Abridgment

Characteristics of Urban Freeway Guide Signing in Selected Cities

CARROLL J. MESSER AND ROGER W. McNEES

The results and findings of a physical inventory of selected attributes of freeway guide signing found in 10 major cities in the United States are described. Four of these cities were located in the state of Texas and six were outside the state. Data were collected on numerous physical design features, including number of sign panels, number of concurrent routes, and bits of information. The results of the study include tabular comparisons of a number of attributes together with comparisons between Texas and out-of-state signing systems. Information load was defined as the total number of bits of information presented on all overhead sign panels on the main lanes of the freeway. The 50th percentile information load level was found to be 10 bits, the 85th percentile level was found to be 15 bits, and the 95th percentile level was determined to be 18 bits. Most of the high-bit-level signs (those having bit rates in excess of 16 bits) were located in Texas. Another signing variable for which comparisons were made between Texas and non-Texas signing systems was concurrent signing. A dramatic finding of this evaluation was the tremendously large number of concurrently marked Interstate and U.S. routes basically found only in the Texas cities.

The motoring public traveling urban freeways has a wide variety of driving experiences and navigational information needs. Local motorists are usually very familiar with the freeway networks within the metropolitan area and therefore use freeway guide signing only to a modest extent, primarily as landmarks used in initiating actions they have already planned. The semifamiliar freeway driver requires more time to read and respond to the signing and may become confused by unexpected, complex operational circumstances. The out-of-state driver would have maximum information needs and therefore would have to rely totally on the guide signing to navigate through the freeway network.

Where Texas urban freeway guide signing is significantly different from signing in other cities of the country, these differences cannot be anticipated by out-of-state motorists and will surprise the unfamiliar motorist. The result is increased response times and probabilities of driving errors (1).

STUDY DESCRIPTION

Objective

The objective of this study was to determine the basic design characteristics of urban freeway guide signing found in Texas cities and in selected cities around the United States that have similar population and geographic features.

Scope

An inventory of selected physical design characteristics of urban freeway guide signing was conducted in 10 major cities during 1979. Six cities were located outside the state of Texas: Atlanta, Chicago, Denver, Kansas City, Los Angeles, and New Orleans. The four Texas cities inventoried were Dallas, Fort Worth, Houston, and San Antonio. A total of 2292 signs were inventoried.

Measurement Procedure

All observations of freeway guide signing were obtained by making routine travel runs along the freeways in standard automobiles. Mileage measurements were read from the odometer. The physical characteristics and message design of each guide sign were inventoried.

Data were collected on the following guide-sign features: location of sign structure, cross-section position (median, overhead, and shoulder), number of sign panels, total bits of information on the panel, number of concurrent route sign panels, and, finally, the total number of concurrent routes on a panel.

The unit used to measure information load on a freeway guide sign was called a "bit". A bit of information on a freeway guide sign in this study was defined as the existence on a guide sign of each of the following items: route number; cardinal direction; destination name; route name (one or two bits); street name; next right (left) (two bits); junction, to, next; exit number; command; exit mileage; exit only; mileage; all lane-use arrows; and business.

Excessively long or possibly confusing route names may be considered two bits of information or load in relation to estimating the degree of difficulty in the reading task. Concurrent route markings are a troublesome signing problem in most Texas cities, since many urban freeways are often marked as Interstate as well as U.S. highway routes.

STUDY RESULTS

The results of the inventory effort are described according to the basic measures previously described. A more detailed analysis of information statistics follows.

Inventory Mileage

A total of 1053 miles of freeways were inventoried in the 10 cities. The total mileage within Texas was approximately equal to the out-of-state mileage. The mileages shown represent almost all radial-oriented freeways in each city. Very little loop (beltway) freeway mileage around the cities was observed. A breakdown of these data is given below (note that signs are the same as sign structures in this paper and that a sign structure may have more than one sign panel):

Name of City	Miles of Inventory	No. of Signs	No. of Signs per Mile
Out of state			
Atlanta	59.0	142	2.41
Chicago	103.5	249	2.41
Denver	69.0	176	2.55
Kansas City	66.7	192	2.88
Los Angeles	187.1	220	1.18
New Orleans	35.9	84	2.34
Subtotal	521.2	1063	2.04
Texas			
Dallas	151.2	280	1.85
Fort Worth	106.1	310	2.92
Houston	97.7	308	3.15
San Antonio	176.9	331	1.87
Subtotal	531.9	1229	2.31
Total	1053.1	2292	2.18

The average number of sign structures per mile in the Texas inventory was found to be 2.31 sign structures/mile while the out-of-state sign density was 2.04 sign structures/mile.

The data show that Houston and Fort Worth have the highest density of signing: Sign density for Fort Worth is 2.92 signs/mile, and Houston's average sign density of 3.15 signs/mile is the highest value. It should be noted that the sign densities in Dallas, San Antonio, and Los Angeles--1.89, 1.87, and 1.18 signs/mile, respectively--are a little misleading. All three of these cities have undeveloped belt routes, which results in very few signs. In general, the most severe sign-density problems are found near the downtown area of the central city due to the unusually high frequency of access ramps and freeway-to-freeway interchanges. Near the downtown areas, sign densities of more than 4.0 signs/mile are likely to occur.

Sign Types

Median signs (151) included all guide signs located in the median of the freeway. The most common median signs observed were the ground-mounted exit and distance sequence signs. Shoulder signs (1117) included all single ground-mounted signs located on the right shoulder of the freeway, all T-mounted exit gore signs, and all ramp exit signs. All signs located on a single overhead sign bridge over the freeway main lanes were classified as "overhead" (1024).

The primary purpose of this phase of the inventory was to determine the usage characteristics of the median-mounted exit and distance sequence signs. The results show that Los Angeles and Houston have the most median signs. Except for the use of median-mounted signing in Los Angeles and Houston, the aggregate usage characteristics per mile of freeway inventoried were very similar.

Information Load

A study of the accuracy of route selection and reading times in a human factors laboratory (2) indicated that overhead sign structures with one or more panels that have more than 20 bits of information are unsatisfactory and that guide signs that have more than 16 bits are not desirable. The sign inventory determined that the 50th percentile (median) information load is 10 bits. The modal, or most frequently observed, value was also 10 bits. The table below gives the rank order of the cities that had signs with 16 bits of information or more:

Rank Order	Name of City	No. of Signs
1	New Orleans	0
2	Denver	3
3	Los Angeles	4
4	Atlanta	8
5	Kansas City	8
6	Chicago	13
7	Fort Worth	14
8	Dallas	14
9	San Antonio	16
10	Houston	18

The data also indicate that the 85th percentile level of the signs was about 15 bits of information or less. The 95th percentile level was determined to be 18 bits; that is, 5 percent or less of all signs had 19 bits or more. Less than 1 percent of all signs had more than 21 bits of information.

A more detailed breakdown of the distribution of information loads on signs reveals that the Texas cities tend to be the leaders in information loading. Every Texas city inventoried had more than one guide sign with more than 20 bits on it.

Since the total in-state and out-of-state freeway miles of inventory are about equal (532 versus 521), direct numerical comparisons are justifiable on an aggregate basis. A total of 15 signs in the four Texas cities had information loads of greater than 20 bits. Only 6 signs in the six out-of-state cities were observed to be so cluttered.

Number of Panels

The Texas cities have a slightly larger percentage of three- and four-panel applications on their urban freeways. In total, Texas had about 25 more four-panel signs than did the out-of-state systems, and nearly 70 or more three-panel signs.

Information Load per Panel

The average number of bits of information per sign panel was determined for each of the 10 cities inventoried. The four Texas cities all had average levels per panel less than any of the remaining five out-of-state cities.

It can be observed that the median information bit level (50th percentile) for the "busiest" sign panel per sign is about five bits; whereas the 85th percentile busiest panel would contain about seven bits in all of the cities. Dallas and San Antonio have 19 signs between them that have more than eight bits of information on one sign panel. Only a few of the large California sign panels in Los Angeles came close to being so loaded.

Concurrent Signing

Concurrent signing occurs when a freeway is included in more than one route-numbering system. A dramatic finding of this evaluation is the tremendously large number of Interstate and U.S. concurrent freeway routes (sign panels) found in Texas in comparison with the out-of-state systems. In the four Texas cities, there are 392 panels that have Interstate-U.S. concurrent signing compared with only 73 panels in the out-of-state systems (see Table 1). Only one Interstate-U.S. concurrent sign was found in five of the six non-Texas cities.

One may note that 18 percent of Texas signs have two concurrent routes (panels) signed and about 4 percent of the total Texas population of overhead freeway guide-sign structures have three concurrent routes.

CONCLUSIONS

The following conclusions are drawn from the field inventory data of the 10 selected cities in the United States and previously reported research (2) and are founded heavily on basic precepts of driver expectancy (1):

1. Fort Worth and Houston have more signs per mile than would be expected by most out-of-state drivers.
2. Los Angeles and Houston are the only two cities that extensively use median-mounted destination and distance sequence signs. Denver has installed these signs along one freeway.
3. The 85th percentile and 95th percentile bit levels of all overhead guide signs, excluding the ramp exit panel, were found to be 15 and 18 bits, respectively.
4. Texas cities tend to have most of the large, cluttered signs observed in the United States.

Table 1. Number of urban freeway guide-sign panels with concurrent route signing.

Inventory Location	Number of Guide-Sign Panels						
	Interstate-Interstate	Interstate-U.S.	U.S.-U.S.	Interstate-State	U.S.-State	None[a]	Total
Out of state							
Atlanta	20	0	1	0	0	57	78
Chicago	44	0	15	3	4	104	170
Denver	6	1	4	0	4	77	92
Kansas City	11	72	9	0	0	116	208
Los Angeles	3	0	0	0	0	159	162
New Orleans	0	0	0	0	0	64	64
Subtotal	84	73	29	3	8	577	774
Texas							
Dallas	23	93	1	0	0	105	222
Fort Worth	0	69	19	0	6	75	169
Houston	0	95	0	0	9	89	193
San Antonio	4	135	5	2	0	105	251
Subtotal	27	392	25	2	15	374	835
Total	111	465	54	5	23	951	1609

[a]None = one route number (no concurrent signing).

5. Texas stands almost alone in the continued use of redundant concurrent signing of an Interstate freeway with U.S. route numbers.

6. There are a few signing locations in Texas where the combination of a large number of concurrently signed intersecting routes are combined with a high-speed, large, multilane freeway facility, which results in signing plans that are likely to surprise and overload out-of-state motorists who are unfamiliar with them.

REFERENCES

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Traffic Control and Geometrics for Weigh-in-Motion Enforcement Stations

CLYDE E. LEE AND RANDY B. MACHEMEHL

A discussion of geometric design concepts for weigh-in-motion (WIM) enforcement stations is presented. In-motion weighing techniques for trucks have been developed in recent years by which estimates of static axle weights can be made reliable to within 10 percent for trucks running at speeds of 60 km/h (37 miles/h) and perhaps higher and within about 2 percent for trucks running at speeds of 20 km/h (12 miles/h) or lower. High-speed weighing can be used to screen out only the suspected weight-limit violators and allow the obviously legally loaded trucks to pass without stopping and waiting to be weighed. Suspects can be checked for actual violation by a low-speed WIM system at rates up to 10 trucks/min without stopping or by static scales at perhaps 20 trucks/h with stopping required. A number of WIM enforcement-station layouts are possible. Two configurations are suggested. A recommended system of signs, pavement markings, and traffic-control signals that will guide the driver smoothly through the WIM enforcement station at reduced speed, but without stopping, is presented. It is concluded that weight-enforcement operations can be accomplished safely, efficiently, conveniently, and economically with properly designed WIM equipment, weigh stations, and traffic-control systems.

The current energy situation and rising economic pressures have, in recent years, fostered demands for increases in commercial vehicle sizes and weights. The resulting use of larger, heavier trucks is causing planners, engineers, economists, and enforcement personnel to realize the importance of having adequate, current information on truck size and weight available. Such data have historically been collected by stopping trucks at weigh stations or at the roadside for weighing and measurement. Both the quantity and the quality of the data obtained by this method have generally been somewhat limited, mostly because of the very high user and collection-agency costs associated with vehicle deceleration, waiting, and acceleration maneuvers required for static weighing. Site-construction costs and safety have also been considerations.

Electronic in-motion weighing equipment is now available to supplement or replace static weighing devices. Such equipment makes it possible to collect the needed vehicle weight and dimension data without requiring trucks to stop. Eight states are currently using in-motion weighing systems for enforcement purposes, weight surveys, or both (1). The geometric configuration of the weighing sites and the provisions for traffic control range from