TECHNICAL MEMORANDUM

DIAGNOSTIC STUDIES OF HIGHWAY VISUAL COMMUNICATION SYSTEMS

HPR-2(108)

STUDY SITE NO. 15

IH-610 (NORTH LOOP AND WEST LOOP) HOUSTON, TEXAS

TM2(108)-15

INTRODUCTION

The "Diagnostic Studies of Highway Visual Communication Systems" research project has been designed to: (1) review the current practices in visual communications with the automobile driver using a multi-discipline team approach; (2) identify the deficiencies in these practices, and; (3) recommend changes in the existing standards. Pilot studies were conducted in three states (Arkansas, California and Maryland) in order to develop the diagnostic study techniques and to acquaint the members of the Project Policy Committee with these procedures. This memorandum is a detailed report on the results of the diagnostic team review of sites within these states. The opinions expressed are those of the diagnostic team and not the recommendations of the research staff. The results of pilot studies and the improvements recommended by the staff will be combined as an interim report to be published in the near future.

DESCRIPTION OF STUDY PROCEDURES

The diagnostic evaluation of the study site was conducted using both the driver interview and open-end questionnaire techniques. Each member is asked to drive a route following the instructions of the interviewer. The route included short sections and adjacent facilities as illustrated in Figure 1. The driver was asked to comment on the roadway section as he drove, and these comments were recorded. The interviewer asked questions only as necessary to keep the conversation productive. At the conclusion of each driving phase (night and day), the subject was asked to complete a questionnaire. The interviews and the comments on the questionnaire are the basis of the material presented in this memorandum.

STUDY SITE CHARACTERISTICS

Study Site No. 15 was a 7.9 mile section of Interstate Highway 610 in the City of Houston, Texas. The study section begins at the intersection of Woodway and the West Loop, west of the downtown area, and continued along the West Loop and North Loop to Irvington, north of the downtown area. The study section is wholly within the City of Houston, Texas.

Field studies were conducted on this study site during the week of August 11-15, 1969. The weather throughout the study period was clear and warm, and there were no adverse conditions that could have affected the results of the study.

The diagnostic team assembled for this study was composed of individuals with the following occupations:

A Traffic Engineer from the New Hampshire Highway Department,
A Captain from the Houston Police Department,
A professional truck driver,
A Traffic Engineer from the Texas Highway Department,
A secretary,
A housewife.

Each member of the diagnostic team was given a thorough visual examination by a registered optometrist. All the diagnostic team members were found to have visual capabilities within the requirements of the Texas driver licensing law and there was no indication of a color deficiency or color blindness. One team member, however, was almost at the limit of the static visual acuity required in the Texas law and it was suggested by the optometrist that this individual should use glasses while driving, although he was not required to do so by law.

Loop 610 in the City of Houston is a major freeway loop around the downtown area of the city and is a basic eight-lane freeway throughout the study section. Continuous frontage roads are provided throughout much of the length of the study section. The primary exception is the area between the Hempstead Highway and Interstate 10 where the frontage roads are interrupted by the Texas and New Orleans Railroad. The travel lanes are 12 feet in width and the left shoulder is approximately 6 feet in width, the right shoulder is 10 feet in width. The entire study section was continuously illuminated with double mast-arm mounted 1000 watt luminaires at 50 feet located in the median. Opposing directions of travel were separated by continuous guardrail in the median.

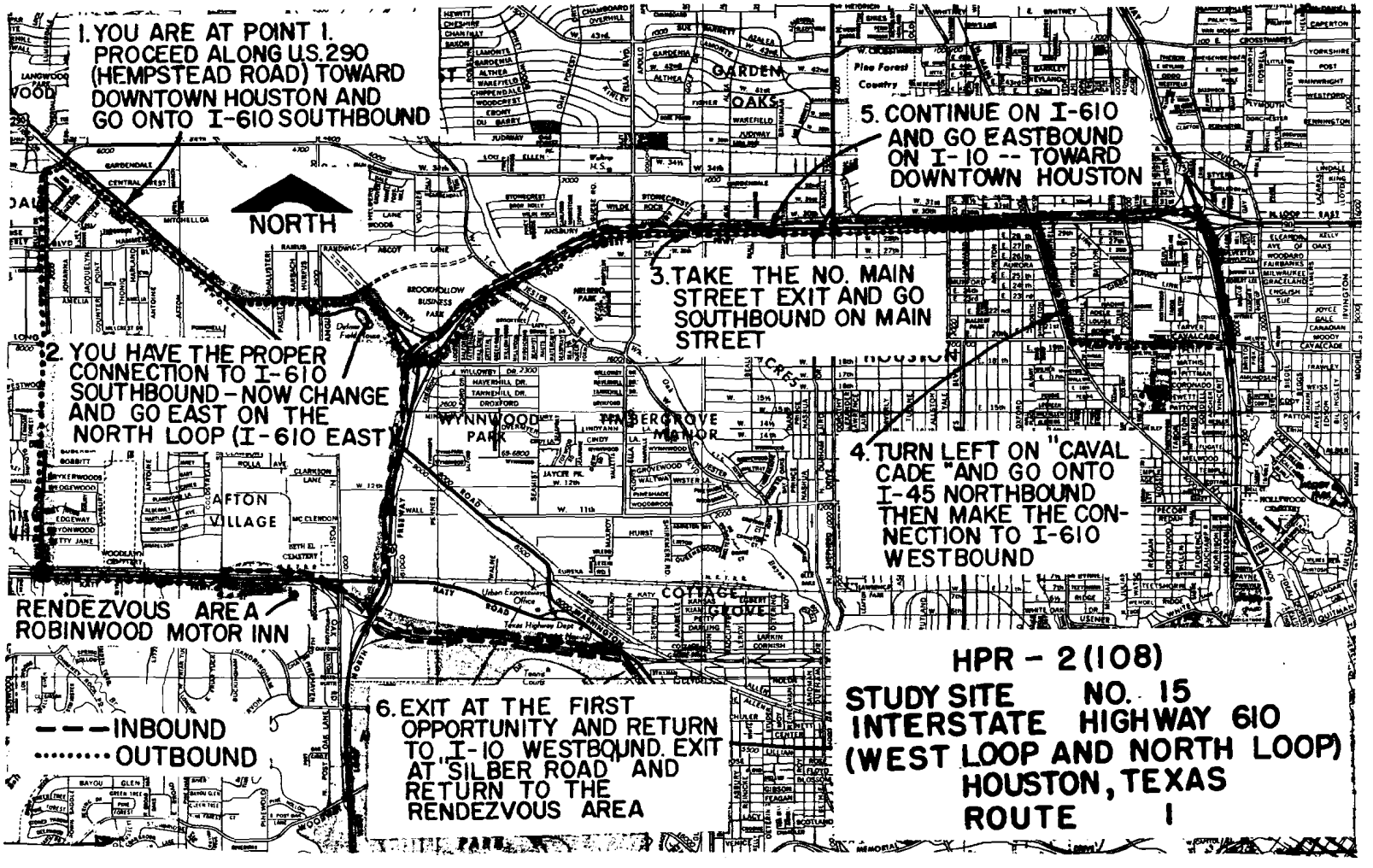
The study section included three major directional interchanges and eleven diamond type, full or partial, interchanges. Two of the directional interchanges were four level structures with four semi-directional connections.

The pavement markings used in the study section were formed using the ceramic traffic buttons placed in a configuration to simulate painted lane lines. Supplementary raised reflective pavement markers located between every other line were used. The shoulders, both left and right, on the elevated structures had red ceramic tile sections placed transverse to the direction of traffic flow at frequent intervals. This marking was used to identify the emergency parking areas, to discourage the use of the shoulder for through traffic movement, and for a tactile effect when the driver drifts out of the through traffic lane. Edge lines were provided on the left (median) side of the roadway but not on the right. Paint chanelization is used to identify the gore areas on the exit ramps. No supplementary word messages used on the pavement in the study section, however, some of the off-ramps were identified by raised reflective pavement markers placed in the form of an arrow down the ramp for identification at night.

The signing on the study section was typical of an urban freeway section and to a relatively high standard. On-ramps to the freeway section, in general, did not have control and the off-ramps usually terminated in a one-way frontage road on which the frontage road was controlled by a "YIELD" sign. Most of the directional signing was overhead on sign bridges with some of the advanced signing being placed in the median.

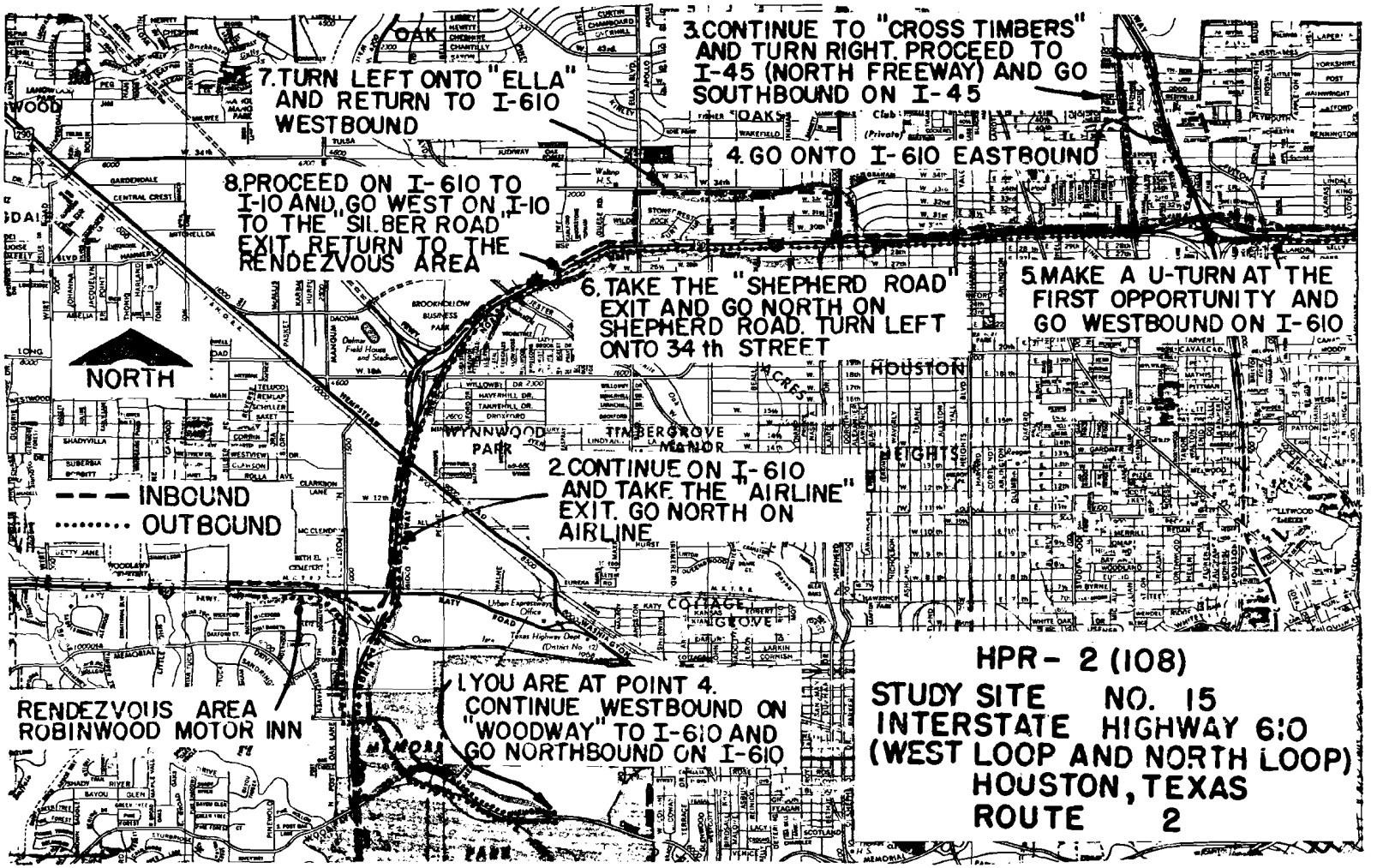
Parking on the freeway proper is permitted only on an emergency basis, however, uncontrolled parking is permitted along the full extent of the frontage roads paralleling the main lanes. A limited number of regulatory signs applicable to special situations are used in the study section. The posted speed throughout the study section is 55 mph maximum limit and 40 minimum limit. The running speed of the higher speed vehicles from the traffic stream exceeds the posted limit with the 85th percentile approaching 65 mph. The traffic volumes on Loop 610 are currently in excess of 100,000 vehicles a day and the accident rate is considered to be about normal for urban freeway facilities. That is, there is no indication of unusually high accident frequency within the study section.

Strip maps of the study section indicating the driving routes are presented in Figures 1 and 2.



STRIP MAP OF STUDY SITE NO. 15 INDICATING DRIVING ROUTE #1

FIGURE 1



STRIP MAP OF STUDY SITE NO. 15 INDICATING DRIVING ROUTE #2

FIGURE 2

DIAGNOSTIC TEAM REVIEW

FRONTAGE ROAD DESIGN

In discussing the frontage roads and connections to the freeway, one of the team members expressed the opinion that non-continuous frontage roads are very confusing to the traveling public. This point was backed up by comments by other team members that unfamiliar drivers tend to expect complete interchange facilities at all intersecting major roadways and the use of continuous frontage roads would serve as a means of alleviating any problems created by partial interchange facilities. It was also suggested that in the overall design of complicated interchanges an area should be provided in advance of the interchange where the driver could pull off and study a layout of the interchange area and make his decision, should he be confused about which roadway to take.

Another design area regarding the service roads which seemed to be important to the driver dealt with the junction of the slip off-ramps with multi-lane service roads. When the "YIELD" sign is placed on the service roads, a driver in the left hand lane is unable to view the ramp without coming to a complete stop. If he stops in order to get a view of the ramp, then he is likely to be hit from the rear by a vehicle preceeding on the frontage road. It was suggested that in such situations, the left hand lane of the service road should be painted out just in advance of the off-ramp terminal so that the off-ramp could terminate in its own lane on the service road.

FRONTAGE ROAD AND CONNECTING ROADWAY SIGNING

There were two major areas of concern dealing with the signing to the Interstate Highway on connecting roadways; (1) the use of localized names on advanced signs should be discouraged. For example, the use of "NORTH LOOP" is not meaningful to an unfamiliar driver. (2) The advanced signing should always give the proper lane in order to make a given connection. After considerable discussion, it was the opinion of the team that local naming of roadways should be discouraged on all advanced signing and the assigned State Route numbers should be the primary communication element for identifying connecting roadways with supplementary cardinal direction plates be used to indicate the general direction of the roadway.

FREEWAY DESIGN

It was the general consensus of the opinion of the team members that as a whole, there were very few geometric design elements on the study section that they felt should be altered. Most of the comments referred to the interaction of geometric design with the other elements of the communication system and will be discussed later in this report.

FREEWAY SIGNING

The diagnostic team in considering the signing used on the Loop 610 study section, felt that there were a few points which should be made regarding the sign location, and sign composition. One of the strongest criticisms concerned the placement of signs on or near horizontal curves and in or near the merging sections, where the driver is fully consumed with the driving task. It was strongly suggested that consideration should be given to locating the signs at a point where the driver has more time to consider the material being presented to him.

One of the points in the study section that created particular difficulty for the subject drivers was the westbound approach to the Interchange with U.S. Highway 290 (the Hempstead Highway). At this point, four approach lanes are divided with two lanes going to U.S. 290 and two going through on Interstate 610. There are small right side mounted regulatory signs advising the driver that the right two lanes must exit and an overhead sign with lane assignments provided just at the gore area. The approach to the bifurcation point is on a horizontal curve to the right and it is very difficult for the driver to associate the lane assignments on the overhead sign with an individual lane. It was also noted by the team members that the regulatory black and white signs advising the two lanes must exit, were not particularly meaningful because they did not know whether the exit meant Interstate 610 or the roadway to some other point; in this case, the Hempstead Highway. It was generally agreed that the overhead sign installation would be far more effective if it were located well in advance of the bifurcation point. It was also suggested that a schematic type of signing would be more effective for the lane assignments than the word messages that are currently being used. Some of the team members felt that a wide black band delineated into four lanes which splits with an arrow curving to the right and one to the left showing two lanes in each direction and the appropriate route number associated with each arrowhead would be more descriptive and could be interpreted more quickly by the driver than the signing currently being used at the location.

There was also considerable criticism of the use of a sign such as "DOWNTOWN" without the use of the associated route number. It was the consensus of opinion of the team that anytime a destination, even though it be a general destination, is used on a directional sign the associated state or federal route number should be used with it.

There was considerable discussion of the fact that signs which do not have a green background were not effective in conveying information to the driver, simply because his primary concern on the freeway is to be in the proper lane for the maneuver that is required. As a result, the driver's primary interest is on information which is important to him and such information should be conveyed on overhead signing and preferably with a green border or background.

One of the connecting roadways to the study section used as a part of the basic driving runs, was Interstate 10 from the West Loop toward the downtown area. This section, at present, has temporary signing and several comments were raised regarding the adequacy of the temporary signing for operation on this facility. The adequacy during daylight conditions was generally considered to be satisfactory and no strong recommendations were made. At night, however, the temporary signing was inadequate for the task involved and it appeared that the reflectivity of the signs was negligible. It was suggested that temporary signing should meet the same high standards of reflectivity and/or illumination required of permanent signing prior to the opening of the facility to traffic.

There was also some criticism of referring to sections of the Interstate 610 Loop as West Loop, East Loop, North Loop, etc. It was felt that this was very difficult for the stranger to comprehend and understand and it might be better if the designation were something of the order "IH 610 WESTSIDE" rather than North Loop or West Loop. There was also some consideration of the problem of local names being used on the advanced signing for facility and a conversion to the route numbers with cardinal directions, once one is on the facility. This interface between the major street system and the freeway system is most important to the smooth operation within the interchange areas and there appears to be a rather serious breakdown in communications on this study section. It was generally agreed by the diagnostic team that above all, the treatment should be uniform throughout the entire interchange. That is, the advanced sign should carry a designation which is the same as the signing in the interchange area proper. Switching from West Loop and North Loop to Interstate Highway 610 eastbound and southbound is very confusing to the driver. It was also noted that it was highly desirable that all advanced street name signs erected by the State or by a local municipality should contain the associated state highway or U.S. highway number if one exists.

FREEWAY ILLUMINATION

The general consensus of the diagnostic team indicated that the lighting provided on Loop 610 was very adequate and created no glare problems for the driver. The definition of the roadway ahead and in general the driver's ability to see the roadway under the existing illumination was considered quite adequate for operational speeds of 50-60 mph. The only point of some concern dealt with the identification of exit facilities and was indicated by several of the team members that exit ramps on the right were not adequately defined by illumination placed in the median. It was suggested by several of the team members that an additional luminaire should be placed immediately over the exit ramps. This is particularly important when the exit ramp is not visible to the driver for substantial distance in advance of the ramp.

The commercial lights along the right-of-way were of considerable concern to members of the diagnostic team and it was felt that the rotating flashing light should not be allowed along any major highway facility. It was also noted that the commercial signing for service stations was very effective for the driver, did not create any glare problems, and probably eliminated the necessity for the state providing informational signing on the freeway proper to serve such facilities.

There was some discussion of the desirability of lighting urban freeways and it was the consensus of opinion of the diagnostic team that it was a very desirable feature and the practice should be continued. It was noted by one of the team members that continuous illumination of the freeway gives the driver better depth perception at night and thus makes him more comfortable while driving on the freeway.

PAVEMENT MARKINGS

The raised pavement markers used on the study section were considered to be very desirable by the subject drivers. It was noted that the visibility of the buttons is approximately equivalent to a painted line under daylight conditions and that the reflective pavement markers provide very adequate lane delineation at night. The lay drivers commented that the vibration created by running over the raised markers when they drift out of the traffic lane was very important to them. The only serious question raised regarding the adequacy of the existing pavement markings dealt with the identification of the exit ramp areas at night. It was noted by a majority of the team members that several of the exit ramps were in such a position that they were very difficult to find at night and it was suggested that a full complement of post-mounted delineators, pavement markings, and pavement markers be used in order to identify the ramp for the driver. The use of edge lines adjacent to the exit facility would greatly enhance the driver's visibility of the ramp or at least give him greater assurance of the actual exit point if they were used. It was also suggested that it would be desirable to have a continuous edge line on lighted urban freeway facility just to make the driver more confident that he has not drifted off onto the shoulder or is rapidly approaching an exit without being aware of its actual location.

There was considerable discussion on the use of the reflective pavement markers formed in the shape of an arrow pointing down the off-ramp and its ability to convey to the driver information on ramp location and relative direction. The majority of the team members felt that this was very effective in defining the angle of the ramp and generally the location of the ramp when the surface of the roadway was visible to the driver. However, when the surface of the roadway is hidden by vertical or horizontal geometry, it is impossible for the driver to pick up the markers and thus little or no information on the ramp location and relative angle is available. It was suggested that in these cases an edge line, in advance of the actual exit area, or putting additional reflective

markers in the form of an arrow in advance of the actual exit might be effective in conveying the information required; although, there was some feeling that no exit ramp should be designed in which the driver does not have visual contact with the roadway surface.

RAMP DESIGN

It was the general consensus of the diagnostic team that the ramps, both on and off-ramps, on the study section were very adequate and there was no suggestion regarding the geometry with the exception of the relative visibility with respect to the road section.

FREEWAY EXIT ADVANCE SIGNING

The advance signing for the exits from the study section were considered to be very adequate; however, it was noted that virtually all of the exit signs were at the gore rather than some distance in advance of it. It was suggested that in the future, the signs should be located 500-1000 feet in advance of the gore as drivers tend to execute the maneuver under the sign rather than being prepared for it in advance. The use of an arrow on the advance signs placed at the beginning of the deceleration lane was discussed and it was noted that none of the team members felt that this was particularly undesirable. They did indicate that they began to search immediately for the exit ramp when approaching a sign of this type and possibly an arrow with a straight shaft and then bent to the right would be more effective in conveying the relative maneuver that is to be made.

RAMP PAVEMENT MARKINGS

The delineation of the ramps was considered to be adequate throughout the study section as most of the connecting ramps and roadways are elevated and the handrail with the fixed illumination provides reasonably adequate definition of the road section. It was noted by the professional driver, however, that these ramps can be very difficult to identify in fog and it was his suggestion that edge lines be used on both the left and the right in order to make it easier for the driver to maintain the proper position in the lane during bad weather.

APPENDIX "A"

DESCRIPTION OF THE STUDY PROCEDURES

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The diagnostic evaluation of a study is conducted in four separate phases:

a. Preliminary session
b. Day driving phase
c. Night driving phase
d. Diagnostic team review

The preliminary session is designed to introduce the interdiscipline team to objectives of the study and to explain the study procedures. The diagnostic questionnaire is presented to the team and discussed with them. The explanation of the questionnaire concentrates on the fact that it is not designed to obtain a particular response from them, but rather, it is designed to direct their thinking into a particular area and thus elicit comments which the individual might care to make.

The day phase of the on-site review begins on the afternoon of the first day of the study. The diagnostic team members are transported to the rendezvous point at one end of the study section. Two cars are used in the driver interviews and, upon arrival at the study site, the number one drivers begin their driving runs with the other team members remaining in a car stationed at the rendezvous point. The driver is given instructions well in advance of the required maneuver, and his comments regarding the communication systems provided are recorded on a portable tape recorder. The comments are tied to the roadway through reference markers located at the roadside. The marker numbers are read and recorded on tape as each is passed. After completion of the driving run, the team member moves to an observer position and the second driver begins his driving run. A different route is driven by the second driver. Errors made during the driving phase are corrected as soon as it is practical to do so. When both the driver and observer runs are completed, the team member is asked to complete the diagnostic questionnaire on the daylight phase. The process is repeated until all team members have served as a driver and as an observer.

The night phase is conducted in the same manner as the day phase and is held on the evening of the first day of the study.

The morning of the second day of the study is devoted to a team review of the study site. Problem areas are identified, and suggestions regarding possible solutions are discussed. The team is not asked for a consensus of opinion on the improvements which should be made on the study site. Rather, all ideas are explored regardless of how many or how few of the team members might support them.

The comments made on the diagnostic questionnaire and the summaries of the driver interviews are the basis of the Technical Memorandum on the study site which is the formal report of the opinions expressed by the team.

APPENDIX "B"

SUMMARY OF THE DIAGNOSTIC QUESTIONNAIRES

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Study Site No. 15; Loop 610; Houston, Texas

The following is a detailed presentation of the comments made by the diagnostic team members on the diagnostic questionnaires, concerning daylight conditions.

DAY PHASE

Question: Did you, as a driver, lose visual contact with the roadway surface at a distance less than you would desire at any point along the vehicle's projected travel path?

Yes	No	Comments
x		This condition is due more to obstruction from other traffic than restrictions in roadway alignment.
x		On occasion a sign necessary for a given maneuver was below my line of sight over the hill and the required action was difficult to make -- the same for some curves.
	x	I know of overpasses and entrance ramps in our city that do have a short visual contact with surface.
	x	I feel that hills are especially dangerous due to the fact that you cannot foresee conditions on other side of a hill, such as stalled cars.
x		Some of the overpasses are a little sharp, and a stalled car just over one would not allow enough time to stop.
	x	Not a problem under heavy traffic conditions.

What treatment, if any, would you recommend to improve this situation?

I don't think it could be improved.

Yes	No	Comments
		Proper exit and/or merging traffic signs and mileage on the blind side of the hill or curve. The mileage figure--even in tenths--is a good warning.
		Relocate entrance ramps.
		Nothing can be done for existing freeways, but construction of new freeways can take safety features into consideration.

Question: How would you evaluate the importance of being able to continuously see the roadway surface while driving? (Answers: A--Of Little Importance; B--Of Some Importance; C--Relatively Important; D--Critical Problem)

A	B	C	D	Comments
	x			The surface is only one of the factors that gives visual clues as to the direction of the roadway. Being able to see the traffic stream in your lane is sufficient even though surface itself is not visible.
		x		Sometimes it is impossible to construct such a roadway, but good signs in ample time/distance could overcome the difficulty.
		x		Ease of driving when you can see farther ahead.
		x		The importance of this problem depends on the average reaction of a driver. I personally would tend to slow down quite a bit and may cause confusion to drivers behind me.

Question: Do you, as a driver, feel that the ramps and direct connecting roadways are obvious in time for a reasonably alert driver to make a smooth, natural maneuver to them?

Yes	No	Comments
	x	Any maneuver requiring one or more lane changes cannot be made safely after the ramps, etc., are visible at most interchanges.

Yes	No	Comments
x		Usually
x		On these freeways which are relatively new, they are what the doctor ordered.
x		However, this isn't true of all freeways in Houston.

Question: Did the lack of visibility of the roadway surface create any noticeable degree of erratic behavior (slowing substantially, drift into other lane, etc.) on the part of the driver when you were the observer?

Yes	No	Comments
x		On curves one has a tendency to look too far in advance of the vehicle which may cause drifting into adjacent lanes unless traffic in other lanes is present.
x	x	Several times I was not aware of oncoming conditions, but he knew the route and did not ever make an erratic move.
	x	
	x	

Question: Does the driver appear to have difficulty in maintaining the vehicle within the marked lane (i.e., does he tend to move over into adjacent lanes)? (Answers: Yes; NAD--Not To Any Appreciable Degree)

Yes	NAD	Comments
	x	
	x	
	x	The button type markers give good warning.
	x	

Question: Are the through lanes clearly identifiable from the emergency parking areas (shoulders)?

Yes	No	Comments
x		

Yes	No	Comments
No Answer		
x		
No Answer		

If "Yes," how was this accomplished; if "No," how would you suggest that it be accomplished?

Different pavement texture and rumble strips on median shoulders. Edge lining on median shoulders.

Difference in paving or even grass. Sometimes the emergency parking areas are more evident than at others.

By wide stripe on edge of driving lane.

Question: Does there appear to be a substantial number of vehicles driving in the emergency parking areas?

Yes	No	Comments
	x	
	x	
	x	None at the time.
	x	

Question: Are the roadside hazards (bridge abutments, piers, guardrails, sign posts, etc.) removed a sufficient distance from the through lanes to insure reasonable safety?

Yes	No	Comments
	x	Most of the noticeable problems of this sort were on other than freeway main lanes with the exception of gore areas in major interchanges.
x		
x		This is the general rule on newer expressways.
x		

If "No," are the hazards visible for a sufficient distance to prevent the driver being startled by them?

Yes	No
x	
x	

Question: What do you feel is a minimum safe distance from the outside edge of the through lane to an obstruction?

Feet	Comments
20	
4 - 4½	It should be less than a car's width--obviously less so a following car would not be tempted to squeeze past; it should be wide enough so a driver would not be tempted to drift away from it.
12	At least the width of a parking lane with some to spare.
No Answer	

Question: Do the curves require an excessive amount of driver concentration, thus increasing the hazard of other objects along the roadway? (Answers: Yes; No; Poss--Possibly)

Yes	No	Poss	Comments
	x		
		x	The curves constituting exit or entrance ramps are often tight and require concentration. It is not a safe place for signs giving other information.
		x	The lane marker button helps.
	x		
	x		All the curves were quite easy to make.
		x	Curves at interchange points are misleading. Smooth curves without ramps, etc., are pleasing.

Question: Is there sufficient advance notification for the exit ramps and direct connecting roadways under light-to-moderate traffic conditions?

Yes	No	Comments
	x	This is especially true where some lanes must exit.
	x	Some, yes; but others would only allow the proper maneuverability only in very light traffic.
x		At some locations it was necessary to cross two lanes to get into the proper through lanes and not enough distance.
	x	Some of the newer freeways do, but just about all of them are guilty in some instances.
	x	Advance notice sign was not up for all the main streets, but the ones that had signs were real good.
	x	Not without some prior knowledge. I-610 northbound to I-10 east, critical; I-45 southbound to I-610 west.

Question: Is there sufficient advance notification of exit ramps and direct connecting roadways under heavy traffic conditions (i.e., limited lane change capability)? (Answers: Yes; No; Prob--Probably)

Yes	No	Prob	Comments
	x		Under heavy traffic there is almost no lane change capability except for sudden erratic maneuvers which can't be considered safe.
	x		Some, yes; but many are impossible. When signs occur far enough back, with mileage, the driver can plan and execute his maneuvers.
x			
	x		Unless you're familiar with your route or on a freeway with arrows indicating lanes and the traffic is heavy you may not be able to get to a lane to make your exit.

Question: Where lane assignments are indicated (i.e., a requirement to be in a certain lane), are the assignments clear and easily understood?

Yes	No	Comments
x		In most instances this assignment is too late or easily missed.
x		But sometimes a bit late!
x		Some signs did not have down arrow over lane and could be confusing.
x		One of the best improvements is signing, especially for a driver unfamiliar with the freeway.
No Answer		
x		Except at I-610; S.H. 290 interchange; not enough distance for weaving maneuver.

If "No," please indicate the source of the confusion.

They may be clear and easily understood, but not strictly true; also a "must exit" lane sign should indicate where the exit leads (i.e., to I-10 west, etc.).

Question: Do the existing lane assignments result in an unnecessary lane change (i.e., indicate a change to another lane when both lanes continue in the desired direction)?

Yes	No	Comments
	x	
x		Unless one knows the route this happens often; also, the reverse--a driver may learn too late that he must be in a given lane to follow his planned route.
x		At one location I encountered this, but I have a habit of getting into an extreme left or right lane anyway.
	x	There will be lane changes regardless, so this lane cuts down on unnecessary changes.

Question: Are the exit ramps clearly identified and outlined?

Yes	No	Comments
x		I had no problem in locating ramps.
x		
x		
x		On the freeways where the new signs have been used, they help a lot.

If "No," how should they be marked; if "Yes," how are they marked?

Green background--white letters and arrows.

Question: When advisory speeds (safe speeds) are posted, are they reasonable in light of the roadway and traffic conditions ahead?

Yes	No	Comments
x		Only noticed one on study route, and the posted speed at 45 mph seemed OK; however, signs could have been larger.
x	x	Complicated interchanges might become less so at speeds slower than straight away.
x		
x		

Question: Are the directional sign messages clear and concise so as to minimize the possibility of driver confusion?

Yes	No	Comments
x		On main lanes of freeways; none on surface street systems where local names are used instead of route numbers on advance signing.
	x	The shield emblems indicating major traffic way, Interstate and Loop, should be brighter names--North Loop, Int. 610, etc.--and should be uniform. Exits onto city streets seem to be better than interchange instructions

Yes	No	Comments
		for highways and to places within the city just off these highways (i.e., "to S.A.," "to Austin.")
x		With some exception on double lanes leaving the freeway.
	x	Signs tend to use different languages (i.e., they should state both loop, directions, and route number or freeway name).
	x	On approaching the freeway from a cross street, you have passed where you should have chosen your lane before you know which lane to be in.
x		On the main lanes of the freeway, the directional signing was relatively clear.

Question: Are adequate speed change areas (acceleration and deceleration lanes) provided so as to eliminate the need for a substantial speed reduction in the through traffic lanes? (Answers: A--Always; U--Usually; O--On Occasion; S-- Seldom)

A	U	O	S	Comments
	x			
	x			
x				Very good on these roadways.
	x			

Question: Could the signs be moved further from the edge of the roadway so as to reduce the associated accident potential and still retain an acceptable degree of effectiveness? (Answers: Yes; Poss--Possible; Prob N--Probably Not)

Yes	Poss	Prob N	Comments
	x		On some signs only.
		x	A driver should not have to take his eyes too far off the immediate traffic to read a sign.

Yes	Poss	Prob N	Comments
	x	x	Possible, but probably not, as the roadways have too many lanes.
		x	

Question: Where hazard warnings are provided, can they easily be associated with the hazard involved? (Answers: Yes; ISC--In Some Cases; No)

Yes	ISC	No	Comments
x			
x			But some signs are in black on white and not readily observed.
x			
x			

Question: Are warnings provided for hazards which are obvious and for which little if any warning is actually required? (Answers: Yes; IFC--In a Few Cases; No).

Yes	IFC	No	Comments
		x	
		x	
x			
		x	

Question: Does there appear to be an excessive amount of official informational signing (directional signing) along this section of Freeway? (Answers: Yes; Poss-Possible; No).

Yes	Poss	No	Comments
		x	Some may be relocated to obtain greater effectiveness.
		x	But if it is far enough in advance of any required action and preferably above the freeway.
		x	Very good.
	x		

Question: Is the informational signing provided of real value to a majority of the traffic? (Answers: Yes; Poss--Possibly; No)

Yes	Poss	No	Comments
x			
x			Except when it is not clear or is misleading.
x			If the driver will read and use information.
	x		

Question: In my opinion, the roadside advertising in this section competes with the official highway signing for the driver's attention to: (Answers: MD--A Marked Degree; SD--Some Degree; LD--A Limited Degree; VLD--A Very Limited Degree, If at All).

MD	SD	LD	VLD	Comments
		x		On arterial system only.
	x			
x				In some cases blend with informational signing.
x				I don't believe they should allow any commercial advertising except the large gasoline signs which are very necessary, especially if a car is in trouble.

APPENDIX "B"

SUMMARY OF THE DIAGNOSTIC QUESTIONNAIRES

Study Site No. 15; Loop 610; Houston, Texas

The following is a detailed presentation of the comments made by the diagnostic team members on the diagnostic questionnaires, concerning nighttime conditions.

NIGHT PHASE

Question: Are the ramps obvious, to the reasonably alert driver, at a sufficient distance in advance of the necessary maneuver such that a smooth, natural maneuver to the ramp is possible?

Yes	No	Comments
	x	Better edge lining; buttons would help.
	x	Beginning at ramp, deceleration lane is not clear. Type II delineators begin where asphalt shoulder still exists. Entrance ramp gores are especially difficult to locate.
x		But the reflector marker at all the exits would help.
x	x	If marked with illuminated arrows on roadways, yes. If only marked with gore and nothing on right side, no. Signs are generally good and timed well.
x		Good signing; ramp exiting 610 (eastbound) to North Main is in need of more lighting. Only Ramp 1 had trouble being seen clearly at night.
x		

Question: The existing lighting provides a view of the road which is:
(Answers: A--About the same as daylight conditions;
B--Somewhat less than daylight conditions but adequate to discern the various features of the roadway;
C--Adequate to light the through lanes, but the ramps are not as visible as they could be;
D--Inadequate for safe driving.)

A	B	C	D	Comments
		x		Ramps hard to see from frontage road to main lanes.
		x		See above. Where median mounted luminaires are used, it would be good to use supplementary lights at ramp gore areas both entrance and exit ramps.
	x			Lighting is real good.
		x		Approach ramps seem to be better than exit ramps, perhaps because one is approaching rather than leaving well lighted area.
	x			Lighting is good.
	x			The higher the lighting, the better because it takes away much of the glare.

Question: Do the pavement markings (lane lines) show up well at night?

Yes	No	Comments
x		Buttons with reflectors better than paint.
x		The reflector type marker is much better than the painted line.
x		Reflective pavement markers show up well, but markings do not, with the exception of some lighted sections.
x	x	Reflective buttons are fine. Dark buttons only furnish auditory warning at night. White lines when fresh are good, but worn, dirty white lines are inadequate. Considering the constant replacement of them, they probably are no cheaper.
x		Excellent!
x		The raised markings which reflect at night were very helpful.

Question: Does the glare from opposing headlights and/or the roadway lighting tend to obscure the driver's view of the roadway ahead?

Yes	No	Comments
	x	One-way frontage roads throughout the study site.
	x	
	x	Headlight barrier screening prevents this on main lanes very effectively.
	x	
	x	Glare screen has eliminated this problem where installed.
	x	Our freeway had a screen which eliminated the problem.

Question: Does the lighting eliminate the need for special roadway delineation (i.e., roadside reflectors, pavement edge lines, etc.) on the through lanes? (Answers: Yes; Poss--Possibly; No).

Yes	Poss	No	Comments
		x	No amount of lighting can take the place of daylight, so pavement edge lines are necessary.
		x	
		x	Any help that can be given a driver to guide him would be of great help.
		x	Especially on the side opposite the luminaires.
		x	Some unlighted sections were saved by reflectors; lack of reflectors even on lighted areas made roadway delineation more difficult.
		x	Pavement edge lines should be placed on all roadways. Great asset during inclement weather.

On the ramps?

Yes	Poss	No	Comments
		x	Ramps particularly need delineation at night.
		x	Same as above.
		x	
		x	All the above applies especially to ramps; the lighting does not extend its intensity far enough to clarify the ramps. They need reflective material.
	x		Speed on ramps reduced, not as important but would help.
		x	Same as above.

Question: Does the location of the roadway signs with respect to the lights make them difficult to read at a glance? (Answers: Yes; ISC--In Some Cases; No)

Yes	ISC	No	Comments
	x		Route markers were above headlights at S.H. 290 and Loop 610 Route markers in right were occasionally lost.
		x	I saw only one or two signs that the lights blocked out by glare.
		x	
	x		Sometimes the metal of the sign glared in the light and made the words and directions indistinguishable; some commercial signs here did likewise on the roadway.
		x	
	x		

Question: In your opinion, would varying the color of the lights (i.e., use yellow rather than blue-white) on exit and entrance ramps assist in identifying these areas? (Answers: Yes; Poss--Possibly; No)

Yes	Poss	No	Comments
		x	Too much Mickey Mouse.
	x		It might help.
	x		With median mounted system, any additional light on the ramp side would serve to identify the ramp area.
	x		But too many varying colors of light might be confusing; reflectors appear to be simpler and more efficient.
		x	
		x	Yellow could not take the place of blue-white.

Question: In your opinion, would the use of colored edge lines (say blue for off-ramps and yellow for on-ramps or some similar combination) assist in the delineation of the ramps? (Answers: Yes; Poss--Possible; No)

Yes	Poss	No	Comments
x			Would like to try some.
	x		
	x		
	x		On both sides of exit or entrance ramps.
		x	
		x	White is still the best because it serves a dual purpose such as a helping and guiding line during fog and rain.

Question: Where hazard warnings are provided, can they be easily associated with the hazard involved?

Yes	No	Comments
x		In general, yes.

Yes	No	Comments
x		In most cases except for "YIELD" signs.
x		
x		
x		
x		

Question: Do commercial signs and lights along this freeway distract you to any appreciable degree? (Answers: Yes; Poss--Possible; No).

Yes	Poss	No	Comments
		x	None on study site.
		x	
		x	
		x	Except when they cause a glare on the highway signs as noted above. Also, blinking or rotating lights which simulate traffic emergencies are extremely irritating.
x			Commercial signs (lighted) are in most cases a distraction and in some cases cause highway markers to blend.
x			The amount of lighted commercial signs should be limited so as not to distract the driver from highway signs.

APPENDIX "C"

SUMMARY OF DRIVER INTERVIEWS

APPENDIX "C"

SUMMARY OF DRIVER INTERVIEWS

Study Site No. 15; Interstate Highway 610; Houston, Texas

The following is a detailed presentation of the driver comments recorded on tape during the driving runs.

GEOMETRIC DESIGN

DAY PHASE

I think I would like to get off the freeway in all cases by going to the right (cloverleaf). It might be harder to design but it would be easier to drive.

Traffic was such that by the time I realized that I was in the lane drop, it was too late to move into the lane I wanted (this comment is made on the westbound approach to the interchange with U.S. Highway 290 on the North Loop).

The distance from the Woodway entrance to the San Antonio exit (Interstate 10) is real short and there is no definite signing that tells you positively that there is a lane drop.

I think there should be more room than normal between an entrance and such a complex exit especially when there is a lane drop (the driver is referring to the distance between the Woodway on-ramp going northbound on the West Loop to the Interstate 10 exit to San Antonio and downtown Houston).

NIGHT PHASE

I do lose some sight distance on some of these vertical curves but it is not particularly disturbing.

If there had been more traffic, I'm sure I would not have been able to make the lane change to get out of that trap lane (the driver is referring to the exit to Interstate 10 westbound from Interstate 610 northbound on the West Loop).

FREEWAY SIGNING

DAY PHASE

I saw the sign but it didn't say anything about Interstate 610 at all. All it said was "West and North Loop" and I didn't associate it with Interstate 610 (the driver is referring to the advance signing for the Dacoma Turn to Interstate 610).

I think that sign is good (the driver is referring to the diagrammatic sign which shows the left lane arrow going through the center lane arrow going through and to the right and the right lane arrow to the right only). It lets you know which traffic must go where. (The driver is referring to the sign on the approach to the intersection of Dacoma and the frontage road to U.S. 290).

I have already noticed the inconsistency of the signing. This one particular freeway is signed by two different names, Interstate 10 and the North Loop.

I would like to note that the median mounted cantilever signs do not appear to be effective for the assignment of traffic when they are four-lane in one direction (the driver is referring to the sign approaching the Shepherd St. exit going eastbound on the North Loop).

I like that sign that says "RIGHT LANE MUST EXIT" because it tells me not to get into it if I don't want to exit (this comment is made just prior to the 610-Interchange on Interstate 45 going southbound).

NIGHT PHASE

I wish they would have had a route marker on that sign. "WEST LOOP" means nothing to me. (The driver is referring to the directional sign in the gore between Woodway and Memorial Drive going westbound on Woodway).

This is a pretty hairy move from that turn onto the frontage road to the entrance to 610 north for it might be heavy traffic. It might possibly be better if the route marker shield were placed in the gore rather than on the extreme right side of the frontage road (the driver is referring to the entrance ramp to Interstate 610 northbound from the Woodway interchange).

I probably wouldn't have caught that lane change if you hadn't mentioned it to me. I guess there isn't enough distance to install all the necessary signs, especially with so many destinations to list. (The driver is referring to the distance between the Woodway interchange and the Interstate 10 U.S. 90 exit from Interstate 610 northbound).

I didn't even see the signs saying "RIGHT TWO LANES MUST EXIT" (the driver is referring to the signs posted just in advance of the U.S. 290 exit going westbound on the North Loop).

I don't believe that three lines of copy on an informational sign is too much. It is reassuring to know where you stand with respect to upcoming streets.

I can't emphasize enough how much I like these advance street name signs. I really can't think of anything I would do different to them. I see the sign "RIGHT TWO LANES MUST EXIT" but I don't know whether I want to or not. Although it does give me a pretty good idea of

DAY PHASE

I've just become accustomed to the blue shield to mean an interstate highway.

I don't literally use the one mile, one and ½ mile, etc. distances. It just gives me an idea of how far it is before I must get into another lane or whatever I'm going to do.

I think it depends on how familiar I am with the area as to how religiously I follow the lane designation arrows.

I think perhaps some modification of the sign commented upon earlier (the driver is referring to the diagrammatic sign with the arrows indicating dual right turn situation).

To make it fit a freeway would be a real good idea.

No, I don't think a yellow tab on the overhead sign to indicate a lane drop would be particularly effective for me.

I didn't notice the speed sign under the warning sign (the driver is referring to the 610 branch of the Interstate 610 - U.S. 290 bifurcation point going westbound on the North Loop).

I think definitely that more people associate these freeways with North Loop, West Loop, etc. rather than Interstate 45, Interstate 610,etc.

I think it is because the names mean something to me whereas the numbers have no meaning to them at all.

NIGHT PHASE

what is ahead; I think perhaps some other advance signing might be advantageous (the driver is referring to the southbound approach to Interstate 610 on Interstate Highway 45).

I think they could go ahead and put the Interstate Highway 610 shield on that sign. ("NORTH LOOP, WEST LOOP - LEFT LANE" on Hempstead Highway prior to the Dacoma cutoff). It would make it easier for me to understand.

I don't believe they used the advance sign on the frontage roads and not at all on cross streets. They might get to them eventually, but I am satisfied the way they are.

I think the advance exit signs with the arrows on them are all okay on this section. On this section they are defined well enough so that there is no real problem. But on the San Antonio freeway and on Interstate 45 in some places I have noticed that I might have a tendency to turn too soon or at least look for them too soon. I really like them better when they are in the gore.

This entrance is blind. I didn't see the route marker shield on the right and I just assumed that this was the entrance ramp. Of course, it is not illuminated here and that might make it harder to see (the driver is referring to the entrance ramp on the Interstate 610 westbound from Irvington Street).

I think all the signs that depend on reflectorization are real poor on a freeway. I think these overhead signs are excellent. I don't believe three lines of copy are too much to read because they are overhead and you have plenty of time to read them. Also, they are big enough to read quite a ways off.

DAY PHASE

I think that sign with 90 pointing to the right should be more obvious. You could be way down that other street before you saw it (the driver is referring to the roadway approaching the U.S.290 interchange with Interstate 610. It should be noted that the overhead sign bridge was down for routine maintenance at the time of the study).

I definitely think those signs with the distance to the exit are real good. The only trouble is getting people to use them. We have found that most people just don't pay any attention to them.

I think all hospitals should be signed from a freeway. The name might help but I think that is against the rules. I don't know whether the average person would accept a diagrammatic sign for a hospital. I just like words.

I thought the advanced signing to Interstate 45 was very good (this comment was made on Crosstimbers on the eastbound approach to Interstate 45).

I don't see anything to indicate this frontage road was one-way. I have just come to expect it, I guess. (The driver is referring to the frontage road to Interstate 45 going southbound from Crosstimbers).

I guess the reason I missed that turn is because of the lack of advance warning (the driver is referring to the turn from U.S. 290 or the Hempstead Highway onto Dacoma).

NIGHT PHASE

I don't think there is enough advance warning to that exit (the driver is referring to the airline drive exit from Interstate 610 going eastbound).

Now, I am not sure whether North Freeway and Interstate 45 is the same thing. I don't believe that advanced street name signs show up as good at night as in the day time. Maybe if it were bigger it would catch your attention better (the driver is referring to the advance sign to 34th Street on North Sheppard Drive going northbound).

I think the overhead signs are a tremendous improvement over those signs along the roadside. (The driver got trapped and had to exit onto U.S. Highway 290 from Interstate 610 westbound and made the loop onto Dacoma to get back on Interstate 610 westbound - in this case the west loop).

I think at this signal (Dacoma) they should have something to help you correct your mistake , such as a sign saying "TO 610 SOUTH." I think they should combine the route markers along the freeway names.

I think that even the local people must use the sign. So much of these freeways look the same that you just can't depend on memory.

We have had more favorable comments on these advance signs on major intersections than anything that we have ever done.

I believe that I would rather see the route marker shields along with that "NORTH LOOP, WEST LOOP, LEFT LANE" (on the Interstate Highway eastbound approaching the turn onto Dacoma).

DAY PHASE

I think a route marker would have been better than "NORTH LOOP, OR WEST LOOP, LEFT LANE". I think as long as these signs are overhead they are effective, regardless of where they are mounted (the driver is referring to cantilever median mounted or overhead mountings).

A median mounted cantilever might tend to draw someone into the left lane anticipating the maneuver from that lane when actually it is from the right (the driver is referring to the advanced signing for the North Main St. exit).

I think these advanced signs one and one-half blocks in advance of the intersection are real good (the driver is referring to the "NORTH FREEWAY NEXT SIGNAL" on Cavalcade approaching Interstate 45).

I don't believe that route marker is sufficient to tell me anything. It is on the right and I must turn left, also, there is nothing to tell me to make this ramp (the driver is referring to the placement of the directional signing to Interstate 45 northbound at the interchange with Cavalcade Street).

I believe that I would rather have route markers or standard trail blazers rather than referring to open (North Loop, West Loop), etc. (the driver is referring to the advance signing to interstate 610 northbound on Woodway).

NIGHT PHASE

I assume that these signs are just temporary because they certainly are not standardized and they are not too good (the driver is referring to the signing on Interstate 10 east of the 610 loop going toward downtown Houston).

DAY PHASE

NIGHT PHASE

I believe that this 610 route shield should be on both sides of the road, particularly on this three lane frontage road (the driver is referring to the entrance ramp from Woodway to Interstate 610 northbound).

I think the biggest mistake I've noticed was the lack of co-ordination between city signing and freeway signing. This could be alleviated by simply incorporating the route marker shield with the loop name advance sign.

I appreciate these advance street name signs more when I am in a town that does not have them. I have gotten used to them real quickly. It doesn't say anything about Interstate 610 here and all it does say is Katy Road - Hempstead Road, etc., nothing about 610 (the driver is on Washington Street approaching the turn to Interstate 10 Westbound).

It says here "RIGHT LANE MUST EXIT" and I don't know whether I want to exit or not (this comment is made as the drivers approach from the interchange with Interstate 610 on Interstate 45 going southbound).

I believe that there should be some kind of sign here. They don't have anything and you don't know what you are getting into (the driver is referring to the entrance ramp to Interstate 45 northbound from the Cavalcade interchange).

DAY PHASE

NIGHT PHASE

I have found that in a lot of cases the sign is right over your head just when you are to make the intended maneuver. I think all the signs should be the same color on the freeway. That one is black on white and all the rest of them are white on green. (The driver is referring to the "RIGHT TWO LANES MUST EXIT" on Interstate 610 westbound approaching the interchange with U.S. Highway 290).

PAVEMENT MARKINGS

DAY PHASE

I like the buttons a lot more than the paint. If you happen to unconsciously drift out of your lane you can tell if there are buttons, but you can't with paint.

I can see the buttons as good if not better than the paint particularly at night. I don't feel that the white line on the left side of the road is particularly useful to me. It might be useful at night, more so than during the day, but I just don't think it is necessary. I can tell where the edge of the road is.

I have a comment on the width of the edge line here on the left side of the road. It looks to be at least 12 inches wide. I believe that it is just overlapped (on Woodway approaching the interchange with Interstate 610) but I like it. If you were to hit that curve at any great rate of speed you would go over the curve into some of these signs or that abutment as somebody already has. (This comment is made on Woodway Street approaching Interstate 610).

I think that the red jiggle bars serve their purpose very well. They will really shake you if you drive on them at any speed.

I think an edge line would almost always be helpful. Even when there is good contrast with the shoulder and particularly in fog.

I don't believe there would be any real advantage to different colors of edge line however.

NIGHT PHASE

The pavement buttons are real good. They outline better at night than in the daytime and I guess that's because of the contrast.

I like the rumble effect of the buttons. It gives me an audible signal when I make a mistake.

I have not heard any of the truckers mention any problems of skidding or lose of control caused by these buttons, although, I understand that they might be dangerous for motorcycles.

I like the idea of those reflective arrows on the surface of the ramps. I noticed that they don't have them on the North Main Street exit.

I like a definite delineation to tell me where the edge of the road is on a ramp (the driver is on the ramp to Interstate 10 westbound from Interstate Highway 610 southbound).

I like those little white bumps. If there aren't too many cars, or if you are tired, they will let you know when you happen to drift over.

I have driven in states that have edge lines and I really like them, particularly when it gets colder here and we start having the early morning fog. I think it would really help alot.

After driving on the Gulf Freeway when they had nothing but a line down and then coming over here to these buttons, I think it is just tremendous. It really helps me a lot, although I think it would be just as effective if every other stripe were taken out.

DAY PHASE

The raised pavement markers have been real effective on concrete pavements and we now use them almost exclusively.

I think the edge line is good where you don't have good contrast between the main lanes and shoulder. Of course, here you have jiggle bars to tell you you are not on the main lanes so they might not be necessary here (the driver is in the interchange of Interstate 45 north to 610 west).

I think it would be just as effective to eliminate ever other stripe of these raised markers. Just as effective for the driver and half as expensive for the Highway Department.

Recognizing that motorcyclists do have trouble with these raised buttons, I think we should be keeping them to a minimum while keeping them effective.

NIGHT PHASE

We have had some motorcycle officers go down because of these buttons. They cross these and it causes them to go into a high speed wobble and they go down.

These pavement arrows with the red reflectors on the back of them have evidently helped quite a bit because I have noticed fewer incidents of people driving the wrong way since they have put those arrows down.

On the Katy Freeway and towards town I noticed that it was real hard to tell the difference between the shoulder and the main lanes. An edge line there would particularly be a life saver especially in inclement weather.

On type turns such as this I think the edge line on the road would be real valuable (the driver is referring to the direct connector from U.S. 290 eastbound to Interstate 610 eastbound).

I think I would be lost without these pavement buttons here, especially since it is not illuminated (the driver is referring to the section of Interstate 610 just east of the Interstate 45 interchange).

FREEWAY ILLUMINATION

DAY PHASE

NIGHT PHASE

I haven't really thought about it much but I think on a freeway the lighting needs to be high. The higher it is the less it causes glare.

I personally like to have the light on the edges pointing in rather than on the median pointing out. I think you get better lighting that way. My only real objection is that they are too far apart. You have a light and then a dark and so on. I believe that they should be closer together.

You can sure tell the difference when you get on one of these freeways that is not lighted (the driver is referring to the section of Interstate 10 from Interstate 610 loop on the west toward the downtown area of Houston).

MISCELLANEOUS COMMENTS

It bothers me not to be able to see the ramp as I come upon it. The reason that I knew to get over in the left lane was because none of our freeways ever go to the right in order to get on (the driver is referring to the entrance ramp to Interstate 45 north from Cavalcade Street).

This is a real good entrance here. The acceleration lane is real good (Woodway entrance to Interstate 610 northbound).

Now this particular one, both lanes go to Interstate 610 west but the sign led me to believe that there was only one lane for each direction (the driver is on the connector from Interstate 610 from Interstate 45 going northbound on 45).

This is an interesting configuration here. If I hadn't had to stop here I probably wouldn't have seen the "CAVALCADE" sign because I had just assumed that it was East 20th Street (the driver is on North Main Street at the Intersection of Cavalcade and 20th).

I don't guess I really associated any real difference between the North Freeway and the North Loop because they are all interconnected.

When I see a sign that says my maneuver is 8/10 of a mile away, I think I automatically move over to the right assuming that the exit will be on the right.

I had just completely forgotten that I wanted to go east on Interstate 10. Any type of discussion tends to distract me.

I guess most people have come to learn what the red ball and green arrow both mean at the same time (the driver is going northbound on Airline at the front of Interstate 610).

Along here (on Airline Drive going northbound) a lot of people think that it is a paved shoulder but it is actually a driving lane.

I don't believe the average person recognizes the difference between the average delineators and the white ones. I think that the basic problem is due to the lack of education. There are so many types of signs that the average person doesn't understand them all. (The discussion was regarding the use of schematic signing in diagrammatic signing.)

That left turn lane might draw some people into turning onto that one-way frontage road (this comment is made going eastbound on Cavalcade at the interchange with Interstate 45).

Protected left turns are another thing that are real good. I am of the opinion that perhaps all turns should be that way.

This is what scares me, when they have an arrow but it isn't protected. I have come to expect them to be protected when they have a left arrow.

I think maybe the uniformity should be in design rather than in signing to get people used to the geometry rather than the consistency in signing.

I don't think I even noticed the barrel impact attenuators back there. I wouldn't consider them an eye sore at all (the driver is referring to the attenuation system on the westbound exit to Interstate 10 from Interstate 610 going southbound).

I think generally it was a pretty good section. I didn't notice any real bad geometrics, the signing could possibly stand a few reconsiderations, the speed seemed to be adequate and signed well, the signalization at the cross streets was clear and concise, I think all in all it was a pretty good section of roadway (this comment is made by the visiting traffic operations engineer).

I don't get confused with the red ball and a green arrow. Maybe I am just used to them but I don't see that they could be confusing.

I haven't heard any real comments from other truckers on those "Call Boxes" but I bet they would be real handy for the other drivers.

I think that something should be done to coordinate all the maps in the counties so that you would find the same type everywhere. I got a map from Hertz in Dallas and it was real good. One section had all the little streets in detail and the other one had the freeway system with all the exits and the interchanges which was real good if you were by yourself and could only glance at it. Another section had all the major streets indicated.

With a few basic exceptions I couldn't tell the difference between operating this road at night or during the day. That hill there is particularly bad. I don't know what it is exactly, I just don't like the idea of barreling over a hill not knowing for sure what is on the other side (this comment is made on Airline Drive going northbound between Interstate 610 and the Cross Timbers Intersection).

Another thing that I like is the glare screen. It keeps oncoming headlights out of your eyes.

I was real glad to see them put up these emergency call boxes. I bet they are real helpful getting stalled cars off the road.

I'm not too sure whether or not it is such a good idea or not to have this left turn bay here. Perhaps we should not have it before the actual intersection. The adjustment causes someone to think that they can turn left onto the one-way frontage road (this comment is made going eastbound on Cavalcade approaching the interchange with Interstate 45).

I think that the glare screen is wonderful. I don't believe that they could have done a better job. They serve two purposes: 1) they keep the glare out of your eyes, and 2) they keep pedestrians from crossing the freeway and that is a real problem.