NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM
SYNTHESIS OF HIGHWAY PRACTICE 21

HIGHWAY LOCATION REFERENCE METHODS

HIGHWAY RESEARCH BOARD
NATIONAL RESEARCH COUNCIL
NATIONAL ACADEMY OF SCIENCES—NATIONAL ACADEMY OF ENGINEERING

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HIGHWAY LOCATION REFERENCE METHODS

RESEARCH SPONSORED BY THE AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS IN COOPERATION WITH THE FEDERAL HIGHWAY ADMINISTRATION

AREAS OF INTEREST:
TRANSPORTATION ADMINISTRATION
MAINTENANCE, GENERAL
HIGHWAY SAFETY

HIGHWAY RESEARCH BOARD
DIVISION OF ENGINEERING NATIONAL RESEARCH COUNCIL
NATIONAL ACADEMY OF SCIENCES—NATIONAL ACADEMY OF ENGINEERING 1974

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

Systematic, well-designed research provides the most effective approach to the solution of many problems facing highway administrators and engineers. Often, highway problems are of local interest and can best be studied by highway departments individually or in cooperation with their state universities and others. However, the accelerating growth of highway transportation develops increasingly complex problems of wide interest to highway authorities. These problems are best studied through a coordinated program of cooperative research.

In recognition of these needs, the highway administrators of the American Association of State Highway and Transportation Officials initiated in 1962 an objective national highway research program employing modern scientific techniques. This program is supported on a continuing basis by funds from participating member states of the Association and it receives the full cooperation and support of the Federal Highway Administration, United States Department of Transportation.

The Highway Research Board of the National Academy of Sciences-National Research Council was requested by the Association to administer the research program because of the Board's recognized objectivity and understanding of modern research practices. The Board is uniquely suited for this purpose as: it maintains an extensive committee structure from which authorities on any highway transportation subject may be drawn; it possesses avenues of communications and cooperation with federal, state, and local governmental agencies, universities, and industry; its relationship to its parent organization, the National Academy of Sciences, a private, nonprofit institution, is an insurance of objectivity; it maintains a full-time research correlation staff of specialists in highway transportation matters to bring the findings of research directly to those who are in a position to use them.

The program is developed on the basis of research needs identified by chief administrators of the highway departments and by committees of AASHTO. Each year, specific areas of research needs to be included in the program are proposed to the Academy and the Board by the American Association of State Highway and Transportation Officials. Research projects to fulfill these needs are defined by the Board, and qualified research agencies are selected from those that have submitted proposals. Administration and surveillance of research contracts are responsibilities of the Academy and its Highway Research Board.

The needs for highway research are many, and the National Cooperative Highway Research Program can make significant contributions to the solution of highway transportation problems of mutual concern to many responsible groups. The program, however, is intended to complement rather than to substitute for or duplicate other highway research programs.

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The members of the advisory committee selected to monitor this project and to review this report were chosen for recognized scholarly competence and with due consideration for the balance of disciplines appropriate to the project. The opinions and conclusions expressed or implied are those of the research agency that performed the research, and, while they have been accepted as appropriate by the advisory committee, they are not necessarily those of the Highway Research Board, the National Research Council, the National Academy of Sciences, or the program sponsors.

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PREFACE

There exists a vast storehouse of information relating to nearly every subject of concern to highway administrators and engineers. Much of it resulted from research and much from successful application of the engineering ideas of men faced with problems in their day-to-day work. Because there has been a lack of systematic means for bringing such useful information together and making it available to the entire highway fraternity, the American Association of State Highway and Transportation Officials has, through the mechanism of the National Cooperative Highway Research Program, authorized the Highway Research Board to undertake a continuing project to search out and synthesize the useful knowledge from all possible sources and to prepare documented reports on current practices in the subject areas of concern.

This synthesis series attempts to report on the various practices without in fact making specific recommendations as would be found in handbooks or design manuals. Nonetheless, these documents can serve similar purposes, for each is a compendium of the best knowledge available concerning those measures found to be the most successful in resolving specific problems. The extent to which they are utilized in this fashion will quite logically be tempered by the breadth of the user's knowledge in the particular problem area.

FOREWORD

By Staff
Highway Research Board

This report will be of special interest to highway administrators, planners, and others who have responsibility for the selection and establishment of highway location reference methods within their jurisdictions. Sufficient information is offered on the methods that have been used, including the common milepost method and many others, and on the experiences with each, to provide individual highway agencies with a good base for judging the quality of the performance of the methods that they now employ, and for adopting modifications that may appear to be desirable.

Administrators, engineers, and researchers are faced continually with many highway problems on which much information already exists either in documented form or in terms of undocumented experience and practice. Unfortunately, this information is often fragmented scattered, and unevaluated. As a consequence, full information on what has been learned about a problem is frequently not assembled in seeking a solution. Costly research findings may go unused, valuable experience may be overlooked, and due consideration may not be given to recommended practices for solving or alleviating the problem. In an effort to resolve this situation, a continuing NCHRP Project, carried out by the Highway Research Board as the research agency, has the objective of synthesizing and reporting on common highway problems—synthesis being defined as a composition or combination of separate parts or elements so as to form a whole greater than the sum of the separate parts. Reports from this endeavor constitute a special NCHRP Report series that collects and assembles the various forms of information into single concise documents pertaining to specific highway problems or sets of closely related problems. This is the twenty-first report in the series.

Use of devices to provide a means for locating a position on a highway is not new, but has become increasingly important as the complexity and size of highway operations have increased. The processes that have been applied are numerous, and the results have been variable. This report of the Highway Research Board records the methods that have been used, and cites the advantages and disadvantages of each.

All location reference *methods* are recognized to be parts of reference *systems* that include both office and field procedures intended to facilitate a variety of activities that occur in such fields as planning, safety, and maintenance. The commonly used milepost method, the less common reference post method in which the post may contain only a sequence number, and other lesser used methods, are described and analyzed within the perspective of the systems in which they are employed. No single all-purpose method or system is recommended. Areas where existing information is inadequate and research could be productive are pointed out.

To develop this synthesis in a comprehensive manner and to insure inclusion of significant knowledge, the Board analyzed available information (e.g., current practices, manuals, and research recommendations) assembled from many highway departments and agencies responsible for highway planning, design, construction, and maintenance. A topic advisory panel of experts in the subject area was established to guide the researchers in organizing and evaluating the collected data and for reviewing the final synthesis report.

As a follow up, the Board will attempt to evaluate the effectiveness of this synthesis after it has been in the hands of its users for a period of time. Meanwhile the search for better methods is a continuing activity and should not be diminished. An updating of this document is ultimately intended so as to reflect improvements that may be discovered through research or practice.

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Information on current practice and ongoing research was provided by several highway agencies. Their cooperation and assistance were most helpful.

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HIGHWAY LOCATION REFERENCE METHODS

SUMMARY

Devices to locate a position on a public way have existed at least since the time of the Roman Empire, but it is only in recent years that highway location reference systems have increasingly been used to improve highway agency functions such as planning, safety, and maintenance. A highway location reference *system* is a set of office and field procedures that includes a highway location reference *method*. The latter is a way to identify a specific location with respect to a known point. The system is seen as the procedures that relate all locations to each other and includes techniques for storing, maintaining, and retrieving location information. This report deals mainly with location reference methods, but recognizes that it is difficult to discuss methods apart from the system.

The primary objective of any highway location reference method is to provide a means for designating and recording the geographic positions of specific locations on a highway and for using the designations as a key to stored information about the locations. The most significant characteristic of any method is its orientation toward use in the field. Thus, a method must be simple because it is used by personnel at various levels of technical competence. There must also be a uniformity in the procedures through which locations are identified and recorded to facilitate correlation of all points.

Three elements common to all location reference methods are (a) identification of a known point, (b) a measurement from the known point, and (c) a direction of measurement. The various methods generally may be grouped into two categories—sign-oriented methods and document-oriented methods.

The distinguishing characteristic of the sign-oriented method is placement of either milepost signs or reference post signs along roadways. A milepost allows a user in the field to determine where he is in relation to a known point (route beginning, county line, etc.) simply by adding (or subtracting) the distance from the location to the milepost. A reference post ordinarily does not permit computation of a location in the field because the reference post does not provide location information in terms of miles. The milepoint must be computed in a central office (usually by computer) using a file that contains actual milepoints for each reference post. *It is the necessity of this step and the existence of the file that distinguishes the reference post method from the milepost method.* In most agencies the mileposts are, in fact, being used as reference posts. Even though there may not be a formal version of the file, the true locations of the mileposts are retained somewhere in the records of the agency.

More states use mileposts than any other highway location reference method. The sign messages vary from only the milepoint to those showing route number, county, and milepoint. Frequently, because of construction changes, mileposts do not indicate true milepoints. When this occurs, an equation is used to relate milepost signed milepoint to true milepoint. The equation is for office record purposes

and not field purposes. Therefore, when mileposts are reported, they are adjusted to true milepoints on the basis of the equation. Thus, it can be seen that the milepost method can frequently also be considered in the reference post category.

The reference post method was developed as a solution to the problem caused when changed route lengths affect milepost numbers. In some states the mileposts became reference posts, as their true location was kept in a file in the office. In other states actual reference posts were established. The major advantage of the reference post is that the post does not have to be adjusted for changes in route length caused by construction—only the office file needs to be changed.

Both mileposts and reference posts are used by highway agencies to inventory traffic control devices, to record work locations for maintenance forces, to locate utility crossings, etc. Police forces use them when issuing citations or when recording accidents. In some remote areas, they are used as mailing addresses.

Document-oriented methods are used because an agency did not want to incur the costs of installing signs in the field. There are two types of document-oriented methods: those that use diagrams or logs that show physical features with their milepoints, and the method based on the use of available street maps. The former use identifiable roadway features, such as intersections, bridges and railroad crossings, on a strip map or log with their milepoint or reference point numbers. These are prepared and kept up-to-date in the office and must be used in the field in order to identify a location. The document-oriented method using available street maps is the most widely used in the United States today, particularly with respect to accident location. The common form refers a location to an intersection of city streets. In a few cities this has been developed into a highly sophisticated application.

Other location reference methods are in experimental or limited use. Chief among these is the use of coordinates. Coordinates provide a unique, permanent identification for any given point, but the determination of coordinates by manual means is time consuming and error prone. Another method uses common roadside objects for referencing. These include bridges that have unique numbers posted on them; utility poles, also with unique numbers; railroad grade crossings that are now being assigned unique numbers; and, occasionally, rural mailboxes with addresses on them.

To the casual user of a highway location reference method, there appear to be many widely different methods in use today. In fact, there really is not a great deal of fundamental difference among the several most commonly used methods. Regardless of the name assigned to the method, all use a distance measurement from an "incident" to a known point, the direction of measurement, and a description of the known point. The characteristics are the same whether the calculation for true milepoint is done in the field, accomplished manually in the office from a straight-line diagram, or performed by the computer.

Little information is available concerning the costs associated with highway location reference methods and systems. The available information was pertinent only to an agency's own procedures and was not applicable to procedures used in other agencies. A location reference system may function economically in one agency but not in another because of differences in the degree of integration of the various factors involved (e. g., field procedures, office procedures, knowledge and experience of personnel, and information needs of users). The success of an agency's system does not seem to be dependent on how economical it is, but, rather, on how well the agency implements reference procedures that are responsive to *all* of the users in the highway agency.

There is much interest in research to determine which highway location refer-

ence method is "best." In fact, there are not a number of totally different location methods, but only variations of that basic set of procedures by which any location is physically referenced in the field. Research, then, should not be directed toward finding a "best" method, but toward those aspects of location referencing that have not received much attention.

The placement of physical markers remains a question. On two-lane highways, placement at alternating sides of the road has been used successfully by several states. On divided highways, a better procedure is placement on both sides. When two or more routes are concurrent, it is recommended that signs that include a route number contain the number of the highest level system on the concurrency.

There is need for a systematic approach to design and implementation of a location reference method. This would include due regard to the potential users and to the techniques that would have to be employed in using the method. There should also be an educational effort to acquaint users of location reference methods with the theory and operational aspects of the methods.

Any research effort concerning highway location reference methods should be directed toward those aspects of location referencing that have not received much attention. For example, there is the value of location referencing to the public. There is a feeling among the states that milepost signing is of some value to the driving public, but just how important it really is has not been studied. Another potential research area concerns low-volume roads. In most states there is doubt as to whether there is anything to gain from installation of reference signing on these roads. Research is needed to determine, in more detail, the categories of highways on which reference signing is warranted.

CHAPTER ONE

INTRODUCTION

HISTORY

Devices that assist travelers on public ways to orient themselves with respect to their intended destination or some other location of importance have existed for many years. Milestones were found along the roads of the Roman Empire (*1*) and it has been suggested by Borth (*2*) that they may have had an even earlier origin in Asia in view of the tendency of the Romans to borrow ideas from peoples whom they conquered.

The milestones installed on the Roman roads were of assistance to travelers primarily by informing them of the distance from their point of origin or destination, usually a city. They also appeared on the roads built by the Romans in Britain, although they fell into disuse after the fall of the Empire. Official distance markers did not appear in England until the 18th Century (*3*). Among the first were those installed by Trinity College on the Cambridge-Barkway Road in 1727. Their usefulness and popularity were indicated by the comment that they "created a great sensation, travelers circulating eulogistic accounts of them all over the country" (*3*). Later in the 18th Century the use of milestones spread rapidly because they were required by the Statute of 1773. English highway authorities were required by the General Highways Act (1882) to erect milestones (*3*).

The use of milestones in America had its early beginning with the markers installed on the Boston Post Road in 1763 by Benjamin Franklin (*2*). An example of an early milestone is shown in Figure 1. Their widespread use, however, did not begin until the early 1920's, when markers known as mileposts appeared on the roads of a few states, initially in the form of concrete pillars (*4*). Gradually the mileposts began to be replaced by signs indicating mileages and their principal purpose was to aid travelers.

The rapid expansion and drastic changes in the nation's

highway system beginning about 1916 were reflected in significant modifications in highway markings. The realignment and abandonment of roads, together with the construction of many new highways, made many of the old mileage signs virtually useless and they were gradually replaced by signs displaying point-to-point distances and route numbers based on the uniform highway numbering system. In addition, travelers were greatly aided by the widespread production and distribution of tourist maps that made use of readily identifiable landmarks as well as mileage markers and signs.

This increased availability of other devices for the guidance of travelers resulted in a marked decline in the use of mileposts except in a few states and on turnpikes. However, with the passage of the 1956 Highway Act, which required that mileposts be installed on the Interstate System, these markers became more significant. Rather than a device primarily for the convenience of travelers, they gradually became a basic element in the planning, construction, and administration of the national highway system. The safety standards included in the Highway Act of 1966, which required procedures for accurate identification of accident locations, added further emphasis to mileposts.

Since 1966, the prevailing attitude toward mileposts has been to consider them for use in location referencing and not necessarily as a convenience to the traveling public. This attitude, which appears to be gaining advocates, considers the milepost to be a reference post; that is, the number on the post is not necessarily considered to be an accurate mileage figure. This particular approach was generated as an attempt to resolve the problem that arises when construction changes the length of a route and makes milepost numbers invalid.

Other location reference methods have been developed to combat this problem. Some states have employed such methods as mileposts on paper and the referencing of locations to landmarks such as intersections, whereas other states have changed the zero points for their mileposts to county lines and to the beginnings of control sections in an effort to reduce the impact of construction changes on their mile markers.

Regardless of how or why they came into existence, almost all of the methods do have a degree of commonality in that their derivation from or similarity to spaced mile markers reflects their heritage back to the ancient milestones.

PURPOSE

The need for improved information systems in highway administration has become increasingly evident over the past few years. With the increasing use of sophisticated computer equipment by highway engineers, opportunities exist for the development of better information systems in several highway functions, including planning, safety, and maintenance. Any highway information system requires the input of data on many phases of the highway network, but a common denominator (i.e., a key or identifier for use in storing and retrieval of data) is usually the location of specific points along the roadway. A system to facilitate the identification of these points—a highway location reference system—is thus an essential part of the over-all information needs of a highway agency.

There is a definite distinction between a highway location reference *system* and a highway location reference *method,* the former being a larger set of office and field procedures that includes the latter. The *method* is seen by the user in the field as a way to identify a *single* location; i.e., to reference a specific position with respect to a known point. The *system* is seen as the procedures that relate all locations to each other. It includes the techniques for storing, maintaining, and retrieving location information. Although this report deals mainly with the location reference method, it recognizes that the very nature of some methods makes it impossible to discuss the method aspect apart from the system.

STUDY PROCEDURE

Two sources contributed to the gathering of information and the assembling of this report. First, discussions were conducted with representatives of the agencies in several states concerned with the use of location reference methods. Included were law enforcement personnel, maintenance personnel, traffic engineers, public utility engineers, highway planning personnel, and members of city engineering departments. These discussions provided valuable information regarding the types of location reference methods used and the nature of problems encountered.

A second source was a survey of location reference methods as used by the various states conducted in late 1971 by the Federal Highway Administration. Although the results of that survey have not been formally analyzed, the data were useful in the preparation of this report.

GLOSSARY

The purpose of this glossary is to define the various terms as they are used in this report, because their meanings tend to vary in common usage.

LOCATION—The name given to a specific point on a highway for which an identification of its linear position with respect to a known point is desired. A location may be where an accident occurred, where a roadway characteristic (such as surface width) changes, where an operational characteristic (such as traffic volume) changes significantly, or where some maintenance activity started or ended.

HIGHWAY LOCATION REFERENCE METHOD—The technique used to identify a specific point (location) or segment of highway, either in the field or in the office.

HIGHWAY LOCATION REFERENCE SYSTEM—The total set of procedures for determining and retaining a record of specific points along a highway. The system includes the location reference method(s) together with the procedures for storing, maintaining, and retrieving location information about points and segments on the highways.

MILEPOST—A physical entity, ordinarily a sign, placed beside a highway and containing a number that indicates the mileage to that point from some zero point on the highway.

MILEPOINT—The name given to the numerical value of

Figure 1. Early American milestone.

the mileage displacement from a base point to any location.

REFERENCE POST—A physical entity, ordinarily a sign, placed beside a highway and containing a number that does not reflect a milepoint, but is an identification number for the point of location of the post. The identification number is associated with the actual milepoint of the location in office records.

REFERENCE POINT—A fixed, identifiable feature, such as an intersection, railroad crossing, or bridge, from which a location can be measured or referenced.

USER—Anyone who employs a location reference method to identify a location or to find a location on a highway. Users may fall into any of the following categories: state or local highway agencies; law enforcement agencies; other government or private agencies with concerns related to highways; emergency services; and the motoring public.

OBJECTIVES OF HIGHWAY LOCATION REFERENCE METHODS

The primary objective of any highway location reference method is to provide a means for (1) designating and recording the geographic position of specific locations on a highway and (2) using the designations as a key to stored information about the locations. This permits users of the method to use or modify stored information and subsequently to find a location in the field. Thus, the identification of a location can be made in the field at the time of data collection or in the office at a later time.

The most significant characteristic of any method is its orientation toward use in the field. Consequently, emphasis should be given to those methods that provide simple and fast procedures for identifying an individual location. The method must be simple because it must be used by personnel at various levels of technical competence. A maintenance foreman is using an elementary highway location reference method when, after learning of an unexpected snowdrift, he sends a crew to "find where the snowdrift is and remove the snow from the road." More sophisticated reference methods require not only more permanent landmarks but also position designations less likely to be duplicated than the designation "where the snowdrift is."

Another objective of the method is provision for uniformity in application of procedures through which various highway-related data observations are located. This means that the procedures for identifying and recording a location should not depend on the independent viewpoints of the various organizational units making the observations. Rather, a method should be established that can be used uniformly by all units to produce compatible data. This will facilitate eventual correlation of all points identified by a method.

At the same time, it is recognized that different location reference methods can be employed, but this should be done only on different kinds of highway networks; e.g., state highways, county roads, and urban streets can each have a different method employed on them and still be compatible. To employ different methods on a single highway system would necessitate cumbersome data processing procedures and would defeat the objective of having a basically simple and easy field method.

LINEAR RELATIONSHIP OF POINTS

Compatibility between different location reference methods can be achieved because of a significant characteristic of highways—they are linear. When a traveler moves along a highway, he is moving in a linear manner and commonly measures his progress and orients himself in terms of distance and direction from or to a known point.

Obviously, any two locations referenced to the same known point are related linearly to each other; that is, it is known how far apart they are. It has become common for highway authorities to use this technique of distance and direction from a known point to identify highway locations or sections in their data files. The known point may be a state line, a county line, a control section terminus, or some other fixed location. This form of location identification has come to be known as "route number/milepoint" identification.* It is the most familiar and perhaps the simplest way of relating any point on a highway with all other points. Most of the location reference systems now in use are based on route number/milepoint identification in the data records, either directly or through some variation of this principle.

Three elements common to all location reference methods are (1) identification of a known point, (2) a measurement from the known point, and (3) a direction of measurement. The presence of these elements permits computation of the true milepoint for a given location. The known point can be any fixed highway feature—a milepost, a reference post, a bridge, an intersection, a railroad grade crossing, etc. It is, therefore, possible to derive a milepoint identification for a location using any of several location reference methods. A location reference system can include several different location reference methods, all of which are compatible within the system. For example, mileposts on the Interstate highway system, reference posts on the state highway system, and bridge or intersection numbering on county roads each provide the basis for different methods. Each of the methods uses a referencing device (milepost, reference post, etc.) that has a number associated with it. The procedures followed to obtain a milepoint for a referenced location with any of the three methods are similar, and therefore can be used within the same kind of location reference system. Then, because the methods are within the same kind of system and are compatible, the locations identified under one method can be related (through the milepoints) to those identified under another method.

A different kind of location reference system is necessary to obtain milepoints for locations that are referenced by using landmark names (e.g., the Falls Road overpass, DuPont Circle, etc.). The procedures to obtain milepoints for locations referenced in this way are somewhat different from those for locations referenced by using numbers. Although the procedures could be the same, the usual case is that additional steps (usually manual) are required with the landmark reference methods and, thus, a different location reference system results.

Because the two different kinds of systems can compute milepoints for referenced locations, the systems are compatible in the same way that two different methods are compatible.

The distinction between the method and system aspects of location will become evident in the next chapter.

* Other generic terms that are equivalent to the word "milepoint" include *log-mile* and *post-mile*.

CHAPTER TWO

LOCATION REFERENCE METHODS

This chapter describes the character and use of location reference methods being employed today, and includes a discussion of the similarities and differences as well as relative advantages and disadvantages. The comparison is facilitated by grouping the methods into two major categories—sign-oriented methods and document-oriented methods. The selection of the categories is based on the way the methods are designed and used for location identification.

Several considerations that are inherent in discussion of the two categories of methods are:

1. Many states have spent considerable time and effort either in designing and implementing new methods or in improving existing methods for use on their highway systems. Although little effort has been made to establish these "formal" methods on non-state highways, some counties have independently implemented such methods; however, they generally are not coordinated with each other or with the methods established by the state highway department. The prevalent method on non-state highway systems is one in which local landmarks and intersections are used as points of reference. In use, this method often is not applied consistently either within or between jurisdictions and, therefore, may be classified as "informal." Although both the "formal" and "informal" methods are treated in this report, greater attention is given to the "formal" methods.

2. The recording of accumulated odometer readings for state highway planning surveys is not considered as a separate method in itself and therefore does not appear in either of the two categories. This inventory procedure is rarely used for referencing individual locations (such as an accident site) because the referencing would necessitate, in each case, a field measurement from the accident site to some official zero point.

Odometer readings are used mostly by field crews when conducting inventories that require a series of location identifications (accumulated mileages from a zero point) at points along a roadway where a characteristic of the roadway changes. These inventories are used to determine the true milepoints of roadway features, including bridges, intersections, mileposts, reference posts, railroad crossings, and any other device that is used as a reference point in a location reference method.

3. No attempt is made to categorize methods according to their adaptability to rural or urban situations. Although each of the methods can be used on any particular system of roads, it must be recognized that the differing characteristics of urban streets and rural roads may require selection of the most suitable method on each.

4. A significant potential use of location reference methods is the directing of emergency services to the site of an incident. Investigation indicated that, in general, the only methods used for this purpose are those that can be considered as "informal." For example, State Police dispatchers in Washington are familiar enough with the local landmarks in their respective districts that emergency services are directed with reference to those landmarks.

SIGN-ORIENTED METHODS

The distinguishing characteristic of the sign-oriented methods is the placement of a series of either milepost signs or reference post signs along roadways. Although there are similarities between these two kinds of signs, there are significant differences in the way they are used. In addition, signs may only be numbered adhesive strips that are affixed to roadside objects.

Mileposts (Figs. 2 and 3) have a simplicity that is inherent in signs that are uniformly spaced and in numerical sequence. This allows both the trained and the untrained user to determine where he is in relation to some known point (route beginning, county line, etc.). As a result, the use of mileposts probably is the most widely known and the best understood of the various location reference methods.

To identify a location in the field using a milepost number, the distance from the location to the sign is added to or subtracted from the number on the sign. The computation can be made in a central office at a later time, by recording in the field the milepost number together with the distance and direction to the location.

Methods that use reference posts, on the other hand, ordinarily do not permit computation of a milepoint in the field because reference posts are points of reference that do not usually provide highway location information in terms of miles. As with mileposts, a distance and direction to a location must be recorded with the reference number. A milepoint is computed in a central office, usually by electronic computer, by using a file that contains the actual milepoints for each of the reference posts. *It is the necessity of this step and the existence of the file that distinguish the reference post method from the milepost method.* In a majority of agencies it is not recognized that mileposts are, in fact, being used as reference posts, although there may not be a formal version of the file. Usually, true locations of mileposts are retained somewhere in the records of the agency and are used to adjust location identifications referenced to mileposts. The variations between the two methods are otherwise slight, and it is not uncommon to find them in combined use.

The locations identified by the reference post method must be translated into route and milepoint identifications to put them into a more widely understood form. Highway agencies, either because of tradition or because of the nature of highway network, invariably think in terms of distances, usually miles. Records of the highway network and of activities on it generally are kept in terms of distances from some zero point.

Comparison of Sign-Oriented Methods

Characteristics of Mileposts

- Signs may be placed at any spacing (usually 1 mile).
- Signs contain the actual milepoints or approximate mileages of the locations.
- Zero points are usually at route beginnings, at county lines, or at control section limits.
- The messages on the signs may or may not be readable from a moving vehicle.

Characteristics of Reference Posts

- Signs may be placed at any spacing. In some cases, placement is at major intersections and jurisdictional boundaries, at fixed uniform intervals, or a combination of these two plus placement at special roadside features.
- Central office records containing the true milepoints of reference post signs must be kept.
- Signs ordinarily contain numbers that are not related to a milepoint. The signs also may include route number and jurisdictional information.
- The signs may or may not be in numerical sequence along a route.
- The messages on the signs may or may not be readable from a moving vehicle.

Use of Mileposts

- Because this method incorporates signs containing milepoints, the actual milepoint for a location of interest on a highway can be readily determined in the field. The distance from the location to a sign is added to or subtracted from the number on the sign, depending on the direction of travel.
- An alternate procedure is to record the distance, direction of measurement, and sign number, leaving the computation of the actual milepoint to office procedures.

Figure 2. Oregon milepost.

Use of Reference Posts

• The milepoint is not computed in the field when this method is used. The distance, direction of measurement, and sign number must be recorded, leaving the computation of the actual milepoint to office procedures.

Advantages of Mileposts

• Because the signs reflect mileage, which is familiar to most people, this method can be easily learned.

• The motoring public is usually provided information for charting progress along the roadway.

• There is fairly uniform spacing, so the user does not have to proceed more than some fixed distance to find a marker.

• The numerical sequence provides easy orientation.

Figure 3. Arizona milepost.

Advantages of Reference Posts

• Changes in route lengths caused by construction do not affect the placement of signs or the validity of the numbers on them.

• The signs apply to all concurrent routes.

• Spacing of the signs is frequent enough so that users will not have to travel long distances without encountering one.

Disadvantages of Mileposts

• Changes in the length of a route after initial placement of signs result in numbers not reflecting true milepoints.

• Where there are concurrent routes, the numbers on the signs reflect mileages for only one of the routes.

• The placement of signs along highways can create problems for maintenance forces.

Disadvantages of Reference Posts

• Depending on the sign numbers, the motoring public may not be provided information for charting progress.

• The placement of signs along highways can create problems for maintenance forces.

Mileposts

Mileposting was the location reference method most often named by the states in the 1971 FHWA survey of such methods. This is not unexpected, considering the long history of mileposts. Also contributing to this apparent popularity is the fact that the *Manual on Uniform Traffic Control Devices* (MUTCD) requires installation of mileposts on the Interstate Highway System (Fig. 4), other freeways, and certain expressways. Where milepost signs are used, requirements contained in the MUTCD must be followed.

There is an obvious lack of uniformity in mileposting today, as can be seen in their spacing (0.1 to 2 miles), size, and various types. Two states attach aluminum tape strips to the back of existing directional signs, marking the mileage information on the tape (Fig. 5). The sign messages themselves vary from showing only the milepoint to providing route number, county, and milepoint.

Mileposts have become familiar to both highway officials and the driving public. In Oregon, which probably has the longest active history of using mileposts for location referencing, they are almost considered as landmarks. They are widely used by the public, by law enforcement agencies, and by the Oregon DOT. The highway patrol makes use of the mileposts when issuing citations and for recording accident locations (the location portion of an Oregon accident report is shown in Fig. 6). Where mileposts exist on county roads, they are used by county sheriffs.

Oregon, however, typifies a frequently found variation of the milepost method in that they maintain a milepoint log and a strip map showing current milepoints for roadside features. Where route length changes have occurred, equations are given; consequently, when either milepost references or computed milepoints are reported, they are adjusted to true milepoints on the basis of the equations. Thus, although the state has mileposts in place and considers its method to be milepost oriented, it can be con-

sidered in the reference post category, also. This illustrates the difficulty in classifying a method, particularly by name only.

California uses mileposts for locating utility crossings and showing locations of utilities adjacent to the roadway. In Washington, outdoor sign permits show the locations of signs in terms of milepost reference. Examples of both documents are given in Appendix A. The highway patrols in both Washington and California ordinarily do not use mileposts to identify accident locations. Instead, other known features such as overpass structures (Fig. 7) or crossroads are used, illustrating again the coexistence of mileposting and another reference method.

Nevada took a "formal" approach in developing the Nevada milepost system. It is noteworthy that the impetus to the development effort was management's desire to gather accurate maintenance-cost data on the state highway system. The method was developed by a committee called a "milepost team" so that the resultant technique could be used by all divisions of the highway department for standard identification of locations. The team was composed of representatives from the accounting, construction, maintenance, planning and utilities divisions.

The right-of-way and maintenance divisions use this method to identify roadside land parcel locations and maintenance activities, respectively. The highway patrol uses mileposts in identifying the location of accidents. The patrolman normally measures the distance from a milepost, computes a milepoint, and records the result.

Problems encountered by the states in using mileposts range from the difficulty of reading small signs (a major

Figure 4. A typical Interstate milepost.

reason why the highway patrol in Washington found them difficult to use) to the inaccurate numbers on the signs caused by construction changes. Other problems include those inherent with any network of small roadside signs: maintenance forces must work around them and signs may be covered by snow, knocked down, or stolen.

The major problem, however, is caused by the changes in route lengths resulting from construction. Several different procedures have been established to counteract this difficulty. For example, Oregon uses equations. Other states replace the mileposts. In those states where mileposts are replaced because of construction, they are usually zeroed at frequent points along a highway, such as county lines, control section termini, or maintenance section limits.

Reference Posts

The reference post method seems to have developed as a solution to the problem caused by the fact that changing

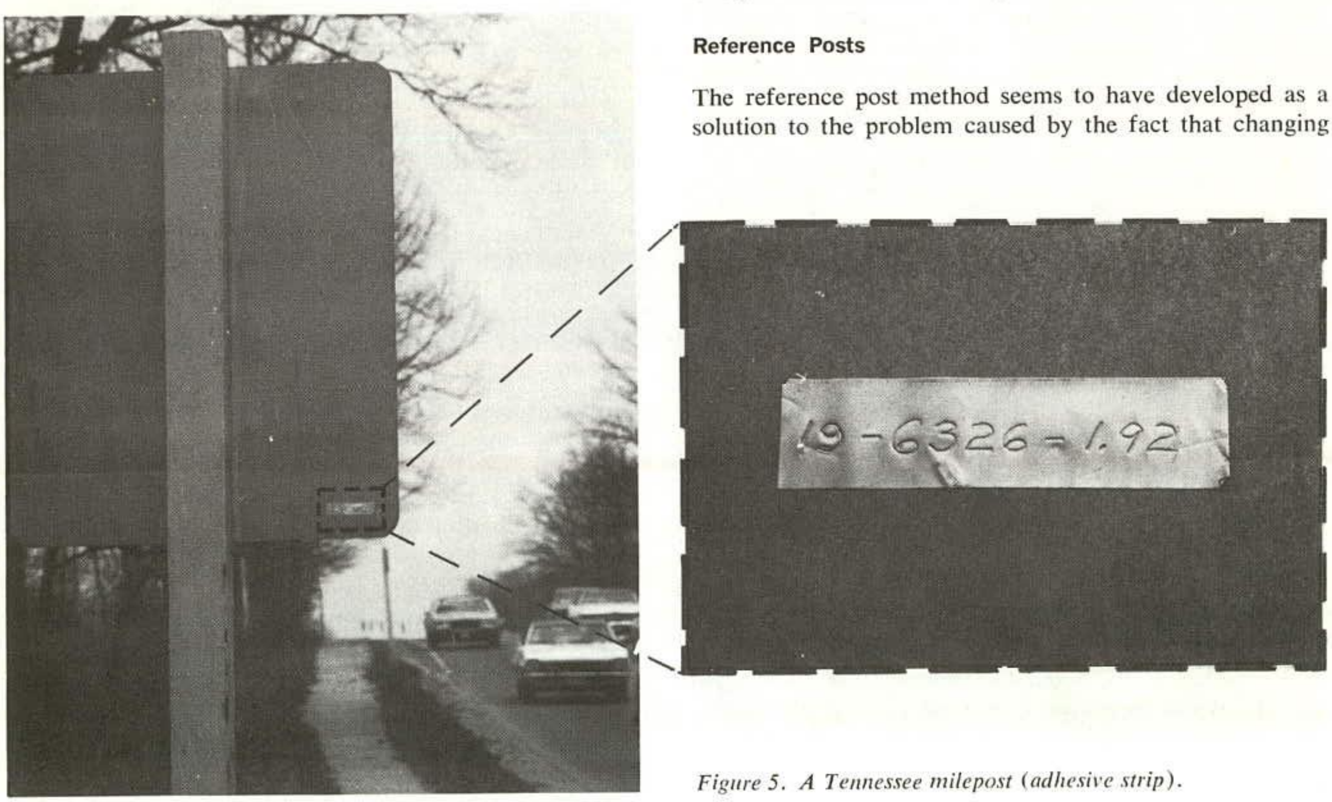


Figure 5. A Tennessee milepost (adhesive strip).

STATE OF OREGON

Accident Report — Police ☒ FATAL ☐ INJURY ☐ PROP. DAMAGE — OREGON STATE POLICE–BEND (DEPARTMENT) — NO. ____

DATE OF ACCIDENT	TIME OF ACCIDENT ☐ A.M. ☒ P.M.	ARRIVED AT SCENE ☐ A.M. ☒ P.M.	CITY	COUNTY	
10-9-72	Est. 8:30	9:02	NA	Deschutes	SHEET 1 OF 3 SHEET(S)
OCCURRED ON (Route Number or Name)			AT INTERSECTION OF (Route Number or Name)		DO NOT WRITE IN THIS SPACE
Highway 97					
IF NOT AT INTERSECTION	☐ FEET N S E W	(Intersecting highway or street, landmark, or house no.)		MILE POST	NEAREST CITY
.2	☒ MILES ☐☒☐☐ OF	N.W. Galloway Ave.		117.7	4 MILES N ☒ S ☐ E ☐ W ☐ OF Redmond
ACCIDENT INVOLVED	☐ PEDESTRIAN, ☒ OTHER MV	☐ RR TRAIN ☐ BICYCLE	☐ ANIMAL ☐ OVERTURNED IN ROAD	☐ RAN OFF ROAD ☐ OTHER NON COLLISION	☐ FIXED OBJECT ☐ OTHER OBJECT ☒ CITY, COUNTY OR STATE PROPERTY DAMAGED.
CODE FOR INJURY (Use only the most serious one in each space for injury) K - Dead before report made.		A - Visible signs of injury, as bleeding wound or distorted member; or had to be carried from scene. B - Other visible injury, as bruises, abrasions, swelling, limping, etc.		C - No visible injury but complaint of pain or momentary unconsciousness. D O - No indication of injury.	

Figure 6. Location identification on Oregon accident report.

route lengths affect the validity of milepost numbers. Mileposts were used originally to make a direct computation of milepoints in the field, but with construction projects continually changing the lengths of routes this became difficult. A number of states revamped their approach by keeping a record of where the signs really were in relation to a zero point. A few states adjusted the field computations in the headquarters office by using this record of true milepoints. In others, field computations were not made, but the factors required to make the computation were recorded as discussed previously. Thus, the reference post method had its beginnings. Actual reference posts were installed in several states where the route length problem was recognized early.

An obvious advantage of reference posts is that construction changes affecting the length of a route do not affect the validity of the reference numbers. It becomes necessary to adjust the milepoint equivalents in the central file, but no field adjustments are needed except for any reference posts actually displaced by the construction.

Another advantage results from the central file aspect.

Figure 7. Overpass structure with crossroad name.

The file can contain all the route numbers (and equivalent milepoints) for highway segments on which there are concurrent routes. Thus, a location identification can be reported using any of the concurrent route numbers.

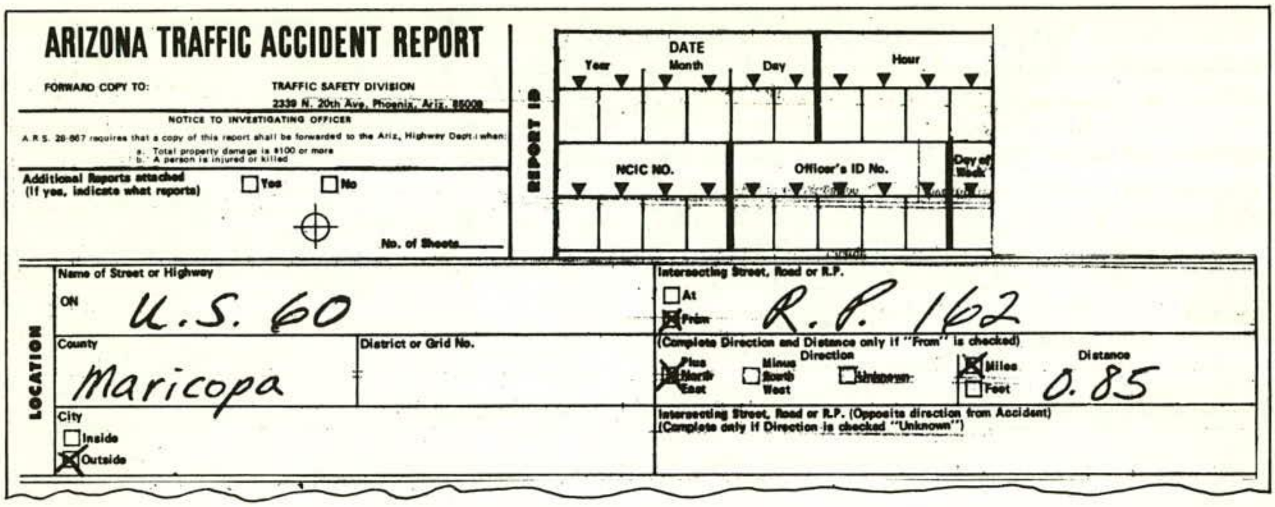
Examples of Reference Post Method Use

Evolution of the reference post method is exemplified by the procedures established by *Arizona* during development of its Accident Location Identification and Surveillance System (ALISS). The following is excerpted from documentation of ALISS:

> Study of location referencing techniques resulted in three primary decisions:
>
> - Locations would be identified by specifying the road name, a reference point on that road, and the directed distance from that reference point to the location.
> - The reference points to be used would principally be milepost signs and intersection centroids.
> - ALISS would maintain data sufficient to describe the centerline alignment of each road in the system.
>
> The development of an adequate location referencing system for the State of Arizona necessitated a close scrutiny of the milepost system. It was determined that the milepost system as used on the Arizona State Highway System violated some basic premises commonly associated with a milepost system:
>
> - They are not consistently 1.00 miles apart.
> - They are not consistently ascending as one travels in the cardinal direction of the highway.
> - Because of realignment problems they are not always consecutively numbered.
>
> As a result of the above deficiencies and the success of the reference point concept in other states, it was decided to use the milepost signs as reference points, not as true mileposts, and utilize the reference point concept in the development of the system.

The method is implemented only on the state highway system at the present time.

The reference posts in Arizona are used by several different organizational units of the highway department. When locating accidents, the highway patrolmen record the distance and direction from a particular reference post, as well as the reference post number. A portion of an Ari-


ARIZONA TRAFFIC ACCIDENT REPORT

FORWARD COPY TO: TRAFFIC SAFETY DIVISION
2339 N. 20th Ave., Phoenix, Ariz. 85009

NOTICE TO INVESTIGATING OFFICER

A.R.S. 28-667 requires that a copy of this report shall be forwarded to the Ariz. Highway Dept. when:
a. Total property damage is $100 or more
b. A person is injured or killed

Additional Reports attached (If yes, indicate what reports) ☐ Yes ☐ No

No. of Sheets

REPORT ID

DATE: Year | Month | Day | Hour

NCIC NO. | Officer's ID No. | Day of Week

LOCATION

Name of Street or Highway: ON U.S. 60

Intersecting Street, Road or R.P.: ☐ At ☒ From R.P. 162

County: Maricopa | District or Grid No.

(Complete Direction and Distance only if "From" is checked)
Direction: ☒ Plus North East ☐ Minus South West ☐ Unknown | ☒ Miles ☐ Feet | Distance 0.85

City: ☐ Inside ☒ Outside

Intersecting Street, Road or R.P. (Opposite direction from Accident) (Complete only if Direction is checked "Unknown")

Figure 8. Location identification on Arizona accident report.

zona accident report is shown in Figure 8. The patrolmen also use the reference posts to record location identifications where citations are issued and as places to meet with other patrolmen.

A traffic control device inventory was conducted using this method. The distance, direction, and reference number were stored in computer-readable records and became the identification scheme in the records. A sample record layout is given in Appendix A.

Maintenance forces record work locations between reference posts (nearest posts only) to provide a relationship between maintenance work and other route-oriented records.

The reference posts also are used as mailing addresses in remote areas of the state.

Wisconsin took another approach in establishing a reference post method. As with Arizona, the method was devised in connection with development of an information system. In this case, the larger system was known as the Integrated Operations System, which encompassed most of the activities of the highway department. One of the subsystems, Highway Data and Information System, required an identification procedure that would be acceptable throughout the highway department's varied activities.

After much discussion and study, the designers settled on an identification scheme that included reference posts. The posts are in place on all state trunk network highways and are placed at state, county, and civil town boundaries; certain at-grade intersections; bridges; railroad crossings; as well as all highway termini. A maximum spacing of one mile is used.

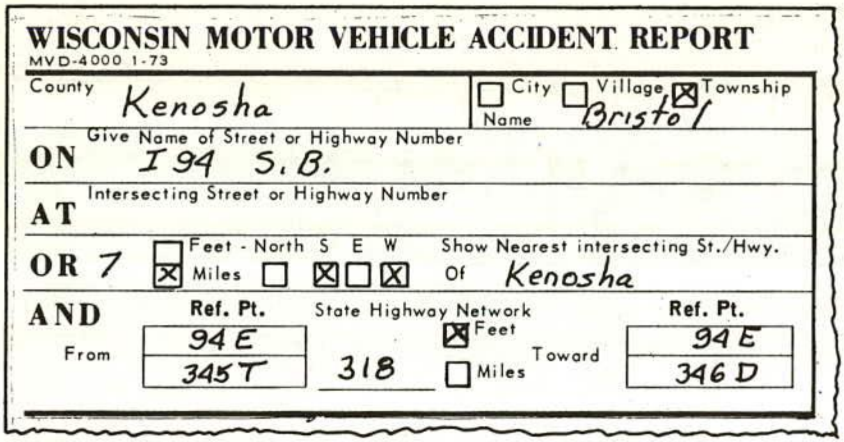
On a typical Wisconsin reference post (Fig. 9) the upper number on the sign is the highway identification, which includes highway number and cardinal direction, and may include a prefix for highway type in special cases. The lower number is the reference point number, which is in sequence in the cardinal direction of the highway. An alphabetic character is used for expansion of the reference post number.

Figure 9. Wisconsin reference post.

Reference posts are used to report almost all of the highway-oriented data on state trunk network highways. A typical data input form is shown in Appendix A. Figure 10 shows the location portion of an accident report form.

Maine developed a variation of the reference post method primarily for accident location purposes. After a study of methods used by other states, it was decided to develop a method patterned after the nodal network principles used in highway planning.

All major intersections on the state highway system are numbered and signed (two at each location), together with city/town lines, urban lines, railroad grade crossings, and major bridges (Fig. 11). "Dummy" sign locations are


WISCONSIN MOTOR VEHICLE ACCIDENT REPORT
MVD-4000 1-73

County Kenosha	☐ City ☐ Village ☒ Township	Name Bristol

ON — Give Name of Street or Highway Number: I 94 S.B.

AT — Intersecting Street or Highway Number:

OR 7 ☐ Feet - ☒ Miles — North ☐ S ☒ E ☐ W ☒ — Show Nearest intersecting St./Hwy. Of Kenosha

AND	Ref. Pt.	State Highway Network		Ref. Pt.
From	94 E / 345 T	318	☒ Feet ☐ Miles Toward	94 E / 346 D

Figure 10. Location identification on Wisconsin accident report.

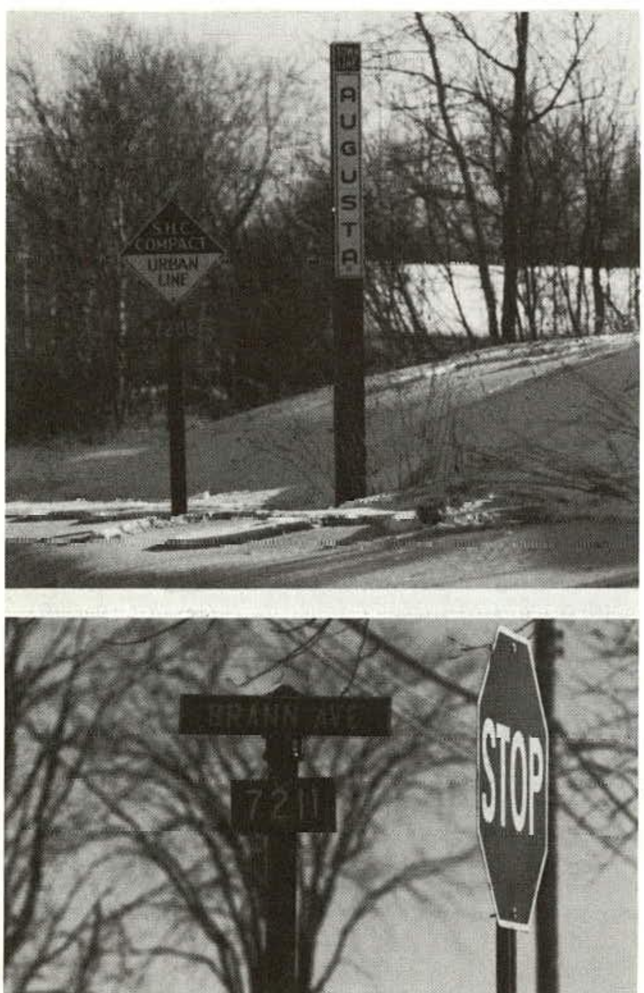


Figure 11. Maine node signs: upper, at town line; lower, at intersection.

established where spacing exceeds 2 miles (3.2 km) in rural areas and 1 mile (1.6 km) in urban areas. Each roadway of limited-access facilities is numbered as an individual roadway. Reference posts are placed at ramp terminals and at the intersections of directional roadways within major channelized intersections.

The reference posts are shown on maps—generally 2 miles to an inch (1:125,000)—that are made available to state and local police and highway commission districts. The four-digit numbers generally are in sequence from south to north and from west to east within a county, with the first digit indicating the highway system.

At present, the method is used only to locate accidents in the field, although efforts are being made to incorporate the identification scheme into the roadway characteristics file. Investigating officers are required to record the reference numbers from both of the reference posts between which an accident occurs and the distance to one of them. Figure 12 shows the location portion of an accident report.

Although it appears that an officer must drive out of his way to read the numbers, in practice this generally is not done; many officers keep a notebook containing reference post numbers in the order that they appear along the sections of highway.

The only significant problem identified is one typically associated with signs in northern states—the signs sometimes get buried in snow.

DOCUMENT-ORIENTED METHODS

The methods in the document-oriented category were developed primarily because highway agencies did not want to incur the costs of installing special signs in the field. The methods are characterized by the use of strip maps in lieu of physical signs. The document-oriented methods can be classified into two groups: (1) those using diagrams or logs that show physical features together with the true milepoints or reference numbers of those features, and (2) the method based on use of available street maps. The two groups are referred to hereafter as Document Method I and Document Method II, respectively.

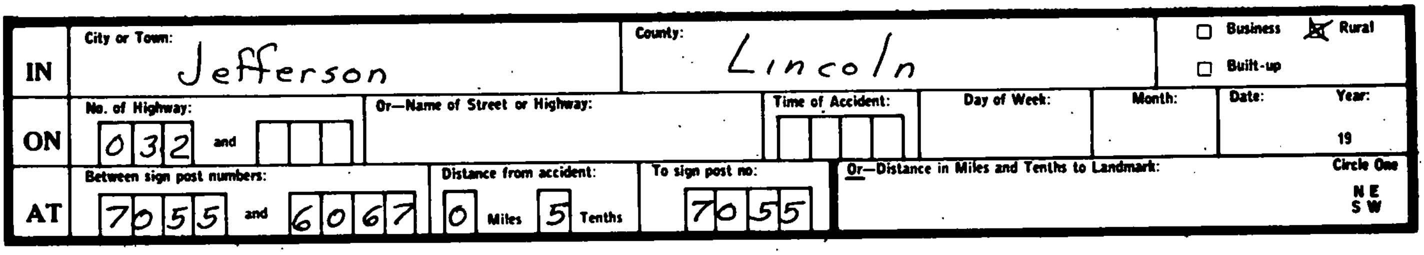

IN
City or Town: Jefferson
County: Lincoln
☐ Business ☒ Rural
☐ Built-up
ON
No. of Highway: 032 and
Or—Name of Street or Highway:
Time of Accident:
Day of Week:
Month:
Date:
Year: 19
AT
Between sign post numbers: 7055 and 6067
Distance from accident: 0 Miles 5 Tenths
To sign post no: 7055
Or—Distance in Miles and Tenths to Landmark:
Circle One N E S W

Figure 12. Location identification on Maine accident report.

Comparison of Document-Oriented Methods

Characteristics of Document Method I

- The true milepoint is assigned to each identifiable feature shown on a strip map or straight-line diagram.
- Printed logs list identifiable features, using the name by which the feature is known in the field. The true milepoint of each feature is printed following the name. The log generally is in order by route number.
- A variation of the foregoing two methods is use of a reference number in place of the true milepoint.
- The method can be employed either in the field or in the office.

Characteristics of Document Method II

- Names of intersecting streets as seen on maps are used as reference points. Names of streets shown on maps in conjunction with addresses recorded in the field may also be used to identify locations.
- The method is especially applicable in urban areas, but it is often applied on low-volume rural roads as well.
- The method can be employed either in the field or in the office.

Use of Document Method I

- Because this method does not employ special signs along the highway, the actual milepoint of a location is determined by: (1) identifying a topographic feature on a diagram or log that is nearest to the location in the field, and (2) measuring the distance and recording the direction from the location to the feature as identified on the diagram or log. The milepoint is then calculated by adding to or subtracting from the milepoint of the feature on the log the measured distance from the location. The calculation may be done either in the field or in the office.
- An alternative approach is to use reference numbers in lieu of milepoints for the features on the diagram or log. When reference numbers are used, the procedure followed is generally the same as that for the reference post method previously described under "Comparison of Sign-Oriented Methods."

Use of Document Method II

- The name of the street (or highway) on which the location of interest lies and the name of the intersecting street that is nearest to the location are recorded, as well as the distance from the location to the intersecting street. A milepoint number may be determined by office personnel, using maps or logs showing the true milepoint of the intersection. Where the milepoint of the location is not desired, the recorded information is retained in the submitted form.
- An alternate procedure uses street names and addresses. The name of the street on which the location of interest lies and the street address number closest to the location are recorded. Office personnel then determine the position of the location with respect to the beginning of the street or to a particular block.

Advantages of Document Methods I and II

- Special signs are not needed.

Disadvantages of Document Methods I and II

- When construction changes require revisions to diagram or log milepoints and street maps, steps must be taken to ensure that users of the method receive the revisions.
- The motoring public is excluded as a potential user of the method.
- There may be instances of misspelled names, street and road names that are similar or identical, roads and streets with no names or numbers, or roads with more than one name that require special consideration.

Document Method I

In essence, Document Method I consists of "paper signs." Identifiable roadway features such as intersections, bridges, and railroad crossings are shown on strip maps or listed in log form, together with associated milepoint or reference point numbers (in some cases, both). The method is considered document-oriented because the paper strip maps or logs must be prepared and updated in a headquarters office and because the paper must be used in the field in a manner analogous to an office procedure in order to make a location identification. The logs or strip maps also are used in the central office to determine location identification from rough narrative descriptions.

Examples of Document Method I Use

Alaska has mileposts in place on most of the state highway system, but they are historical mileposts and do not reflect the true mileage to the point of post placement. On some highways the mileposts were installed originally in a direc-

tion opposite to the way records are now kept. In other instances, mileposts were installed from opposite ends of the same route. As a result, the state considered it necessary to develop a new location reference method, particularly because it was decided not to reinstall the mileposts. The mileposts are useful, however, in remote parts of the state, where they are used as mailing addresses. They also play a significant part in the state's location referencing procedures, although the actual location reference identification is a number taken from a reference point log.

The reference point log was developed for use in the Department of Public Safety to identify accident locations on the state highway system. A page of that log is shown in Figure 13. Existing mileposts (which have no relation to current route mileages) are used as a base, with identifiable landmarks shown as a displacement from the signs. In general, the mileposts mark the termini of sections, which are assigned location control numbers called reference numbers. The reference number and displacement value are permanently assigned. Highway patrolmen, in locating an accident, record the reference number, the reference point number from the log, a measurement from the reference point, and the direction of measurement. An example of how these elements are recorded is shown in

R02-16F-5000-72006 DEPARTMENT OF HIGHWAYS ROAD LOG PAGE 12- 6

DEPARTMENT OF PUBLIC SAFETY 01/01/72

PUBLIC SAFETY REGION 2

REPORTING DISTRICT 12

STERLING HIGHWAY 1110000)

HOMER-SEWARD/GLENNALLEN HIGHWAY

LOCATION REFERENCE CONTROL	POINT	REFERENCE POINT DESCRIPTION	SIDE OF ROAD	LOG POINT
00210240				
	.27	DWELLING	LEFT	29.89
	.27	SMALL MILITARY INSTALLATION	RIGHT	29.89
	.27	VACANT DWELLING	RIGHT	29.89
	.44	DWELLING	LEFT	30.06
	.80	DWELLING	LEFT	30.42
	.89	POWER PLANT	LEFT	30.51
00210250				
	.00	MILEPOST 148	LEFT	30.54
	.02	VACANT DWELLING	RIGHT	30.56
	.06	DWELLING	RIGHT	30.60
	.12	DWELLING, SEASONAL	LEFT	30.66
	.18	DWELLING	LEFT	30.72
	.29	ROAD	RIGHT	30.83
	.75	DWELLING	LEFT	31.29
	.75	DWELLING	RIGHT	31.29
	.76	DWELLING	RIGHT	31.30
	.96	DWELLING	LEFT	31.50
00210260				
	.00	MILEPOST 147	LEFT	31.53
	.03	ROAD NOT OPEN FOR PUBLIC USE	LEFT	31.56
	.25	VACANT DWELLING	LEFT	31.78
	.93	VACANT DWELLING	LEFT	32.46
00210270				
	.00	MILEPOST 146	LEFT	32.57
	.35	DWELLING	LEFT	32.92
	.65	FAIRGROUND	RIGHT	33.22
	.75	SMALL BUSINESS	LEFT	33.32
	.78	SMALL BUSINESS	LEFT	33.35
	.78	DWELLING	LEFT	33.35
	.81	DWELLING	LEFT	33.38
00210280				
	.00	MILEPOST 145	LEFT	33.44
	.00	DWELLING	LEFT	33.44
	.49	ROAD NOT OPEN FOR PUBLIC USE	LEFT	33.93
00210290				
	.00	MILEPOST 144	LEFT	34.31
	.73	VACANT DWELLING	LEFT	35.04
00210300				
	.00	MILEPOST 143	LEFT	35.18
	.28	ROAD NOT OPEN FOR PUBLIC USE	RIGHT	35.46
	.38	DWELLING	RIGHT	35.56
	.46	POWER PLANT	LEFT	35.64
	.65	ROAD NOT OPEN FOR PUBLIC USE	LEFT	35.83

Figure 13. Alaska reference point log.

Figure 14. Although a route number is shown on the log, it is not the major identification key, and officers may, in fact, record a locally known highway name rather than a number.

A similar method is used by maintenance forces. A road log similar to the one used by Public Safety has been developed for their use. Figure 15 shows a page from that log. The reference point number on the maintenance log is a whole-mile value and is based on the accumulated route mileage to a particular reference point. The reference point for which this whole-mile number is assigned, however, is that for which the route milepoint is just over a half-mile fraction. Thus, the log appears to show reference point numbers as being one mile apart when, in fact, they are not one mile apart. The maintenance forces record their work location using the nearest of the reference points shown on the log.

Oregon provides a strip map (Fig. 16) for use by highway patrol and highway department field personnel, although there also are mileposts for use as a location reference method. Intersections and other features are shown, together with the respective milepoint of each feature. Strip maps are located in each highway patrol field office. Patrolmen normally record a location in terms of distance from some landmark, such as an intersection, while at the scene of an accident. If such a landmark is not available, the officer will reference to a milepost. When he returns to the field office, he uses the strip map to obtain the current milepoint for the referenced landmark and computes the actual milepoint for the accident location. This milepoint is recorded on the accident report (see Fig. 6).

Document Method II

Document Method II is the most widely used in the United States today. A large number of states, cities, and counties use this method for locating accidents. It is employed widely for accident location on low-volume roads and local city streets—even those streets or highways that may be on a class of roads that incorporates another of the reference methods.

Application of intersection referencing on low-volume rural roads is generally on an "informal" basis. The method is applied loosely in many states and does not result in consistently accurate location identifications. Available information indicates that accident location is the most common use of this method on low-volume rural roads.

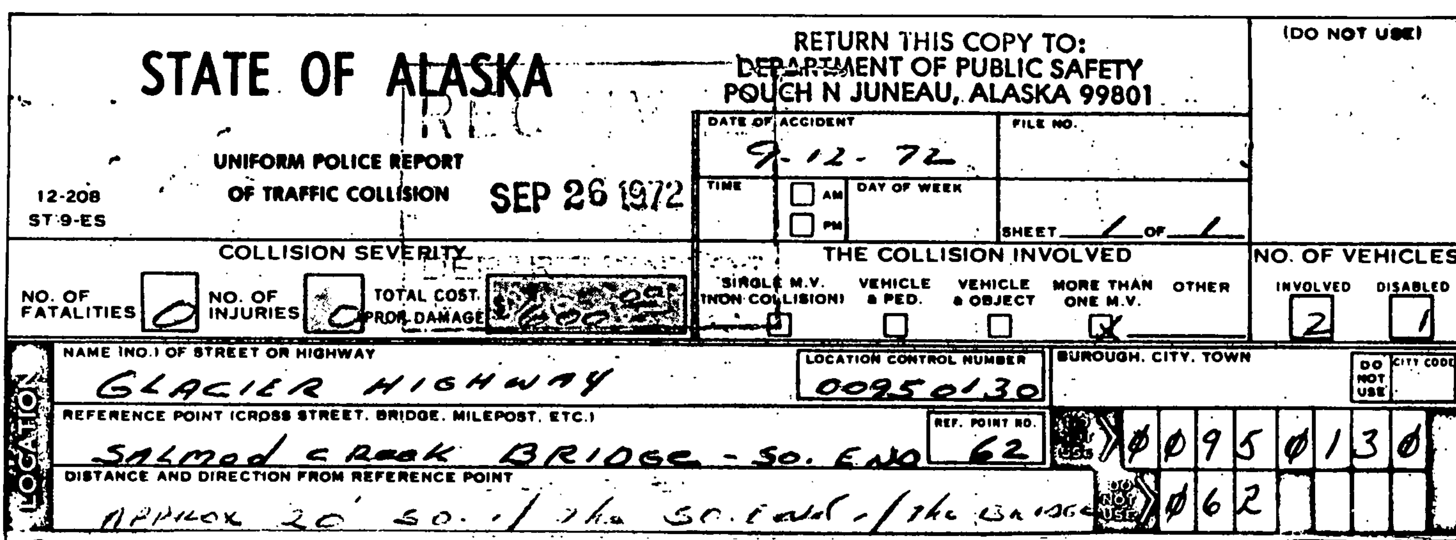
Some states omit reference signing in cities because it is more accurate for city police to locate accidents from the nearest intersection (Fig. 17) than to travel several blocks to a reference sign. If milepoints have been established for the intersections, the locations referenced to intersections can be easily converted in the office to milepoints.

Intersection referencing as practiced in most cities is an "informal" application of the method; however, in some cities, intersection referencing has developed into a highly sophisticated application. Los Angeles is one of these cities, using the intersection reference method as a base for its Traffic Accident Information System.

Examples of Document Method II Use

In *Los Angeles* a unique five-digit code is assigned to each city street. Thus, any intersection (approximately 40,000) can be defined by a combination of two street codes. Figure 18 shows the location portion of the Los Angeles Police Department traffic accident report for property damage and slight injury accidents. Non-intersection accidents are located by recording (1) the name of the street on which the accident occurred (primary street) and a perpendicular distance from the curb to the accident scene, and (2) the name of the nearest intersecting street (secondary street) and the distance from the nearest intersecting curb to the accident scene.

The location identification is subsequently coded in the office, where the five-digit street codes are added, as well as other special codes regarding the accident itself. It


STATE OF ALASKA

UNIFORM POLICE REPORT OF TRAFFIC COLLISION

12-208
ST 9-ES

SEP 26 1972

RETURN THIS COPY TO: DEPARTMENT OF PUBLIC SAFETY POUCH N JUNEAU, ALASKA 99801

(DO NOT USE)

DATE OF ACCIDENT: 9-12-72 | FILE NO.

TIME: AM / PM | DAY OF WEEK | SHEET 1 OF 1

COLLISION SEVERITY: NO. OF FATALITIES 0 | NO. OF INJURIES 0 | TOTAL COST PROP. DAMAGE

THE COLLISION INVOLVED: SINGLE M.V. (NON COLLISION) | VEHICLE & PED. | VEHICLE & OBJECT | MORE THAN ONE M.V. X | OTHER

NO. OF VEHICLES: INVOLVED 2 | DISABLED 1

LOCATION

NAME (NO.) OF STREET OR HIGHWAY: GLACIER HIGHWAY | LOCATION CONTROL NUMBER: 0095 0130 | BOROUGH, CITY, TOWN | DO NOT USE | CITY CODE

REFERENCE POINT (CROSS STREET, BRIDGE, MILEPOST, ETC.): SALMON CREEK BRIDGE - SO. END | REF. POINT NO. 62 | USE: Ø Ø 9 5 Ø 1 3 Ø

DISTANCE AND DIRECTION FROM REFERENCE POINT: APPROX 20' SO. of the SO. end of the BRIDGE | DO NOT USE: Ø 6 2

Figure 14. Location identification on Alaska accident report.

RO2-16F-RPGL-71171	DEPARTMENT OF HIGHWAYS ROAD LOG		04/28/71	PAGE 3
	DISTRICT -			
	JUNEAU MAINTENANCE STATION - 11			
	STATE ROUTE 100095 KTN/WRG/PSB/JNU/HNS			
	DIXON ENTRANCE-CANADIAN BORDER		491.22 MILES	

ROUTE MILEAGE	REFERENCE POINT	BRIDGE REFERENCE	FEATURE	SIDE OF ROAD
367.10	367		CURVE	LEFT
367.10			SMALL BUSINESS	RIGHT
367.18			JUNKYARD - GARBAGE	RIGHT
367.25			ROAD	LEFT
367.29			CURVE	RIGHT
367.29			SMALL BUSINESS	RIGHT
367.32			DWELLING, STORE	LEFT
367.32			SMALL BUSINESS	RIGHT
367.34			SMALL BUSINESS	RIGHT
367.39			OUTSIDE STORAGE AREA	RIGHT
367.39			ROAD	LEFT
367.43			SMALL BUSINESS	RIGHT
367.44			SMALL BUSINESS	RIGHT
367.46			JUNKYARD - AUTO	RIGHT
367.51	368		SMALL BUSINESS	RIGHT
367.57			OUTSIDE STORAGE AREA	RIGHT
367.59			BRIDGE (UNDER 104 FT) MIDPOINT	
		900792	NO. 792 OVER LEMON CR SLOUGH NO 2	
367.59			BRIDGE (OVER 104 FT) ENDING	
367.59			BRIDGE (OVER 104 FT) BEGINNING	
367.61			TRAIL	LEFT
367.66			CHURCH	LEFT
367.72			BRIDGE (UNDER 104 FT) MIDPOINT	
		900790	NO. 790 OVER LEMON CR SLOUGH NO 1	
367.72			LODGE	LEFT
367.72			BRIDGE (OVER 104 FT) BEGINNING	
367.72			BRIDGE (OVER 104 FT) ENDING	
367.80			DWELLING, STORE	LEFT
367.86			MILEPOST 5	LEFT
367.87			SCHOOL	LEFT
367.90			STATE BUILDING	RIGHT
368.05			ROAD NOT OPEN FOR PUBLIC USE	RIGHT
368.10			CURVE	LEFT
368.14			CHURCH	RIGHT
368.67	369		CURVE	LEFT
368.88			MILEPOST 4	LEFT
368.92			TURN OUT	RIGHT
369.28			TENANT HOUSE	LEFT
369.28			SMALL BUSINESS	LEFT
369.37			CURVE	RIGHT
369.45			TRAILER COURT	LEFT
369.48			BRIDGE (OVER 104 FT) BEGINNING	
		901188	NO.1188 OVER SALMON CR	
369.48			BRIDGE (OVER 104 FT) BEGINNING	
369.50	370		BRIDGE (OVER 104 FT) ENDING	
369.50			BRIDGE (OVER 104 FT) ENDING	

Figure 15. Alaska maintenance reference point log.

should be noted that, with the exception of the location identification, most of the data elements relative to the accident are coded in the field. Office coding is done because the complex nature of accident location identification on a large city street network would require excessive expenditure of time in the field by the investigating officer.

Determination of location identifications is facilitated by the existence of two files. The first is an intersection file that contains such data elements as x,y coordinates, traffic controls, roadway characteristics, and maintenance areas. There are also "pointers" that identify the next intersection in each direction, thus facilitating computerized route searches. The second file, a street network file, contains records delineating street segments on all functionally classified streets, together with data on traffic volumes, segment classification, traffic controls, and roadway characteristics.

In *North Carolina*, the intersection reference method is used with a somewhat higher degree of formality. This state is one of few in which the Department of Transportation has responsibility for all highways and streets except some municipal streets. The Department has assigned numbers to the highways under its jurisdiction and has placed these numbers at all intersections. Thus, practically

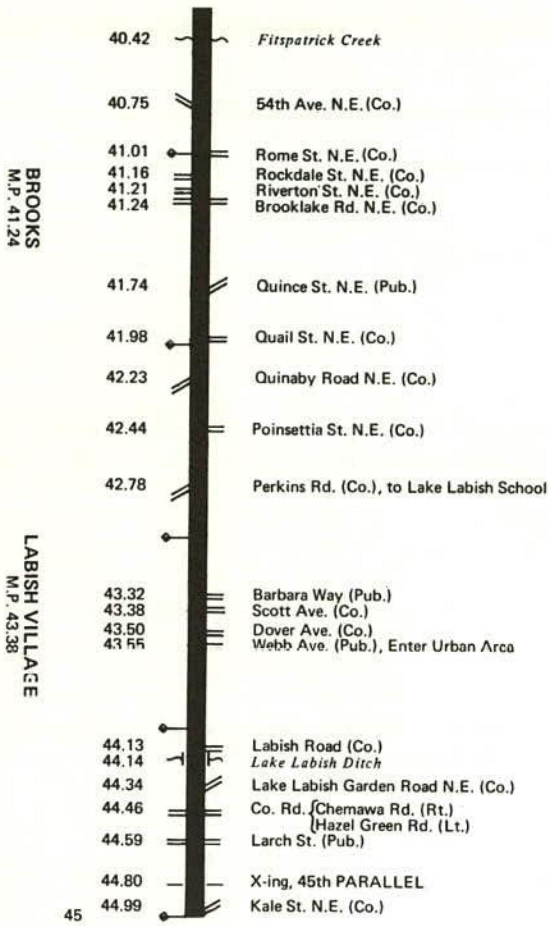


Figure 16. Segment of Oregon strip map.

Figure 17. Street signs at intersection.

all intersections and highways have unique "names," even though the original purpose for installing numbers was not to serve as location reference markers. The names of the municipal streets not under state jurisdiction are also used for location referencing.

To identify the location of an accident, an investigating officer records the number of the highway on which the accident occurred, the distance to an intersection, the number of the crossroad, and the direction from the intersection. A milepoint is computed in a headquarters office by use of an intersection location file. This file contains milepoint locations for intersections, bridges, and railroad crossings. Bridges and railroad crossings also have unique numbers and are signed.

A further illustration of the difficulty in classifying the various methods is that the location reference method used in North Carolina conceivably could be considered as being similar to the sign-oriented methods used in Maine and Wisconsin. The deciding factor for classification purposes is that North Carolina uses signs already existing at intersections and maintains an intersection log with milepoints.

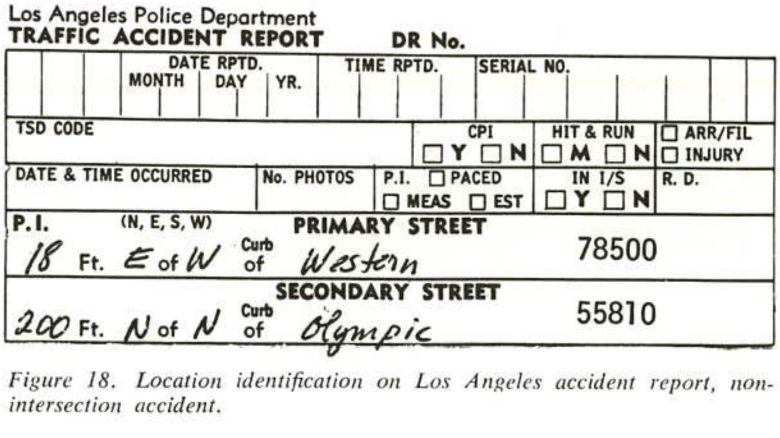

Los Angeles Police Department
TRAFFIC ACCIDENT REPORT DR No.
DATE RPTD. MONTH DAY YR. | TIME RPTD. | SERIAL NO.
TSD CODE | CPI ☐ Y ☐ N | HIT & RUN ☐ M ☐ N | ☐ ARR/FIL ☐ INJURY
DATE & TIME OCCURRED | No. PHOTOS | P.I. ☐ PACED ☐ MEAS ☐ EST | IN I/S ☐ Y ☐ N | R. D.
P.I. (N, E, S, W) PRIMARY STREET
18 Ft. E of W Curb of Western 78500
SECONDARY STREET
200 Ft. N of N Curb of Olympic 55810

Figure 18. Location identification on Los Angeles accident report, non-intersection accident.

OTHER METHODS

There are other variations of location reference methods which are not included in any of the foregoing categories because they are experimental or in limited use. The most significant of these methods is the use of coordinates. Coordinates provide a unique identification for any given point, but determination of coordinates by manual means is, even in an office, a time-consuming procedure with a higher potential for error than any of the other methods. A major advantage of the coordinate method is that a point on a highway identified by coordinates is permanently located in a two-dimensional plane space. Thus, the point identification is not affected by changes that occur in the length of the highway. For historical purposes, then, the identification is permanent.

The most concerted attempt to employ coordinates to date was competently discussed in detail in *NCHRP Report 79* (*5*). The following are excerpts from that report:

> . . . Simply stated, the concept calls for location of an accident site to be identified by its unique set of plane coordinates. The system depends on a complete set of maps with coordinate grids imprinted. In Indiana, where the concept is under development, the U.S.G.S. topographical maps have been used as a base. Extensive work was involved in preparing the grid overlays (state plane), as well as the addition of informative data. The new 7½-min series (1 in. = 2,000 ft) has been used.
>
> There are several approaches to the use of this concept. The first approach involves the printing of a large number of maps and their distribution to all police officers in the state. The police officer then determines the coordinates of the accident site while he is investigating the accident and reports these coordinates directly. An alternate approach, of course, would be to code the coordinate locations in the office using the route location data which are now on the accident report form.
>
> . . .
>
> . . . The coordinate concept has several severe problems which will limit its general usefulness. The quantity of data required under the system to uniquely identify a location is considerably more than in other systems. Fourteen digits are required to express the coordinate location, plus an additional two or three for the route number. Obviously, the more voluminous the information, the greater data processing costs. In addition, the lengthy identification numbers are more susceptible to recording and reporting errors and the errors are more difficult to detect. At the same time, the accuracy requirements are inherently greater with this process, as allowances for small errors can result in the accident being located in an entirely different facility.
>
> The availability and/or production of maps is a further problem. The U.S.G.S. maps are available in most states at the scale of 1 in. = 4,000 ft, and at this scale [40 ft is represented by 0.01 in.]. In some parts of the country U.S.G.S. maps are now available in the new 7½-min series (1 in. = 2,000 ft), but even at this scale [40 ft is represented by 0.02 in.], assuming that base maps are available, the cost of modification can run in the order of $30 per mile, and this does not consider the additional work which would have to be done to make the maps useful in urban areas.
>
> Re-mapping of the United States at the 7½-min (2,000-ft) scale has proceeded slowly, mainly because 90 percent of the Geological Survey's mapping budget still is spent on covering unmapped areas of the country. A very large percentage of the existing maps are outdated by the U.S.G.S.'s own standard (5 years urban, 10 years rural). At present it takes a full three years from the beginning of aerial photography to issuance of the final product by the U.S.G.S. For these reasons it is clear that the availability of appropriate maps would be a severe restraint on the widespread use of the coordinate system.
>
> Distributing maps to the police for their use in directly reporting coordinates would appear to be a risky procedure based on current knowledge and experience. Field procedures should be kept as simple as possible, due to the wide range of data collection competencies. At this time, it is not clear that the typical accident investigator can accurately locate his position on a map and read coordinates to the necessary requirement. The problem of map reading in adverse conditions (such as darkness, rain, snow, and in relatively rural areas with few landmarks) should be apparent.

It should be noted that the coordinate method described is not being used at present for location identification, but is included here because of the interest that has been shown in the method.

A few western states have either considered or are using their existing grid-oriented network of local roads as a basis for a coordinate scheme. These roads usually follow section lines and, as a result, divide the states into squares. By taking a zero point at the most southwestern road location in a county, it is possible to identify a location in terms of number of miles east and north of the zero point. This does not give the unique identification that a set of coordinates taken from a U.S.G.S. map would, but it is easier to obtain.

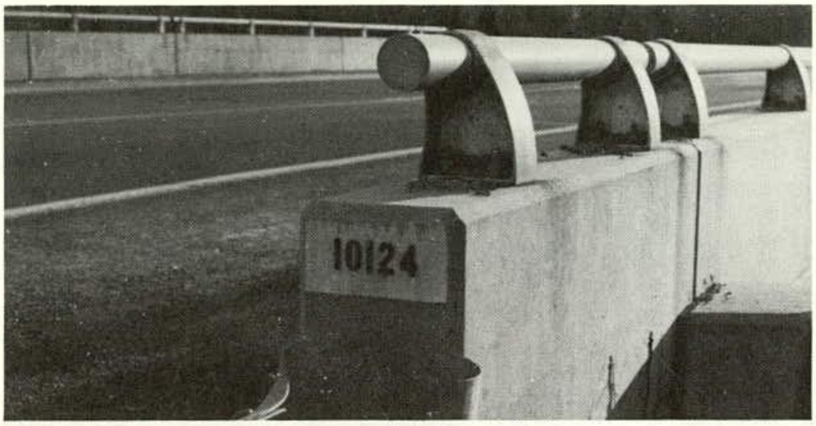
A number of common roadside objects are, at times, particularly in rural areas, used for location referencing (Fig. 19). These objects are usually numerous enough that they can become a network of nodes or points to which incidents such as motor vehicle accidents can be referenced.

Among such commonly found objects are bridges that have unique numbers posted on prominent parts of their abutments, piers, or parapets. Another roadside object is the utility pole, which usually also has a unique identification number affixed to it. Although these numbers are normally intended as identification for maintenance purposes, they can be used as reference points, especially when the numbering scheme is unique in a state.

Railroad grade crossings, which have always been readily identifiable landmarks in the same sense that bridges are landmarks, are now being assigned unique numbers as part of a national effort to develop an inventory of all public and private railroad crossings. These numbers will provide another series of unique nodes that can be used for referencing purposes.

In rural areas it is not uncommon for law enforcement personnel to reference an accident to an address on a roadside mailbox. Rural mailboxes with addresses, as well as bridges, utility poles, and railroad grade crossings, can be used as effectively as reference posts provided some measure of the mileages that the mailboxes are from a beginning point is part of the central file.

Thus, any or all of these common roadway features can become a network of reference points for location purposes and can be used in lieu of installing reference posts or for expansion of existing location referencing to lower highway classifications.



Bridge

Utility Pole

Railroad Crossing

Rural Mailbox

Figure 19. Roadside objects with unique numbers.

CHAPTER THREE

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

To the casual user of a highway location reference method, there appear to be many widely different methods in use today. There is a tendency to "see" significant differences between methods on the basis of different names. To make matters more confusing, terms such as "straight-line diagram," "route log," "coordinates," "milepoint," and even "milepost" and "reference post," are used rather loosely in connection with location reference methods. The initiate confronted with this situation must somehow determine the "best" method for his particular agency.

The preceding discussion has attempted to show that there really is not a great deal of fundamental difference between the several most commonly used methods. The method that incorporates the use of both milepost signs and strip maps is virtually the same as the method that is based on the use of reference posts and the same strip maps. Further, a nodal sign at an intersection or, for that matter, any sign at all, really is a landmark like any other, such as a bridge or even an intersection itself.

Regardless of the name assigned to the method, all use a distance measurement from an "incident" to a known point, the direction of measurement, and a description of the known point. The characteristics are the same whether the calculation for true milepoint is done in the field, accomplished manually in the office from a straight-line diagram, or performed by the computer.

Initially, in the preparation of this report it was intended that information regarding the economics of highway location reference methods would be included. However, visits to the various states, together with the other sources of information used, revealed that the costs associated with reference methods and reference systems were not readily available. Further, the scant information that was obtained proved to be pertinent only to a particular highway agency's own procedures and was not applicable to procedures used in other agencies.

The variables affecting costs are many, particularly with regard to the efficiency with which computers are used in the location reference systems. A location reference system may function economically in one agency and not in another because of differences in the degree of integration of the various factors (e.g., field procedures, office procedures, knowledge and experience of those responsible, and the location information need of all users) that play a role in the effective implementation of a location reference system. The success of a particular state's system does not seem to be overly dependent on how economic it is, but rather on how well that particular agency implements reference procedures that are responsive to all of the users in the highway agency.

Currently, there is much interest in research to determine which of the more commonly used highway location reference methods is "best." Sometimes the research purpose is to provide simple, clean answers to questions such as what is "best for locating accidents" or "best for use by police personnel." It has been one of the objectives of this report to dispel the confusion and misconceptions that have surrounded the subject of highway location reference methods. The degree to which this objective has been accomplished will be measured by how well the readers of this document come to understand that there are not a number of totally different location methods, but only variations of that basic set of procedures by which any location is physically referenced in the field.

The research effort, then, should not be directed toward finding the "best" method, but rather toward those particular aspects of location referencing that have heretofore not received much attention. Included in this chapter is a discussion of some of those aspects that may be subject to study or that should be considered in the selection and implementation of a location reference system.

PROBLEMS AND RECOMMENDATIONS

Several problem areas associated with physical markers are not specifically addressed in this report. One concerns sign placement on two-lane highways and the question of whether to install signs (either mileposts or reference posts) on alternating sides of a highway at a particular spacing, along one side at the same spacing, or along both sides of the highway. The alternating procedure has been used successfully by several states, thus resulting in fewer signs being used.

Alternating sign placement on divided highways is of questionable value, although a few states have done this. Where the median is narrow and the signs are large enough to be read without crossing the opposing roadway, it can be a workable procedure. It must be remembered, however, that the signs along an opposing roadway are facing in the wrong direction for travel on the other roadway. When the signs are small or there is a wide median, they should be placed at the desired spacing along both roadways, thus eliminating the inconvenience and danger of crossing to the opposing roadway.

Milepost numbers ascending either in the cardinal highway direction for both roadways or in the direction of travel for each roadway is another problem area regarding milepost placement on divided highways. The problem is more pronounced in the case of individual roadway alignment. Although most agencies use the former procedure, the latter approach has generated some interest. At this time there is not enough evidence to show the advantages of one over the other.

Another problem can occur when reference post signs

include a route number. There are many instances where two or more routes are concurrent and the question arises as to which route number is to be used on the overlap. Because record keeping in the states has generally become more sophisticated over the years, the records of most agencies are fully capable of cross-referencing between concurrent routes; therefore, it is recommended that reference post signs that do include a route number contain the number of the highest level system on the concurrency (e.g., a US numbered route over a state numbered route).

Two areas require emphasis in order for there to be an effective location reference method that not only is simple and convenient to use, but also will, in fact, be used. First, there is the need for a systematic approach to the design and implementation of a location reference method. Often, reference signs have been installed without regard to who the users are or the techniques that would have to be employed to make use of the signs. It can be said that a number of location reference methods have evolved rather than been developed.

A number of examples can be given to illustrate how a systems approach could result in greater correlation between the various motorists aid, safety, and records systems. One example is to correlate the placement of roadside call boxes (Fig. 20) with the spacing of reference post or milepost signs. Numbers subsequently assigned to the call boxes would be in sequence or, at least, in keeping with the same numbering scheme being used to reference other locations along the highway. Another possibility would be to include in construction projects the installation of permanent markers that are coordinated with other roadside markers, thus forming the nucleus of a statewide market system.

The second area of emphasis concerns an educational effort to acquaint potential users of location reference methods with the theory and operational aspects of the methods. Potential users include employees of user agencies as well as the motoring public. This effort alone should increase the effectiveness of location reference methods.

Table 1 gives the number of states where some agency in a state (e.g., state highway department, county highway agency, or city engineering department) actually uses one or more of the listed methods in a manner similar to the procedures discussed in Chapter Two. It is not possible to list the methods on a state-by-state basis because of the difficulty in ascribing the same name to methods used by the various states. Although the methods appear to be similar and may in fact be the same, different states call them by different names. Listing the methods in this manner could be confusing. The methods are grouped according to the activity area in which they are used. It is obvious that the methods are not widely used outside of accident location and maintenance functions.

Value to Public

There is a strong feeling among the states that the driving public is an important user of highway location referencing. Charting progress and orientation are most often mentioned as the driver's principal uses.

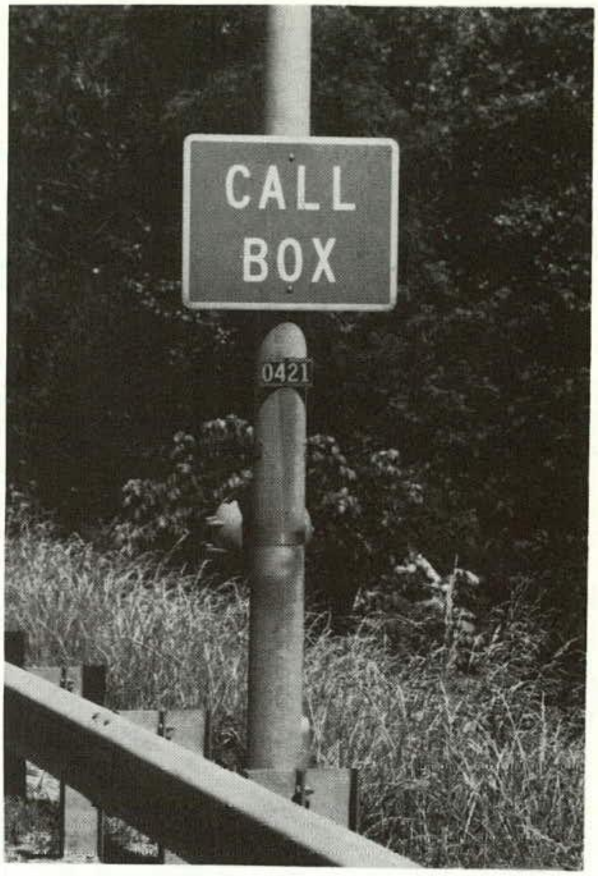


Figure 20. Call box with identification number.

Experience in Arizona indicates that persons familiar with the mileposts do occasionally use them to report incidents or accidents, a decided advantage to law enforcement personnel in dispatching the nearest available officers and other needed emergency equipment.

In Wisconsin, it is held that the public is not served by reference signing such as mileposts:

> For any particular mile marker the beginning or ending terminus is not indicated on the sign and the shifting in a concurrency (overlapping routes) is only confusing. The traveling public is interested in the total length of his trip or how far it is to his destination at various times during the trip. Since each trip normally traverses segments of numerous routes, the milepoint marker is of less value than trying to sum the segmental mileages printed on a map. A long duration use of the milepoint method eventually will require the use of equations or re-milepointing the remainder of the route due to construction relocations. The chances of re-milepointing a route (with appropriate field markers) is about as good as having the highway user compute the equations as he travels. (Response to a question in FHWA survey of location reference methods).

There is little doubt that milepost signing is of some value to the driving public, but just how important it really is has not been determined.

TABLE 1

NUMBER OF STATES IN WHICH LOCATION REFERENCE METHODS ARE USED BY AREA OF USE[a]

METHOD	ACCIDENT LOCATION	TRAFFIC CONTROL DEVICE INVENTORIES	MAINTENANCE ACTIVITIES	UTILITY PERMITS	OUTDOOR SIGN LOCATION	ROW DOCUMENTS
On state highway systems:[b]						
Sign-oriented:						
Reference post	7	1	3	0	0	0
Milepost	26	2	14	4	1	1
Document-oriented:						
I (maps, logs)	15	1	8	1	0	0
II (intersections)	6	0	0	0	0	0
On other roads and streets:						
Sign-oriented:						
Reference post	1					
Milepost	1					
Document-oriented:						
I (maps, logs)	5					
II (intersections)	12					
Other:						
Coordinates	3					

[a] Includes only those states where the method actually is used for location identification. Based on responses to a survey of location methods conducted by the Federal Highway Administration in December 1971.
[b] Some states use more than one method.

Low-Volume Roads

Few states apply a location method other than the "landmark" or "intersection reference" method to low-volume rural roads. In almost all of the states doubt is expressed as to whether there is anything to gain from the installation of some type of reference signing on these roads. Two states that are planning to install reference signing on low-volume rural roads are Colorado and Florida.

A review of low-volume roads in five states that have readily available accident data revealed that 71 percent of the state-maintained mileage represented roads with an ADT of 750 or less, yet these roads contributed only 7 percent of all accidents in the five states. Oglesby and Altenhofen reported in *NCHRP Report 63* (*6*):

> When the annual toll in lives, injuries, and damage to property from motor-vehicle accidents in the United States is totaled, the resulting losses seem staggering. Yet when these are spread over almost 4,000,000 miles of roads and streets and 24 hours a day for 365 days, the probability of an accident occurring in a given mile of road within a given hour becomes extremely remote. And this probability becomes even smaller on the low-volume rural roads that are the concern of this study.

For urban extensions of state highways in Oregon, Head (*7*) reported:

> Accident rates on low-volume roads do not have a strong relationship with any roadway feature (referring to pavement width or effective lane width).

It may be reasonable to conclude, therefore, that installation and maintenance of reference signing on low-volume roads is of questionable value.

Most states do not gather or retain comprehensive data regarding low-volume roads. Even the basic data that are a part of the states' records for such roads are not often identified within specific locations. Rather, the lengths of segments having uniform characteristics are determined and retained, which is generally sufficient to meet the current reporting requirements of Federal agencies and those of many states. Thus, precise location identifications of roadway features on low-volume roads have not been necessary. Further research is required to determine, in more detail, the categories of highways on which reference signing is warranted.

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2. Borth, C., *Mankind On The Move.* Automotive Safety Foundation, Washington, D.C. (1969) 314 pp.
3. Wilkinson, T. W., *From Track To By-Pass.* Methuen and Co., London (1934) 240 pp.
4. "A Summarized Review of Mileposting on State Maintained Highways in the United States." Insurance Inst. for Highway Safety (1967) p. 16.
5. Garrett, J. W., and Tharp, K. J., "Development of Improved Methods for Reduction of Traffic Accidents." *NCHRP Report 79* (1969) p. 101.
6. Oglesby, C. H., and Altenhofen, M. J., "Economics of Design Standards for Low-Volume Rural Roads." *NCHRP Report 63* (1969) p. 78.
7. Head, J. A., "Predicting Traffic Accidents from Roadway Elements on Urban Extensions of State Highways." *HRB Bull. 208* (1959) pp. 45-63.

APPENDIX A

EXAMPLES OF USE OF LOCATION REFERENCING ON OFFICIAL DOCUMENTS

BRIDGE / FILE MAINTENANCE (Office Data)

P-P-660A-72

File No.	Preprocessor Key						
	Tran.	Maintenance Date			Co.	Type	Struc. No.
		Yr.	Mo.	Day			
1 2	3	4 5	6 7	8 9	10 11	12	13 14 15
0 8							

Card No.	[redacted]				[redacted]		+ or —	Dist. Miles	Dist.	Co. 2	Current Town Village City	Principal Route	On/Un	Features Intersected
	Co.	Type	Number	Pr.	Number	Let.								
16 17	18 19	20	21 22 23	24	25 26 27	28	29	30 31 32	33	34 35	36 37 38	39 40 41 42 43 44 45 46 47	48	49 50 51 52 53 54 55 56 57 58 59 60 6
0 1														

Card	Needs Study Section No.	Defense				Latitude	Longitude	Vuln.	By-Pass	Toll	Cust.	Owner	FA Sys.	Juris
		Section No.	Bridge Letter	Mile Point	Section Length									
16 17	18 19 20 21 22 23 24 25 26	27 28 29 30	31 32 33 34	35 36 37	38 39 40	41 42 43 44 45	46 47 48 49 50 51	52	53 54	55	56	57 58	59 60	6
0 2														

Card No.	[redacted]				[redacted]		+ or —	Dist. Miles	Other Route	On/Un	Features Intersected
	Co.	Type	Number	Pr.	Number	Let.					
16 17	18 19	20	21 22 23	24	25 26 27	28	29	30 31 32	33 34 35 36 37 38 39 40 41	42	43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 6
0 3											

WASHINGTON
STATE HIGHWAY COMMISSION
DEPARTMENT OF HIGHWAYS

FRANCHISE

DISTRICT NO. 5 FRANCHISE NO.

The application of

for a franchise to construct, operate and maintain a buried telephone cable

on a portion of State Route No. 220, *in* Yakima

County, Washington, having come regularly on for hearing on the 20 TH *day of* NOVEMBER,

19 72, *before the Washington State Highway Commission, hereinafter referred to as the "Commission", under the provisions of Chapter 47.44 RCW as amended, and it appearing that notice of said hearing as required by law has been duly given, and that it is for the public interest to grant said application, it is*

ORDERED that a franchise be granted to

, hereinafter referred to as the "Holder", to construct, operate and maintain A BURIED TELEPHONE CABLE

on the following described portion of State Route No. 220, *in* Yakima *County, Washington, for a period of twenty-five (25) years from the date of entry of this order, subject to the terms and conditions stated upon the reverse side hereof and special provisions attached hereto:*

Description as attached on sheet 1, and by this reference made a part of this franchise.

Special provisions as attached on sheet 1A.

No work shall be done under this franchise until the party or parties to whom it is granted shall have communicated with and received instructions from Utilities Engineer

P. O. Box 52, Yakima, Washington 98907

Dated at Olympia, Washington, this ***day of*** , 19

APPROVED AS TO FORM:

William E. Howard
Assistant Attorney General

WASHINGTON STATE HIGHWAY COMMISSION

By
Chairman

Beginning at a point with a buried telephone cable on the north side of SR 220, Toppenish West (Hospital Road to Ashue Road) at approximate M.P. 0.91 located in the SE $\frac{1}{4}$ SE $\frac{1}{4}$ of Section 5, Township 10 North, Range 20 East, W.M., thence crossing said highway to the south side and extending in a westerly direction along the south right of way line to a point opposite approximate M.P. 2.09, thence crossing said highway to the north side and extending in a westerly direction along the north right of way line to a point opposite approximate M.P. 2.64, thence crossing said highway to the south side and extending in a westerly direction along the south right of way line to a point opposite approximate M.P. 7.32 located in the NE $\frac{1}{4}$ NW $\frac{1}{4}$ of Section 8, Township 10 North, Range 19 East, W.M. in Yakima County, Washington.

Also including buried telephone cable crossings of the highway in conduit listed as follows:

Buried telephone cable crossing at approximate M.P. 1.57 located in the SW $\frac{1}{4}$ SW $\frac{1}{4}$ of Section 5 and in the NW $\frac{1}{4}$ NW $\frac{1}{4}$ of Section 8, T. 10 N., R. 20 E. W.M.

Buried telephone cable crossing at approximate M.P. 2.44 located in the SW $\frac{1}{4}$ SW $\frac{1}{4}$ of Section 6 and in the NW $\frac{1}{4}$ NW $\frac{1}{4}$ of Section 7, T. 10 N., R. 20 E.W.M.

Buried telephone cable crossing at approximate M.P. 3.66 located in the SW $\frac{1}{4}$ SW $\frac{1}{4}$ of Section 1 and in the NW $\frac{1}{4}$ NW $\frac{1}{4}$ of Section 12, T. 10 N., R. 19 E.W.M.

Buried telephone cable crossing at approximate M.P. 4.68 located in the SW $\frac{1}{4}$ SW $\frac{1}{4}$ of Section 2 and in the NW $\frac{1}{4}$ NW $\frac{1}{4}$ of Section 11, T. 10 N., R. 19 E.W.M.

Buried telephone cable crossing at approximate M.P. 5.13 located in the SW $\frac{1}{4}$ SE $\frac{1}{4}$ of Section 3 and in the NW $\frac{1}{4}$ NE $\frac{1}{4}$ of Section 10, T. 10 N., R. 19 E.W.M.

Permit No.

DIST. 03 CO. Yol RTE. 84 P.M. 3.23/4.25

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS, DIVISION OF HIGHWAYS

UTILITIES ENCROACHMENT PERMIT

To

Marysville, California

Dated August 17, 1972

, Permittee

1. Subject first to the applicable law, and second, to the terms and conditions Relating to Utility Encroachments issued by the State of California, Department of Public Works, Division of Highways, which by this reference is made a part hereof, permission is hereby given to install buried telephone cable along the north side of road 03-Yol-84-3.23/4.25.

Work shall be done as shown on Drawing No. , submitted with the application, except as modified below and on the following attachments.

Permittee is authorized to place cable within 3 feet of edge of paved shoulder in area where there are trees in the right of way.

Special attention is directed to the attached "Protection of Trees" requirements.

In area where there are no trees in right of way, cable shall be placed as close to right of way line as possible.

All work shall be done in accordance with the attached "Underground Utilities & Sewers" requirements and as follows:

All fill slopes and drainage ditches shall be restored to as good or better than existing.

When work is not in progress, all equipment shall be removed outside the shoulder area.

All work shall be conducted and completed to the satisfaction of Superintendent N. C. Rigby, referred to in this permit as the Division

(Continued on Page 2)

in accordance with your Plan No. attached.

2. This Permit has been issued by the Division of Highways pursuant to:

Complete Proper Line
(xx) Your Application of August 8, 1972
( ) Utility Notice No. of , 19
( ) Agreement No. of , 19

3. This Permit applies only to the work specifically authorized above.
4. Inspection required by Division—Full ( ) Partial ( )
5. This Permit shall be void unless the work hereinabove provided for shall have been completed before November 17, 1972, unless time extension granted by separate Rider.

DISTRIBUTION:
2 White to Permittee
1 White to Mtce. Superintendent
1 Pink to Headquarters—Mtce.
1 Blue to Dist. Utility Engineer
1 Yellow to file
1 Green to
Inspector Phone

DEPARTMENT OF PUBLIC WORKS
Division of Highways

District Engineer

By
District Engineer

(Copies of the incorporated Terms and Conditions may be obtained upon request.)

Mail With Proper
Fee To: →

WASHINGTON STATE HIGHWAY COMMISSION
DEPARTMENT OF HIGHWAYS
Highway Administration Bldg. - Olympia, Wash. 98504

ATTENTION OUTDOOR SIGN PERMITS

DO NOT USE
District No. 2
Inventory No.
Approved
Date

APPLICATION - OUTDOOR ADVERTISING SIGN PERMIT

Application Date: .... 19 ....

Application Made for: Existing Sign ☐

New Sign to Be Erected ☐

Type or Print Name and Mailing Address of Erector or Maintainer of Sign in Space Below

NAME ....

ADDRESS ....

CITY & STATE ....

DO NOT USE THIS SPACE

Date Application Received Olympia: 3-29-72

Permit and Label Number Assigned: ....

FOR OLYMPIA USE ONLY

Renewal Year .... $ ______ Pd.

Renewal Year .... $ ______ Pd.

Renewal Year .... $ ______ Pd.

Computer Update Coding Sheet Completed ....

Inventory No. ....

Control Section 1201

C.S.M.P. 11.81

S.R.M.P. 462.63

This Sign (will) (will not) Become Non-conforming May 10, 1974

Location of Sign:

State Highway No. S.R. 12

Distance from Highway Right of Way Line .... Ft.

Direction From Highway Sign Visible RIGHT WEST

Distance from Activity Being Advertized .... Miles

Sign Description:

SIZE: 10 Ft. X 60 Ft. Total Area Sq. Ft. ....

Miles and Direction From Nearest Corp. Limits C.S. 1201 MILE POST 11.81

SHAPE: Rectangular ☐ Square ☐ Octagonal ☐ Round ☐

OTHER: Describe ....

Copy of Sign Message: ....

Name and Address of Activity Being Advertised: ....

Authorization of Owner or Occupant of land on which sign is erected or maintained upon:

Name: ....

Address: .... City & State ....

I, the undersigned, have consented to the erection and maintenance of an outdoor advertising sign on property which (~~I own~~) (I lease) in conformance with Washington Outdoor Advertising Control Sign Law (Chapter 62, Laws of 1971) and The Highway Commission rules and regulations for outdoor advertising control along interstate, primary and scenic routes.

Fee: $10.00 Per Sign Face

Signature ....
~~Owner~~, or Occupant

Make checks or remittance payable to: Department of Highways

A copy of lease accepted in lieu of signature

Signature of Highway Department employee validates this permit and acknowledges receipt of fee paid.

By ....
For Washington State Highway Commission
Department of Highways

HWY FORM 224-018 REVISED 11/71

Use Reverse Side If More Space Needed

ARIZONA HIGHWAY DEPARTMENT

SIGN RECORDS DATE ___________

CARD CODE 301

GUIDE SERVICE INFORMATIONAL OR SPECIAL SIGN MESSAGE

CARD CODE	SIGN LOCATION: DISTRICT	ROUTE TYPE	RT. NO. PREFIX	ROUTE NUMBER	RDWY. REFER.	MARKER	T.I. SEQ.	LETTER	DISTANCE BETWEEN R.P. AND SIGN LOC.	DIRECTION FROM R.P.	AUX ROAD	CONNECTION MOVEMENT	SIDE OF RDWY.	SIGN SEQUENCE	RT. DIRECTION OF SIGN	SIGN TYPE	SIGN NUMBER	SIGN NUMBER SUFFIX	ASSEMBLY ORD	SEGMENT ORDER	SIGN MESSAGE
1 2 3	4	5	6	8 9 10	11	12 13 14	15	16	17 18 19	20	21	22	23	24	25	26	27 28 29 30	31	32	33	34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61
3 0 1																					
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ROUTE TYPE
(COLUMN 5)
I INTERSTATE ROUTE
U U.S. ROUTE
S STATE ROUTE

ROUTE NUMBER PREFIX
(COLUMN #6)
A ALTERNATE ROUTE
B BUSINESS ROUTE
T TRUCK ROUTE
S SPUR
L LOOP
X TEMPORARY ROUTE

ROADWAY REFERENCE
(COLUMN #11)
N NORTH
E EAST
S SOUTH
W WEST

DIRECTION
(COLUMN #20)
N NORTH
E EAST
S SOUTH
W WEST

AUXILIARY ROAD
(COLUMN #21)
0 LOOP
1 RAMP
2 FRONTAGE ROAD
3 CROSSROAD
4 CROSSROAD-LOOP
5 CROSSROAD-RAMP

CONNECTION MOVEMENT
(COLUMN #22)
0 RIGHT
1 LEFT
2 RIGHT/RIGHT
3 LEFT/LEFT
4 RIGHT/LEFT
5 LEFT/RIGHT

SIDE OF ROADWAY
(COLUMN #23)
R RIGHT
L LEFT
O OVERHEAD

ROUTE DIRECTION OF SIGN
(COLUMN #25)
N NORTH
E EAST
S SOUTH
W WEST

SIGN TYPE
(COLUMN #26)
W = W-SERIES
R = R-SERIES
G = G-SERIES
M = M-SERIES
E = E-SERIES
D = D-SERIES
S = SPECIAL
H = H-SERIES
I = I-SERIES
C = C-SERIES

APPENDIX B

SELECTED BIBLIOGRAPHY

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"A Summarized Review of Mileposting on State Maintained Highways in the United States." Insurance Inst. for Highway Safety, Washington, D.C. (1967) 22 pp.

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Published reports of the

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

are available from:

Highway Research Board
National Academy of Sciences
2101 Constitution Avenue
Washington, D.C. 20418

Rep. No.	*Title*
—*	A Critical Review of Literature Treating Methods of Identifying Aggregates Subject to Destructive Volume Change When Frozen in Concrete and a Proposed Program of Research—Intermediate Report (Proj. 4-3(2)), 81 p., $1.80
1	Evaluation of Methods of Replacement of Deteriorated Concrete in Structures (Proj. 6-8), 56 p., $2.80
2	An Introduction to Guidelines for Satellite Studies of Pavement Performance (Proj. 1-1), 19 p., $1.80
2A	Guidelines for Satellite Studies of Pavement Performance, 85 p.+9 figs., 26 tables, 4 app., $3.00
3	Improved Criteria for Traffic Signals at Individual Intersections—Interim Report (Proj. 3-5), 36 p., $1.60
4	Non-Chemical Methods of Snow and Ice Control on Highway Structures (Proj. 6-2), 74 p., $3.20
5	Effects of Different Methods of Stockpiling Aggregates—Interim Report (Proj. 10-3), 48 p., $2.00
6	Means of Locating and Communicating with Disabled Vehicles—Interim Report (Proj. 3-4), 56 p. $3.20
7	Comparison of Different Methods of Measuring Pavement Condition—Interim Report (Proj. 1-2), 29 p., $1.80
8	Synthetic Aggregates for Highway Construction (Proj. 4-4), 13 p., $1.00
9	Traffic Surveillance and Means of Communicating with Drivers—Interim Report (Proj. 3-2), 28 p., $1.60
10	Theoretical Analysis of Structural Behavior of Road Test Flexible Pavements (Proj. 1-4), 31 p., $2.80
11	Effect of Control Devices on Traffic Operations—Interim Report (Proj. 3-6), 107 p., $5.80
12	Identification of Aggregates Causing Poor Concrete Performance When Frozen—Interim Report (Proj. 4-3(1)), 47 p., $3.00
13	Running Cost of Motor Vehicles as Affected by Highway Design—Interim Report (Proj. 2-5), 43 p., $2.80
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15	Identification of Concrete Aggregates Exhibiting Frost Susceptibility—Interim Report (Proj. 4-3(2)), 66 p., $4.00
16	Protective Coatings to Prevent Deterioration of Concrete by Deicing Chemicals (Proj. 6-3), 21 p., $1.60
17	Development of Guidelines for Practical and Realistic Construction Specifications (Proj. 10-1), 109 p., $6.00
18	Community Consequences of Highway Improvement (Proj. 2-2), 37 p., $2.80
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20	Economic Study of Roadway Lighting (Proj. 5-4), 77 p., $3.20
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22	Factors Influencing Flexible Pavement Performance (Proj. 1-3(2)), 69 p., $2.60
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20	Rest Areas (Proj. 20-5, Topic 4-04), 38 p., $3.60
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Under the terms of its Congressional charter, the Academy is also called upon to act as an official—yet independent—adviser to the Federal Government in any matter of science and technology. This provision accounts for the close ties that have always existed between the Academy and the Government, although the Academy is not a governmental agency and its activities are not limited to those on behalf of the Government.

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THE NATIONAL RESEARCH COUNCIL was organized as an agency of the National Academy of Sciences in 1916, at the request of President Wilson, to enable the broad community of U. S. scientists and engineers to associate their efforts with the limited membership of the Academy in service to science and the nation. Its members, who receive their appointments from the President of the National Academy of Sciences, are drawn from academic, industrial and government organizations throughout the country. The National Research Council serves both Academies in the discharge of their responsibilities.

Supported by private and public contributions, grants, and contracts, and voluntary contributions of time and effort by several thousand of the nation's leading scientists and engineers, the Academies and their Research Council thus work to serve the national interest, to foster the sound development of science and engineering, and to promote their effective application for the benefit of society.

THE DIVISION OF ENGINEERING is one of the eight major Divisions into which the National Research Council is organized for the conduct of its work. Its membership includes representatives of the nation's leading technical societies as well as a number of members-at-large. Its Chairman is appointed by the Council of the Academy of Sciences upon nomination by the Council of the Academy of Engineering.

THE HIGHWAY RESEARCH BOARD, organized November 11, 1920, as an agency of the Division of Engineering, is a cooperative organization of the highway technologists of America operating under the auspices of the National Research Council and with the support of the several highway departments, the Federal Highway Administration, and many other organizations interested in the development of transportation. The purpose of the Board is to advance knowledge concerning the nature and performance of transportation systems, through the stimulation of research and dissemination of information derived therefrom.

HIGHWAY RESEARCH BOARD

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