MICHIGAN DOT REFLECTS ON SIGNS

DAVID LONG

The nighttime effectiveness of most highway signs depends on their retroreflective sheeting, which reflects vehicle headlights, allowing the text of the signs to be read. As the sheeting ages, however, it becomes less effective at reflecting light, and the legibility of the sign gradually decreases. At some point the sign should be replaced, but at what point? To date, transportation agencies have no standards to guide them in making this determination. This situation is about to be rectified. In 1993 Congress directed the Secretary of Transportation to develop retroreflectivity standards for signs. The Michigan Department of Transportation has developed a new method to assess retroreflectivity, thereby aiding compliance with the new standards.

PROBLEM

Traditionally, a sign's retroreflectivity is assessed in one of two ways. The first method is to rate signs visually on the basis of an observer's assessment, either at night using a vehicle's headlights or during the day using a Q-beam light source. The second method is to place a retroreflectometer against the sign. The instrument emits a beam of light and then measures the amount of reflected light.

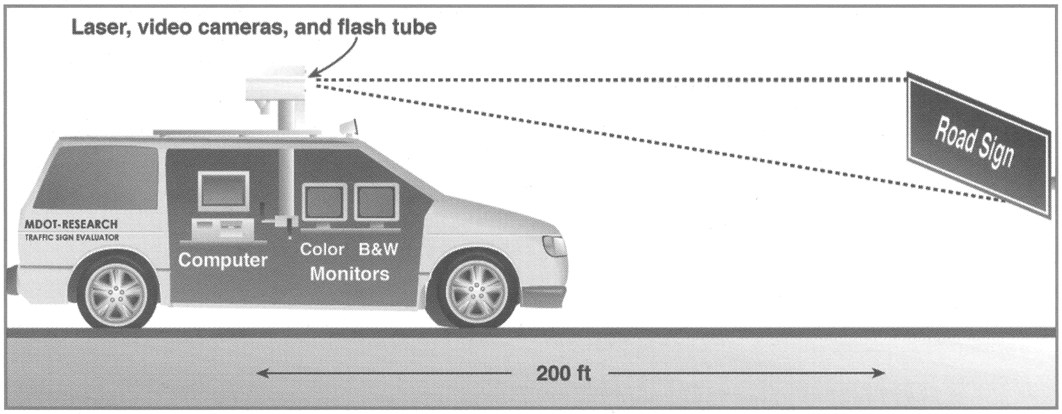
Both methods have shortcomings. In visual rating, individual observers will score the same sign differently. Even the same observer will assess a sign differently as he or she becomes tired. Comparing signs is difficult because variations in background and illumination level affect a viewer's assessment of a sign. Glare from the headlights of oncoming vehicles has a dramatic effect on the perception of a sign at night. Although the retroreflectometer is an objective method, it can be expensive and time-consuming. As many as 60 measurements may be needed to evaluate the retroreflectivity of a large sign; frequently a lane of traffic must be closed to do so.

SOLUTION

The Michigan Department of Transportation in conjunction with the Federal Highway Administration, has developed an innovative technique to measure a sign's retroreflectivity accurately and economically. The technique is the culmination of several research efforts, including National Cooperative Highway Research Program (NCHRP) Project 5—10, A Mobile System for Measuring Retroreflectance of Traffic Signs. This project yielded a system concept for rapidly assessing the retroreflectivity of signs and demonstrated the concept's feasibility through the creation and testing of a proof-of-concept model and the construction of a prototype system. In 1990 this system was presented to NCHRP and turned over to FHWA for refinement and dissemination. Since that time, the agency has been working with MDOT to develop the mobile evaluation of traffic signs (METS) system.

The system consists of a van equipped with two video cameras, a flash tube, a laser mounted on the roof, and a computer and two video monitors inside the van. None of the equipment represents new technology, but the way it is put together makes the system the only one of its kind. Using METS, a two-person team can evaluate 300 to 400 signs a day. The flash tube is sufficiently bright that signs need not be evaluated at night. Because METS operates at highway speeds, the flow of traffic is never disrupted.

As METS travels down the road, the video operator keeps the video camera and laser focused on the sign. The laser measures the distance between the van and the sign being evaluated. When the distance measures 62 meters (203 feet), the flash tube illuminates the sign. A slight delay before activation of the cameras allows the whole sign to be captured at 61 meters (200 feet), the optimal distance for the camera lenses. After the image is



Michigan Department of Transportation's mobile evaluation of traffic signs (METS) van.

captured, the computer digitizes and stores it as a 256-kilobyte file.

A software system developed by MDOT uses the digital black-and-white image to calculate the retroreflectivity of the sign. All of the pixels in the continuous gray-scale image are converted to either black or white. This image is then used to calculate reflectivity values, after calibration for different sign colors. Separate values for the legend and background can be calculated, allowing the contrast ratio to be determined. The color image has a wider view than the black-and-white image and is used to identify and inventory the signs.

APPLICATION

MDOT has used METS to assess the retroreflectivity of 10,000 signs since 1994. The system can produce a report on an individual sign that includes the color and black-and-white images, the sign location, and the sign's retroreflectivity values. The system can also produce a graph of these values on a section of road as long as 80 kilometers (50 miles). This graph has been found to be the best tool for determining when to replace signs along a given corridor.

BENEFITS

The most important benefit of METS is that wornout signs are detected and replaced more reliably, improving public safety. When mandatory retroreflectivity levels for signs are established, all transportation agencies will need the capability (either in house or through a contractor) to measure retroreflectivity. Of the three available methods—visual rating, retroreflectometer, and METS—the last or a similar system is the most practical for measuring the reflectivity of large numbers of signs in the field.

In addition, METS makes information more readily available to analysts. As digital images and retroreflectivity ratings of signs are collected over time, the performance of a given sign's sheeting can be evaluated.

Finally, METS appears to offer a cost advantage over visual rating and use of the retroreflectometer. In NCHRP Report 346, *Implementation Strategies for Sign Retroreflectivity Standards*, the estimated cost of visual rating is $3.93 per roadway mile for daytime inspection and $5.40 per roadway mile for nighttime inspection. The estimated cost of the retroreflectometer approach is $14 per sign in labor alone; traffic-control and equipment expenses would increase the figure. By contrast, the cost of using a METS-type system was estimated, as part of NCHRP Project 5-10, to be only $3.70 per sign. This figure includes labor costs ($1.00), vehicle operating and maintenance costs ($0.33), and capital costs, which were amortized over 3 years ($2.37), and reflects five 5-hour data collection sessions each month. Increasing the efficiency and number of these sessions per month would decrease the figure.

For further information, contact David Long, Materials and Technology Division, Michigan Department of Transportation, 8885 Ricks Road, Lansing, MI 48909 (telephone 517-322-6138, fax 517-322-5664, e-mail longd@state.mi.us).

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Suggestions for "Research Pays Off" topics are welcome. Contact G. P. Jayaprakash, Transportation Research Board, 2101 Constitution Avenue, N.W., Washington, D.C. 20418 (telephone 202-334-2952; e-mail gjayapra@nas.edu).