World Academy of Science, Engineering and Technology
International Journal of Humanities and Social Sciences
Vol:7, No:3, 2013

Traffic Signs

A. Gutiérrez, A. Castillo, J. M. Gómez, J. M. Gutiérrez, and A. García-Cabot

***Abstract*—**Road signs are the elements of roads with a lot of influence in driver's behavior. So that signals can fulfill its function, they must overcome visibility and durability requirements, particularly needed at night, when the coefficient of retroreflection becomes a decisive factor in ensuring road safety. Accepting that the visibility of the signage has implications for people's safety, we understand the importance to fulfill its function: to foster the highest standards of service and safety in drivers. The usual conditions of perception of any sign are determined by: age of the driver, reflective material, luminosity, vehicle speed and emplacement. In this way, this paper evaluates the different signals to increase the safety road.

***Keywords*—**Luminosity, orientation, retroreflection, traffic signs.

I. Introduction

TRAFFIC sign need to be clearly visible at night in order that their message is seen by drivers. In areas where the level of background luminance is low, retroreflective material alone is normally adequate to provide sufficient illumination for this purpose. In areas of street light, the conspicuity of traffic signs is reduced, as they stand out less against a brighter background. There is, therefore, a legal requirement for traffic signs and traffic bollards to be lit during the hours of darkness if the sign or bollard is within 50 meters of a street lamp that forms part of a system of street-lighting.

There has been a significant improvement in the performance of glass bead and microprismatic retroreflective signing material technologies for permanent traffic signs. These retroreflective materials give, under some conditions, high levels of performance in terms of both sign conspicuity and message legibility, the need for direct lighting is requirements for traffic signs and bollards should be reviewed, but extreme care needs to be taken in order to ensure that there is no reduction in the level of safety for drivers at night.

There are high costs [1], both financial and environmental, of illuminating permanent traffic signs. The development of high performance glass bead and microprismatic retroreflective material means that in some circumstances, equivalent or similar levels of illumination may be provided by these signs alone without the need for direct lighting.

A. Gutierrez is with the Computer Science Department, University of Alcalá, Spain. (e-mail: alberto.gutierreze@uah.es).
A. Castillo is with the Computer Science Department, University of Alcalá, Spain. (e-mail: ana.castillo@uah.es).
J.M. Gómez is with the Computer Science Department, University of Alcalá, Spain. (e-mail: jose.gomez@uah.es).
J.M. Gutiérrez is with the Computer Science Department, University of Alcalá, Spain. (e-mail: josem.gutierrez@uah.es).
A. García-Cabot is with the Computer Science Department, University of Alcalá, Spain. (e-mail: a.garciac@uah.es).

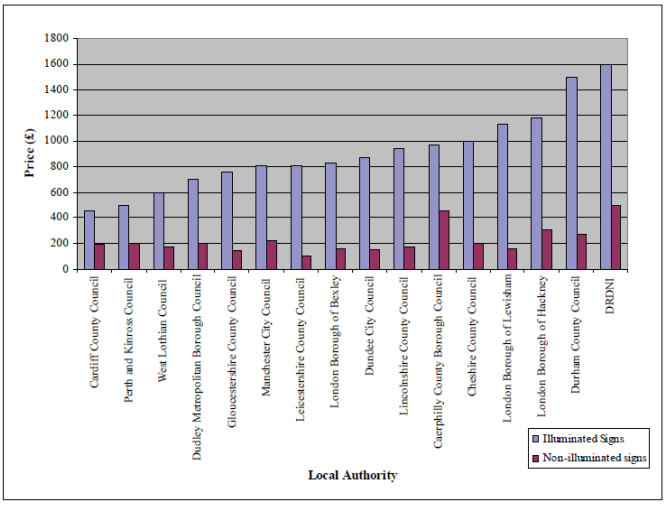


Fig. 1 Price of installing illuminated and non-illuminated signs [1]

The overall objective of this paper is to review the costs and safety benefits of traffic signs, with a view to identifying circumstances where it might be appropriate to light them.

It is understood that the usual conditions of perception of any signal is determined by: age of the driver, reflective material, luminosity, vehicle speed and siting.

II. Older Drivers

Older pedestrians do not currently represent a major road safety problem in most Western societies compared with other age groups such as the young. They are, nonetheless, identified internationally and in Australia [2] as an 'at-risk' road user group because they are involved in significantly more casualty crashes per head of population than younger pedestrians, particularly those resulting in fatal or serious injury outcomes.

As the next generation of older road users will increase and become more mobile, road safety problems among the elderly are expected to become more substantial in the years ahead.

We want to show the research of Benekohal [3] who conducted a survey of older drivers in the US and found that the following activities become more difficult for these drivers:

- Reading street signs in towns
- Driving across an intersection
- Finding the beginning of a right turn at an intersection
- Making a right-turn at an intersection
- Following pavement markings
- Responding to traffic signals

Benekohal also found that the following highway features become more important to drivers as they age.

Open Science Index, Humanities and Social Sciences Vol:7, No:3, 2013 publications.waset.org/8453/pdf

- Number of left-turns
- Width of travel lanes
- Size of traffic signals

The opportunity, therefore, exists through enhancements to road design standards and practices to reduce older driver crash and injury risk in circumstances where safe gap selection is critical. While it is not possible to eliminate the gap selection task for drivers at intersections, it is possible to modify, through road and traffic engineering design, the nature and, hence, the risk associated with the gap selection task for older drivers. Suggested road design countermeasures to target this problem for older drivers could include:

- Replacing stop and give-way signs with fully controlled traffic signals in appropriate locations to lessen the decision-making task for older drivers.
- Provision of a roundabout – with roundabout control, older drivers need only select a gap in one direction of traffic at a time.
- Provision of fully controlled right-turn phases – this greatly simplifies the gap selection task for older drivers and addresses site-specific problems with limited sight distance, high traffic volumes and high speeds.

III. Sign Backing Board

To improve conspicuity against a complex or dark background, a regulatory sign may be mounted on a yellow or another colour backing board. A backing board must be rectangular in shape. A backing board must not itself be provided with a border, nor give the impression of being an additional border. Where it seems that a sign is not being noticed by drivers, it should be checked to ensure that it is well-sited, not obscured by vegetation or other obstructions, and is of the appropriate size and in good condition.

A backing board must be reflectorized to increase its conspicuity at night. In most cases these are lit when placed on lit roads, or are mounted parallel to the kerb, and on unlit roads reflectorisation of the sign is usually sufficient to ensure night-time conspicuity. A backing board may also be fluorescent; this greatly increases conspicuity in dull weather and at dusk. Fluorescence can also be particularly effective in drawing attention to signs mounted in deep shadow, e.g. below overhanging trees. However, fluorescence is visually intrusive and should be used with discretion.

But backing boards have a drawback, the large overall size of the assembly can sometime obstruct sight lines but we think that always must use of a backing board because it increase the visibility distance although the following principles should be considered when using backing boards[4]:

- The backing board colour should provide a contrast between the sign and the environment (eg it would not be desirable to use a green backing board where there is a significant area of similarly coloured vegetation located behind the traffic sign).
- Bright, conspicuous backing boards should be used sparingly to indicate high crash risk sites.

IV. Orientation

For optimum results, the orientation of a traffic sign to face oncoming traffic is extremely important.

Generally, signs should face the driver's line of sight. When using reflectorised sheeting, the sign should be facing 5 degrees away from the driver's line of sight to reduce possible and undesirable reflection from sign surfaces. The next image depicts how to correctly orient reflectorised signs at the side of the road. For gantry signs, the orientation is directed at the road users for whom the message is intended.

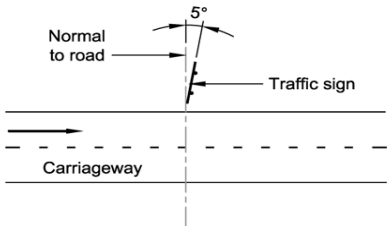


Fig. 2 How to correctly orient reflectorized signs at the side of the road [4]

Orientation of a sign must also consider the traffic environment. A sign placed at a certain angle where it can be seen by the target users must not mislead or distract other roads users for whom it is not intended.

V. Siting of Traffic Light

Recent collaborative European research has shown that drivers need to be able to detect guidance markings at a distance equivalent to a minimum of two seconds of travel time. If the visibility is less than this, drivers tend to adjust too late when the road changes direction. They run too close to the center line on left hand bends or too close to the road edge on right hand bends. The higher the prevailing traffic speed, the greater the visibility distance required to maintain this two second "preview time". If it is not provided, drivers tend to miss the curve, or proceed in a series of staggers.

It is essential that drivers have an unobstructed view of traffic signs. The distance which should be kept clear of obstructions to the sight line, whether caused by vegetation, other signs or street furniture, is known as the clear visibility distance. The higher the prevailing traffic speeds, the greater this distance needs to be.

TABLE I
Minimum Clear Visibility Distances [5]

85th percentile speed of private cars (mph)	Minimum clear visibility distance (meters)
Up to 20	45
21 to 30	60
31 to 40	60
41 to 50	75
51 to 60	90
Over 60	105

Open Science Index, Humanities and Social Sciences Vol:7, No:3, 2013 publications.waset.org/8453/pdf

Open Science Index, Humanities and Social Sciences Vol:7, No:3, 2013 publications.waset.org/8453/pdf

This table specifies minimum clear visibility distances. These should normally be measured from the center of the most disadvantaged driving lane. It is important that the full recommended sight line to the whole of the sign face is preserved. Cutting back of vegetation only in the immediate vicinity of the sign might not be sufficient; sign visibility should always be checked from the appropriate viewing distance although there are a variety of factors influences the visibility distance of a road marking. Visibility distance is adversely affected by glare from oncoming vehicles, dirty headlamps or windscreen and especially by rain; the glass beads which produce the night time luminance are drowned by excess water, greatly reducing the brightness of the line. Older drivers also see a marking less well than the young; someone seventy years old may suffer a reduction in visibility distance of more than 20% compared with drivers still in their twenties.

VI. Sign Position

The position of traffic sign affects how much light from the vehicle headlights falls upon it. This in turn affects how bright the sign appears to driver. Signs positioned next to the driver lane receive the most light, while overhead signs receive the least. There are four traffic sign positions and these are shown in image below.

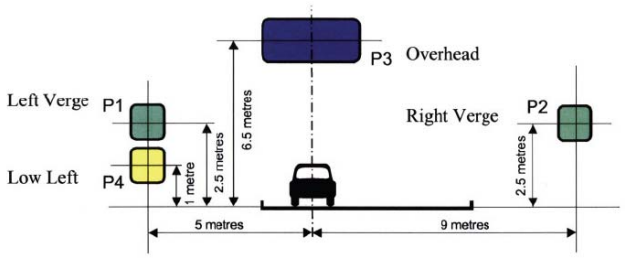


Fig. 3 The four positions traffic signs can be mounted [1]

VII. Retroreflection

Retroreflection is a property of a material that enables it to return light back in the general direction of the source. It is measured in units of candelas per lux per square-meter (cd/lx/m2).

Retroreflection is most commonly used to enhance road safety by utilizing the property with items such as traffic signs, roadway channelizes, pavement markings, and tapes for heavy vehicles in order to increase the conspicuity of these objects at night. Traffic signs retroreflect light from a vehicle's headlamps, or incident light, back toward the vehicle. Although the light is retroreflected toward the vehicle headlamps, the driver is able to see much of this returned light because of their relative position.

Tiny glass beads are incorporated in road markings so that they reflect the light from vehicle headlamps back towards the driver. This makes the marking much brighter at night than nonreflectorised materials. The new European Standard for road markings (BS EN 1436) specifies several different classes for night-time brightness. Brighter markings are visible at greater distances, and may provide an acceptable level of performance for a longer time before renewal becomes necessary

The values of the next table are minimum coefficients of retroflection (Ra) for new sheeting expressed in candelas per lux per square meter. Measurements are made in accordance with CIE Publication 54:1982.

TABLE II
Minimum Clear Visibility Distances [5]

MINIMUM COEFFICIENTS OF RETROREFLECTION (R_A)				
Obs. Angle	Color	Entrance Angles		
		-5°	15 °	40 °
12'	White	360	220	120
	Yellow	270	145	80
	Red	65	42	16
	Interstate Green	50	40	12
	Blue	30	15	9
20'	White	180	160	95
	Yellow	122	110	65
	Red	34	32	13
	Interstate Green	32	30	11
	Blue	14	10	7
1.0°	White	20	16	5
	Yellow	12	8	3
	Red	3	2	1
	Interstate Green	2	2	0,8
	Blue	1	1	0,5
2.0°	White	5	2,5	1,5
	Yellow	3	1,5	0,2
	Red	1	0,4	0,3
	Interstate Green	0,5	0,3	0,2
	Blue	0,2	#	#
# Value greater than zero but not significant or applicable				

Geometrical considerations are not the only that dictate the performance of retroreflective materials. There are other environmental and man-factors that can reduce the visual performance of retroreflective sign face material like dew formation, dirt and graffiti.



Fig. 4 The same sign photographed at night using the camera flash, in the presence (left) and absence (right) of dew [1]

A. Dew and Frost

A study was conducted on traffic signs in the Province of New Brunswick, in eastern Canada [6]. The outcome was that

frost reduces the retroreflectivity levels of traffic signs by an average of 79 percent, with this reduction is necessary to install other system to sure the safety of the drivers.

The following image shows the reduction in retorreflectivity caused by frost and dew in white sheeting.

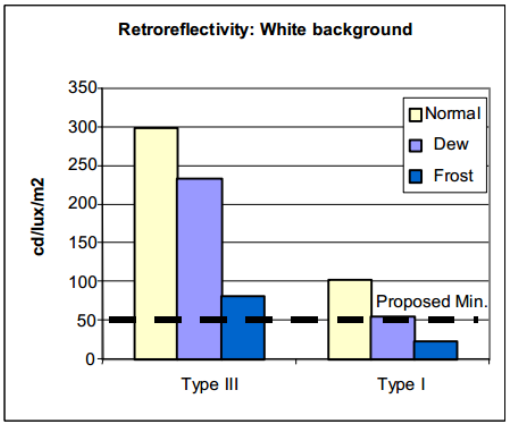


Fig. 5 Reduction in retroreflectivity caused by frost and dew in white sheeting [6]

VIII. Illumination

Retroreflective material provides a comparable level of illumination to direct lighting in many circumstances, but it cannot by itself provide sufficient illumination to justify the removal of all lighting of signs.

Solar powered sign lights may be considered as a practical alternative to using mains power, especially in situations where electrical connections and cabling are not yet installed.

A. Solar Powered Signs

The installation of electrical connections and cabling to traffic signs can be a significant upfront cost. This process can also add long delays to completing the installation of traffic signs. These facts, coupled with the increasing cost of mains electricity make solar powered signs a very attractive proposition. A solar panel provides free electricity. Whilst a wide range of vehicle-activated signs are solar powered, at this time there are very few solar powered external lights for signs.

IX. Conclusions

The driver's ability to detect and understand a traffic sign is not solely related to its retroreflectivity characteristics, dew and frost significantly reduce the retroreflectivity levels of traffic signs, although also it depends of siting, age and position, so there are to include new elements to increase the visibility of drivers like backing board or solar powered.

References

[1] J. Cooper, K. Stafford, P. Owlett and J. Mitchell. CSS Street Lighting Project SL5/2007. Published Project Report PPR382. Review of the lighting requirement for traffic signs and bollards.
[2] Jennie Oxley and Brian Fildes. Monash University Accident Research Centre. Older pedestrian safety issues.
[3] Jennie Oxley, Bruce Corben and Brian Fildes. Monash University Accident Research Centre. Road environment design for older drivers
[4] Traffic control devices manual. Part 1. General requirements for traffic signs. December 2008. NZ Transport Agency.
[5] 3M Traffic safety systems, HIP specification guidelines.
[6] Eric D. Hildebrand. Reductions in traffic sign retroreflectivity caused by frost and dew.

Open Science Index, Humanities and Social Sciences Vol:7, No:3, 2013 publications.waset.org/8453/pdf