without police assistance. The second limit is that should traffic be diverted to a different routing on a non-motorway network, the direction indications on these roads must be accurate and consistent. This is more often than desired not the case, and communication with drivers becomes nonexistent. Thirdly, such systems are expensive to set up, operate and maintain. These arguments alone can dissuade an authority from investing in them, especially with the current economic situation.

Speaking of communication with drivers, the Commission of the European Communities has been working for many years on research for electronic traffic aids on major European roads. This is known as the COST 30 Project. Communication with drivers can be done in several ways, from using radio information systems, to in-board communication with external electronically given messages of the most complex type. During the past year, all the European countries involved have set up their systems on the motorway between the Hague and Rotterdam in the Netherlands and research is being carried out to find the most suitable mixture of solutions for uniform application in the Common Market countries. Once again, all these systems need serious direction indications that are accurate, consistent and always up to date. Otherwise, the most sophisticated hardware soon becomes inoperative.

Sign Maintenance and Public Funding

Lastly, a word on the situation in Europe regarding the maintenance and financing of all road signing.

Several instances, both international and national, have established that the quality of road signing in Europe -- and elsewhere in the world, too -- is far from satisfactory. According to the International Road Federation which published a brochure on the subject last October, road signing and safety equipment maintenance must be radically improved.

Many signs are set up and abandoned to the elements of time; they soon become ineffective and dangerous. It is urgent to set up well planned maintenance programs in all of Europe and for this the establishment of inventories is a must.

Several countries are beginning to set up systems using one of the three systems of data collection -- manual surveys, photo-logging, and video-logging systems. In the U.K., the research project for using a highly technical video-logging/computer system for the maintenance of all direction indication signing is well under way. It is expected to see the first application by the end of 1984.

The purpose is to save enormous amounts of fuel by eliminating the possibilities of drivers getting lost or choosing energy-wasting itineraries, by providing accurate and consistent road direction indications. It has been estimated that up to eighty percent of drivers conform to the indications they find on these signals and it is expected that once they become confident in the indication system, this will increase even more.

Funding can and must be found from existing sources of income. European tax systems ensure sufficient funds for road construction and maintenance; it is only necessary to reserve a small amount of these funds for the maintenance of all road signing and safety equipment along European roads, country by country. As said by the International Road Foundation:

> "In order to prevent the roads of Europe from becoming hopelessly inadequate, IRF strongly appeals to the responsible authorities that they should urgently establish definitive programs for road maintenance in general with sufficient funding, and in particular for the maintenance of road markings, signing and other safety equipment . . . and to recognize that highways generate far more income than the amount of money reinvested in the network."

In conclusion, the trend in Europe should be, in the coming years and generations, to improve the quality of road signing and to reduce the risks of finding a large number of signs and markings in poor state as is the case today in many places.

VISIBILITY REQUIREMENTS FOR OVERHEAD GUIDE SIGNS

Anthony C. Stein and R. Wade Allen, Systems Technology, Inc., Hawthorne, California

The work currently in progress is under contract to the Federal Highway Administration (Contract DTFH61-83-C-00141). Its purpose is to determine the driver's visibility requirements for overhead guide signs. To date we have determined the time interval requirements for the driver to detect, recognize, read, and act on an overhead guide sign. We have also identified the other driving behaviors to which the driver must attend, and the amount of time that these behaviors require. From these data we can predict the sight distances that the driver requires for using overhead guide signs.

We have developed a computer program for the IBM PC which uses the available data on headlighting patterns and sign photometrics to present a graphic representation of sign conspicuity and legibility. The overall structure of the program is illustrated in Figure 1. Ultimately the program will compute sign conspicuity and recognition distances. The basic geometrical variables have been implemented in the program thus far, including the graphical output shown in Figure 2 which shows sign location relative to the vehicle heading direction and the vehicle's headlight pattern.

In the future phases of the contract we expect: 1) to determine the luminance and array of various in-service sign materials; 2) to determine the photometric values of current signing materials; 3) to perform a laboratory study to determine the conspicuity requirements of drivers for a range of locations typical of overhead guide signs installed in accordance with MUTCD; 4) to identify situations where night illumination or reflectorization of signs may be needed; 5) using the FHWA HYSIM driving simulator, to determine the threshold values separating where either reflectorization or external illumination is needed; 6) to perform a field validation of the findings of the previous task; 7) to determine cost estimates for various overhead sign treatments; and finally 8) to summarize the findings of the project and provide recommendations for preferred treatments under specific highway situations.

Figure 1 - Computational Steps for a Computerized Overhead Guidesign Conspicuity/Legibility Analysis

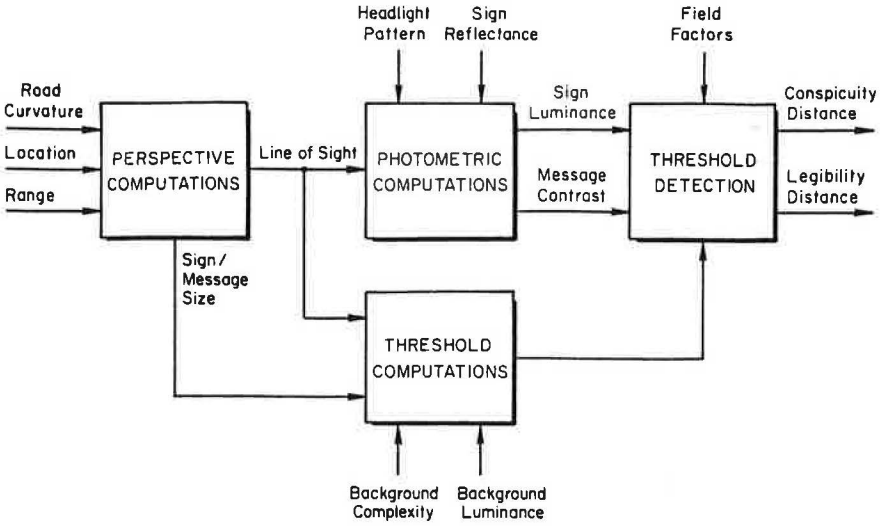
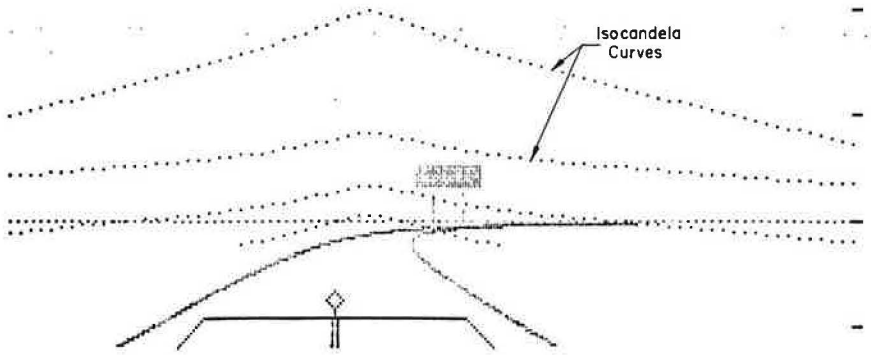


Figure 2 - Computer Graphics Plot Showing Overhead Guidesign Relative to Vehicle Heading Direction and Headlight Beam Pattern



LUMINANCE OF TRAFFIC SIGNS AT NIGHT

Prof. H. J. Schmidt-Clausen, Technische Hochschule, Darmstadt, West Germany

The luminance of traffic signs was investigated in a 1:10 scale model experiment and the ranges of the minimum, sufficient, and otimum luminance of traffic signs at night were determined. The measurements were done with the threshold, the visual acuity and a rating scale as criteria.

These results were compared with those in the real street situation. The following parameters were among others considered:

- European/American low beam light distribution
- Class I/Class II retroreflective materials
- Indirect illumination by luminous flux reflected on the pavement surface

These tests and observations show that sign luminance (white area) of between 3.5 cd/m^2 and 10 cd/m^2 is quite sufficient. The luminance range between 10 cd/m^2 and 35 cd/m^2 is rated as 8n optimum luminance. The upper limit increases up to $\approx$ 60 cd/m^2 with glare of opposing vehicles.

TRAFFIC SIGNAL BRIGHTNESS REQUIREMENTS FOR THE NIGHTTIME DRIVING ENVIRONMENT

Mark Freedman, KETRON, Inc., Philadelphia, Pennsylvania

The objective of this FHWA-sponsored research project is to determine the traffic signal brightness levels needed to satisfy the perceptual requirements of motorists for signal conspicuity, especially at night. The research techniques included analytical studies of the effects of driver age on the need for signal visibility, a laboratory study to determine the particular needs of color-vision-deficient drivers, a controlled field study to expand and validate the laboratory investigations, and a set of observational field experiments at six signalized intersections to determine the traffic operations and safety impacts of reduced brightness levels. Guidelines and criteria were developed to determine whether signal dimming is desirable at particular intersections. The economic impacts of a variety of dimming techniques were evaluated.

The analytical study of the brightness needs of the elderly driver (70-74 chosen as design age) indicated that while a traffic signal must be about