

These Digests are issued in the interest of providing an early awareness of the research results emanating from projects in the NCHRP. By making these results known as they are developed and prior to publication of the project report in the regular NCHRP series, it is hoped that the potential users of the research findings will be encouraged toward their early implementation in operating practices. Persons wanting to pursue the project subject matter in greater depth may obtain, on a loan basis, an uncorrected draft copy of the agency's report by request to the NCHRP Program Director, Highway Research Board, 2101 Constitution Ave., N.W., Washington, D.C. 20418

## Urban Area Highway Guide Signing

*An NCHRP staff digest of the essential findings from the final report of NCHRP Project 3-12, "Urban Area Highway Guide Signing," submitted by G. F. King and H. Lunenfeld, from ALL, a division of Cutler-Hammer, Farmingdale, New York.*



### THE PROBLEM AND ITS SOLUTION

Concepts and standards for highway guide signs have long been developed and established by highway officials in publications such as the *Manual on Uniform Traffic Control Devices* (MUTCD). Nevertheless, on the basis of actual conditions in many urban areas, it is entirely reasonable to question whether the present standards insure that motorists are properly guided in their travels within urban communities.

The research project reported on here was instituted as a continuation of an earlier project that had led to the publication of NCHRP Report 123, "Development of Information Requirements and Transmission Techniques for Highway Users." Its objectives were to answer the following four questions related to problems of urban travel guidance. First, where do existing guide signing standards, as embodied in MUTCD and similar manuals, fail to provide the motorist with required information at the time and place where it is maximally usable? Second, in what specific instances are deficiencies of the existing system most noted and most severe, and how can these deficiencies be best characterized? Third, what alternate or revised urban guidance solutions can be developed that, within the constraints of feasibility, overcome these difficulties? Fourth, in what specific areas do these effective solutions require changes from current standards and current practices and how can these changes be implemented in actual practice?

The approach to the problem taken by the research agency was to set up a series of coordinated tasks that can be grouped into four principal functions. The first of these was to characterize the guidance problem. This was done by making a survey of the literature, by holding discussions with other researchers and traffic operations personnel, by administering questionnaires

to a nationwide sample of drivers, and by conducting a number of typical guidance missions in several selected urban areas. The last activity led to a collection of guidance studies from which a set of guidance problems could be derived and evaluated.

The second function began with identifying from the foregoing activities the major urban area guidance problems and potential solutions for them. A set of candidate problem/solution pairs was then developed for evaluation. After selecting three test sites in a representative urban area for applying and evaluating the problem/solution pairs, motion picture sequences were prepared encompassing the test trips and problem solutions.

The third group of activities dealt with evaluation of the problem/solution pairs in a laboratory simulation. Two sets of guidance material were prepared, one depicting the signing treatment found in the field and the other depicting research-generated solutions. These were administered to matched groups in simulated navigational tasks on the streets depicted in the previously prepared movies. The performances of test subjects were compared, and the results were analyzed to determine whether differences or deficiencies existed between the two sets of guidance materials.

The fourth task was to prepare recommendations for urban area guide signing on the basis of the test evaluations, in a form suitable for inclusion in the *Manual on Uniform Traffic Control Devices*.

## FINDINGS

### General Conclusions

The project's search for and analysis of deficiencies in the urban travel guidance system led to the conclusion that deficiencies existed in five distinct areas, four of which were system deficiencies, and the fifth a deficiency in implementation. These deficiencies, not in priority order, are:

First, the availability and usability of maps for trip planning and trip execution by strangers in urban communities falls far short of what is needed. One of the prime resulting shortcomings is that motorists are unable to make a proper and adequate trip plan. They then subsequently encounter difficulties in implementing and confirming a trip plan.

Second, certain guidance system failures manifest themselves at the interfaces between freeways and the conventional street networks. These are difficulties in (a) choosing the proper freeway exit, (b) choosing the appropriate travel direction at the foot of the ramp, (c) locating a freeway from the arterial system, and then (d) determining the correct entry point for the desired direction of freeway travel.

Third, there is a lack of the appropriate arterial identification and destination signing needed for the task of arterial navigation. The motorist not only has inadequate guidance about the identity of the arterial on which he is traveling, but also has inadequate foreknowledge about the identity of crossing arterials as he approaches them, or about the destinations served by the arterial network.

Fourth, the present guidance system does not contain suitable remedies for drivers who become lost or who fear they are lost. The system does not provide adequate displays of confirmatory and reassurance information, sufficient

trailblazing, opportunities to revise trip plans, or clearly marked opportunities for U-turns.

Fifth, the system experiences implementation difficulties because of the following typical operational deficiencies: failure to employ MUTCD-recommended devices beyond the bare minimum; failure to mobilize all required skills and good judgment in sign location and message content; failure to review and update the sign system when highway system changes occur; and, almost universally, failure to maintain signs properly.

### Special Findings

The final report of the project lists many specific findings from the separate and distinct study tasks undertaken. These are grouped by the following subheads for convenience or reference to the final report presentation:

State-of-the-Art-Survey - A synthesis of the literature review and technical discussions yielded the following study inputs:

1. The existing state of the art of urban guidance is inadequate for a full analysis of the problem or for evaluation of the adequacy of proposed solutions and remedial measures.
2. Although a considerable body of knowledge exists concerning the attributes of some specific system elements, the interactions of these elements, and especially their specific attributes within the urban environment, have not received sufficient consideration.
3. No organized body of user experience with urban guidance exists that could serve as a basis for a detailed analysis of user needs.
4. A number of specific solutions to specific problems have been developed and advocated. Some of these have received empirical evaluation.
5. A few studies have derived general principles applicable to urban area guidance, or to specific portions of the system, but not in sufficient detail to serve as a basis for system design.
6. A set of constraints exists that limits the freedom of action in the design, implementation, and operation of urban guidance systems. These include administrative, legal, jurisdictional, budgetary, personnel, and technological constraints, and the extent of driver knowledge.

Review of MUTCD - The review of pertinent sections of the MUTCD led to findings that it does not alert the user sufficiently to the potential problems to be encountered in designing an urban guidance system. Furthermore, the control devices recommended, and their recommended application and use, may not be adequate to satisfy the guidance needs of the urban driver, especially if only the minimum requirements are followed. Additionally, adherence to the Manual may not lead to consistent, adequate, and uniform systems of urban directional signing.

Nonetheless, considerable improvements in the current status of urban guidance are possible by the intelligent application of the devices contained in the MUTCD if all the appropriate optional devices are used, and if budgetary, administrative, and personnel constraints do not force minimum solutions.

Case Studies in Urban Guidance - Thirty-one cities in the United States

and Canada were visited to generate a set of data defining the similarities and differences in urban guidance elements and problems on a geographic and size basis. Test subjects were placed in a set of real and simulated direction-finding missions. Of 114 case studies analyzed, a total of 959 individual direction-finding problems (or approximately 9 problems for each case) resulted. The percentage distribution by type of problem (Table 1) clearly shows that the majority were associated with arterial navigational inadequacies, such as city signing on arterials, problems in city layout, and mapping or other pre-trip problems. Analysis of the results according to geographical location, urban size, type of driver (stranger, local stranger), and type of trip preparation produced no statistically significant differences within each of these classes of variables.

Questionnaire Survey - To determine user-perceived problems in urban guidance, two questionnaires were developed and distributed nationwide. Although not fully stratified considering all driver population demographic variables (the returns were skewed to the high end on educational and income levels), more than 700 usable questionnaires representing a broad sample of the driving public were returned. Roughly one-half of the returns were from drivers classed as "strangers" and one-half from "local strangers." The "stranger" is a driver unfamiliar with the route and the area, who is using the facility for essentially the first time. The "local stranger" is a driver assumed to be familiar with the area but not the route, who may be using the facility for the first time or who is repeating an occasional trip. Some of the findings were as follows:

1. For both "strangers" and "local strangers" the average number of trips to unfamiliar areas was approximately seven per year.
2. Most trips by both groups were made for a variety of social and recreational purposes. More than one-third of the "stranger" trips and one-quarter of the "local stranger" trips included a business purpose.
3. Most "stranger" trips were preceded by trip-planmaking, mainly by using maps.
4. More than one-half of all respondents reported feeling lost at some stage of their most recent trip and one-half of this group actually became lost.
5. Respondents in the "stranger" class were primarily concerned with maps and information centers, sign messages, and a general lack of signing information. "Local strangers" were mainly concerned with a lack of arterial identification and sign messages. Both types of respondent were concerned with signing techniques (sign size, legibility, target value), blockage, and illumination.

The results of ranking by respondents of the importance of different information types are given in Table 2. Route numbers are of primary importance to strangers, with street names ranked second. Except for a reversal of these first two positions, local strangers ranked the seven information types comparably. The relative placements of route numbers and route names confirms the MUTCD requirement that numbers should always take precedence over names. Compass direction is the least important element.

There was more divergence when guidance problem types were ranked. Table 3 shows that the leading problem for both driver types occurs with directional signing on arterials. For strangers, the next two major difficulties related to maps, and these problems were followed with difficulties posed in choosing exit

ramps and locating entrance ramps. Freeway-arterial interchange points accounted for three of the five main problems encountered by local strangers, and the lack of system forgiveness was ranked third by this group.

Signing Solutions - A number of solutions that have been suggested by others are endorsed by the research. These include larger and better-placed street signs with advance signing at major intersections, better application of advance route markers, and more use of diagrammatic signs and trailblazers.

Solutions generated by the project are directed particularly to the arterial navigation problem. Part II of Appendix B of the final report is a draft of proposed changes to the MUTCD, which relate mainly to Section 2D, "Guide Signs, Conventional Roads." It is suggested that this section could be divided into three parts: "General," "Rural Arterial Highways," and "Urban Arterial Highways." An example of one proposed change is illustrated by Figure 1, which shows suggested arterial direction signs. Other designs are suggested for advance arterial identification signs. It is clearly recognized that these represent only first approximations, and prior to actual field use must receive considerable attention on the part of competent and experienced graphic designers.

Empirical Evaluations - Some of the proposed solutions were tested empirically by means of simulated navigational tasks given to 113 subjects, who were shown the 16-mm movie of three test highway sections. At selected points of directional choice, subjects were shown a 35-mm slide representation of either the existing directional information or the proposed signing and asked what maneuver would be appropriate for the task. The finding was that the proposed treatments, as a whole, were better than the existing signing. When aggregated by class, advance arterial signing, arterial direction signs, and displays of Cartesian (grid) coordinates, all showed statistically significant improved performance by the experimental group. These results provided the basis for recommending the changes in the MUTCD.

### Recommendations

Among the recommendations emanating from the project were the following items, some of which bear on the changes to MUTCD outlined by Appendix B:

1. Upgrade arterial signing to standards prevailing on the freeway system.
2. Make increased use of trailblazers.
3. Develop rules and criteria for choosing destination messages by class of destination.
4. Improve sign construction, erection, and maintenance practices.
5. Improve highway map accuracy, availability, and the correlation between map information and signing practices.
6. Improve driver skills in map reading and trip planning through driver education and verify these skills through driver licensing and examination procedures.

### APPLICATIONS

This research effort was designed to identify existing problem areas in the field of urban guidance and to develop improved methods for overcoming these problems. Although the research effort was structured to yield results capable of immediate application, certain recommendations require preliminary legislative, administrative, or budgetary action. Others are capable of immediate implementation.

Improvements in urban guidance can be achieved by the use of currently available devices and techniques — if these devices are properly designed, optimally located, and adequately maintained. Similarly, recommendations regarding maps can be implemented quickly, since most official state highway maps are revised annually. No preliminaries are necessary for highway authorities to make greater use of mass media for communicating information of interest to motorists.

The main channel for applying the results of this research is through the MUTCD. The report urges the National Advisory Committee on Uniform Traffic Control Devices to examine and evaluate the material presented in Appendix B, together with the supporting evidence in other parts of this report, and to sponsor experimental use of the traffic control devices recommended therein.

Appropriate recommendations concerning changes in the MUTCD could then be made to the Federal Highway Administrator.

TABLE 1  
CLASSIFICATION OF DIRECTION-FINDING PROBLEMS

<u>PROBLEM CATEGORY</u>	<u>PERCENT</u>
Difficulty in arterial and street route following	51.0
Difficulty in freeway and expressway route following	9.2
Difficulty in freeway entrance finding	8.8
Unsuitability of trip planning aids	6.7
Difficulty in freeway exit finding	4.9
Confusion due to local name and place use	4.0
Decision complexity due to multiple routings	3.6
Unavailability of trip planning aids	3.5
Difficulty in route following at ramp terminal	2.9
Road signs that violated driver expectancies	2.5
Problem in recovery once mistake was made	2.0
Difficulty in finding local street addresses	0.9
	<u>100.0</u>

TABLE 2  
GUIDANCE INFORMATION TYPES RANKED IN ORDER OF IMPORTANCE,  
BY CLASS OF DRIVER

<u>Stranger</u>	<u>Local Stranger</u>
1. Route numbers	Street names or numbers
2. Street names or numbers	Route numbers
3. City names	City names
4. Destinations	Destinations
5. Exit numbers	Exit numbers
6. Route names	Route names
7. Route compass directions	Route compass directions

TABLE 3

MAJOR TYPES OF GUIDANCE PROBLEMS RANKED IN ORDER OF IMPORTANCE,  
BY CLASS OF DRIVER

<u>Stranger</u>	<u>Local Stranger</u>
1. City directional signs that did not provide the information you expected to see.	1. City directional signs that did not provide the information you expected to see.
2. Road maps were not available.	2. The entrance ramp to a freeway or expressway was hard to find from city streets.
3. Road maps that did not give enough street details or were hard to read.	3. If you made a wrong turn or got lost it was hard to get back on the right route.
4. Finding the best exit off-ramp in a city was hard to do.	4. Finding the best exit off-ramp in a city was hard to do.
5. The entrance ramp to a freeway or expressway was hard to find from city streets.	5. Signs at the end of a city exit ramp did not give enough information to find your way.

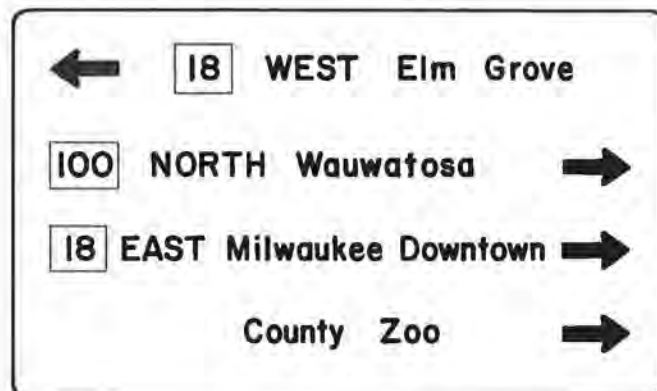
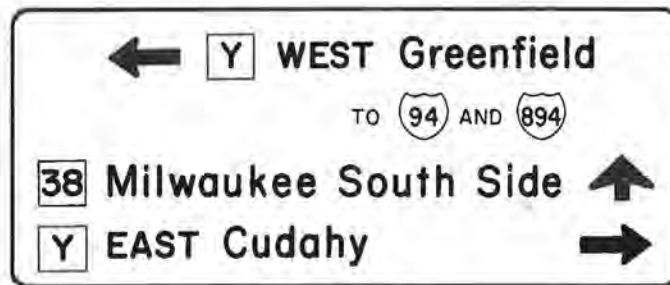


Figure 1. Suggested arterial direction sign.