combining the data from the two tables above yields an estimated savings in lamp-replacement costs of $2500/year. Although this figure is only approximate, it indicates that lamp-replacement cost savings are a relatively minor consideration. In fact, the savings represent only 10 percent of the savings realized from reduced power consumption.

PUBLIC ATTITUDE

At the time the city made its request for reduced roadway lighting, the Austin area was experiencing a severe energy shortage. The shortage was brought about by the failure of the city's contracted natural-gas supplier to furnish sufficient quantities of natural gas to meet all of the area's electrical power needs. It appeared that the shortage would be long term and that there would be critical peaks dependent on environmental conditions. In response to the energy shortage, the city launched an extensive campaign for energy conservation. The lighting cutback on I-35 was a sincere attempt by the city to make apparent its willingness to contribute to this conservation program.

A critical concern, then, is the effect that the reduction in roadway lighting had on public attitude toward energy conservation. Unfortunately, very few conclusive data were available on public reaction to the lighting cutback. Personnel of the Austin Transportation Department and TSDHPT who were interviewed in conjunction with this study indicated that they received only a minimal amount of reaction from the public in the form of complaints or praise.

CONCLUSIONS

Based on the findings of the research reported in this paper, a substantial cutback in roadway lighting on urban and suburban freeways may not be a satisfactory energy conservation measure. The savings in electrical power consumption associated with such a cutback are offset to a large extent by significant increases in accident frequency and severity resulting from the added hazard of nighttime driving on an unlighted or partly lighted roadway. In addition, the savings in lamp-replacement costs and gains made toward increasing public awareness of the energy problem appear to play only a minor role in determining the effectiveness of a lighting cutback to conserve energy.

It should be noted that this study only addressed one strategy for conserving energy consumed by roadway lighting installations--i.e., turning off the lighting. There are other conservation techniques--e.g., conversion to high-pressure sodium lamps and staggered lighting cutbacks--that may result in substantial energy savings without adversely affecting traffic safety. In addition, no attempt was made to measure or calculate lighting levels in the affected sections.

In 1975, the findings of the study were forwarded to the Austin Transportation Department. Since then, the roadway lighting on I-35 through Austin has been returned to its full level of operation.

ACKNOWLEDGMENT

I would like to express my appreciation to the individuals who significantly contributed to the research summarized in this paper, which was originally presented at the 15th Annual Symposium of the SAFE Association in December 1977. Special acknowledgment is extended to Carl Anderson and Robert Jenkins of TSDHPT for their valuable assistance in the collection of data.

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Abridgment

Operational Field Study of Urban Freeway Guide Signing in Dallas

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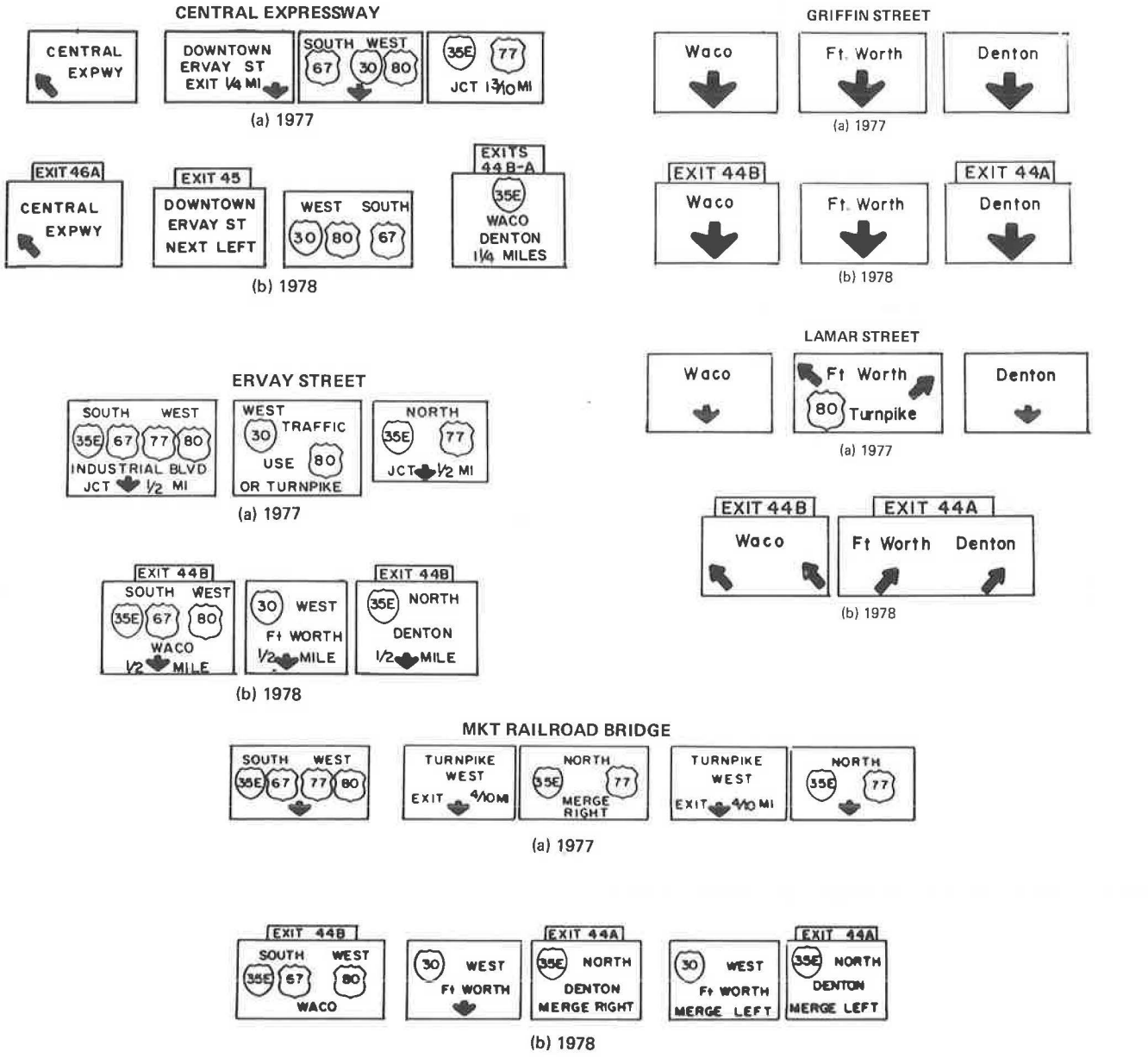
A traffic operational field study conducted on an urban freeway in Dallas, Texas, is described. Major signing modifications were made to the freeway guide signing by state forces exogenous to the research effort. Before and after study data on lane volumes, lane changes, and erratic maneuvers were collected and evaluated. Some specifics and a few general conclusions and recommendations are offered. The operational field study was conducted along westbound I-30 near downtown Dallas. The before study was conducted during 1977 and the after study in 1979. During this period, the freeway guide-signing system was updated to 1970 Manual on Uniform Traffic Control Devices standards. Operational studies of volumes, lane changing, and erratic maneuvers were made to determine what effects might be attributed to the signing and what changes, if any, occurred as a result of these changes. Some positive operational changes were noted, but the causal relations were clouded by the fact that the Dallas-Fort Worth Turnpike was made into a toll-free road (I-30) between the before and after studies.

Traffic operational field studies were conducted along Interstate 30 in Dallas to determine what changes, if any, occurred in the traffic flow due to changes made in freeway guide signing. Operational performance measures used to determine operational changes included lane volumes, lane changes, and erratic maneuvers.

LOCATION OF STUDY SITE

The study site was located along westbound I-30 near

Figure 1. Before and after signing at five locations approaching I-35E interchange in Dallas.



downtown Dallas. The study section began at the Good-Latimer overcrossing and proceeded westbound past the Missouri-Kansas-Texas (MKT) railroad bridge to the I-35E interchange. The overall length of the study section was 1.2 miles. The geometrics of this section of I-30 are basically a six-lane depressed freeway with parallel feeder roads in the depressed section.

BEFORE-AFTER SIGNING

The new 1978 signing system included revised freeway guide signing from I-635 through downtown Dallas, a distance of about 10 miles. Most of the critical signing changes, however, were made in the study section. The before (1977) and after (1978) signing for the last locations approaching the I-35E interchange are shown in Figure 1.

STUDY METHODOLOGY

To determine whether any detectable operational changes had occurred that might be attributed to the new signing system, a relatively large-scale field study was conducted. To make this determination, changes in lane-volume distribution, lane changing, and erratic maneuvers were observed at selected locations.

Several methods were used to record the operational data. A 10-member study team was used to observe traffic operations. Six members made manual traffic-volume counts by lane at the Good-Latimer, Griffin, and Lamar Streets bridges. Lane volumes and lane changes were recorded by using a portable television video recording system at the Ervay Street bridge. A similar video recording system was operated by two people at the MKT railroad bridge adjacent to the I-35 interchange.

Data recording was coordinated by the study supervisor by means of walkie-talkie communication with each location. Personnel at each manual-count station made cumulative counts each 5 min beginning on the hour or the half-hour as appropriate.

Table 1. Chain sequence of highest traffic volume in lane 3 for either before or after study by 1-h time periods.

Starting Time	Study Location				
	Good-Latimer Streets	Ervay Street	Griffin Street	Lamar Street	MKT Bridge
2:30 p.m.	B	A	B	B	A
3:30 p.m.	B	A	B	B	B
9:30 a.m.	A	A	A	A	A
10:30 a.m.	B	A	B	B	B

Note: B = lane 3 highest in before study, and A = lane 3 highest in after study.

The Ervay Street video recordings were the only sources of lane-changing data. Erratic maneuvers were studied at the junction of I-30 and I-35E at the MKT railroad bridge with another video recorder. These maneuvers were classified as to level of severity as follows:

Level of Severity	Maneuver
1	Minor gore penetration
2	Heavy gore penetration
3	Driver completely missed route and backed up the shoulder to change direction

The before studies were conducted primarily on Friday, April 8, 1977, from 2:30 to 4:30 p.m. and on Saturday, April 9, 1977, from 9:00 to 11:00 a.m. The after studies were conducted on Friday, April 6, 1979, and on Saturday, April 7, 1979, at the same times.

RESULTS

Lane-Volume Distributions

Traffic-volume counts by lane were converted into percentages of total flow to discount the effects of possible variations in the general volume levels between the before and after studies. First, a fairly consistent trend toward increasing volumes in the shoulder lane (lane 3) at Ervay Street is noted during the after study over the four 1-h study periods. A chain sequence of the highest percentage lane 3 volume level (of total volume) during either the before or after study by 1-h time periods illustrates this point (see Table 1). Of the nine cases in which lane 3 lane-volume-distribution percentages increased, four were at Ervay Street. The median lane (lane 1) shows a rather consistent reduction in the percentage of the total traffic using it between the two studies.

Similar comparisons at the Lamar Street and MKT (at I-35E) bridges show increasing concentrations of traffic in the middle lane (lane 2) during the after study as compared with heavier traffic found in the outer lanes in the before study. An analysis of these data reveals that a greater percentage of traffic is now headed toward Fort Worth on I-30 than toward Waco on I-35E.

Lane Changing

The data show that the percentage of total lane changing increased slightly from right to left, but only from lane 3 to lane 2. No change in lane changing from left to right was observed.

Overall, a 28 percent drop in lane changing was observed in the section between the before and after studies. The largest percentage reduction consistently was right to left from lane 2 to lane 1 (median lane). These reductions were caused primarily by the change in status of the Dallas-Fort Worth Turnpike to I-30.

Erratic Maneuvers

The frequency of erratic maneuvers is about the same in the before and after cases. A total of 79 were observed in the before study and 73 in the after study. The directional distribution of erratic maneuvers (to right or to left) also remained about the same. However, the level of severity of erratic maneuvers is lower in the after study. During the before study, a total of 18 vehicles were observed making some type of backup at the I-35E junction to correct their route choice. Not one case of a missed route and backup was observed during the after study. Overall, the severity of erratic maneuvers was reduced but remains higher than desired, especially in view of the 13 level-2 erratic maneuvers observed on Saturday morning.

It would appear that the impact of converting the Dallas-Fort Worth Turnpike into a free road (I-30) had a beneficial impact on traffic operations in the study area and explains much of the change in traffic phenomena observed between the before and after studies. However, the new signing system appears to be directing traffic adequately into the appropriate lanes as they approach the I-35E interchange. Improvements to the signing system are still needed, however.

Several improvements to the new signing system are recommended for westbound I-30 in Dallas:

1. Add a post-mounted median sign at Grand Avenue that gives mileage to I-45 and U.S-75 as well as to I-35E.
2. Redesign (or eliminate) the I-30 PULL THRU sign at Fair Park to be consistent with the others.
3. Eliminate the I-30 PULL THRU sign at the Central Expressway and enlarge I-35E advance guide sign.
4. Close the gap in the triple overhead at Akard Street to improve readability.
5. Replace both sets of destination signs at Griffin Street and at the MKT railroad bridge with the route numbers and destination names as well as lane assignment arrows. Visual coding of the PULL THRU sign at Akard Street is misleading and should be corrected and then reinforced at Griffin Street and the MKT bridge.

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