POTENTIAL USES OF VARIABLE-MESSAGE SIGNS IN NEW YORK CITY

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When the New York City Department of Traffic was organized in 1950, it inherited a signal system that was not only inadequate but outdated. The first department mandate was to improve the traffic signal visibility and coordination. Measures of that kind have been found to be effective in providing relief of vehicular traffic congestion, which in turn decreases the accident potential for both vehicles and pedestrians. Now, 21 years later the effectiveness of the modernization program has been amply demonstrated through the analysis of before-and-after studies.

At the present time, more than 50 percent of the city's traffic signals are modernized to meet or exceed the requirements defined in the Manual of Uniform Traffic Control Devices for Streets and Highways. In May 1969, New York City placed on line the first arterial with 124 signals on its new traffic computerized signal system. That digital system provides traffic engineers with a new tool that may be used to extend their application of professional skills over a broader field of traffic and transportation control.

The planned computerized traffic signal system for New York City will ultimately control 7,000 signalized intersections and use approximately 4,500 system sensors. At the present time the Department of Traffic has one computer controlling 450 intersections on 8 arterials in the Borough of Queens, and the projected expansion is at the rate of approximately 500 or more intersections each year.

We have 200 miles of limited-access highways in the city, and their entrances and exits must be coordinated to the best possible degree with the traffic control system of the local streets. The volume of vehicular traffic is approaching the capacity of the roadway system, and the arterial networks are being further burdened by the built-in barriers and demands of the Borough of Manhattan—the focal point for world trade and commerce and the chief traffic generator for the city. This unique borough, therefore, creates a natural attrition to traffic with its many river crossings consisting of tunnels and bridges. In addition, their disparate entrances and exits to the local street systems cause further conflict.

It may be many years before urban transit improvements, which are now in planning or early construction stages, will become completely operational. In the meantime, we are giving serious consideration to alternatives that will aid in the smoother flow of traffic. One alternative is to make the most of the existing street system with the objective of increasing effective capacity with fewer delays, and another involves new construction of streets or street-widening projects. The preferred alternative is to make the most of the existing street system, for the urban areas have nearly exhausted the possibility for expansion; and new construction is costly, brings about hostility from citizen groups, and creates new traffic generators.

Computers that provide parameters from field sensors give traffic engineers opportunities to convert the data into operational programs that will provide optimum timing patterns for variations on a real-time basis and to recognize and transcend to predetermined modes for emergency operation. The emergencies may consist of extreme weather conditions, water-main breaks, major fires, or other interruptions to the normal traffic flow in an urban area.

Although there are stages in development or planning for freeway and expressway control and information systems, it is not the purpose of this paper to analyze those areas. The Department of Traffic as an operating agency is concerned with the problem of lessening traffic congestion within the city and at the same time reducing vehicular and pedestrian accidents and increasing safety to its citizens.

One of the most effective aids in providing information to the drivers is by signs, generally in areas requiring warning, guide, and regulatory information for the driver. Prior to the use of computer-based control and surveillance systems, most of the signs had messages that either were fixed or could be changed or varied by manual operation.

The development of computerized traffic control systems utilizing on-street sensors with closed-loop feedback makes possible the use of variable-message signing under remote control. These signs, used with computer control, must be capable of conveying the proper message to the driver within the established algorithm.

The traffic engineer must specify conditions under which the variable-message signs may be used to the best advantage for his specific purpose. My primary purpose in this paper is to encourage further research and development in the hardware by manufacturers or vendors of those signs so that the user may have choices depending on his needs as defined by his design parameters and the availability of off-the-shelf equipment within competitive pricing.

Variable-message signing requirements, although highly varied, are technically feasible. The design features should consider the life and operation of the sign in the real world. Attention, within cost limitations, is necessary to provide longevity of the lumination source, vandal-resistant features, and easy maintenance such as self-cleaning or convenient methods of manually cleaning and providing preventive maintenance.

The visibility must be such that direct sunlight during daylight hours or high ambient lighting at night, including headlight glare, will not degrade the informational quality of the message. However, if the cost of implementation is such that it is not economically feasible, then the current practice of increasing lumen output by various means or arrangement should be looked into further. The arrangement for a blank-out sign, where usually a sign is either on or off, must be such that the sign is completely blanked out. The preselected message should be relevant to its location and seasonal condition, commanding the attention of the driver, and there should be no reason for the driver to have a lack of understanding when the sign is on.

The sign may be placed on a sign bridge, pole mounted, or attached to an existing structure. In the selection of mounting sites, maintenance costs must be a factor, for accessibility or traffic obstruction or both will be required during maintenance.

The traffic engineer, in using variable-message signs, must take into consideration the roadway geometrics and the best choice for equipment placement to provide maximum visibility and sufficient response time for message recognition and reaction by the driver. The application of variable-message signs in an urban area may be used in a control and surveillance system for ramp-entrance control to facilitate safer merging, ramp-entrance diversion to frontage roads or local city streets, and ramp blank-out signs indicating ramp closure for proper metering of traffic.

In conjunction with a computer-operated traffic signal system, the variable-message signs may be integrated into the control system to control operational routes on local streets for turning restrictions, truck or bus diversion, and alternate routing due to congestion, particularly in areas adjacent to tunnel or bridge crossings where congestion may occur on city streets. The success of this type of operation depends on adequate traffic capacity on available alternate routes, which should be similarly well signed. Where lane control and, in particular, reversible lanes or reversing direction of the entire street segment is instituted, variable-message signs must be used and coordinated with other traffic control devices and computer monitored and operated equipment.

The prescribed messages used by the traffic engineer and available to him from the sign manufacturer should be adequate for standard conditions. The length of these messages should be governed by letter size, which should be readable and understandable within approach distance related to the maximum legal speed for the area of application. There should be no trade-off of letter reduction below the minimal letter size just to accommodate a long message that may tend to confuse the motorist. Rather, a short, easily understood, highly legible message with maximum-sized lettering will lend itself to the most desirable type of signing. This would include easily read symbols, numbers, and letters as well as the use of standard shapes and colors.

The principal criteria in the use of variable-message signs are economic justification and adaptability to the urban street control system. They should be interfaced where required with expressway control and surveillance systems, including ramp metering and diversion strategies within the corridor.

The central headquarters for the systems must contain a map or maps to indicate sign messages in effect and to monitor sign malfunction or failure. In addition, information must be provided visually, preferably by addition of displays to the map, on volumes at specified or critical locations to permit the traffic engineer to analyze the efficiency of the system. This analysis will permit adjustments for fine tuning the system and will provide a manual interface through either a CRT or a hard-copy device for recording traffic information that may be analyzed as algorithms or parameters are changed. A control console should be provided with a manual override so that, in the event of emergency conditions or malfunctions of system equipment, the judgment of the traffic engineer may be communicated to the system by direct intervention.

The communications from central headquarters to the signs for their variable-message operation should be compatible or capable of being provided with an interface to use the same type of communications system that would be used for the urban computerized traffic signal control system. It is important that the complexity of the control systems communications be essentially of one type so that maintenance is easy and maintenance costs are reduced by a reduced inventory of spare parts and components and also that the degree of skill and depth of training of the service personnel may be minimized. The present control concept in New York City is to place all complex equipment at a central control location where highly skilled technicians and engineers are available to analyze and direct the repair of any malfunctions. The equipment on the street, on the other hand, whether it be variable message signs, telemetering equipment, or other traffic control devices, is of minimum complexity so that it can be maintained and repaired by lower level personnel through the replacement of plug-mounted components rather than through elaborate replacement or repair at the site.

In the past there have been many methods used to provide the variable-message signs. Some have had additions in number of messages and size of message, illumination resistant to incident lighting, and various types of lighting including incandescent lamps, neon tubing, and fluorescent lamps. Here again, standards and specifications by the manufacturers will have to be established to determine the effectiveness of any or all of these methods. The operating temperature range must be considered, including solar effect and icing conditions. Other unfavorable environmental conditions may have to be considered that may affect the mechanical and electrical operation and may tend to degrade the effectiveness of the message intended to be communicated to the motorist.

The New York City Department of Traffic has had practically no experience with vehicular variable-message signing, other than to observe some of the installations that have been installed by the various authorities in the area. However, we have purchased and installed many thousands of variable-message WALK-DON'T WALK pedestrian signals. Although those pedestrian signals have not been considered in the same category as vehicular variable-message signs, I would like to discuss the need and use of this type of signal for the exclusive purpose of controlling pedestrian traffic.

Earlier, the Department of Traffic used neon signs but, in addition to the high installation cost and the high cost of replacing neon grids and large transformers, there was also a large operating cost for energy requirements. Several years ago when the department embarked on a full-scale modernization program to bring up to standard all of its traffic signals, consideration was given to the use of incandescent lamps for the lighting source for several reasons. The signal could be physically lighter in weight, power consumption could be reduced, and ease of maintenance and cleaning of the lenses and reflectors could be achieved. The department has since installed incandescent pedestrian signals at thousands of intersections and has had a high degree of success in pedestrian safety and accident reduction. We are planning to continue this program, and I encourage the manufacturers and vendors to continue to improve the performance of incandescent signs. There are many cities, particularly in the West and Southwest, that require a high degree of internal lighting because of the ambient lighting conditions under which they operate. Traffic engineers in those areas have not expressed a great deal of enthusiasm about signs other than the high-intensity type produced by neon grids. The New York City area ambient lighting is generally lower and is more favorable toward the present incandescent lighting intensities, and economic considerations cause us to look for the maximum number of acceptable signs that we may purchase within our budget.

There are several areas where thought must be given if the signs are to be used for their greatest effectiveness: The illumination of the message must be increased without fringing; the lens must be made of material that is essentially vandal-proof; visors on the signs should be as small as possible so that accidental damage, particularly due to turning vehicles, will be slight when signs are mounted in conformance with standard procedures; and lighting sources should have in addition to the fail-safe provisions a means whereby inspection will readily detect the presence of burned-out lamps when multiple lamps are used. The average cursory inspection of pedestrian signs under high ambient lighting conditions many times will fail to reveal a burned-out lamp that decreases the effectiveness of the message. Experienced manufacturers are well aware that longevity of the illuminating source is far from satisfactory at the present time, and that necessitates a continuous inspection effort and consumes an inordinate amount of time at each intersection to observe and report lamp failure on individual pedestrian signs. I am aware that a great deal of work has been done and am assured by lamp manufacturers that research is in progress to alleviate this limited lamp life, which not only causes economic problems but increases the expense of visual inspection and lamp replacement, and, in many cases, results in total failure of the effectiveness of the signal.

Some of the areas that we are discussing may seem far out. If you should feel this to be the case, I ask you to look at the expressway ramp-control studies and the prototype systems for ramp control and expressway surveillance. We are now using reversible lanes on local streets and exclusive bus lanes, and the future of similar projects may lie in the hands of the traffic engineer and the transportation planner. It is incumbent on all of us to remove any excuse for not advancing a valid project because of lack of suitable equipment. It is my hope that this exchange of ideas will increase the activity at the drawing boards and that the ideal piece of hardware will become a catalog item.

The projected increase of vehicular traffic in the future will further burden street systems including expressways and freeways. It is hoped that a visual real-time information system will be used as one of the tools available to the traffic engineer to assist in alleviating congestion. With the technological knowledge and application of known techniques, manufacturers and vendors will be able to offer sophisticated equipment having features that are fail-safe, flexible, and reliable. In addition to these features, economy must be given prime consideration for the establishment of an effective cost benefit to the community.