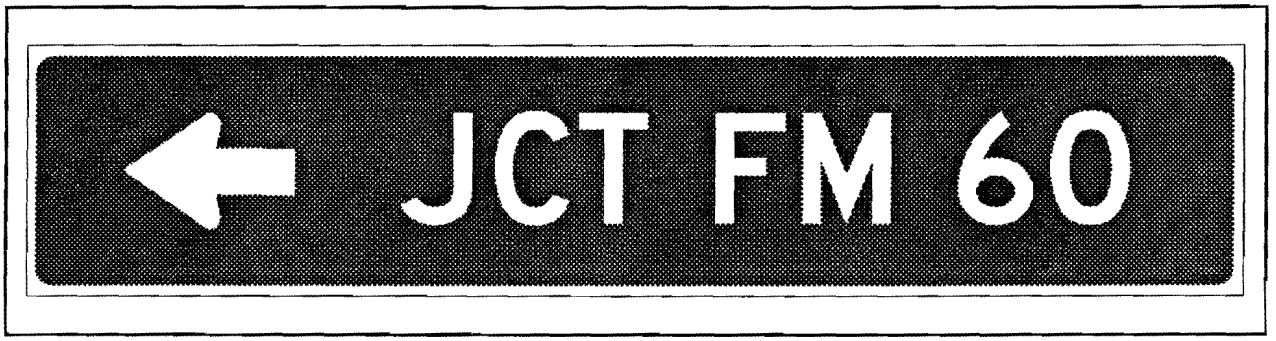


Figure VI-3. Example of Destination Guide Sign for Routes with No Named Destination

Only two of the drivers might be considered familiar drivers at this location; the remaining eight drivers had either not driven this way or were uncertain if they had ever traveled this way. The following results were recorded.

- Eight of ten drivers indicated that the signing at this location was not adequate. In general, however, they were not confused by the absence of a destination sign.
- The same eight drivers favored the use of a destination sign with the "JCT FM 60" message in place of the destination name.

Question 8: Guide Sign Importance and Placement

The next question was asked at the intersection of S.H. 36 and Loop 83 in Caldwell. On the approach to this intersection, the junction assembly is placed adjacent to a SPEED LIMIT 35 regulatory sign and a Signal Ahead symbolic advance warning sign with a flashing yellow beacon. As the drier approached this group of signs, the interviewer instructed the driver to look carefully at the signs and to identify the most important of the three signs. The following results and observations were recorded:

- Four drivers indicated that the warning sign is most important.

- Another four drivers indicated that the regulatory sign is the most important.
- One driver responded that the speed limit and signal ahead sign are equally important.
- One driver indicated that the junction assembly was most important.

Driver familiarity may have been a factor. Three of the four drivers that indicated the speed limit sign is of primary importance were familiar drivers. Three of the four drivers that indicated the Signal Ahead warning sign is of greatest importance were unfamiliar drivers.

Drivers are likely to tend to information which they consider most important, and discard or ignore information which they consider of little value. The results suggest that most drivers would either fail to notice or ignore the junction information at this intersection. This result emphasizes the importance of careful sign placement in a "cluttered" environment.

Question 9: Guide Sign Design and Placement

The ninth question concerned the sequence of guide signs on the S.H. 36 approach to S.H. 21 in Caldwell. Both highways are four-lane undivided with a left-turn lane. The intersection is a four-leg intersection, with turning roadways to facilitate left and right turn movements in each of the four quadrants. In order to remain on the test course, the driver needed to maneuver into the left turn lane and execute a left turn from S.H. 36 North onto S.H. 21 West. The sequence of guide signs approaching this intersection included:

- A junction assembly, with a S.H. 21 route marker and a JCT marker;
- A destination sign, displaying "BRYAN" and an arrow slanted upward to the right;
- A directional assembly/advance route turn assembly, consisting of a S.H. 21 route marker with an upward-slanting right arrow marker and an EAST cardinal direction marker, and a S.H. 21 route marker with a bent left turn arrow marker and a WEST cardinal direction marker;
- A destination sign with the words "CAMERON" and "BASTROP" for S.H. 36 North and S.H. 21 West, respectively; and
- A directional assembly at the intersection, consisting of a S.H. 36 route marker with a NORTH cardinal direction marker and a vertical arrow marker, a S.H. 21 route marker with a WEST cardinal direction marker and a left arrow marker, and a S.H. 21 route marker with an EAST cardinal direction marker and a right arrow marker.

Note that both the destination and directional information for this intersection are presented in two separate signs or sign assemblies, due to the use of the turning roadway for right turns from S.H. 36 North to S.H. 21 East. After driving through the intersection once, the driver was instructed to loop back and repeat this segment of the test course. The interviewer asked the driver to pull to the side of the road and observe the destination guide signs for the intersection of S.H. 21 and S.H. 36. The driver's task was to identify which method of presenting this information would be preferable. Three possible choices were presented. Two signs are currently used. The two new options propose to combine all of the destination information into a single sign. Figures VI-4 and VI-5 illustrate these proposed alternative destination signs. The following results and observations were recorded for this experiment:

- Six of the ten subjects responded that they would rather see the information on one sign. Of these six subjects, five of them chose the drawing of the sign with the straight arrow (Figure VI-4). Most of the subjects that responded this way agreed that the bent arrow (Figure VI-5) would be confusing, and that the straight arrow would be adequate since the main highway is easy to decipher from the small local roads.
- The remaining four drivers said they would like to see the information presented on two signs, as it is.
- The primary reason to keep the information on two signs tended to be to minimize the amount of information on the signs. One subject responded: "I would like to see highway number, destination, arrow, and cardinal direction all on the same sign. It may seem like too much information to process at one time, but if the information on one sign is all related it is not so hard."

Question 10: Comprehension of Recreational Guide Signs

The tenth question concerned a recreational guide sign at the intersection of S.H. 36 and F.M. 976, between Caldwell and Lyons. In addition to the standard destination sign, a second recreational destination sign is used at this intersection to direct travelers to various Lake Somerville recreational attractions. As they approached this location, the drivers were asked to explain the brown color of this sign and where recreational guide signs are used.

Figure VI-4. Proposed Destination Sign for a Highway Intersection with Turning Roadways - Use of Straight Arrow

Figure VI-5. Proposed Destination Sign for a Highway Intersection with Turning Roadways - Use of Bent Arrow

- Nine of the ten drivers associated the brown sign with parks and recreational areas.
- The tenth driver was not aware of the purpose of these signs.

Question 11: Importance of Distance Signs

The next question addressed the importance and frequency of use of distance signs. At the intersection of S.H. 36 and F.M. 60 in Lyons, drivers were shown a distance sign that indicates the distances to Somerville and Brenham as follows: "SOMERVILLE 4 BRENHAM 19." The driver was asked to rate the amount of attention which he or she typically pays to these types of signs on a scale of 1 to 5, with a 1 meaning "I pay no attention to distance signs" and a 5 indicating "I pay much attention to distance signs." The interviewer also asked the driver how often they would like to see this type of sign used: more frequently than at present, less frequently than at present, or about the same. The drivers also had the option of specifying a frequency or spacing for distance signs, in terms of miles or minutes between signs. The following results and observations were recorded:

- The average rating of distance sign importance was 3.8.
- None of the drivers indicated they disregard the distance signs altogether, and two responded that they pay much attention to these signs.
- Seven of the drivers indicated they would like to see more distance signs used, while three indicated that the present use of these signs is sufficient.
- One driver commented that distance signs should be placed every 8 to 11 kilometers (5 to 7 miles).

Comments received from the drivers about distance signs provided some insight into why they are important to drivers. Several of the drivers mentioned using distance signs to gauge trip time or progress towards a destination. Some drivers related that they use the distances to plan stops for gas. The comments also indicated that drivers are uncertain about the distance measurements. Some thought that the distance is measured to the city limit, while some others mentioned the center of town. None of the drivers, however, gave any indication that this uncertainty was of any significance.

Question 12: Placement of the Junction Assembly

One question addressed the placement distance for the junction assembly on a four-lane conventional highway. Specifically, drivers were asked to assess the adequacy of the placement of a junction assembly at the intersection of S.H. 36 and F.M. 1361 in Somerville. At this location, the test course travels south on S.H. 36, then makes a left turn onto F.M. 1361 East. S.H. 36 is a four-lane undivided highway; thus a driver in the right lane who wishes to turn onto F.M. 1361 must execute a lane change maneuver while slowing for the intersection. The interviewer asked drivers if the JCT 1361 sign is too close, and also whether it provides adequate time to change lanes to make a turn if necessary. Exactly half of the driver subjects were familiar with this location.

- Nine of the drivers indicated that the junction assembly was too close to the intersection.
- Seven of the drivers indicated that drivers in the right lane would encounter some difficulty changing lanes if they needed to turn left at this intersection.
- At least one of the drivers had difficulty changing lanes to make the turn, due to traffic in the left lane.

Question 13: Placement of Destination Sign

The next intersection on the test course was at the junction of F.M. 1361 and F.M. 2155. The intersection is a T-intersection, at which F.M. 1361 is the through route and F.M. 2155 is the terminating route. To remain on the course, the driver had to make a left turn from F.M. 1361 East onto F.M. 2155 North and travel toward Snook. The sequence of signs at this intersection included:

- A junction assembly, with an F.M. 2155 route marker and a JCT marker;
- A destination sign, displaying SNOOK and a left directional arrow;
- A directional assembly, including an F.M. 1361 route marker and vertical arrow marker, plus an F.M. 2155 route marker and left arrow marker;
- A confirmation assembly, with an F.M. 2155 route marker and NORTH cardinal direction marker; and
- A distance sign displaying the distance to Snook.

The question asked at this intersection concerned the placement of the SNOOK destination sign. Drivers were asked if the sign was hard to see, and if so, why this was the case. The sign was near a tree, and partially obscured by roadside vegetation. It was also located a significant distance from the edge of the road. Other guide signs were also present, as were signs for a nearby construction zone. Nine of the drivers were unfamiliar with this location. The following results were recorded:

- Two drivers stated that the destination sign was not too difficult to see.
- Eight of the drivers had trouble seeing the sign, and some of these nearly missed the sign altogether.

The drivers were asked to state why the sign was difficult to see. The most common response was that it was too far from the edge of the roadway. The other signs present in the area were also mentioned.

Question 14: Comprehension of SPUR Highway Classification

Upon reaching the town of Snook, the drivers were told to turn left onto Spur 2155. This roadway turns off of F.M. 2155, travels one block west into downtown Snook, then turns back to the north to re-intersect F.M. 2155. A junction assembly, directional assembly, and confirmation assembly are employed to inform drivers about Spur 2155. The drivers were asked to identify the distinction between F.M. and Spur highway classifications. The interviewer also asked if the use of the same number for both roadways is confusing. The following observations were recorded:

- Several definitions of a spur highway were given by the drivers, including "side street," a road that "deviates from the main road and does not come back," "road that goes into downtown," "business loop or side road," and "turn around through town."
- Most of the drivers indicated that use of the same number for the Spur and F.M. highways did not matter. This practice, however, did seem to confuse several of the drivers.
- One driver indicated that it was not really an issue because only local drivers would use a Spur, and by definition, they would be familiar with the area.

Question 15: Design of the Destination Sign

The final question was asked at the intersection of F.M. 60 and F.M. 50 between Snook and College Station. Drivers were asked to pull to the side of the road to observe the destination sign at this intersection. This sign displays the destinations COLLEGE STATION, MUMFORD, and INDEPENDENCE with the appropriate directional arrows for each. The interviewer posed a sequence of questions to the driver regarding this sign. This first question was, "Do you need to see College Station in this sign?" If a yes response was given, a follow-up question was asked, "Do you think that it is necessary to show College Station at this location if no turn is necessary and the distance to College Station is shown after you got through the intersection?" A third question was asked, "Which city should be the first city listed in this sign?" If the driver responded "College Station," then the interviewer posed a final question, "If you were going to Mumford or Independence, which sign should then be listed first?" The following results were recorded:

- All of the drivers responded affirmatively to the first question.
- The responses were evenly divided for the second question; five drivers answered "yes" and five responded "no."
- Nine of the ten drivers responded "College Station," which was the destination for the through movement at this particular intersection, in response to the third question. One driver said that Mumford, the left turn destination, should be shown first.
- Those that answered "College Station" were asked a follow-up question. Six drivers said "College Station," while three drivers changed their original answer and responded "Mumford."

SUMMARY OF FINDINGS

A field study was conducted to evaluate guide sign placement distances, the relative importance of various guide sign information elements, driver understanding of guide sign information, and current designs for presenting highway route number and destination information. The field study also tried to determine what, if any, difficulties drivers encounter when using conventional highway guide signs. A total of ten licensed drivers participated in the field study. The field study provided some limited insight into important issues regarding drivers' use and opinions of conventional highway guide signs. Some of the preliminary findings based on the results of the field study include:

- The use of three destination names on highway signs at or near the intersection may pose problems to some drivers;
- The advance turn arrow marker appears to be well understood by the drivers in this study;
- Placement distances of confirmation assemblies present a problem to many drivers. Drivers often miss these signs because they are located too close to the intersection;
- When regulatory, warning, and guidance information are placed in close proximity to one another, the guidance information is of relatively low importance to many drivers. This may cause the driver to miss or ignore the guidance information;
- Recreational guide signs are well understood by most drivers. A majority associated these signs with recreation or similar activities;
- Distance signs are an important element of the guide sign sequence at conventional highway intersections. Drivers use this information to measure trip progress and plan stops. There is some uncertainty about the distance measurements, but there is no evidence that this is significant; and
- Placement distances of junction assemblies may require revision. In some cases, these signs may be located too close to the intersection. The effects of this are of greatest importance on multi-lane highways.

CHAPTER VII
PRELIMINARY RECOMMENDATIONS

The research activities conducted during the first two years of this study have led to a number of useful findings that can be used to develop improved guidelines for the use of conventional guide signing. Although there is still a year of activity remaining on this study, this chapter describes a number of preliminary guidelines that appear to be supported by the research results. During the third year of this research study, these guidelines will be finalized and presented in a format that will provide for the implementation of the guidelines. These preliminary guidelines have been divided into the following categories:

- **Preliminary Recommendations for Sign Design and Layout** - preliminary recommended changes to the standard design, layout, or appearance of specific signs and a determination of information to include in a sign.
- **Preliminary Recommendations for Sign Placement** - preliminary recommendations regarding the location where guide signs should be placed.
- **Preliminary Recommendations for Highway Classification** - preliminary recommendations related to the various highway classifications on the state system and the manner in which they should be signed.

In the following descriptions of guidelines, the guideline is shown in ***bold italic***. The text following the guideline provides background information and support for the guideline.

PRELIMINARY RECOMMENDATIONS FOR SIGN DESIGN AND LAYOUT

Some of the research findings indicate that changes should be made to the physical layout of the design features of several conventional guide signs. These signs include route markers, cardinal direction markers, destination signs, junction markers, and arrow markers.

Route Markers

Among the more significant of the research findings is that the legibility of route markers used on Texas highways could be improved. Legibility evaluations of the F.M. and S.H. route markers indicated that the 85th percentile legibility distances among older drivers for these signs was about 30 meters (100 ft) and 75 meters (250 ft), respectively. Furthermore, the height of the number in Texas route markers is smaller than those used in a majority of other states. Preliminary recommendations for changes to the design of route markers are described below.

- ***Adopt the 762×610 mm (30×24 in) route marker size for use with highway numbers having three or four digits.*** When the number of digits in Interstate and U.S. Highway route markers increases to 3, the width of the sign is increased from 610 mm (24 in) to 762 mm (30 in) in order to accommodate the number without reducing the number height. The practice of using a wider sign is followed in 24 of the 39 states which provided information about the size of state highway route markers.
- ***Change the border design on the S.H., Loop, Spur, Park Road, and Beltway route markers.*** The border design on these route markers should be changed to a 16 mm (⅝ in) border located 10 mm (⅜ in) from the edge of the sign, as is currently used for regulatory signs. Comments received from TxDOT personnel during the conduct of the research indicate that the 38 mm (1½ inch) border currently used on these route marker creates the difficulties described below. Revising the border would eliminate or reduce these difficulties.
  - During the fabrication process, it is difficult to screen or otherwise fabricate the border all the way to the edge without some spillover. Providing space between the edge of the sign and the border would clean up the fabrication process.
  - The border on these signs is inconsistent with the borders used on regulatory and other signs. A typical 610×610 mm (24×24 in) regulatory sign would have a 16 mm (⅝ in) border located 10 mm (⅜ in) from the edge of the sign. Adoption of the 16 mm (⅝ in) border would increase the interchangeability of sign blanks.
  - At night, the wide black border does not reflect light back to the driver. This decreases the overall size of the route marker and target value of the sign by 23 percent, which makes the sign harder to find at night.
- ***Increase the height of the number in the route markers.*** By using a wider sign and a narrower border, the space available for the highway number is increased and a taller number

can be used. The use of the narrower border will also move the word (TEXAS, LOOP, SPUR, etc) 13 mm (½ in) closer to the border. If the distance between the word and number is decreased from 102 mm (4 in) to 76 mm (3 in), then a 254 mm (10 in) number height can be accommodated.

- ***Change the design of the F.M., R.M., and R.R. route markers to eliminate the shape of Texas.*** The design of the F.M./R.M./R.R. route markers should be changed from the existing design which emphasizes the shape of Texas to the recommended design which is essentially similar to the S.H. route marker. The only differences between the revised S.H. route marker and the recommended F.M./R.M./R.R. route marker is that the letters F.M., R.M., or R.R. would replace the word TEXAS and the height of a four-digit number would be 178 mm (7 in). The 178 mm (7 in) four-digit number height is the tallest that can be accommodated within a 762 mm (30 in) wide route marker. If one of the digits is a "1," then the horizontal spacing is less and a 203 mm (8 in) number can be used.
- ***Move the word in all of the revised route markers to the top of the route marker.*** At the present time, the word is at the top of the Loop, Spur, Park Road, and Beltway route markers and at the bottom of the State Highway (Texas) and recommended FM route markers. For consistency purposes, all words should be at the top of the revised route markers.
- ***Use the same route marker design for both independent installations and for attachment to guide signs.*** At the present time, the route marker for independent use is different from the route marker for attachment to guide signs. This essentially doubles the number of different route marker designs used on the state highway system. Using the same design for independent and guide sign applications would improve driver understanding of the route markers.
- ***Figure VII-1 illustrates the preliminary recommended designs for all of the route markers used for Texas highways.*** This figure illustrates the revised appearance for two-, three-, and four-digit highway numbers for each of the route markers used on Texas highways.
- ***Figure VII-2 provides the standard design dimensions for two of the revised route markers.*** This figure contains the information necessary to fabricate these route markers. It indicates the number/letter heights, line spacings, and border dimensions.

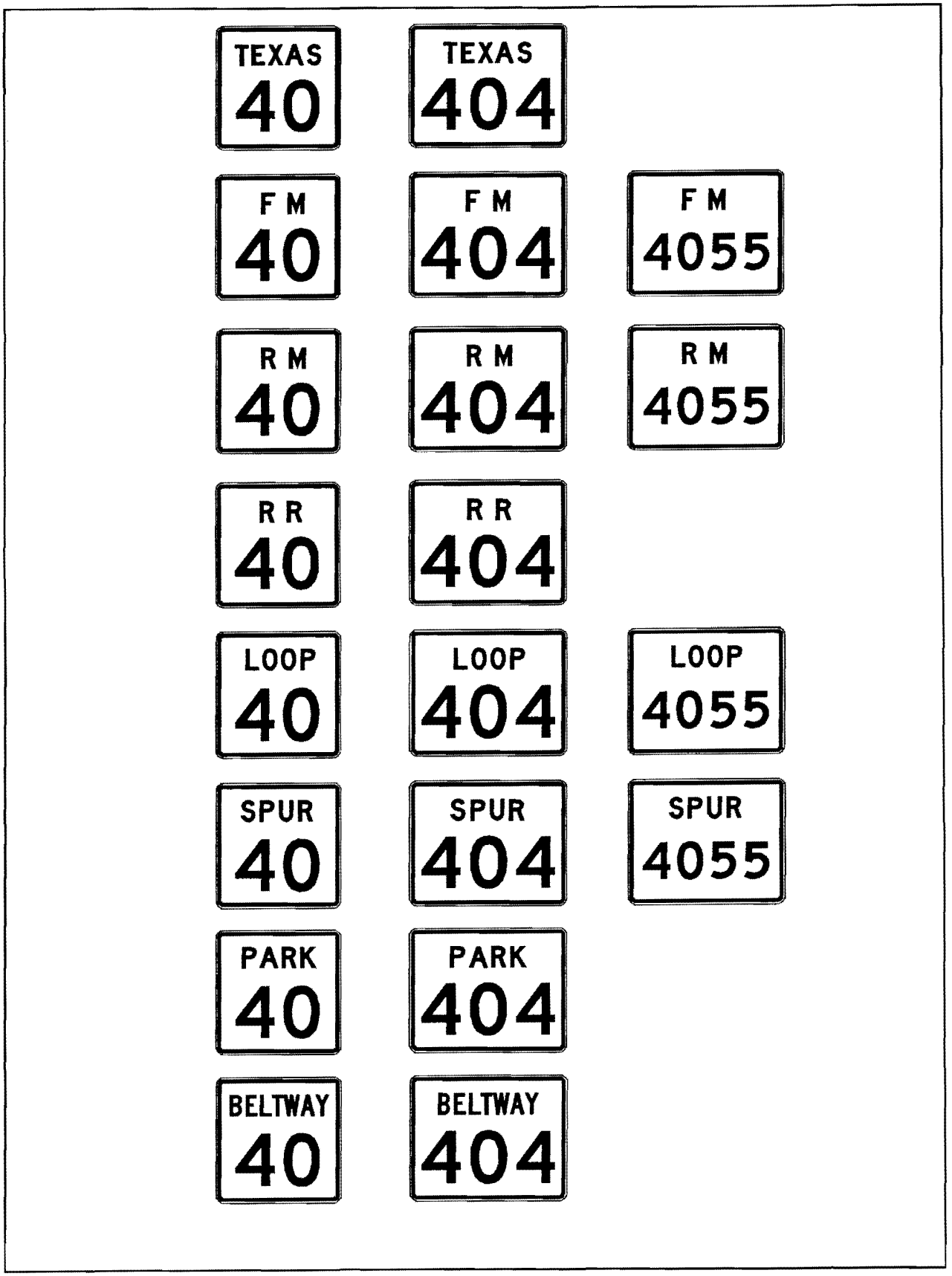
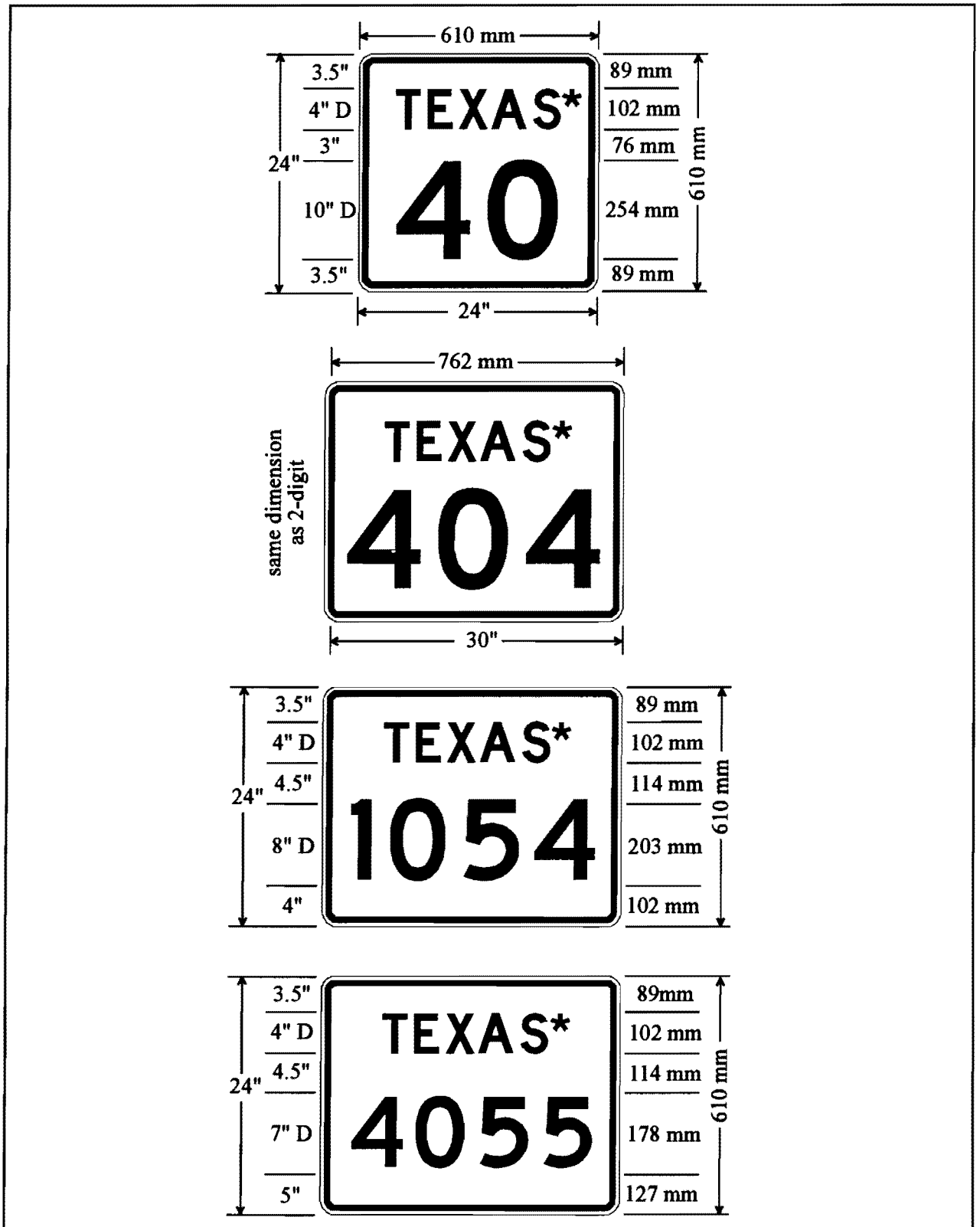


Figure VII-1. Recommended Route Markers



* FM, RM, RR, LOOP, SPUR, PARK, or BELTWAY to replace TEXAS as appropriate. BELTWAY should be Series C.

Figure VII-2. Recommended Route Marker Designs

Cardinal Direction Markers

The design of the cardinal direction markers was revised in the most recent revision to the Texas and National MUTCDs by increasing the height of the initial letter by 25 mm (1 in) in the standard size marker (152 mm/6 in letters). During the first year of the study, the larger initial letter design was compared to the design with all letters the same height. There was no statistically significant difference in the legibility distances of the designs. Therefore, increasing the height of the initial letter does not appear to be justified as a legibility enhancement improvement.

Cities in Destination Signing

Many drivers have become accustomed to the destination-based philosophy of guide signing used on freeways. First- and second-year research results confirm that drivers find destination information very useful.

- ***A system of control cities should be developed to assist drivers in direction finding on conventional highways.*** At the present time, there is no uniform procedure for selecting the city or cities to show in destination signs in advance of an intersection. Some intersections have directional assemblies containing numerous route markers, cardinal direction markers, and turn arrows which may be difficult for drivers to process before they must commit to a driving maneuver. Typically, destination signs do not show major cities that may be located some greater distance from the intersection. Developing a series of control cities from the most well-known Texas cities would provide drivers with an additional useful piece of information to help them determine the proper turning maneuver at the intersection.

Junction Marker

Evaluations of Junction markers indicated that drivers would like to see more information displayed with the Junction marker to help them to properly maneuver onto the intersecting highway. Preliminary recommendations for the design of Junction markers include the following:

- ***A distance plaque may be used at the bottom of a Junction assembly to reduce driver confusion.*** A distance plaque would help drivers identify the location of the intersecting

highway. It is recommended for use when the distance to the intersecting highway is more than 450 meters (1500 feet), when the intersection is not visible from the Junction assembly, or when there are intermediate intersections between the Junction assembly and the intersecting highway. The distance plaque should be located above the Lane-Use marker whenever both signs are used in a Junction assembly.

- ***A Lane-Use marker should be used at the bottom of a Junction assembly to provide lane placement information.*** Research results indicated that drivers prefer to position their vehicle in the proper lane before they arrive in the vicinity of the intersection. Lane-Use markers should be used on multilane highways where vehicles must be located in a specific lane in order to maneuver onto the indicated highway. The Lane-Use marker should be located below a distance plaque if both are used in a Junction assembly.
- ***Figure VII-3 illustrates the use of these plaques with the Junction marker.***

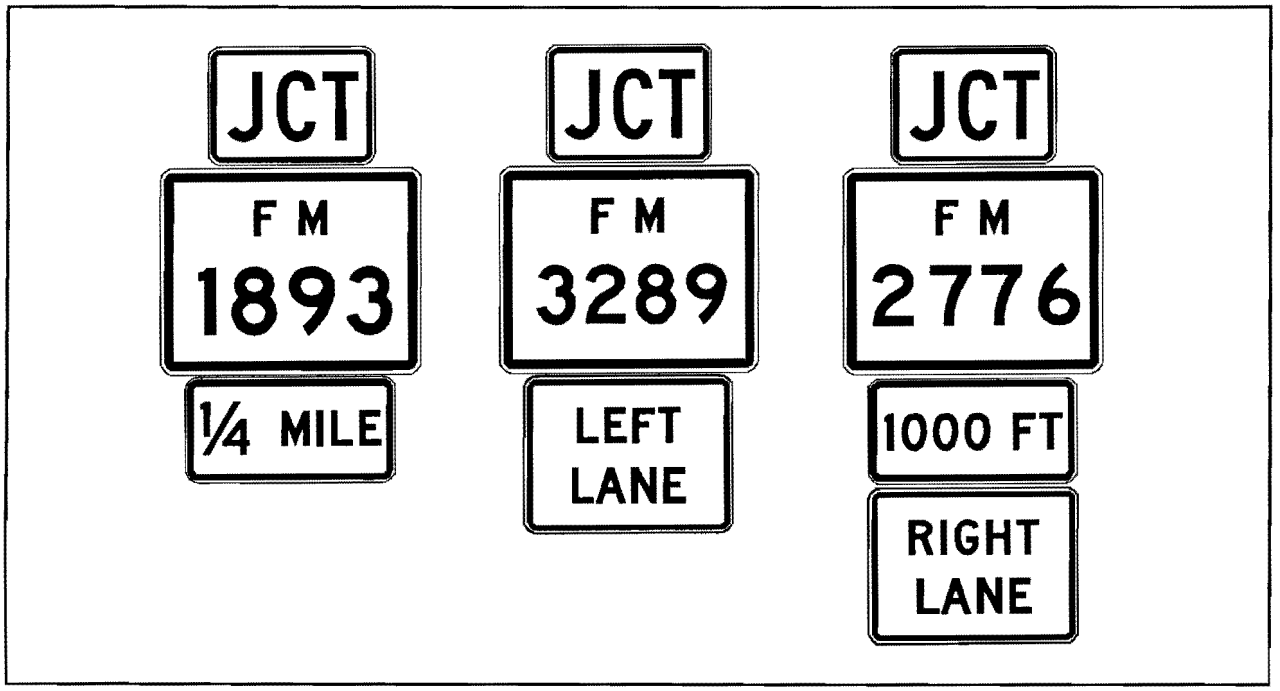


Figure VII-3. Use of Supplemental Plaques with the Junction Marker

PRELIMINARY RECOMMENDATIONS FOR SIGN PLACEMENT

The Texas MUTCD contains several illustrations indicating the placement criteria for conventional guide signs at typical intersections. Figure VII-4 illustrates one of these figures. These illustrations focus upon guide signs and do not include many of the other types of signs that are often installed in the immediate vicinity of the intersection. The results of several different research activities indicate that drivers would like to see guide signs moved further away from the intersection and a reduction in the number of signs in the immediate vicinity of the intersection. The following preliminary recommendations relate to the placement of guide signs at intersections. Figure VII-5 illustrates the placement of these signs.

- ***The Junction marker should be located further from the intersection.*** The usual placement distance for the Junction marker should be 300 to 450 meters (1000 to 1500 feet, approximately ¼ mile), with a minimum of 250 meters (750 feet). This is an increase from the current placement criteria of 250 meters (750 feet) usual and 120 meters (400 feet) minimum. These placement recommendations will provide drivers with more time to identify and respond to the Junction marker.
- ***A redundant Junction marker should be provided for high demand volume, complex, or unusual intersections or interchanges.*** For high volume, complex, or unusual intersections, a redundant Junction marker should be provided further from the intersection to provide drivers with greater notice of the intersection. The redundant Junction marker should be 600-900 meters (2000-3000 feet, approximately ½ mile) from the intersection. The redundant Junction marker should be approximately twice as far from the intersection as the primary Junction marker. The redundant Junction marker would provide several advantages. It would provide drivers with additional time to maneuver their vehicles into proper position to turn at the intersection, it would reduce information overload of the driver near the intersection, and would reduce the probability that a driver would not see the Junction marker. Current practices do not describe the use of a redundant Junction marker. In some cases where a redundant Junction marker is used, it may be appropriate for one of the Junction markers to use a combination sign (discussed in Chapter V) with the word Junction at the top and a distance at the bottom. Figure VII-6 illustrates such a sign.

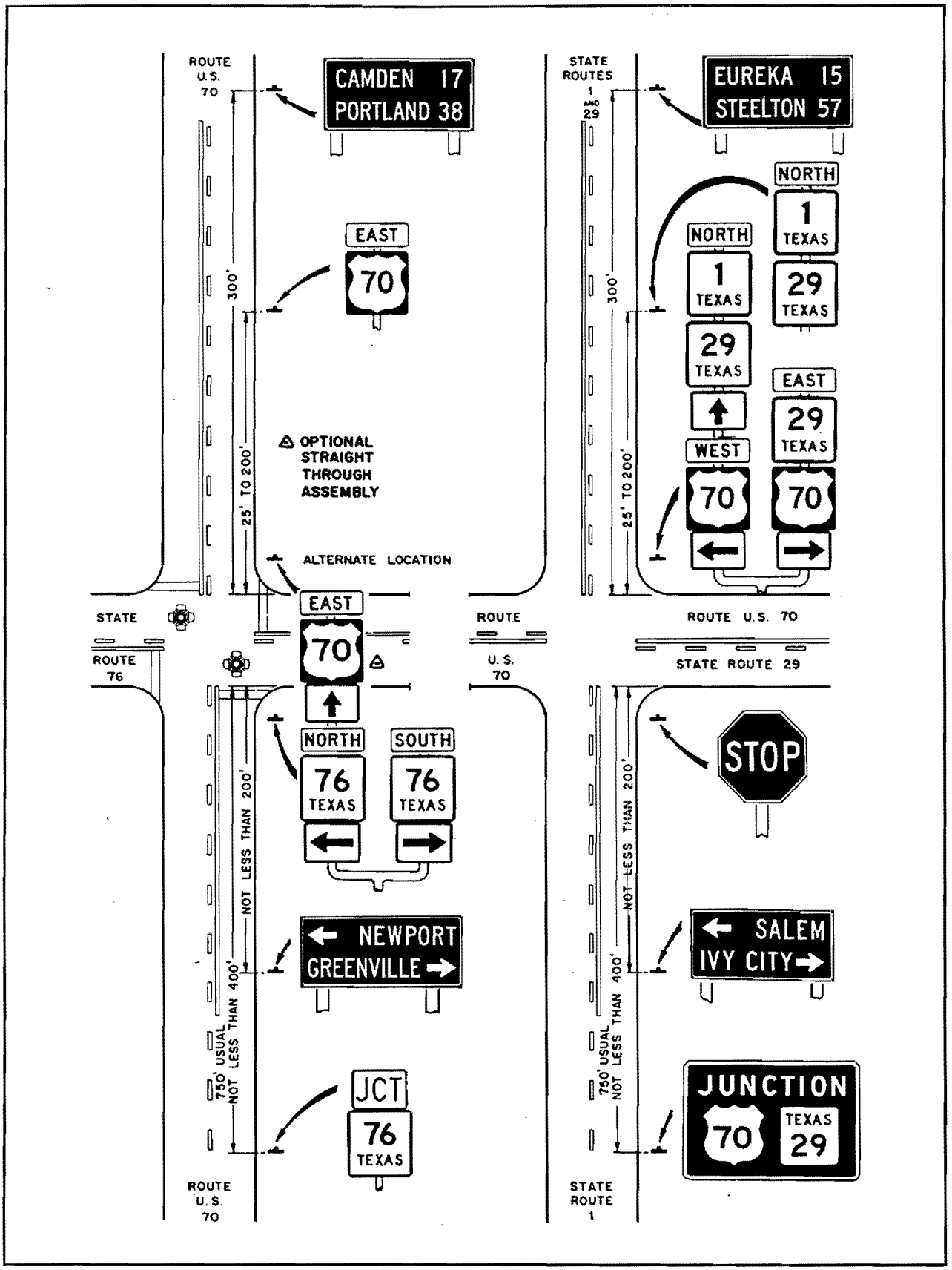


Figure VII-4. Existing Placement Criteria from Texas MUTCD

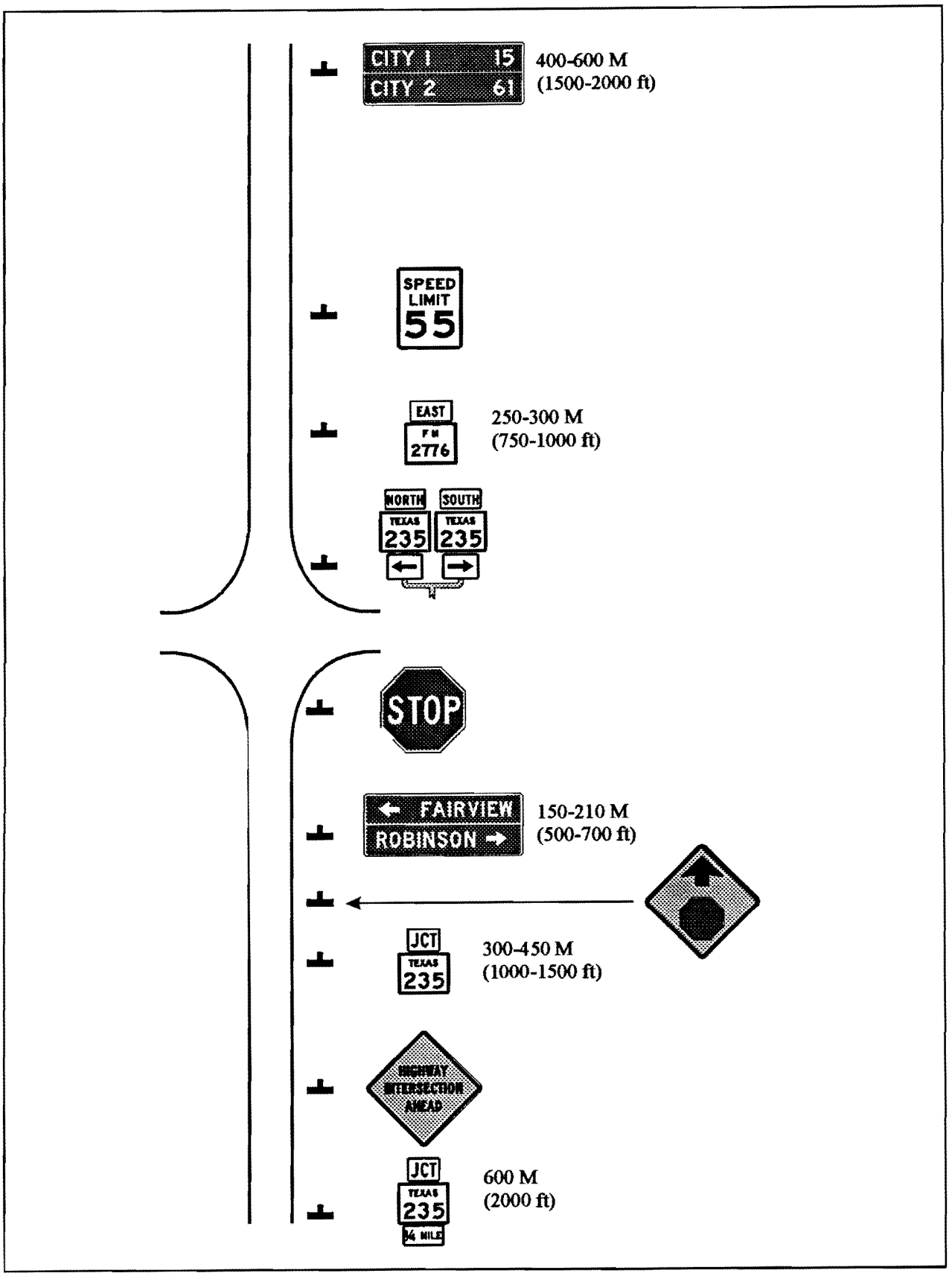


Figure VII-5. Recommended Sign Placement Criteria for Signing at Intersections

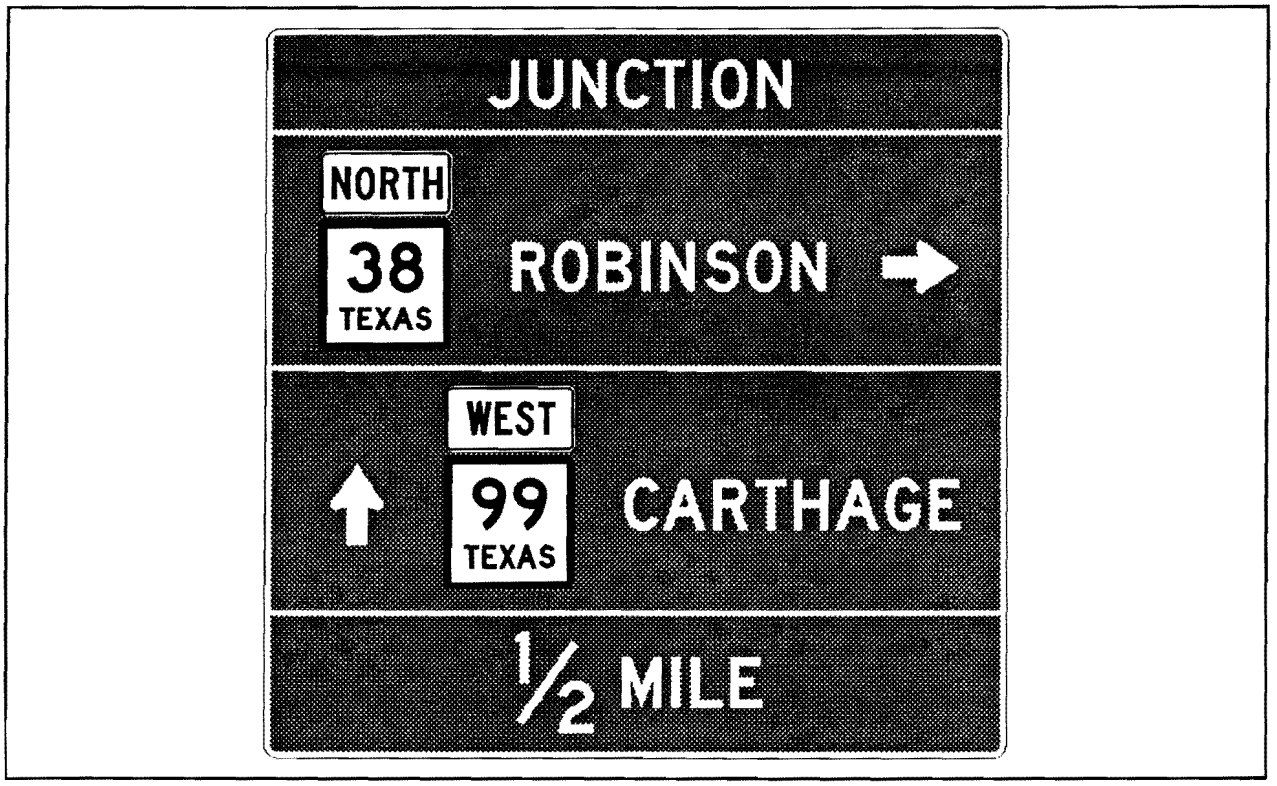


Figure VII-6. Illustration of Junction/Combination Sign

- ***The Destination sign should be located further from the intersection.*** The Destination sign is currently placed no less than 60 meters (200 feet) from the intersection. However, drivers 200 to 300 feet from an intersection are focusing their attention on the intersection itself instead of signing near the intersection. As a result, signs located within this area may be ignored by the driver due to information overload. Moving the Destination sign to a usual distance of 150 to 210 meters (500 to 700 feet) from the intersection, with a minimum of 120 meters (400 feet), would allow drivers to read and respond to the Destination sign before they focus their attention on the intersection itself.
- ***The Reassurance marker should be moved further from the intersection.*** The information provided by the Reassurance marker is not immediately critical to drivers passing through an intersection. Therefore, it can be relocated further from the intersection without seriously impacting traffic operations. Current placement criteria for this sign is 8 to 60 meters (25 to 200 feet) from the intersection. However, drivers turning onto a highway at the intersection will be focusing their attention 60 to 90 meters (200 to 300 feet) in front of the vehicle. As the vehicle turns to the right, the focus of attention also turns to the right, 60 to 90 meters (200 to 300 feet) in front of the vehicle. As such, a driver turning onto a highway may not even see

the Reassurance marker. Relocating the Reassurance marker to 250 to 300 meters (750 to 1000 feet) from the intersection would place the sign in a position where there is a greater probability that it will be observed by drivers.

- ***The Distance sign should be moved further from the intersection.*** The information provided by the Distance sign is also not immediately critical to drivers passing through an intersection. This sign can also be moved further away without a negative impact on traffic operations. This sign should be placed at least twice as far from the intersection as the Reassurance marker. This results in a placement distance of 450 to 600 meters (1500 to 2000 feet) instead of the current placement criteria of 90 meters (300 feet).
- ***Develop sign spreading concepts for application to conventional guide signs at rural intersections.*** The concept of reducing information overload by spreading signing over a longer distance is already being used for freeway guide signing. Rural intersections of conventional highways can also overload the driver with a significant amount of information concentrated in a relatively small area. In addition to the Junction, Destination, Directional Assembly, Reassurance, and Distance guide signs which are located at an intersection, there are many other signs which are commonly located within a few hundred feet of the intersection. Some of these signs may include:
  - **Regulatory Signs** - Stop, Yield, Speed Limit, Lane-Use Control, Keep Right, One Way, No Parking, and other signs.
  - **Warning Signs** - Stop/Yield/Signal Ahead, HIGHWAY INTERSECTION 1000 FT, Crossroad, and other signs.
  - **Guide Signs** - Texas Trail Markers, Recreational Areas, Traffic Generator, and other signs.

  As part of the third-year effort of this study, the relative priority of these and other signs will be assessed and guidelines will be developed for spreading the information presented by these signs over a greater distance in order to reduce driver overload.
- ***Develop a desirable separation distance which should be provided between sign installations near an intersection.*** Closely spaced signing can create the potential for information overload and some signs can also block the sight distance to succeeding signs. In order to reduce the potential for information overload and restricted sign sight distance, a desirable separation distance between signing in the vicinity of an intersection should be adopted. The actual legibility of signs ranges from about 30 meters (100 feet) to well over 150 meters (500 feet), with 60 to 90 meters (200 to 300 feet) being a typical value. Research has also shown that drivers tend to focus their attention 60 to 90 meters (200 to 300 feet) in front of the vehicle.

Because drivers should only have to focus their attention on one sign at a time, a reasonable separation distance would be 60 meters (200 feet).

- ***Develop sign placement typical applications for a variety of intersection geometries and highway combinations.*** Implementation of the sign spreading and sign separation concepts could be improved through the development of typical applications. These typical applications could illustrate the relationships between various signs and various intersection/interchange geometrics. A portion of the third-year activities of this research study will be devoted toward development of these typical applications.

PRELIMINARY RECOMMENDATIONS FOR HIGHWAY CLASSIFICATION

The evaluations of Texas route markers in the driver surveys and laboratory evaluations, combined with the information obtained from the survey of state traffic engineers, indicate that many different highway classifications used in Texas are a potentially significant source of confusion for drivers. The following preliminary recommendation is intended to simplify the classification of highways in the state system.

- ***Reduce the ACTUAL number of unique highway classifications to three.*** Several different aspects of the study findings indicate that drivers do not understand the differences among the many different highway classifications used on the state highway system. None of the 42 states which responded to the state traffic engineer survey indicated that they had more than four different classifications on their state system, and only two or three states had four classes. The Texas system could be dramatically simplified by having only three classes of highways: Interstate Highways, U.S. Highways, and State Highways. This would entail combining all ten of the highways on the state system into a single classification. While such a change may be difficult to implement, the result would be a highway classification scheme which is much easier for drivers to understand.
- ***As an alternative, reduce the APPARENT number of unique highway classifications to three.*** If the actual number of highway classifications cannot be reduced, then the visible differences in signing the various classes should be minimized. This can be accomplished by using essentially similar route markers as indicated in Figure VII-1. These route markers are identical except for the word indicating the highway class. Eliminating the differences between

route markers would simplify the system and reduce driver confusion over the different highway classes.

IMPLEMENTATION OF RECOMMENDATIONS

A significant portion of the third year of this research study will be devoted to the development of a fieldbook for guide signing on conventional highways. This fieldbook will serve as the means of implementing the recommended guidelines and will provide TxDOT personnel in district and area offices with information on the effective use of guide signs on conventional highways. The fieldbook will contain descriptions of the proper use of conventional guide signs, present a large number of typical applications for conventional guide signing, and describe unique practices which have been successfully utilized by TxDOT personnel for unusual situations. It will also provide some guidance on the relative priority among signs when regulatory, warning, and conventional guide signs must be installed within the same area near an intersection.

CHAPTER VIII
REFERENCES

1. *Manual and Specifications for the Manufacture Display and Erection of U.S. Standard Road Markers and Signs.* American Association of State Highway Officials, Washington, D.C., January 1927.
2. *Manual on Uniform Traffic Control Devices for Streets and Highways,* U.S. Department of Transportation, Federal Highway Administration, Washington, D.C., 1988.
3. H.G. Hawkins, Jr., R.T. Bartoskewitz, D.W. Fenno, and J.M. Distin. *Evaluation of Rural Guide Signing: First Year Activities.* Research Report 1373-1, Texas Transportation Institute, Texas A&M University, College Station, Texas, May 1994.
4. *Guide to Metric Conversion.* American Association of State Highway and Transportation Officials, Washington, D.C., 1993.
5. *Traffic Engineering Metric Conversion Factors: Addendum to the Guide to Metric Conversion.* American Association of State Highway and Transportation Officials, Washington, D.C., 1993.
6. *Texas Manual on Uniform Traffic Control Devices,* Texas Department of Transportation, Austin, Texas, 1980, revised through 1994.
7. *United States Road Symbol Signs.* U.S. Department of Transportation, Federal Highway Administration, Washington, D.C., October 1979.

APPENDIX A

STATE TRAFFIC ENGINEER SURVEY INSTRUMENT

The following pages contain the survey instrument used to identify state practices related to guide signing in a number of different areas. The survey was distributed by the Texas Transportation Institute to the state traffic engineer of all fifty states. The survey contains four main sections. They include: their state manual for traffic control devices, conventional guide signing, metric signing, and freeway guide signing. The purpose of this survey was to find how the signing in other states compares to that of Texas. This appendix contains a copy of the actual instrument used to administer the survey.

SURVEY OF STATE TRAFFIC ENGINEERS

Please provide the following information so that we can send you the documents described in the cover letter:

Name: _____

Title: _____

Agency: _____

Address: _____

Telephone: _____

Name of State Traffic Engineer (or equivalent position): _____

_____

PART I. STATE MANUAL FOR TRAFFIC CONTROL DEVICES

TTI is trying to identify current signing practices for a number of different areas. To help us, we would like to identify the type of manual used in each state to establish requirements for traffic control devices.

1. What is the form of manual used by your state to establish requirements for traffic control devices?
   - ☐ 1989 National MUTCD **without** a state supplement
   - ☐ 1989 National MUTCD **with** a state supplement
   - ☐ State Manual (please provide the following information)
     - Name: _____
     - Year: _____
   - ☐ Other (please describe):

2. Which person in your organization is responsible for the MUTCD (or equivalent)?

   Name: _____

   Title: _____

   Telephone: _____

3. Please indicate how an individual might purchase a copy of your state manual or supplement.

   Send order to: _____

   _____

   _____

   _____

   Cost of document: _____

PART II. CONVENTIONAL GUIDE SIGNING

TTI is currently evaluating the use of guide signs on conventional highways in rural areas. As part of this research, consideration is being given to the development and evaluation of alternative designs for route markers on state highways.

1. How many different classifications of state highways are there on your system (Please do not include Interstate or U.S. Highways)?

   ☐ 1 or 2

   ☐ 3 or 4

   ☐ 5 or more

   Comments:

2. Please provide copies of the standard route marker design for the most common highway classifications on your state highway system (Do not include Interstate or U.S. Highways).

3. Do you use colors in, or in combination with, route markers to provide motorists with directional information?

   ☐ Yes (if yes, please describe how colors are used)

   ☐ No

   Comments:

PART III. METRIC SIGNING

TTI is considering how metric units might be presented in the signs which may result from the various research studies. Please answer the following questions related to metric units.

1. Has your agency developed or adopted any sign legends which include metric units?
   - ☐ Yes (if possible, please describe the types of signs or provide copies of the sign layouts)
     Types of signs for which metric legends have been developed/adopted:
     - ☐ Regulatory signs
     - ☐ Warning signs
     - ☐ Freeway guide signs
     - ☐ Conventional guide signs
   - ☐ No

   Comments:

2. If you have developed/adopted sign legends with metric units, please indicate how the metric units are used.
   - ☐ Metric units only
   - ☐ U.S. units with metric units as a supplement (in parenthesis, supplemental plaque, etc.)
   - ☐ Metric units with U.S. units as a supplement (in parenthesis, supplemental plaque, etc.)

   Comments:

3. Has your agency erected any signs which contain metric units?
   - ☐ Yes
   - ☐ No

   Comments:

PART IV. FREEWAY GUIDE SIGNING

TTI is evaluating guidelines for the use of advance signing on multilane freeway exits. This research is focusing upon signing for the optional lane and advance lane assignments for exits located beyond the initial exit from the freeway.

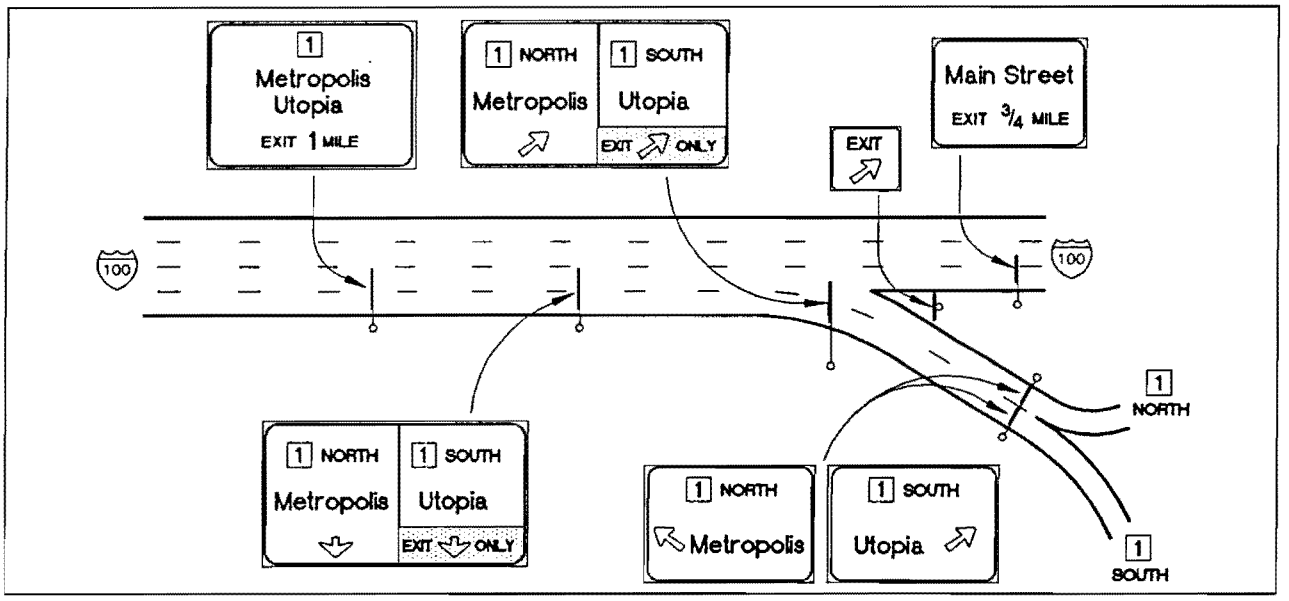
1. Has your agency developed guidelines for freeway guide signing which are different from or more detailed than those in the MUTCD?

   ☐ Yes (if yes, please indicate where these guidelines are located or provide a copy of these guidelines)

   ☐ No

   Comments:

2. The figure below illustrates the typical signing used in Texas for a multilane freeway exit. Please indicate on this figure how the exit would be signed in your state.



Thank you for your assistance. Please return this survey to:

H. Gene Hawkins, Jr.
Texas Transportation Institute
Texas A&M University System
College Station, TX 77843-3135 Phone: (409) 845-6004

APPENDIX B

DRIVER SURVEY INSTRUMENT

This appendix provides a representation of the survey instrument used in the driver survey on conventional guide signs. The survey was a self-administered paper survey which took 10 to 15 minutes for a driver to complete. The survey contains eight questions on conventional guide signs, plus seven additional background questions. This appendix contains a copy of the actual instrument used to administer the survey.

GUIDE SIGNS SURVEY

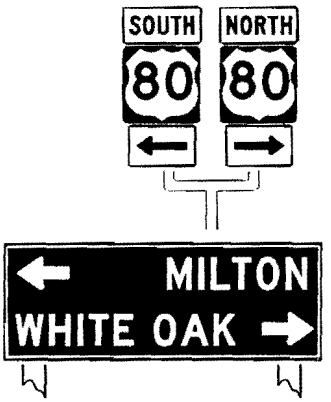
Texas Transportation Institute
Texas Department of Transportation

The Texas Transportation Institute at Texas A&M University is conducting this survey for the Texas Department of Transportation. This survey is being given to evaluate the effectiveness of highway guide signs. Please answer the eight questions in this survey. The results of the survey will help us decide if and how to change highway guide signs.

THIS IS NOT A TEST
THERE ARE NO RIGHT OR WRONG ANSWERS TO THE QUESTIONS

---

1. You are coming up to a highway intersection where you must turn right or left to get where you are going. What information is **THE MOST IMPORTANT TO YOU** in helping you decide which way to turn?



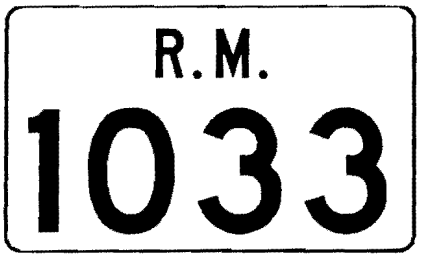
☐ Highway number and direction

☐ The name of the next city on the highway

COMMENTS:

---

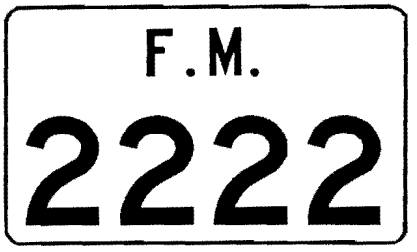
2. What do the initials R.M. stand for in the sign on the right?



☐ Restricted Maintenance Highway
☐ Rural Mail Highway
☐ Rural Miscellaneous Highway
☐ Regulated Motor Vehicle Highway
☐ Ranch Machinery Highway
☐ Ranch-to-Market Highway
☐ Not sure

COMMENTS:

3. What do the initials F.M. stand for in the sign on the right?



- ☐ Free Mail Highway
- ☐ Federal - Miscellaneous Highway
- ☐ Federal Mileage Highway
- ☐ Frequent Maintenance Highway
- ☐ Farm Machinery Highway
- ☐ Farm-to-Market Highway
- ☐ Not sure

COMMENTS:

---

4. As you come up to a highway intersection, you will see a sign like the one to the right. It shows the names of cities that can be reached by turning left or right at the intersection. These cities can be large or small, depending upon the highway. In general, which types of cities are the **MOST HELPFUL TO YOU** in deciding which way to turn at the intersection?

- ☐ A major city regardless of the distance from the intersection.
- ☐ The next county seat.
- ☐ The next city or town that is shown on the Texas state map.
- ☐ The next city or town, regardless of whether it is on the Texas state map.

COMMENTS:

---

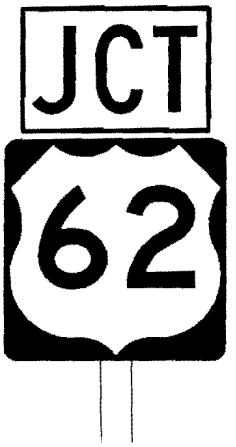
5. Please check the boxes which indicate your level of agreement with the following statements about the sign shown to the right.

	Agree	Uncertain	Disagree
I have trouble reading the sign during the day.	☐	☐	☐
I have trouble reading the sign at night.	☐	☐	☐
The sign needs to be bigger.	☐	☐	☐
It is important to show Texas in this sign.	☐	☐	☐

COMMENTS:

6. The **JCT** sign tells you that you are coming to a highway intersection. Please check the box that represents **YOUR OPINION** of how far this sign should be from the intersection?

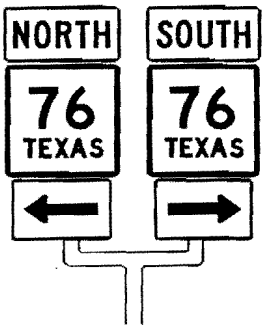
	Time between the sign and the intersection at 55 mph.	Equivalent Distance
☐	1 second	75 feet
☐	2 seconds	150 feet
☐	3 seconds	250 feet
☐	4 seconds	325 feet
☐	7 seconds	550 feet (1/10 mile)
☐	10 seconds	800 feet (1/7 mile)
☐	15 seconds	1200 feet (1/4 mile)



COMMENTS:

---

7. The signs below are typical of those that you would see as you approach Highway 76, which goes north to Newport and south to Greenville. Please indicate **YOUR OPINION** of the importance of this information by placing a "1" next to the most important, a "2" by the second most important, and a "3" by the third most important.



_____ Name of the next city in each direction

_____ Directions in which the highway goes

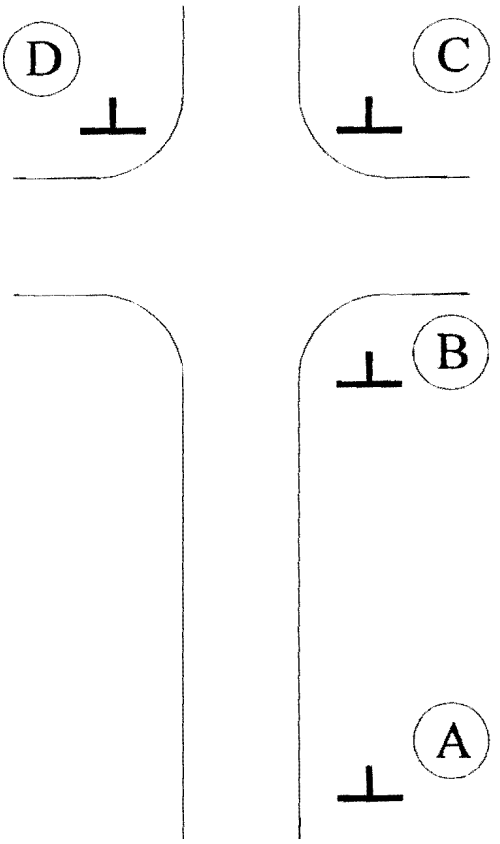
_____ Highway number

_____ Type of highway

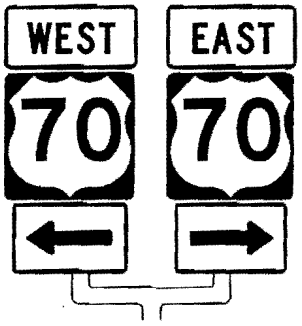
_____ Direction to turn to go in the indicated direction

COMMENTS:

8. The drawing to the right represents a typical highway intersection. Highway signing can be placed before you get to the intersection (Location A) or at various places near the intersection (Locations B, C, or D). Please indicate where **YOU PREFER** the signs below to be located. Check only one box for each sign.



- ☐ Location A - Before you get to the intersection.
- ☐ Location B - Near right side of intersection.
- ☐ Location C - Far right side of intersection.
- ☐ Location D - Far left side of intersection.



Please select only one location for the entire group of signs

- ☐ Location A - Before you get to the intersection.
- ☐ Location B - Near right side of intersection.
- ☐ Location C - Far right side of intersection.
- ☐ Location D - Far left side of intersection.

COMMENTS:

BACKGROUND QUESTIONS

B1. What is your age?
- ☐ 16-24
- ☐ 25-54
- ☐ 55-64
- ☐ 65+

B2. What is your gender?
- ☐ Male
- ☐ Female

B3. What is your ethnic background?
- ☐ African-American (black)
- ☐ Anglo (white)
- ☐ Asian
- ☐ Hispanic
- ☐ Other (please indicate)

_____

B4. What is the highest level of school you completed?
- ☐ Less than high school
- ☐ High school graduate (or equivalent)
- ☐ Trade school graduate
- ☐ Some college
- ☐ College graduate
- ☐ Advanced Degree

B5. How long have you been driving?
- ☐ less than 1 year
- ☐ 1 to 5 years
- ☐ more than 5 years

B6. What type of vehicle do you drive?
(Check **ALL** that apply)
- ☐ Car or Pick-up
- ☐ Large Truck (3 or more axles)
- ☐ RV
- ☐ Other _____

B7. Where do you live?
- ☐ Large city (more than 50,000 population)
- ☐ Medium city (5,000 to 50,000 population)
- ☐ Small city (less than 5,000 population)
- ☐ Rural area (outside of a city)

APPENDIX C

SUMMARY OF DRIVER SURVEY RESPONSES

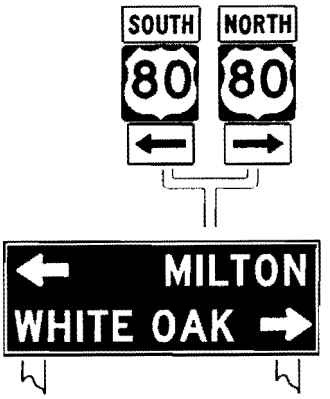
This appendix summarizes the results of the driver survey. The survey instrument (see Appendix B) contained 8 questions on guide signing. There were also 7 background questions. Table C-1 summarizes the characteristics of the sample for the driver survey as determined from the 7 background questions.

Table C-1. Driver Survey Sample Characteristics

Characteristic		Number of Respondents	Driver Survey	Texas Population	Texas Drivers
Age	16-24	45	10.4%	18.9%	15.2%
	25-54	275	63.7%	57.4%	62.4%
	55-64	64	14.8%	10.2%	10.4%
	65+	46	10.7%	13.6%	12.0%
	No Response	2	0.5%		
Gender	Male	227	52.6%	49.3%	51.5%
	Female	198	45.8%	50.7%	48.5%
	No Response	7	1.6%		
Family Background	African-American	7	1.6%	11.6%	---
	Anglo	354	81.9%	60.6%	---
	Asian	4	0.9%	N/A[1]	---
	Hispanic	47	10.9%	25.6%	---
	Other	13	3.0%	2.2%	---
	No Response	7	1.6%		
Level of Education	Less than High School	18	4.1%	28.1%	---
	High School Graduate	130	30.1%	25.9%	---
	Trade School Graduate	20	4.6%	N/A[2]	---
	Some College	127	29.4%	27.8%	---
	College Graduate	86	19.9%	12.6%	---
	Advanced Degree	39	9.0%	5.5%	---
	No Response	12	2.8%		
Years Driving	Less than 1 Year	3	0.7%	---	---
	1 to 5 Years	16	3.7%	---	---
	More than 5 Years	366	84.7%	---	---
	No Response	47	10.9%		
Type of Vehicle Driven	Car or Pick-Up	400	79.7%	---	---
	Large Truck	26	5.2%	---	---
	RV	39	7.8%	---	---
	Other	28	5.6%	---	---
	No Response	8	1.8%		
Area Where Living	Large City (>50,000)	122	28.9%	---	---
	Medium City (5,000-50,000)	151	35.8%	---	---
	Small City (<5,000)	73	16.9%	---	---
	Rural Area	76	17.6%	---	---
	No Response	10	2.3%		
Sample Size	---	432	100%	---	---

Notes: [1]For the statewide proportion, Asians are included in the other category.
[2]Statewide proportion not available.

1. You are coming up to a highway intersection where you must turn right or left to get where you are going. What information is **THE MOST IMPORTANT TO YOU** in helping you decide which way to turn?



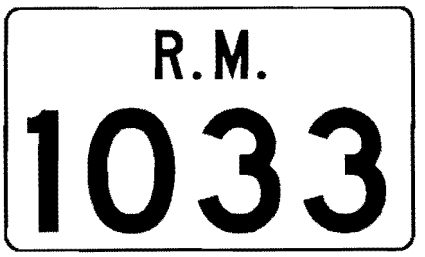
61.1%	Highway number and direction
27.3%	The name of the next city on the highway
10.2%	Both responses
1.4%	No response

COMMENTS:

33 comments

---

2. What do the initials R.M. stand for in the sign on the right?



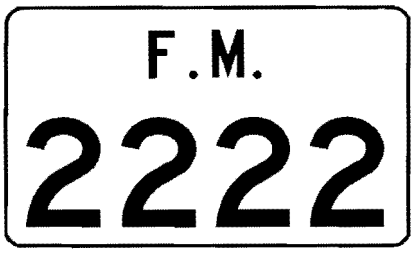
6.5%	Restricted Maintenance Highway
8.6%	Rural Mail Highway
1.6%	Rural Miscellaneous Highway
2.8%	Regulated Motor Vehicle Highway
2.3%	Ranch Machinery Highway
40.5%	Ranch-to-Market Highway
37.0%	Not sure
0.7%	No response

COMMENTS:

3 comments

---

3. What do the initials F.M. stand for in the sign on the right?

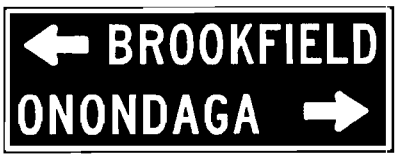


0.5%	Free Mail Highway
0.9%	Federal - Miscellaneous Highway
0.9%	Federal Mileage Highway
0.5%	Frequent Maintenance Highway
5.3%	Farm Machinery Highway
88.6%	Farm-to-Market Highway
3.0%	Not sure
0.2%	No response

COMMENTS:

1 comment

4. As you come up to a highway intersection, you will see a sign like the one to the right. It shows the names of cities that can be reached by turning left or right at the intersection. These cities can be large or small, depending upon the highway. In general, which types of cities are the **MOST HELPFUL TO YOU** in deciding which way to turn at the intersection?



23.2% A major city regardless of the distance from the intersection.
2.1% The next county seat.
54.5% The next city or town that is shown on the Texas state map.
19.7% The next city or town, regardless of whether it is on the Texas state map.
0.5% No response.

COMMENTS:

8 comments

---

5. Please check the boxes which indicate your level of agreement with the following statements about the sign shown to the right.

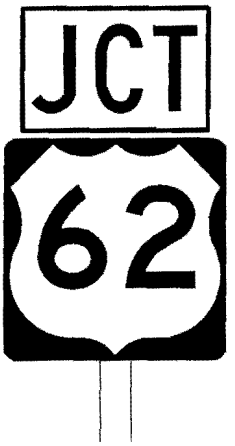
Response	Agree	Uncertain	Disagree	No Response
I have trouble reading the sign during the day.	3.5%	8.6%	70.5%	17.4%
I have trouble reading the sign at night.	27.8%	10.7%	46.9%	14.6%
The sign needs to be bigger.	36.7%	15.6%	35.3%	12.5%
It is important to show Texas in this sign.	54.9%	16.5%	20.0%	8.6%

COMMENTS:

11 comments

6. The **JCT** sign tells you that you are coming to a highway intersection. Please check the box that represents **YOUR OPINION** of how far this sign should be from the intersection?

	Time between the sign and the intersection at 55 mph.	Equivalent Distance
2.5%	1 second	75 feet
3.7%	2 seconds	150 feet
6.5%	3 seconds	250 feet
7.8%	4 seconds	325 feet
22.6%	7 seconds	550 feet (1/10 mile)
16.6%	10 seconds	800 feet (1/7 mile)
1.2%	15 seconds	1200 feet (1/4 mile)



COMMENTS:

16 comments

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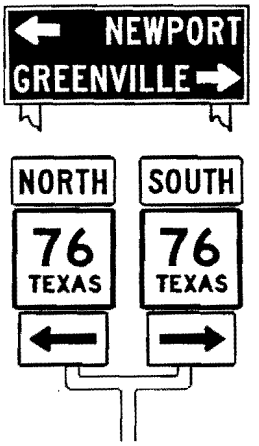
7. The signs below are typical of those that you would see as you approach Highway 76, which goes north to Newport and south to Greenville. Please indicate **YOUR OPINION** of the importance of this information by placing a "1" next to the most important, a "2" by the second most important, and a "3" by the third most important.

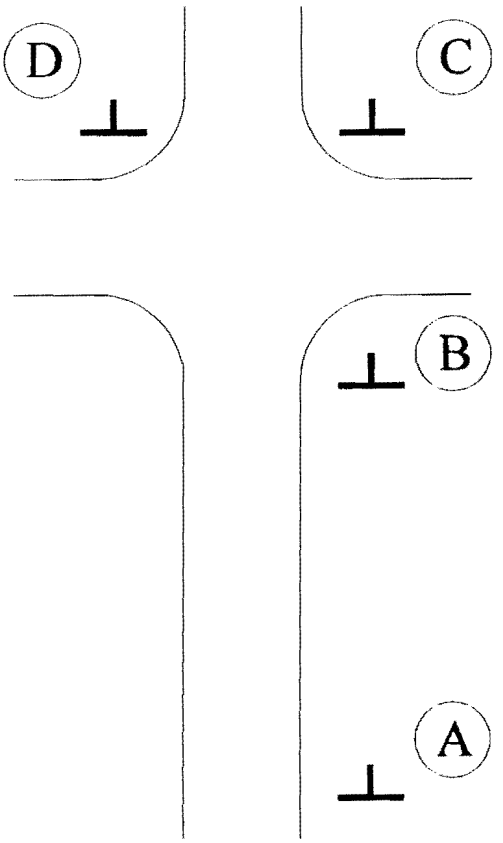
Percent Selecting Indicated Rank			Response
1	2	3	
42.1%	12.7%	16.4%	Name of the next city in each direction
25.5%	30.1%	19.0%	Directions in which the highway goes
35.2%	29.2%	18.8%	Highway number
6.3%	7.2%	12.3%	Type of highway
19.4%	16.4%	24.1%	Direction to turn to go in the indicated direction



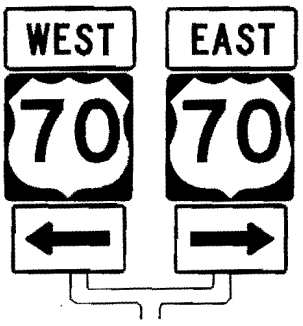
COMMENTS:

1 comment

8. The drawing to the right represents a typical highway intersection. Highway signing can be placed before you get to the intersection (Location A) or at various places near the intersection (Locations B, C, or D). Please indicate where **YOU PREFER** the signs below to be located. Check only one box for each sign.



66.9% Location A - Before you get to the intersection.
23.6% Location B - Near right side of intersection.
6.0% Location C - Far right side of intersection.
1.2% Location D - Far left side of intersection.
2.3% No response.



Please select only one location for the entire group of signs
56.3% Location A - Before you get to the intersection.
31.0% Location B - Near right side of intersection.
9.5% Location C - Far right side of intersection.
1.2% Location D - Far left side of intersection.
2.1% No response.

COMMENTS:

6 comments

APPENDIX D

TECHNICAL MEMORANDUM ON ALTERNATIVE F.M. ROUTE MARKER DESIGNS

The pages in this appendix contain a technical memorandum describing the factors which support the need to develop and evaluate alternative designs of the F.M. route marker. The last two pages of the technical memorandum contain a survey that TxDOT personnel were asked to complete and return to the researchers.

DESCRIPTION OF FACTORS JUSTIFYING THE CONSIDERATION OF ALTERNATIVE DESIGNS FOR THE TEXAS F.M. ROUTE MARKER

Technical Memorandum

by

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Research Study Number 0-1373

Study Title: Evaluation of Rural Guide Signing

Sponsored by
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DESCRIPTION OF FACTORS JUSTIFYING THE CONSIDERATION OF ALTERNATIVE DESIGNS FOR THE TEXAS F.M. ROUTE MARKER

EXECUTIVE SUMMARY

- Standard design features of the existing F.M. route marker:
  - Sign blank is 610×610 mm (24×24 inches).
  - The four-digit highway number has a 102 (4-inch) number height.
- Research activities were conducted to evaluate the legibility of the standard four-digit F.M. route marker.
  - Three different tests were conducted: two in a moving vehicle and one in a stationary vehicle.
  - In daytime conditions, the average measured distance at which 85 percent of the older drivers (60+) could read the F.M. route marker is 32 meters (105 feet).
  - In nighttime conditions, the estimated distance at which 85 percent of older drivers can read the F.M. route marker is 16 meters (53 feet).
  - The estimated nighttime legibility results in an exposure time of 0.66 seconds.
  - Use of high-intensity sheeting for route markers would further degrade nighttime legibility.
- The consistency of the F.M. route marker design with other types of route markers was assessed in a survey of state traffic engineers.
  - The Interstate Highway, US Highway, and 26 state route markers (of the 36 responses) use a wider route marker to accommodate a three-digit highway number.
  - The US Highway and standard FHWA state route marker designs use a 305 (12 in) Series D number in the route marker. Of the 36 states which provided detailed information, 27 use at least a 305 mm (12 in) height for a two-digit number and 22 use at least a 305 mm (12 in) height for a three-digit number.
- Driver information needs were assessed through a driver survey.
  - Survey results indicate that drivers place more emphasis on the highway number than on the highway classification.
  - Only 68 percent of survey participants recognized that the F.M. route marker is used on F.M. highways and 34 percent thought that it was used on state highways.
- The design of the F.M. route marker has changed at least twice in the last 40 years.

DESCRIPTION OF FACTORS JUSTIFYING THE CONSIDERATION OF ALTERNATIVE DESIGNS FOR THE TEXAS F.M. ROUTE MARKER

Research study 1373 is a three-year study evaluating the guide signing currently used on conventional highways in rural areas. The study is presently about halfway through the second year. One of the most significant of the first-year findings was the need to improve the design of the Farm-to-Market (F.M.) Road route marker. Typically, researchers work closely with the Technical Panel Chairman and the Technical Panel (TP) in order to obtain input from TxDOT personnel and to ensure that the interests of TxDOT are properly considered. However, because a change in the standard design of the F.M. route marker could have far-reaching effects, this technical memorandum (TM) has been prepared in order to obtain input from the TxDOT administration regarding the alternative designs and the design requirements used to prepare those designs. This input is being sought so that it can be considered before the research activities are completed. The beginning of this TM describes the reasons why consideration should be given to improving the design of the F.M. route marker. The end of the TM suggests design requirements for developing alternative designs and illustrates possible alternatives for future evaluation. A form is provided at the end of the TM so that readers can comment on the suggested design requirements and alternative designs.

Standard Design

There are almost 66,000 centerline-kilometers (41,000 centerline-miles) of F.M. and Ranch-to-Market (R.M.) highways in Texas. This mileage is divided among approximately 3,544 different highway numbers. The current design for the F.M. route marker is shown in Figure D-1. The standard design is a 610×610 mm (24×24 inch) sign. The design of the R.M. route marker is identical, except that the word RANCH replaces FARM. Throughout this TM, reference is made only to the F.M. route marker, although all statements apply equally to the R.M. route marker. The highway number is contained within the outline of the state of Texas, which limits the size of number that can be used. As a result, the height of the highway number decreases as the number of digits increases. In other words, as the amount of information being conveyed to the driver increases, the size of that information decreases.

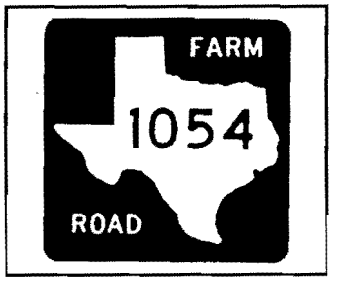


Figure D-1. Current Route Marker Design

In the current F.M. route marker design, one- and two-digit numbers are 152 mm (6-inch) tall, three-digit numbers are 127 mm (5-inch) tall, and four-digit numbers are 102 mm (4-inch) tall. The proportions of 1-, 2-, 3-, and 4-digit F.M. highways within the system are <1, 2, 27 and 70 percent, respectively. Thus, four-digit F.M. markers make up a large majority of the F.M. signs and should be considered as the basis for the design of the marker.

Legibility of F.M. Route Marker

As part of this study, the legibility of the F.M. route marker with 102 mm (4-inch) tall numbers was evaluated in daylight conditions. Legibility distances were obtained from a sample of 32 subjects, 24 of which were age 60 and above and 8 of which were under the age of 50. The evaluation procedure included two dynamic tests and one static test. In the dynamic tests, subjects were required to view the target sign(s) while driving at 55 km/h (35 mph). In the static test, the vehicle was stopped while subjects read the signs.

All total, the 32 subjects made 506 observations in dynamic field testing and 512 observations in static field testing. Table D-1 summarizes the legibility distances that were measured for the four-digit F.M. route marker. These legibility distances show that the average legibility distance of the F.M. route marker which accommodates 85 percent of the older driver test subjects is 32 meters (104 feet). The legibility distances for the F.M. route marker are 55 to 60 percent of the legibility distances that were measured for the state highway route marker.

As a general rule of thumb, the nighttime legibility of the highway numbers can be assumed to be approximately 15 percent less than the daytime legibility distances for most drivers. The actual distance at which the number becomes legible is dependent on many factors, such as the headlights of a vehicle, the retroreflective sheeting of the sign, the driver's nighttime visual acuity, and the presence of glare. Glare and nighttime acuity are particularly significant problems for older drivers. As a result, older drivers have even greater difficulty in nighttime conditions, reducing legibility even more. When the 15 percent reduction is applied to the older driver legibility distances determined in this research, the resulting nighttime 85th percentile legibility of the F.M. route marker is approximately 27 meters (88 feet), and could be less. Furthermore, the retroreflective sheeting does not function once the observation angle becomes more than about 20 to 30 degrees. In other words, once a driver is 11 to 15 meters (35-50 feet) from the sign (for a typical two-lane highway), it does not reflect enough light to be legible.

Table D-1. Legibility Distances (meters/feet) for Four-Digit F.M. Route Markers

Evaluation Test	Legibility Measurement[1]	Older Drivers[2]		Younger Drivers[2]	
		Mean	85th Percentile	Mean	85th Percentile
Static	Best	65(212)	38(125)	79(258)	71(213)
	Certain	58(190)	35(113)	65(213)	55(181)
Single Dynamic	Best	56(182)	31(100)	68(224)	57(188)
	Certain	53(174)	31(100)	63(207)	53(175)
Multiple Dynamic	Best	75(247)	46(150)	82(268)	73(238)
	Certain	67(220)	31(100)	78(255)	65(213)
Average of Tests	Best	65(214)	38(125)	76(250)	65(213)
	Certain	60(195)	32(104)	69(225)	58(190)

Notes: [1]The best measurement is the distance at which the driver thinks he/she can first read the sign. The certain measurement is the distance at which the driver is certain of the sign legend.
[2]For the legibility evaluations, older drivers were age 60 and over and younger drivers were age 50 and under.

The speed limit on most F.M. highways is 90 km/h (55 mph), which limits the time that a driver can view a route marker to just a few seconds. Using the legibility distances shown in Table D-1, the typical length of older driver exposure to the F.M. route marker sign is shown in Table D-2. As shown in the table, drivers at night may be able to read the highway number in the F.M. route marker for about two-thirds of a second. Future evaluations of alternative designs will attempt to determine the length of time that is required to read a route marker.

Table D-2. Typical Exposure Time to F.M. Route Markers for Older Drivers

Driver Age	Percentile	Measured Legibility Distance (meters(feet))[1]	Duration of Daytime Exposure (sec) at 90 km/h (55 mph)	Nighttime Exposure[2] (sec)
60 and over	Mean	60(195)	2.41	1.62
	85th	32(104)	1.29	0.66

Notes: [1]The average legibility-certain distance determined in SPR research study 1373.
[2]Legibility reduced by 15 percent and 11 meters (35 feet) subtracted from the remaining legibility distance to account for the performance of the sheeting at high entrance angles.

The nighttime legibility of route markers is also affected by the retroreflective sheeting used in the sign. Currently, route markers with white backgrounds use engineering grade sheeting. However, high-intensity sheeting is becoming more common in many applications, which includes some route markers. The higher retroreflectivity of high-intensity sheeting causes the numbers in the route marker to wash out, reducing the legibility. If high-intensity sheeting is adopted as the standard material for route markers, the nighttime legibility of the F.M. route marker would be reduced more

than the 15 percent described above. Previous research has shown that drivers need larger letters or letters with a wider stroke when the retroreflectivity of the sign is increased.

Consistency with Other Route Marker Designs

The F.M. route marker uses the square sign shape for all highway numbers, which is why the number height decreases as the number of digits increases. This practice is inconsistent with route markers used on national highways and highways in many other states. When the number of digits in Interstate and US Highway route markers increases to 3, the width of the sign is increased from 610 mm (24-inch) to 762 mm (30-inch) in order to accommodate the number without reducing the number height. The same practice of using a wider sign is followed in 20 of the 25 states which have responded to date to a survey conducted as part of this research.

The numbers in both the Interstate and US Highway route markers are also taller than those in the F.M. route marker. The height of the highway number in the standard state route marker (as shown in the FHWA Standard Highway Signs manual) is the same as those in the US Highway route marker. For the 36 states which included such information in their survey responses, 28 maintain the same number height for both two-digit and three-digit highway numbers. Of the 36 states, 27 use at least a 305 mm (12-inch) tall number for a two-digit number and 22 use at least a 305 mm (12-inch) tall number for a three-digit number. Table D-3 compares route marker size and height of number for several types of route markers.

Driver Information Needs for Route Markers

Guide signs typically present the driver with two pieces of information, the highway number and the highway classification. Based on the findings of driver surveys conducted as part of this research, drivers consider the highway number to be the primary piece of information. In the surveys, drivers were shown route markers for an Interstate Highway, a US Highway, a State Highway, and a F.M. Highway. For the Interstate and F.M. route markers, the words INTERSTATE and FARM ROAD were blacked out. As shown by the response percentages in Table D-4, a significant percentage of drivers do not distinguish between the various highway route markers. These findings indicate that the highway number is more important to drivers than the highway classification.

Table D-3. Comparison of Route Marker Designs

Highway Classification	Digits in Highway Number	Route Marker Size mm (inches)	Height of Number[1] mm (inches)
Interstate	2	610×610 (24×24)	254 (10)
	3	762×610 (30×24)	
US Highway	2	610×610 (24×24)	305 (12)
	3	762×610 (30×24)	
FHWA State Route Marker[2]	2	610×610 (24×24)	305 (12)
	3	762×610 (30×24)	
Texas State Highway	1 or 2	610×610 (24×24)	229 (9)
	3		178 (7)
Texas F.M. Highway	1 or 2	610×610 (24×24)	152 (6)
	3		127 (5)
	4		102 (4)

Note: [1]All numbers use a Series D alphabet.
[2]Standard state route marker design contained in FHWA Standard Highway Signs manual.

Table D-4. Route Marker Recognition

Type of Route Marker Shown to Drivers	Percentage Selecting Each Highway Classification[1]				
	Interstate	US Hwy	State Hwy	F.M. Hwy	R.M. Hwy
Interstate[2]	64*	15	34	1	1
US Highway	20	63*	25	4	2
State Highway	4	6	46*	36	24
F.M./R.M. Highway[3]	3	4	34	68*	20*

Note: [1]Drivers could choose more than one highway type for each route marker.
[2]The word INTERSTATE was blacked out in the route marker, but not the word TEXAS.
[3]The words FARM ROAD were blacked out in the route marker.
*Indicates the correct response.

The importance of the highway number was further emphasized in the answers to a different question in the same survey. When asked to rank the three most important types of information from a list of six, the highway number had the highest percentage of drivers ranking it as the most important (46 percent). The next highest percentage in the most important ranking was the name of the next city or town (20 percent).

Previous Changes in F.M. Route Marker Design

The current design of the F.M. route marker has not always been the standard design used on F.M. highways. The current design was first introduced in the 1967 Texas Manual on Uniform Traffic Control Devices (TMUTCD), which included the two designs for F.M. route markers shown in Figure D-2.

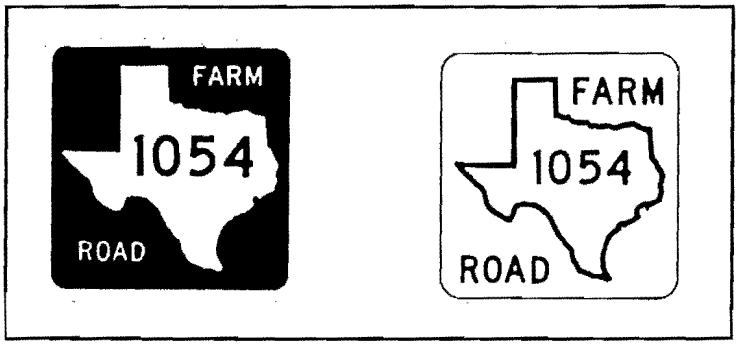


Figure D-2. F.M. Route Marker Design in 1967 TMUTCD

Prior to that, the 1954 TMUTCD included the F.M. route marker designs shown in Figure D-3.

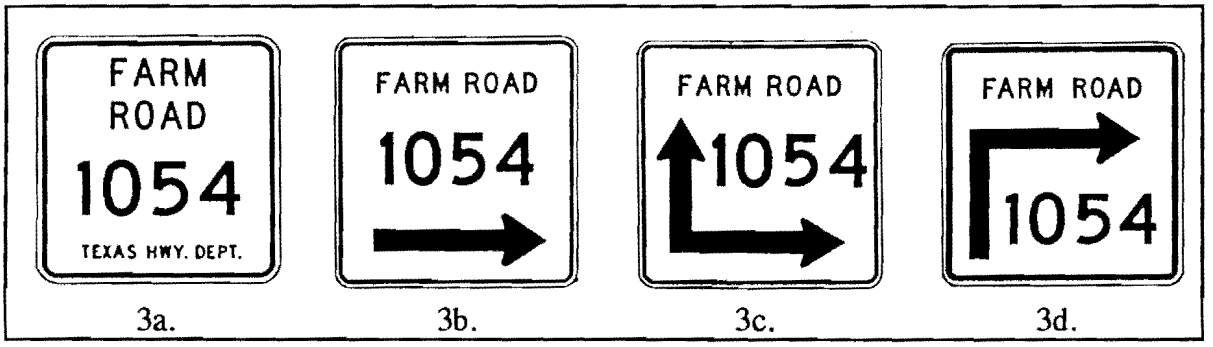


Figure D-3. F.M. Route Marker Designs in 1954 TMUTCD

Design Requirements for Alternative F.M. Route Marker

Once the research indicated that alternative route marker designs should be evaluated, a list of design requirements was developed. The design requirements were divided into two groups: those of primary importance and those of secondary importance. The primary requirements had to be satisfied in all alternative designs. The secondary requirements were satisfied in some designs, but not all. The design requirements are shown in Table D-5. These requirements were then used to develop the various designs shown in Figure D-4 for evaluation in future activities. These alternatives represent a variety of different concepts for the route marker and are being included in this TM in order to solicit input on the alternatives before they are evaluated in laboratory and field experiments.

Table D-5. Design Requirements for Alternative F.M. Route Markers

Primary Requirements	Secondary Requirements
• Route marker design should emphasize the needs of older drivers. • The sign design should accommodate 85 percent of drivers. • Highway number should be the primary feature. • The height of the number should not decrease as the number of digits is increased. • The route marker should fit on standard size sign blanks: 610×610 mm (24×24 in) or 762×610 mm (30×24 in). • The route marker design should be based on a four-digit highway number. • The height of the highway number should be consistent with that in the State Highway route marker.	• The route marker should include some feature which identifies it with Texas. • The route marker width should increase as the number of digits increases. • The height of the number should be consistent with the design of route markers used in other states.

Input on Alternative Designs

As part of this research, evaluations of the existing F.M. route marker and potential alternative designs will be conducted. Based on the result of those evaluations, a new design(s) for the route marker will be recommended, if the new design(s) is found to be more effective than the existing design. However, before initiating these evaluations, input from appropriate TxDOT personnel is being solicited regarding the alternative designs and the design requirements used to prepare those designs. Attached to the end of this TM is a response form that can be used to comment on the alternative designs and the design requirements. Readers are encouraged to identify alternatives which they favor and comment on the validity of the design requirements. Additional comments related to the overall concept of redesigning the F.M. route marker are also encouraged. Response forms, additional comments, and questions should be returned to:

Gene Hawkins
Texas Transportation Institute
The Texas A&M University System
College Station, TX 77843-3135
Telephone: (409) 845-9946
FAX: 845-9761

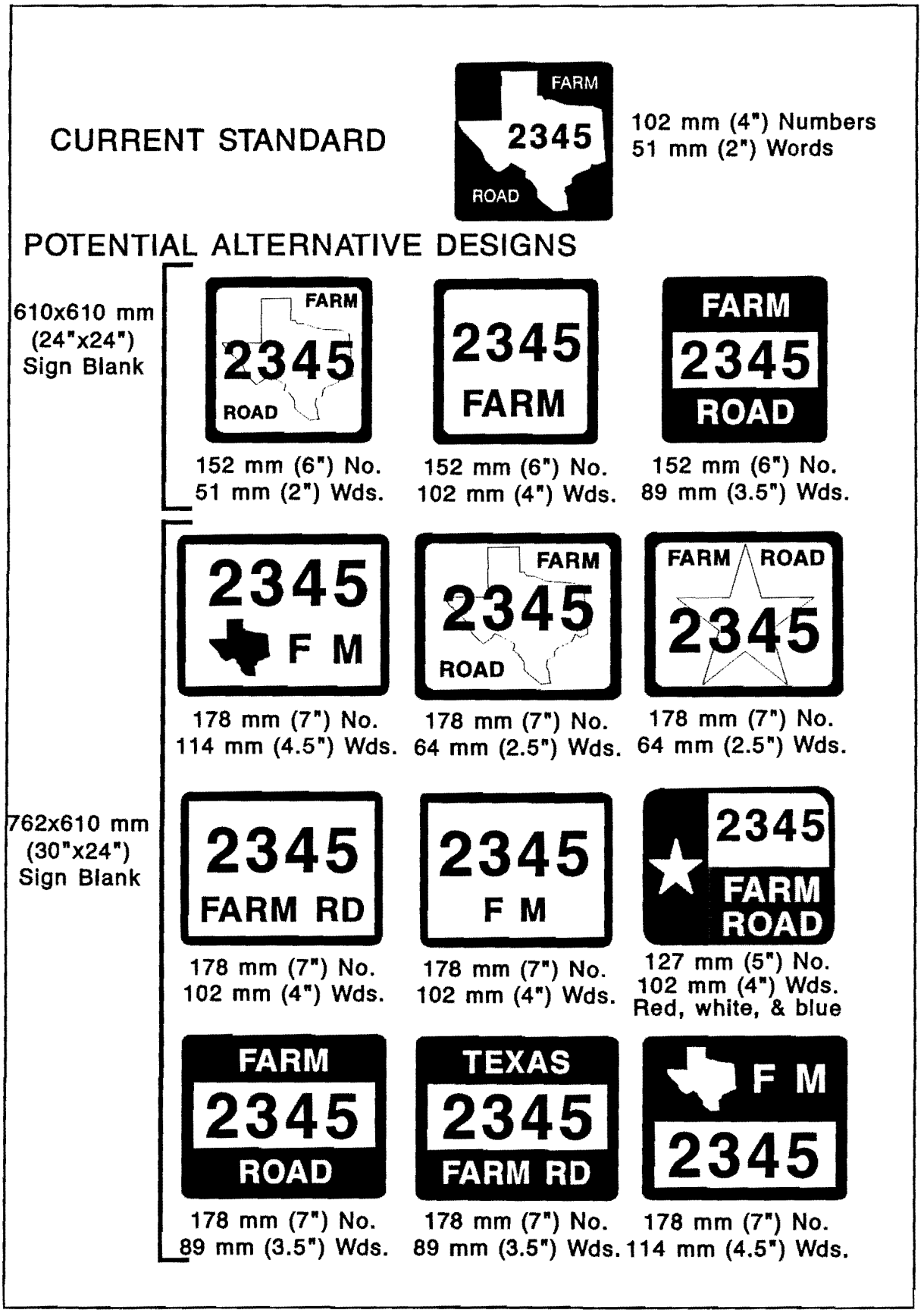


Figure D-4. Alternative Designs for FM Route Marker

RESPONSE FORM FOR F.M. ROUTE MARKER ALTERNATIVE DESIGNS

NAME: _____

TITLE: _____

DIVISION/DISTRICT: _____

The primary purpose of this technical memorandum is to solicit opinions and input relative to the redesign of the F.M. route marker. Please state your level of agreement with the statements in the following tables. Your comments will help us to develop a strategy for future activities in this area.

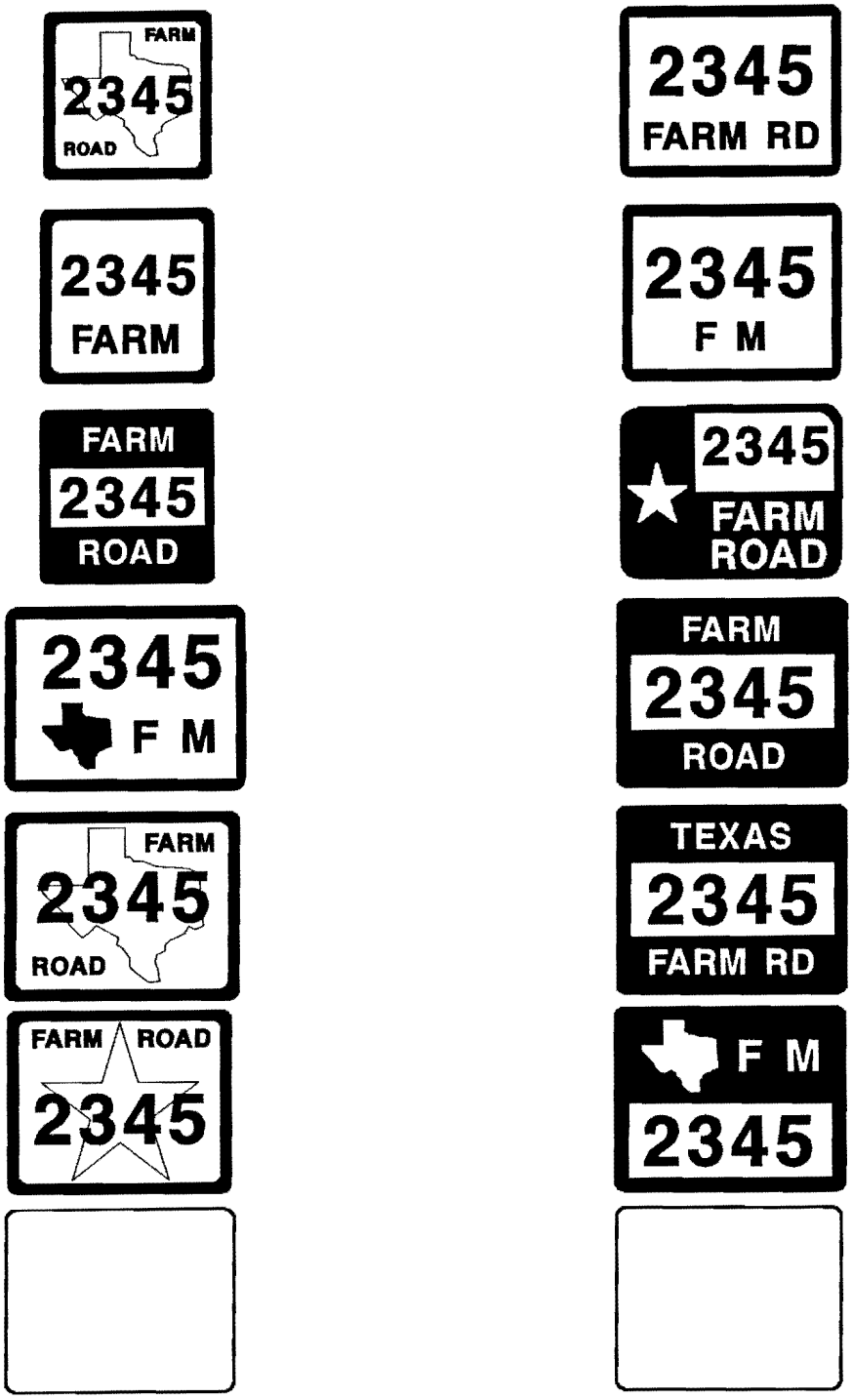
Table D-6. General Opinions About a New F.M. Route Marker Design

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The design of the existing F.M. route marker is adequate.					
There is sufficient justification to consider alternative F.M. route marker designs.					
If a new F.M. route marker design is found to be better, it should be implemented.					
There are institutional barriers to implementing a new F.M. route marker.					

Table D-7. Design Requirements for Alternative F.M. Route Markers
(More detailed descriptions of requirements contained in technical memorandum)

Design Requirements	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Primary					
Meets the needs of older drivers					
Accommodates the needs of 85 percent of drivers					
Highway number should be the primary feature					
Number height doesn't decrease as no. of digits increase					
Fits on standard size sign blanks: 610×610 mm (24×24 in) or 762×610 mm (30×24 in)					
Sign design based on four-digit highway number					
Number height consistent with S.H. route marker					
Secondary					
Has design feature which identifies it with Texas					
A 762×610 mm (30×24 in) sign blank is used for 3- or four-digit numbers					
Number height consistent with other states					

The route markers shown below have been developed as potential alternative designs for the existing F.M. route marker. Please comment on each of the alternative designs or suggest your own design in the blank boxes. Specifically indicate whether you feel that an alternative should or should not be included in future evaluations of alternative designs. The alternatives are shown in greater detail in Figure D-4.



PLEASE ATTACH ANY ADDITIONAL COMMENTS YOU WOULD LIKE TO MAKE.
Please return this survey to: Gene Hawkins / Texas Transportation Institute /
The Texas A&M University System / College Station, TX 77843-3135

APPENDIX E

FILTERED IDENTIFICATION EXAMPLES

This appendix contains the route marker images that were used for two of the route markers in the filtered identification evaluation procedure. Figures E-1 through E-7 are the images for the current F.M. route marker design and Figures E-8 through E-14 are the images for the recommended F.M. route marker. The images were filtered using a computer program which averaged the values of adjacent pixels in the image. This was done over a series of 20 plus steps. Seven of these images were selected for use in the evaluations. The seven levels used in the evaluations ranged from Level 1, which was the highest level of fuzziness, to Level 7, which was a sharp image with no filtering.

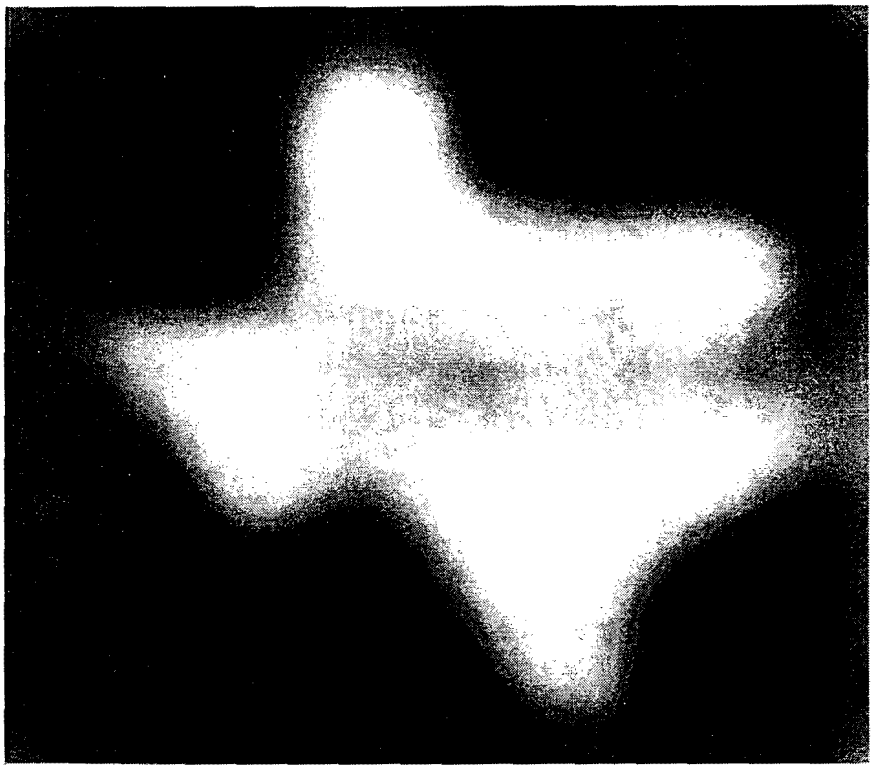


Figure E-1. Current F.M. Route Marker Design, Level 1

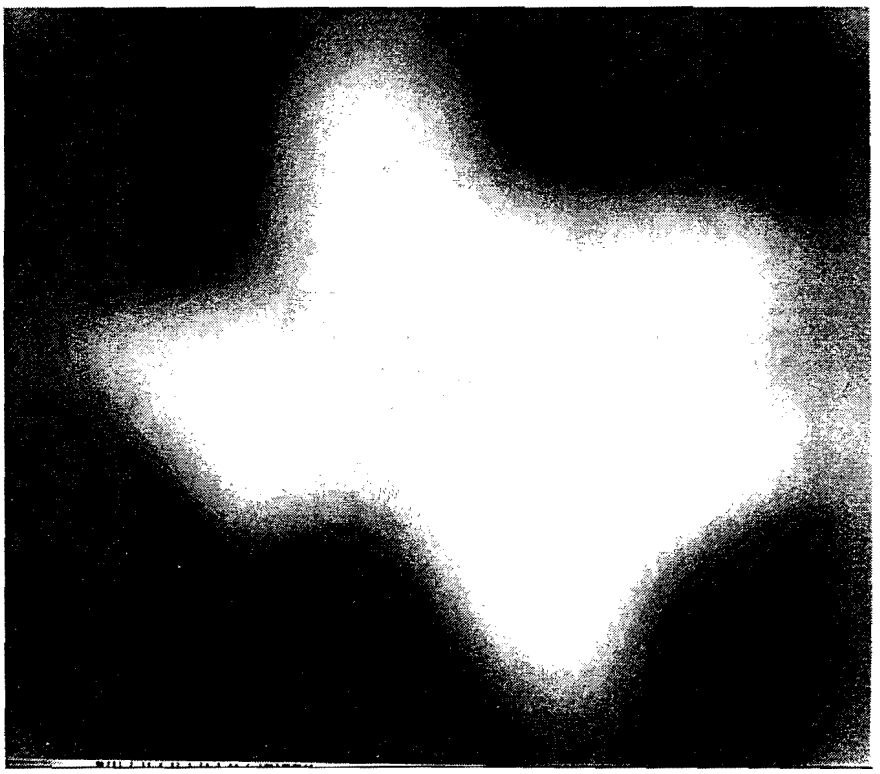


Figure E-2. Current F.M. Route Marker Design, Level 2

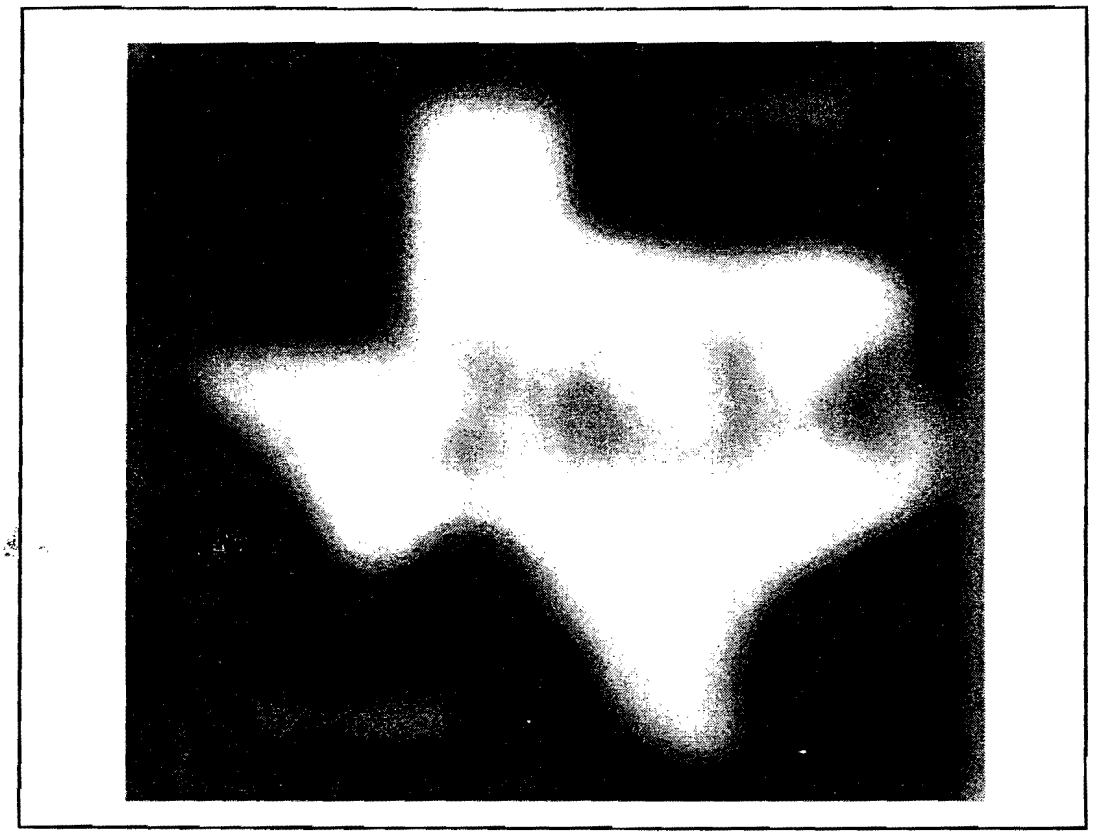


Figure E-3. Current F.M. Route Marker Design, Level 3

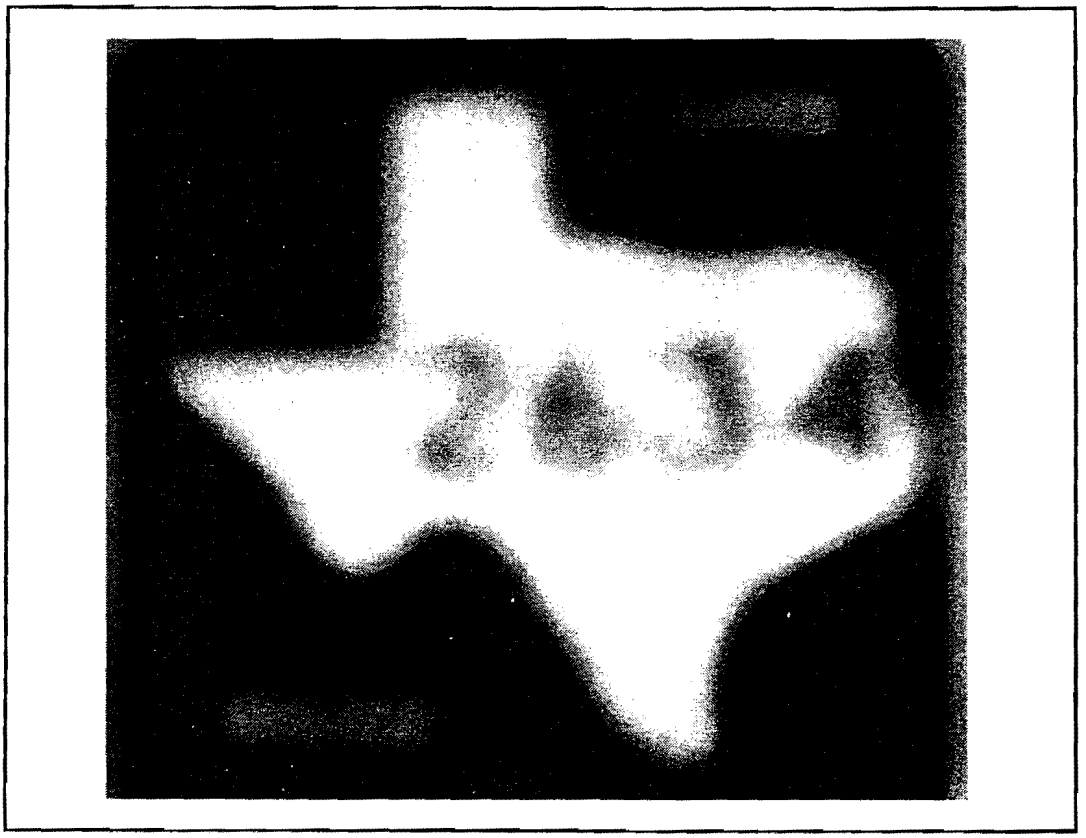


Figure E-4. Current F.M. Route Marker Design, Level 4

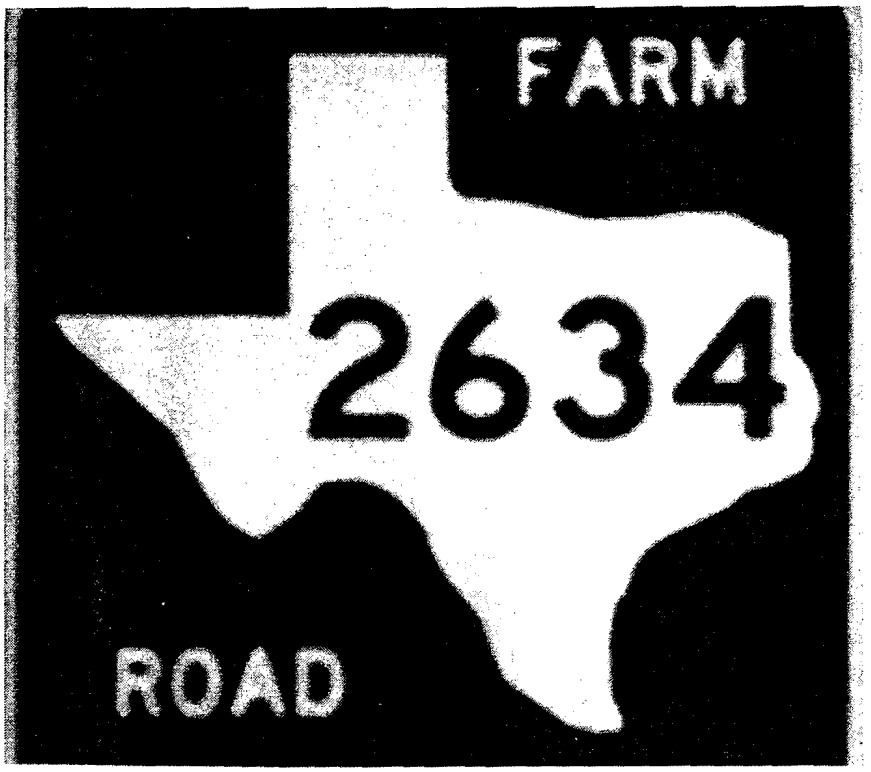


Figure E-7. Current F.M. Route Marker Design, Level 7

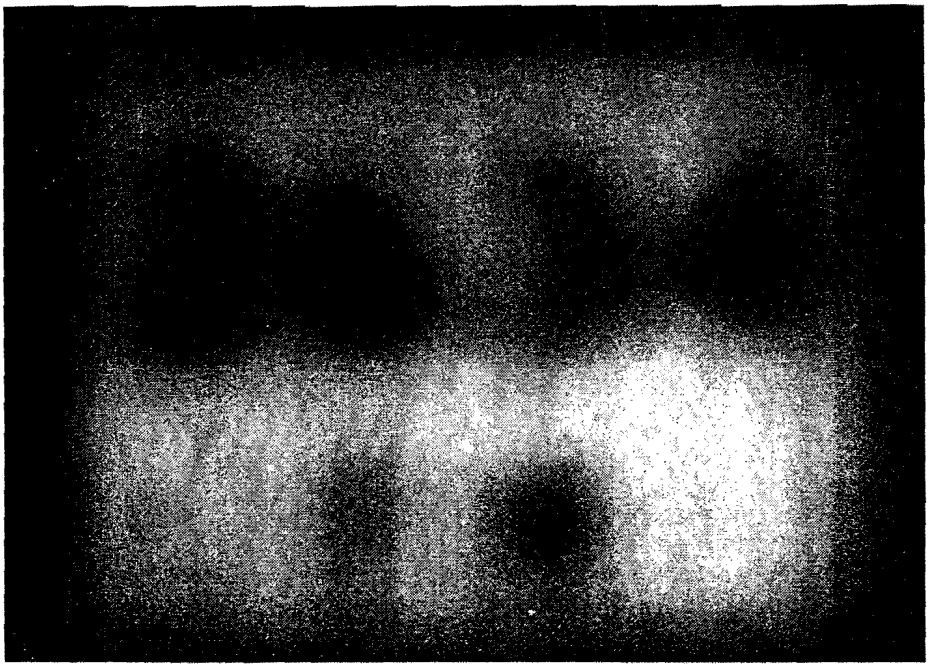


Figure E-8. Recommended F.M. Route Marker Design, Level 1

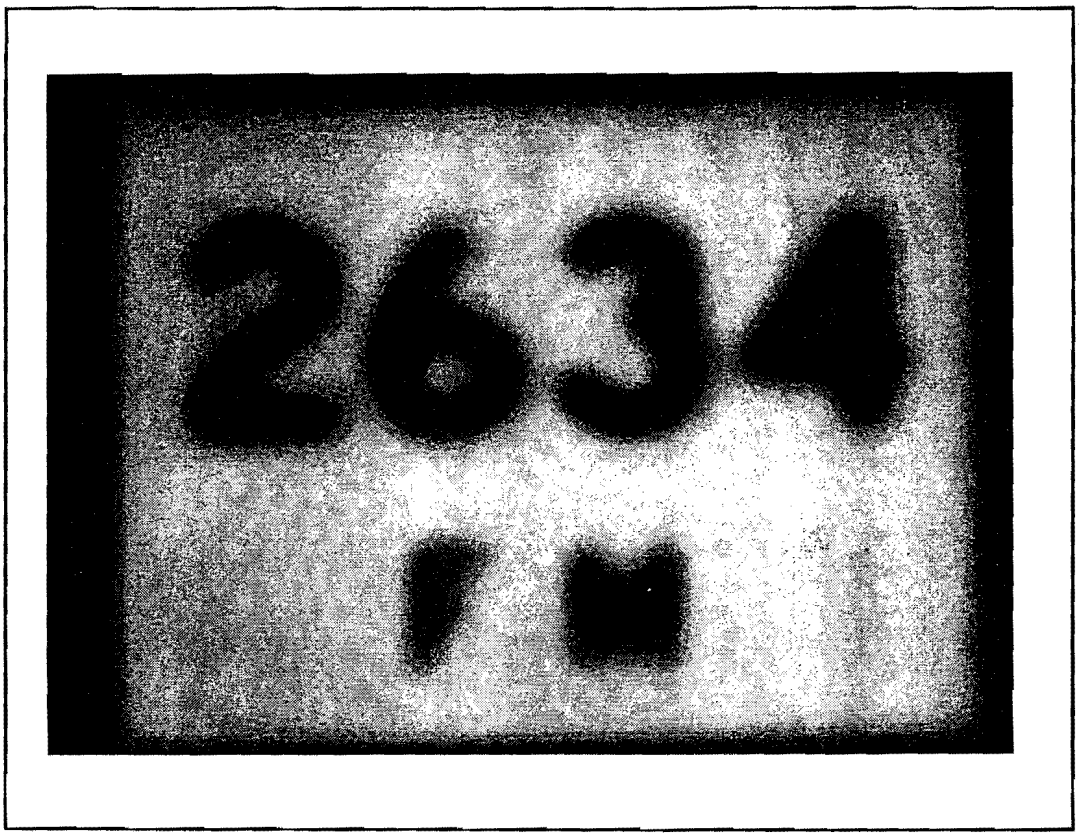


Figure E-11. Recommended F.M. Route Marker Design, Level 4

Figure E-12. Recommended F.M. Route Marker Design, Level 5

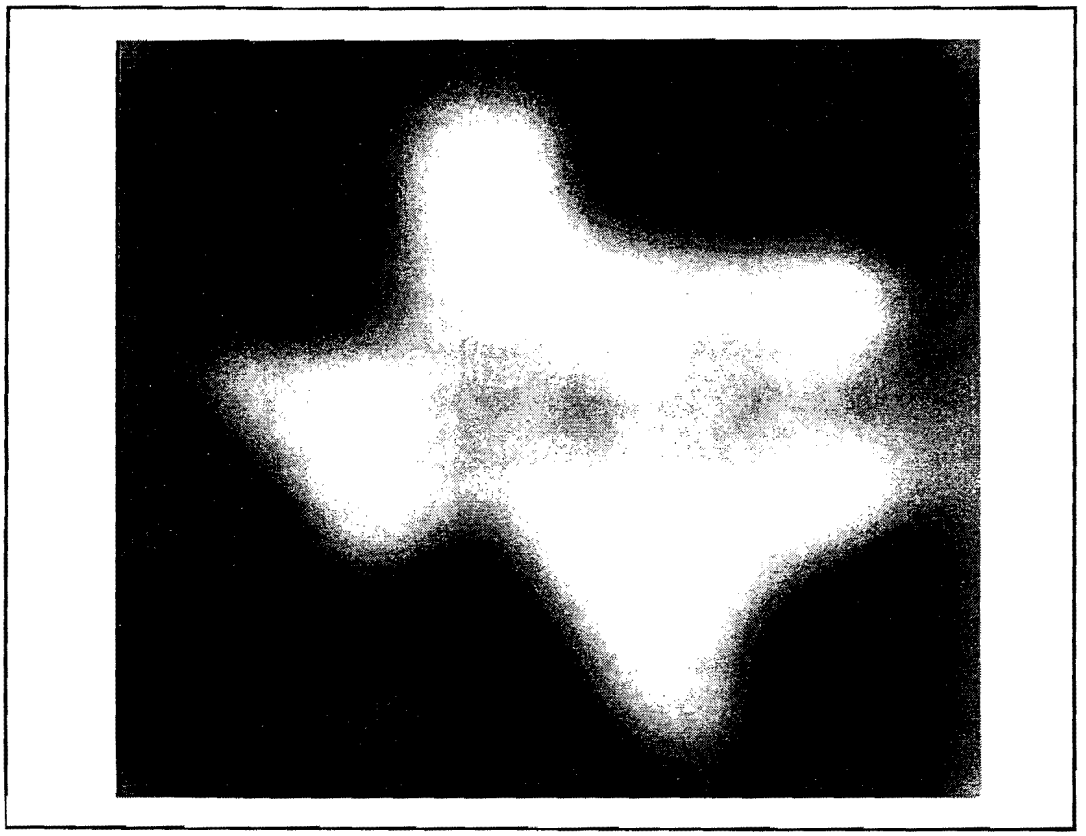


Figure E-1. Current F.M. Route Marker Design, Level 1

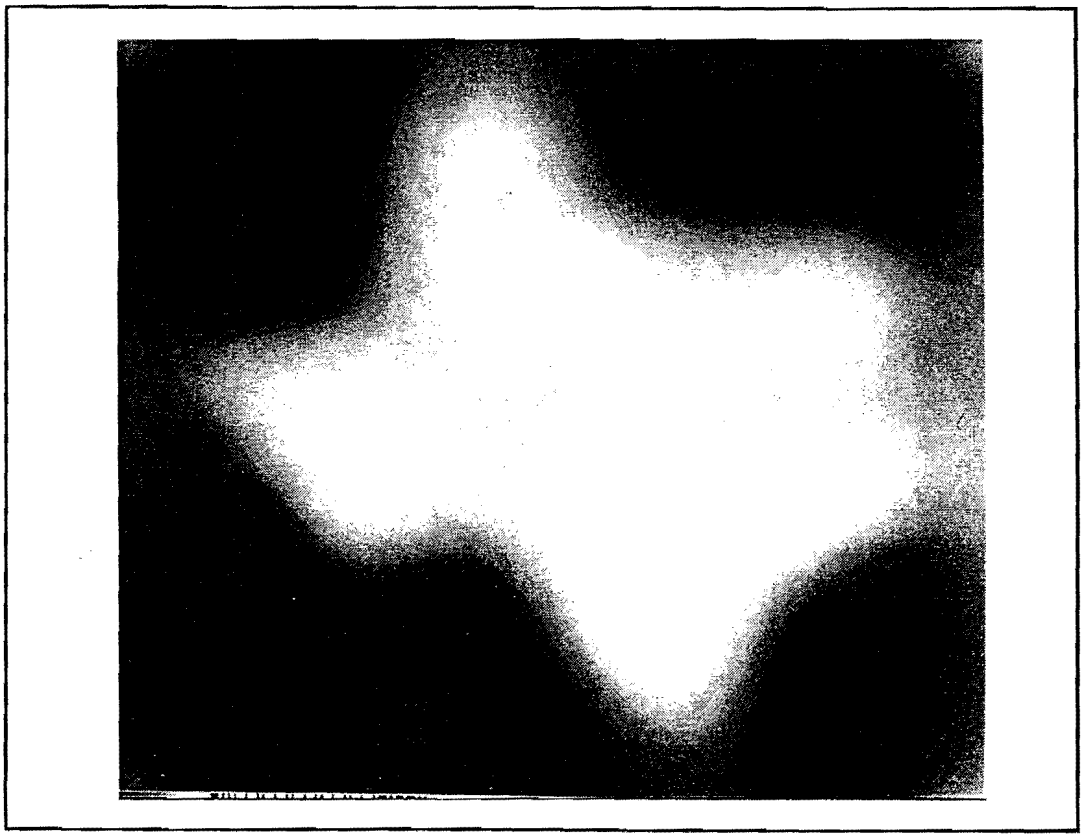


Figure E-2. Current F.M. Route Marker Design, Level 2

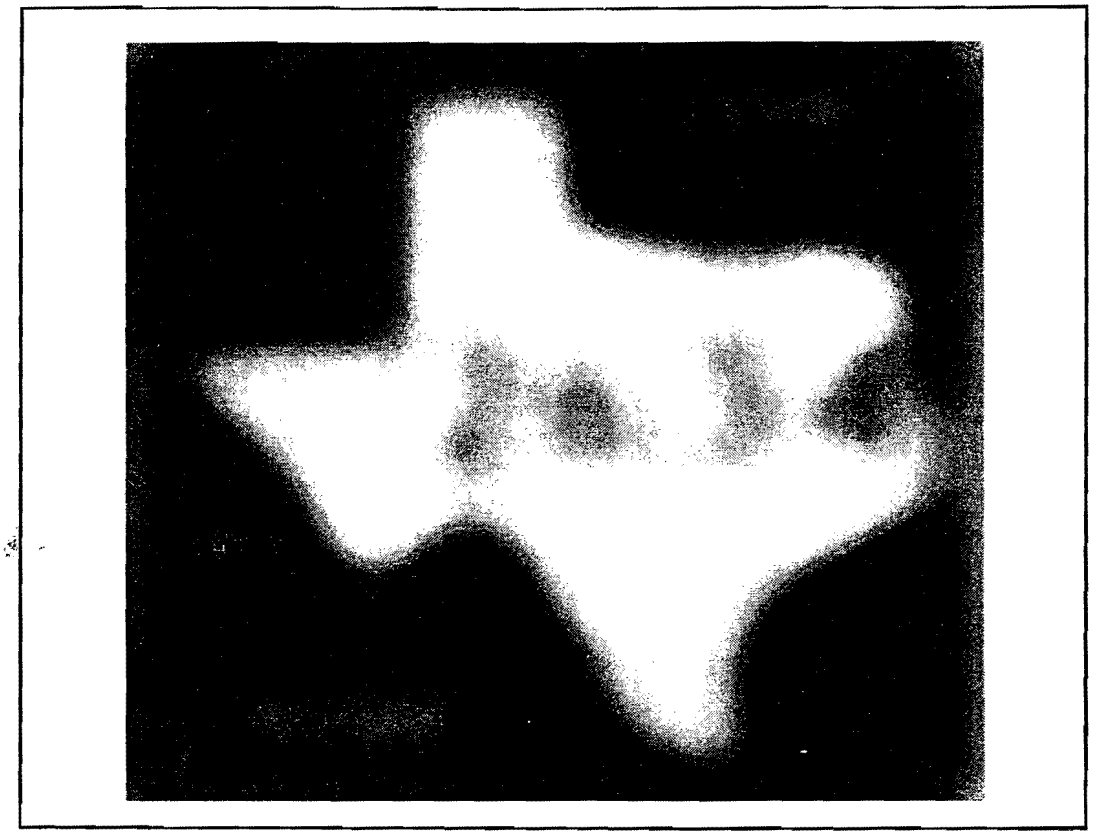


Figure E-3. Current F.M. Route Marker Design, Level 3

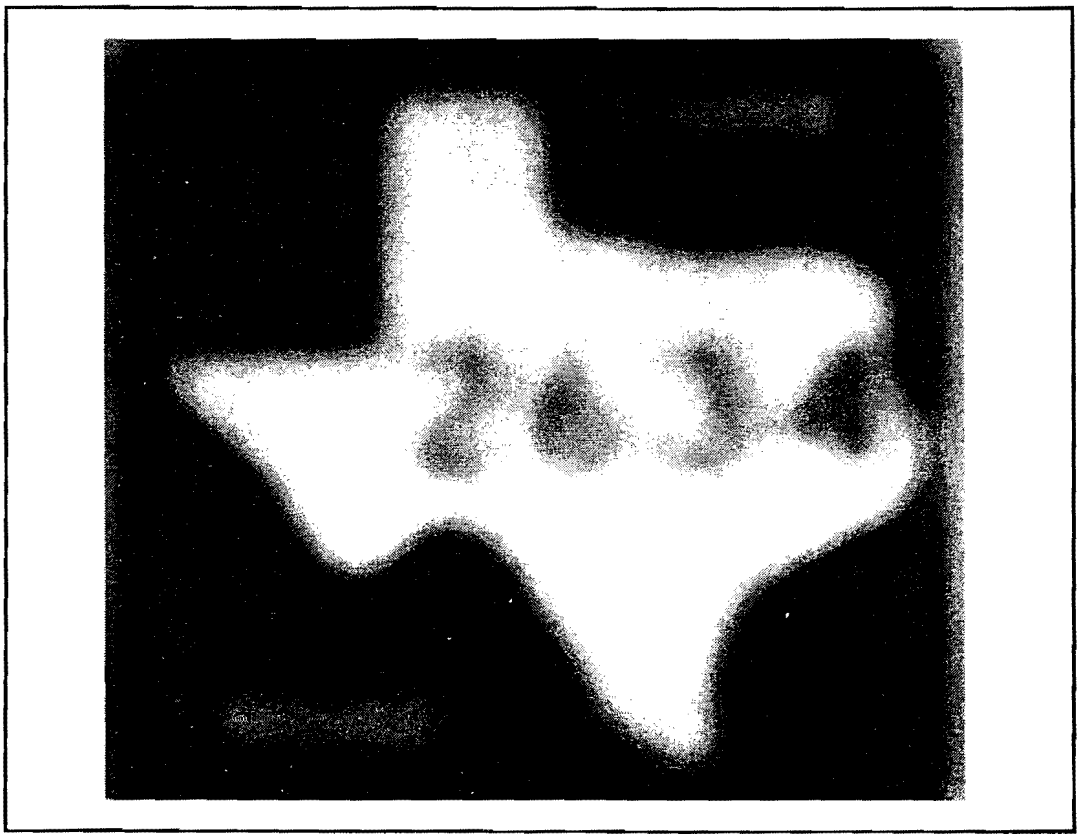


Figure E-4. Current F.M. Route Marker Design, Level 4

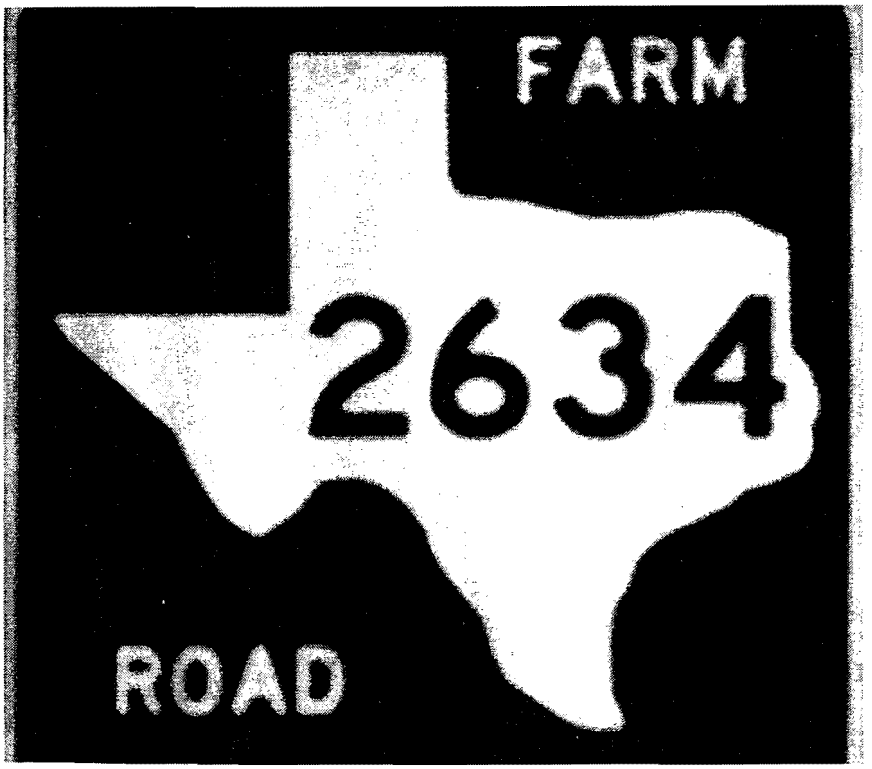


Figure E-7. Current F.M. Route Marker Design, Level 7

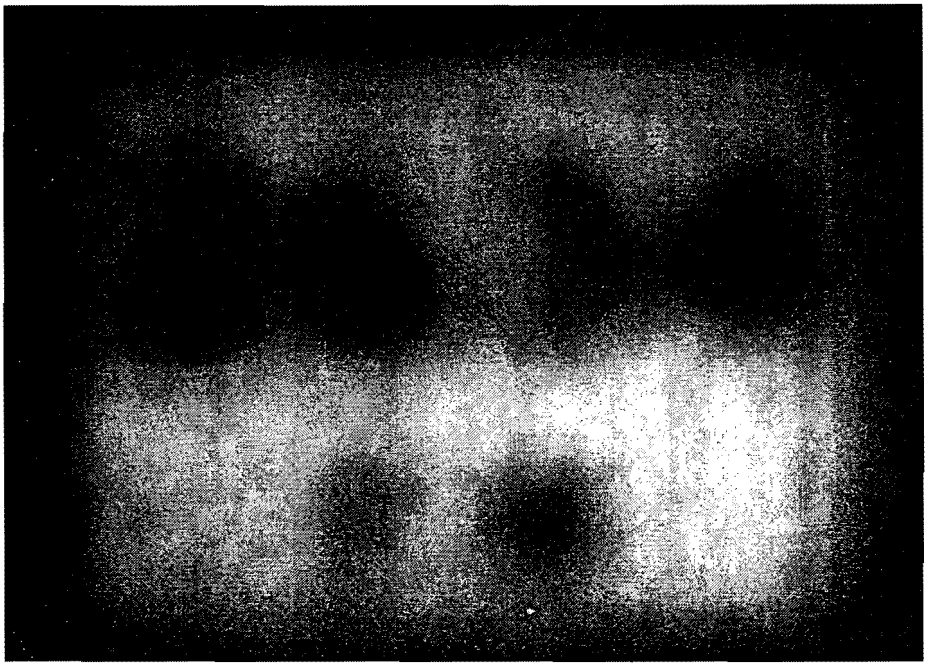


Figure E-8. Recommended F.M. Route Marker Design, Level 1

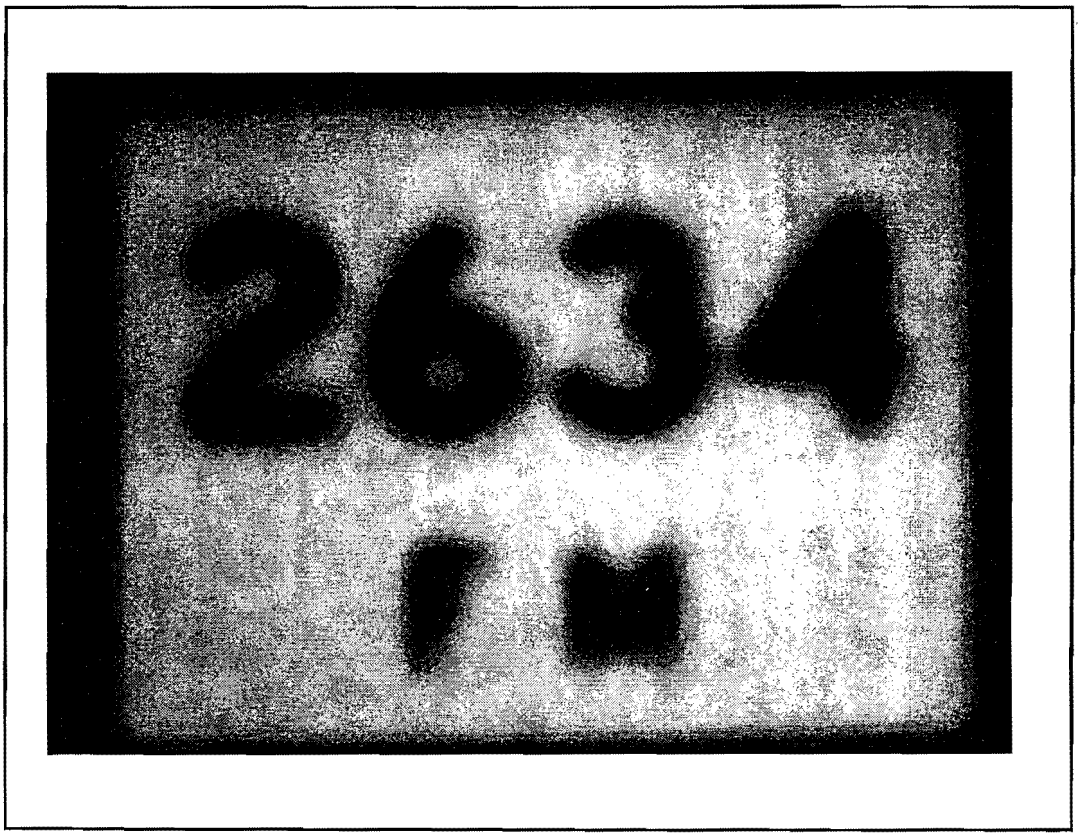


Figure E-11. Recommended F.M. Route Marker Design, Level 4

Figure E-12. Recommended F.M. Route Marker Design, Level 5

APPENDIX F

COMBINATION SIGNS USED IN EVALUATIONS

This appendix illustrates the 15 signs that were used in the evaluation of combination signs. Route markers and cardinal direction markers are black on white, city names are white, and the destination signs in the blended assembly and sign background in the horizontal and vertical displays are green. Signs are displayed by groups according to Table F-1.

Table F-1. Combination Signs in Appendix F

Figure Number	Group	Intersection Type	Direction[1]	Sign Number
F-1	I	three-leg	right	4
F-2			left	13
F-3		four-leg	N/A	12
F-4			N/A	7
F-5	II	three-leg	right	6
F-6			right	10
F-7			left	11
F-8			left	15
F-9			left	1
F-10		four-leg	N/A	14
F-11			N/A	9
F-12	III	three-leg	left	8
F-13			right	3
F-14		four-leg	N/A	5
F-15			N/A	2

Notes: [1]Direction in which three-leg intersection turns.

GROUP I - BLENDED ASSEMBLIES

Three-Leg Intersection

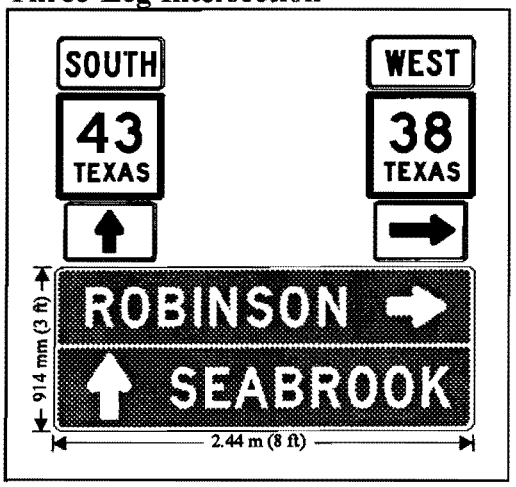


Figure F-1. Blended Assembly
Sign Number 4

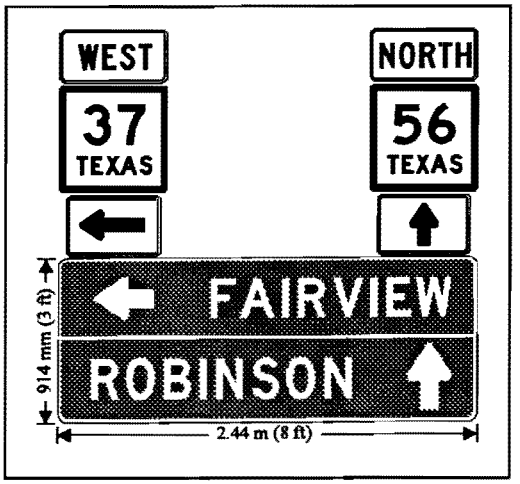


Figure F-2. Blended Assembly
Sign Number 13

Four-Leg Intersection

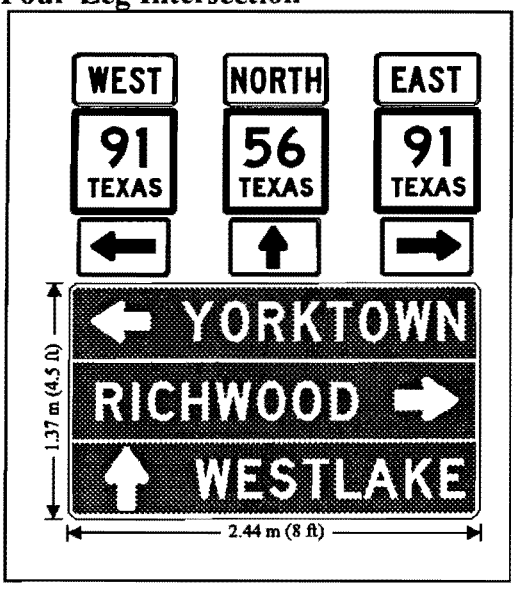


Figure F-3. Blended Assembly
Sign Number 12

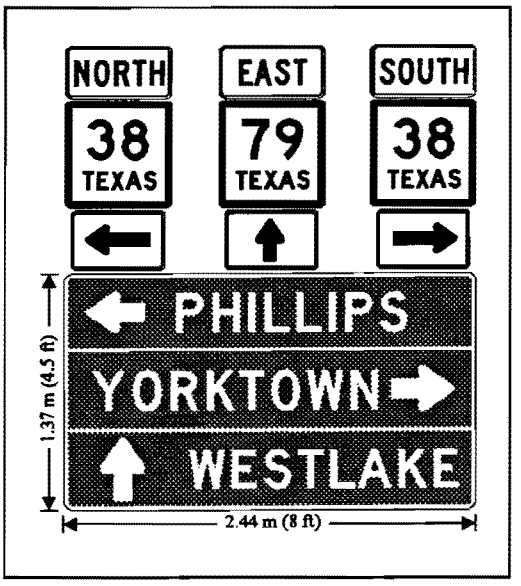


Figure F-4. Blended Assembly
Sign Number 7

GROUP II - HORIZONTAL DISPLAYS

Three-Leg Intersection

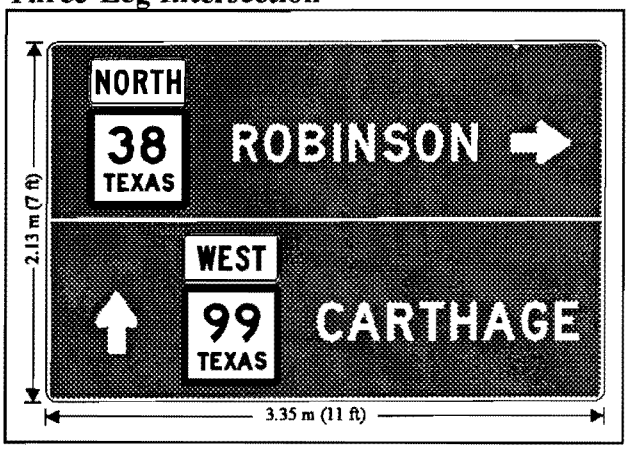


Figure F-5. Horizontal Display
Sign Number 6

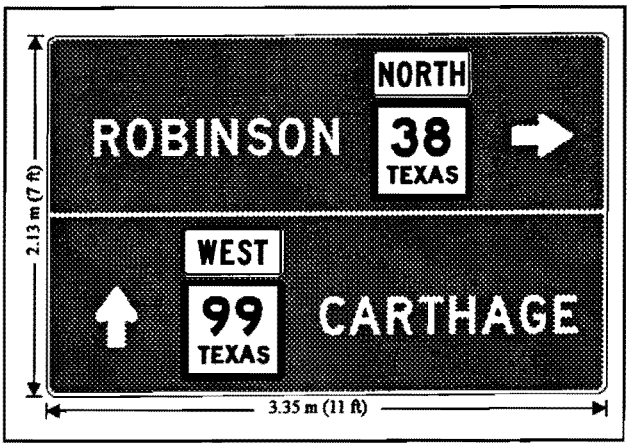


Figure F-6. Horizontal Display
Sign Number 10

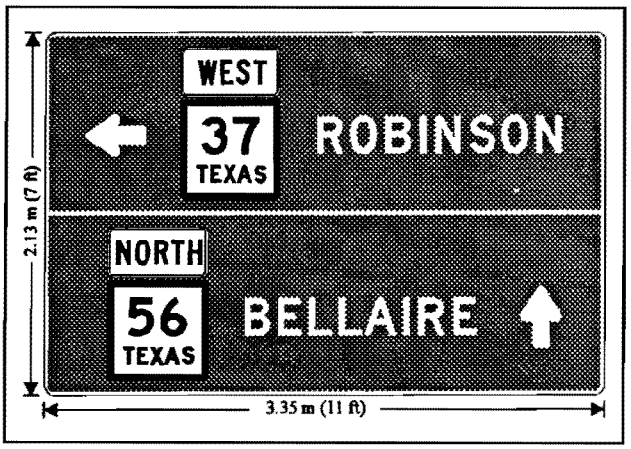


Figure F-7. Horizontal Display
Sign Number 11

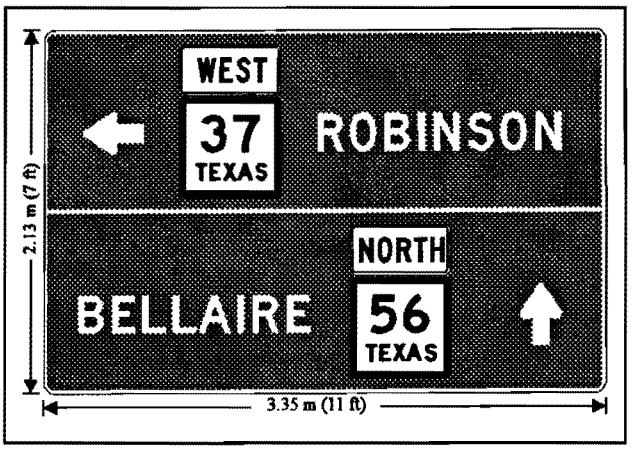


Figure F-8. Horizontal Display
Sign Number 15

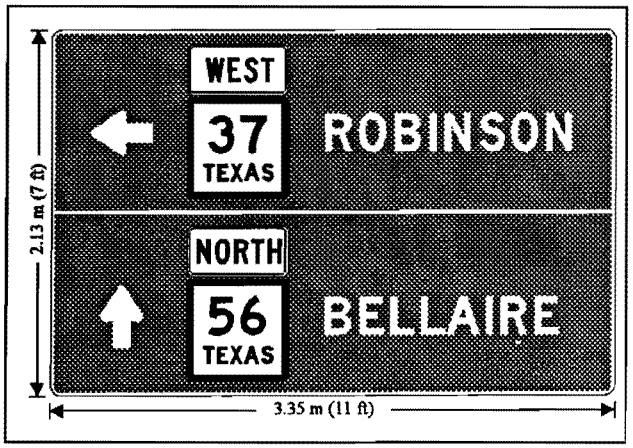


Figure F-9. Horizontal Display
Sign Number 1

Four-Leg Intersection

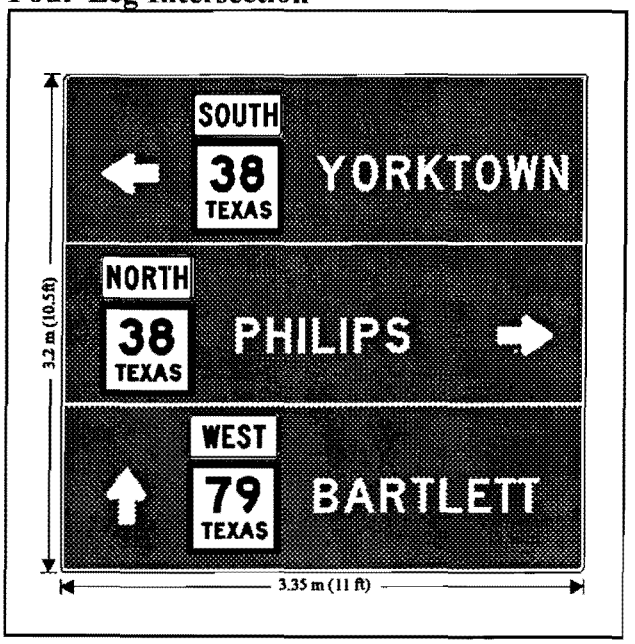


Figure F-10. Horizontal Display
Sign Number 14

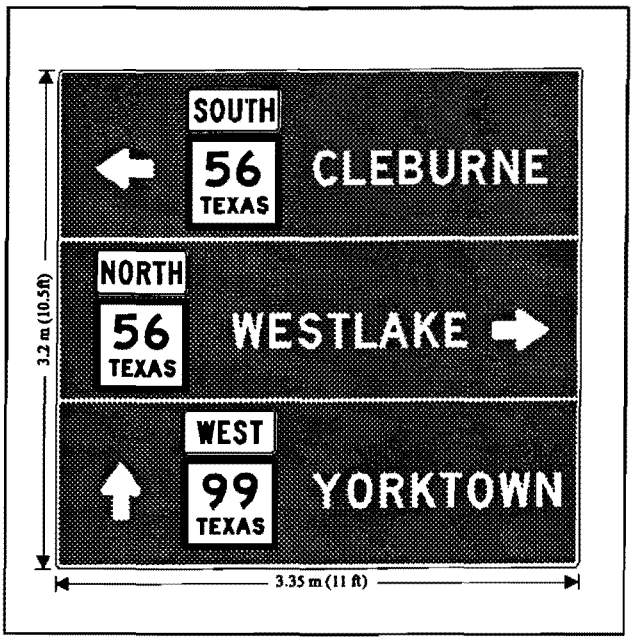


Figure F-11. Horizontal Display
Sign Number 9

GROUP III - VERTICAL DISPLAYS

Three-Leg Intersection

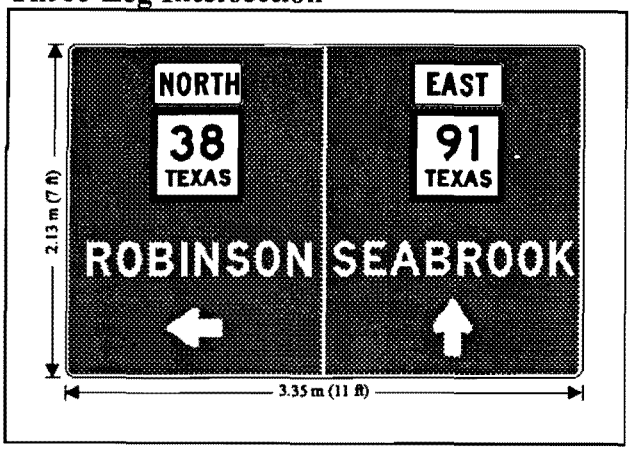


Figure F-12. Vertical Display
Sign Number 8

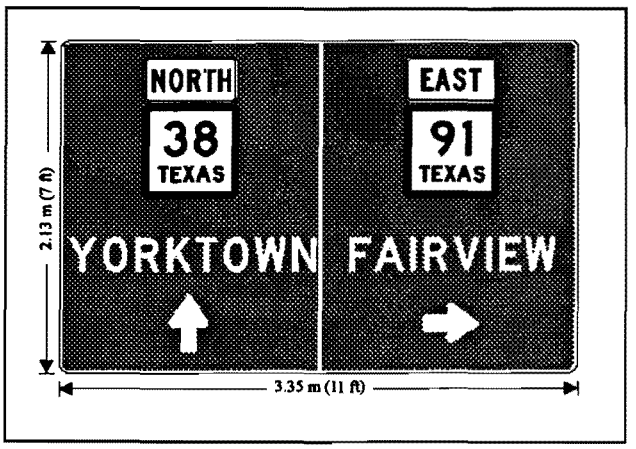


Figure F-13. Vertical Display
Sign Number 3

Four-Leg Intersection

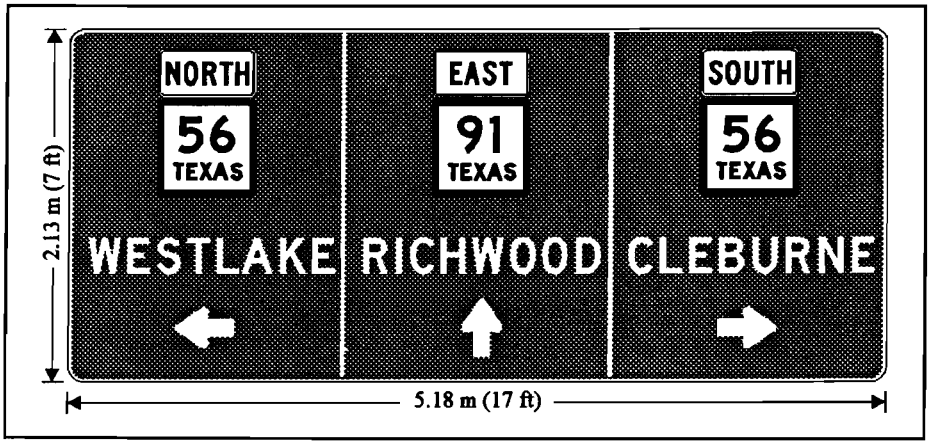


Figure F-14. Vertical Display Sign Number 5

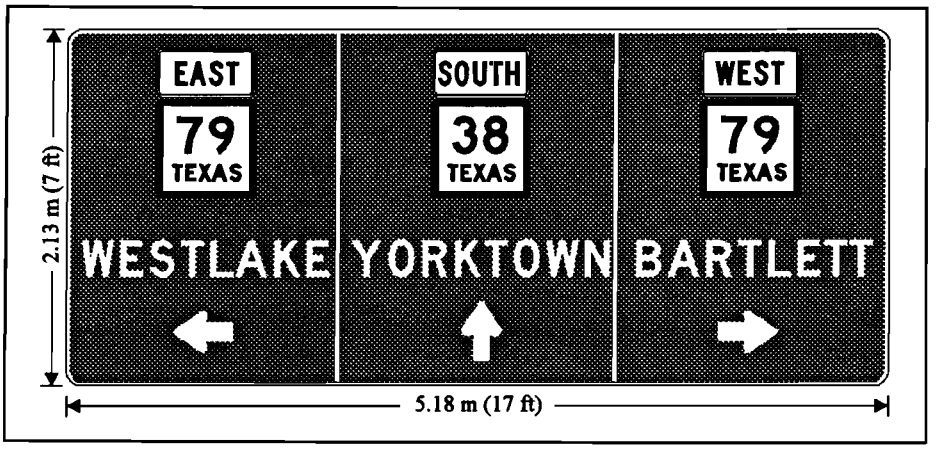


Figure F-15. Vertical Display Sign Number 2