THE APPLICABILITY OF HIGH INTENSITY SHEETING ON OVERHEAD HIGHWAY SIGNS

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(The opinions, findings, and conclusions expressed in this report are those of the authors and not necessarily those of the sponsoring agencies.)

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ABSTRACT

This report summarizes (1) the findings of a research study on the applicability of using high intensity reflective sheeting on overhead signs, and (2) the implementation of recommendations evolving from these findings through elimination of the illumination on many overhead signs in Virginia.

A survey was conducted to determine the percentage of overhead signs meeting the criteria, developed in the research, under which the illumination could be eliminated if they were refurbished with high intensity sheeting, and the plans of several proposed projects were reviewed to obtain an estimate of the percentage of signs on which lighting could be eliminated through the use of the high intensity material. Also, data were collected relative to the installation, energy and maintenance costs for lighting overhead signs.

The study concluded that the illumination could be eliminated on approximately 45% of the existing signs and 50% of the proposed signs through the use of high intensity reflective materials. The benefits anticipated from the implementation of the program include enormous money and energy savings, a significant reduction in the exposure of maintenance personnel to hazardous working conditions, and improved services to the motorists.

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The current practice in Virginia is to reflectorize and illuminate all overhead signs because of their important role in the safe and orderly flow of traffic. Reflectorization is obtained by using reflective sheeting as background and legend materials, and diffuse illumination is provided on the sign surface by lighting fixtures.

However, the provision and maintenance of external lighting create many problems for traffic engineers and maintenance personnel. Cost is always an important factor and the expense of the initial light installation is compounded by the great distances to the power sources and the unfavorable working conditions on the heavily traveled highways. Maintenance of the lighting has proven to be a regular and continuing process that requires periodic night inspections to locate malfunctioning lights.

Associated with the malfunctioning illumination is the loss of sign service to the motoring public, an extremely important consideration, because overhead signs usually are installed at complex locations on the highway and are especially needed during the hours of darkness.

The repairs of overhead sign lighting require that a lane be closed to allow equipment and workmen on the roadway. Traffic volumes on many freeways, especially in urban areas, are such that a lane cannot be taken out of service except for a few hours during the off-peak period. Even then, much inconvenience is created for the motoring public, and the exposure of the workmen to traffic is extremely hazardous.

Another factor that must be emphasized when considering sign illumination is the demand for electrical energy. In view of the national program for energy self-sufficiency, every practical means of energy conservation must be explored. Consequently, the introduction of a high intensity sign sheeting generated much

Human factors were incorporated into the study by requesting individuals such as police officers, engineers, and highway users to make visual comparisons of the visibility and legibility of the signs.

Results, Conclusions, and Recommendations

Findings of the study indicated that the high intensity materials without illumination performed satisfactorily under many conditions. For signs erected on straight sections of roadway there were no statistical differences in the brightnesses of the background materials of the two signs for the motorists traveling in stream traffic. Although the average luminances of the high intensity legend materials were not as bright as those of the illuminated conventional sign, the people who viewed the signs stated that the uniform brightness of the high intensity sign provided greater legibility than the illuminated sign with the uneven light distribution. For a single vehicle traveling with high beam lights the high intensity signs were much brighter; however, for the same vehicle using low beams, the luminances of the high intensity signs were not as bright as those of the adjacent conventional signs. It should be pointed out that as a matter of observation the people who conducted the study are of the opinion that there are only limited occasions when it is feasible for the "lone" motorist to utilize low beams on a freeway. In fact, it was not possible to collect the low beam data at any of the study sites until after 1 a.m., when traffic volumes were low.

The high intensity materials provided constant service whereas the brightness of conventional materials was governed by the external lighting. During service interruptions the luminances of the conventional materials reduced drastically and the brightness was insufficient to provide the motorist proper service.

On a curved approach, where only a limited amount of light from the vehicles was projected upon the overhead signs, the luminances of the unlighted high intensity materials were not sufficient to provide the motorists with the equivalent sign legibility and visibility obtained from the conventional signs.

Although the luminance readings of the unlighted high intensity sign were more uniform than those of the conventional sign, the persons who viewed the signs on the curved approaches unanimously concurred that the lighted sign provided better service.

IMPLEMENTATION

Purpose and Scope

The purpose of this project was to determine the applicability of using high intensity reflective sheeting on overhead signs in Virginia so as to allow elimination of the illumination on them. In particular, the work was undertaken to seek answers to the questions cited above and was not intended to provide an economic analysis. The main objectives were to —

1. determine the percentage of existing and proposed overhead signs that meet the criteria under which the illumination could be eliminated by using high intensity materials,

2. obtain installation cost estimates of the illumination on a typical overhead sign,

3. gather the energy cost of illuminating overhead signs, and

4. obtain cost figures on the maintenance of electrical fixtures which provide the illumination on overhead signs.

Because of manpower and time constraints, the study was restricted to the interstate and primary highway systems. Random samples of statewide data were recorded as it was impossible to obtain complete data on all the overhead signs.

Methodology

The first phase implementation effort was divided into four major tasks and the analytic procedures are presented in the following sections.

Sign Survey

One of the criteria established in the research study stated that the illumination could be eliminated on a high intensity sign erected on a freeway which had a straight approach equal to or greater than the visibility recognition distance.(1)

3. Type and number of lighting fixtures
4. Straight approach distance
5. Type of roadway
6. Posted speed limit

Although existing signs on roadways under construction were not inventoried, the sign plans of several proposed projects were reviewed to determine an estimate of the percentage of signs that could be fabricated with high intensity sheeting and without illumination.

Installation Cost

The majority of overhead signs in Virginia are installed by contract and, unfortunately, the payment for the entire structure is made on a lump sum basis. In an effort to obtain installation cost estimates of illuminating a typical overhead sign, many sign contractors, consulting engineers and traffic agencies were contacted.

Energy Cost

Data on the cost of energy for illuminating signs in various sections of the state were gathered and analyzed. The recorded data included the annual electrical costs, supplier, location of structure, number of signs per structure, and type and number of lighting fixtures.

Maintenance Cost

The Department's accounting system does not have a specific charge code for sign lighting activities, therefore the daily work records covering a 12-month period were reviewed in two highway districts. Data were recorded relative to the labor, equipment, and materials costs of maintaining the sign lighting. Also, data including the number of signs maintained, man-hours required, and labor, equipment, and material expenditures were gathered for two districts that contracted most of the maintenance operations on the lighting of overhead signs during the past year.

Discussion of Findings

A variety of data were obtained relative to the practical application of high intensity sheeting and the elimination of

Table 2 reflect the proposed signs for Route 495 around Washington, D. C. On this 22.1-mile (35.57 km) facility, 231 signs will be erected on 148 structures and 580 mercury vapor lighting fixtures will be required to properly illuminate the proposed enclosed lens signs.

Table 2

Summary of Inventory of Proposed Overhead Signs

Item	Type of Roadway		Total
	Interstate (Route 495)	Primary	
Structures	148	10	158
Curved Approaches	74	5	79
Straight Approaches	74	5	79
Signs	231	21	252
Signs/Structure	1.56	2.1	1.59
Light Fixtures	580	62	642
Fixtures/Sign	2.51	2.95	2.55

The sign survey on existing roadways disclosed the great number and types of light fixtures required to illuminate signs during the hours of darkness (Tables 3 and 4). It is estimated that in addition to the 800 mercury vapor fixtures, 2,700 fluorescent fixtures (12,000 linear feet) are in service in Virginia. To illuminate the average overhead sign, 14.27 linear feet of fluorescent lighting fixtures, or 3.11 mercury vapor fixtures, are required. As shown in Table 4 the majority of the signs are equipped with fluorescent lighting, however the newer installations include mercury vapor fixtures because of their improved performance characteristics.

Table 3

Summary of Inventory of Lighting Fixtures on Overhead Signs
(Estimated Totals in Parentheses)

Type of Fixture	Type of Roadway		Total
	Interstate	Others	
Fluorescent			
4'	1,027	834 (1,112)	1,861 (2,139)
6'	228	230 (306)	458 (534)
8'	23	3 (4)	26 (27)
Mercury Vapor	481	240 (320)	721 (801)

Installation Cost

The installation cost estimates were obtained from the Department's Traffic and Safety Division and consulting firms who were under contract with the Department. The contractors, reluctant to discuss unit prices for lighting fixtures, stated that the prices varied among projects and the date of work. These reasons are appreciated when considering the fluctuations of material prices and the fact that a high unit cost is necessitated on a small project whereas large volume contracts usually result in lower unit costs. However, the contractors did indicate that the Department's estimate of $400 per fixture was conservative.

As shown in Table 2, the number of fixtures on a proposed sign installation is 2.55, while 1.59 signs are planned for each structure. Consequently, an average of 4 light fixtures is proposed on each overhead sign structure, at an estimated installation cost of $1,600.

Overhead sign structures of the 2-pole span type cost an estimated $225 per linear foot of span, and the cantilever type cost $250 per linear foot. The Department estimates that one-third to one-half of these costs are for the walkways on which the light fixtures are mounted. Little, if any, sign maintenance operations are performed from the walkways, therefore the additional expense is mainly for the mounting and maintenance of the lighting fixtures. Of the 148 structures proposed on Route 495 (Table 2), 70 are of the cantilever type, 52 are span structures, and the remaining 26 are mounted on bridges. The average lengths of the cantilever, span, and bridge structures are 28.5, 109, and 23 feet (8.69, 33.22, and 7.01 m), respectively. The average cantilever structure costs $7,125 while the average span structure exceeds $24,500. Because special supports are required for bridge-mounted signs, cost figures were not available although it was surmised that they would be in the price range of the cantilever structure.

Considering that 50% of the proposed structures on Route 495 will be on straight approaches and that high intensity sheeting without illumination would provide adequate luminances, cost savings in excess of $402,000 for the proposed structures could be anticipated by the elimination of the lighting fixtures. Add to these savings $118,000 for light fixtures, and the net savings would be approximately $520,000 on this highway facility, for an average savings of $7,030 per structure. These figures are considered conservative as they were derived from cost estimates for a sign project that would require a large number

Table 5

Overhead Sign Illumination Energy Costs

Location	Number of Signs	Number of Lights	Lin. Ft. of Lights	Annual Elec. Cost	Annual Cost Per Ft.	Supplier
Route 64 West at Parham Road Henrico County	3	11	44	$ 132.00	$3.00	VEPCO
Route 29 North at Route 15 Culpeper County	3	10	42	334.62	7.97	NPECO-OP
Route 95 South at Route 619 Prince William County	3	7	30	75.40	2.51	VEPCO
Route 81 South at Route 614 Botetourt County	3	6	26	75.20	2.89	VEPCO
Route 64 West at Route 81 Augusta County	2	12	48	380.20	7.92	VEPCO
Route 29 South at Route 739 Amherst County	2	6	26	93.60	3.60	APECO
Route 29 North at Route 60 Amherst County	2	7	30	96.00	3.20	APECO
Route 81 South at Route 381 City of Bristol	2	4	24	162.87	6.79	TVA
TOTAL	20	63	270	$1,349.89		
AVERAGE	2.50	7.88	33.75	$ 168.74	$5.00	

Table 6

Overhead Sign Illumination Maintenance Costs

District	No. of Signs	Man-hours	Equipment and Labor Costs	Material Costs	Total Costs	Unit Cost Per Sign	Remarks
Culpeper	—	3,846	$21,300	$2,900	$24,200		State Forces, includes traffic control
Salem	49		3,300	1,050	4,350	$ 89	State Forces includes traffic control
Richmond (Rt. 64)	63	595.4	9,500	2,600	12,100	192	Contract, excludes traffic control
Suffolk (Rts. 44,64 & 264)	142	475.0	14,100	4,100	18,200	128	Contract, includes traffic control

These savings do not include benefits such as reduced exposure of maintenance personnel to traffic, improved services to the motorists, the availability of maintenance crews and equipment for other jobs, and less time required for night inspections to locate malfunctioning lights.

Enormous savings in installation costs could be anticipated from eliminating the illumination on new overhead sign structures. Because of the efforts of sign designers to locate overhead signs on straight sections of roadways, the number of proposed signs meeting the visibility recognition criterion has increased on new construction projects. Fifty percent of these signs are to be placed on straight approaches and the illumination could be eliminated if they were fabricated with high intensity sheeting. Based upon the statistics gathered from the proposed sign project on Route 495, it was concluded that the elimination of lights on the overhead structures could result in an average savings of $7,030 per structure, less $400 to $500 for the additional expense of the high intensity sheeting. For the entire Route 495 project the savings would be in excess of $500,000. Greater savings per structure could be anticipated on projects requiring a small number of signs and in areas where the power sources are great distances from the overhead signs.

Recommendations

The conclusions of the research study showed that the illumination on many overhead signs in Virginia could be eliminated through the use of high intensity reflective materials. The benefits derived through the implementation of the program would include enormous money savings, a significant energy conservation, reduced exposure of maintenance personnel to hazardous work conditions, and improved services to the motorists. In view of the findings of the information gathering survey, the program should be implemented as soon as practical. It is recommended that new overhead signs, those proposed for roadways susceptible to high beam and stream traffic lighting conditions and which have a straight approach equal to or greater than the visibility recognition distance, be fabricated with high intensity material and that the illumination be eliminated. Further, when existing signs are refurbished, the high intensity materials should be used and the lighting disconnected.

There may be locations, other than the straight roadways, where the geometrics are such that the amount of light projected upon the overhead sign from the vehicle's headlamps is sufficient to provide the motorist adequate service.

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