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Conspicuity and Road Safety

Introduction

To see and to be seen is a fundamental prerequisite for the safety of all road users. The visual capacity of the human eye at night is only 5% of its visual capacity during daytime. Visual errors play a very important role as a cause of crashes[1]*. This fact sheet will present ways to improve the conspicuity of traffic signals, road markings, trucks, people being unexpectedly exposed on roads, pedestrians and cyclists.*

Road signals



Traffic signs are one of the primary interfaces between the roadway and the drivers and are used to communicate to drivers information that would otherwise be unobvious. They are there to remind drivers of traffic rules. They can also advice on special dangers and on the way to avoid them. In the modern traffic system driving without signs would be practically impossible or would happen at the cost of countless accidents. This is the reason why coherent, clear and conspicuous traffic signs are an integral part of a traffic system. To be effective, signs must be designed, built and displayed in such a way that the messages they convey are clear, unambiguous, visible and legible.

The lack of traffic signals' conspicuity is often cited as a contributing factor by drivers who are involved in accidents at intersections. Increasing the conspicuity of traffic signals will therefore lead to improved safety performance.

In Canada a total of 19 sites, out of 25 analysed in a study, showed a reduction in the number of accidents after the improvement to the conspicuity of the signal head backboard[2].

A better conspicuity of the signs, text and symbols can lead to earlier legibility by the driver resulting in a shorter reaction time. This is particularly important during the night hours, for older drivers (they need more brightness in order to properly read the sign) and for truck drivers (they have a disadvantage over car drivers as they sit much higher above the headlights and receive the returned light under a much higher observation angle, especially as they come closer to the sign). Finally, improved conspicuity of road signals is needed to offset the changing technology in head light design. The newer version of headlamps significantly reduces indeed the visibility of conventional road signs.

- Two measures to improve road signals

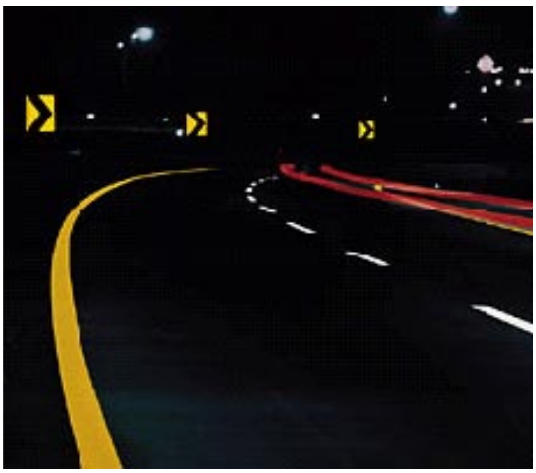
For the moment, there are two measures to improve the conspicuity of road signals: on the one hand, signs which retro reflect the light of vehicle headlamps, on the other hand signs which are lit by fixed auxiliary lighting -- either internal lamps or external luminaries. When fixed auxiliary lighting is not an option, signs should be made from high brightness retro reflective materials that maximise the amount of light returned to the drivers. Ideally, nighttime performance of retro reflective signs should be equivalent to their daytime performance. In addition, fluorescent signs can guarantee an improved performance during the day.

Together with adequate road markings, traffic signs have proven to be a low cost measure with high ratios of benefit to cost. Studies in several countries in construction work zones, school zones and high accidents areas have shown that, whether fluorescent or not, high performance retro reflective signs can have a very positive impact on the driver's behaviour.

"Before and after" studies were performed in the UK of sites at which highly reflective signs were installed. The studies showed statistically significant reductions in injury collisions following the installation of the highly reflective signs.[3]



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Road markings

Clear and visible road markings, coupled with a high level of maintenance, are essential to ensuring a high level of safety on European roads. Road marking must be of the highest quality in order to be visible and lasting and to guarantee a skid resistance that is as good as the one of the adjacent road surface. Application skills will also highly impact on the level of performance and durability. Studies[4] have shown that safe pavement markings should be visible during the night to a degree that allows the driver an absolute minimum of 2.5 seconds reaction time. This can be achieved by an adequate width and retro reflectivity specifications.

- Wet weather conditions

The visibility of road markings is even more important in wet weather conditions. In rainy weather, a reflective water surface often forms on the surface of road markings, with the result that the light from the vehicle is reflected away from it instead of towards it[5]. This is the reason why conventional flat road markings can hardly be seen in the dark when it rains. Although several technologies exist to achieve wet reflectivity, the road authorities rarely require this specification.

- Construction work zones

Yellow temporary road markings play an important role at construction work zones to redirect traffic. When road works are carried out, the existing, permanent markings should be covered to avoid confusion. Once the work is finished the temporary markings should be removed without leaving any trace. Covering with a black paint or bitumen may still cause confusion when the road is wet at night due to the different reflection of the light from the headlamps or street lights.

Effective road marking represents a low cost measure with high ratios of benefit to cost. Therefore road safety audits which need to be performed regularly also should pay a special attention to road markings. Lastly, it is equally important that road markings are continuously and properly maintained.

A study carried out in Norway[6] showed that the benefits of improving the signing of hazardous curves outweighed the costs by a factor of 3.5.

Conspicuity of trucks

Crash investigations show that nearly 5%[7] of severe truck accidents can be traced back to poor conspicuity of the truck or its trailer at night. These accidents can be characterised by the fact that car drivers often fail to recognise trucks or truck combinations driving ahead of them. In most cases trucks are in slow motion, are entering the road or are turning off the road.



Different studies showed that trucks can be rendered much more conspicuous by marking their sides and rear using retro reflective marking tape[8]. Conspicuity marking tape is a high performance retro reflective tape which reflects most of the light falling onto it back towards the light source. The tape, mounted on the rear and sides of the vehicle, enables the driver to identify the truck as an object on the road as well as its height and length. The truck is therefore made visible to other road users thereby reducing accidents, specifically rear and side impacts into large vehicles.

The United Nations Economic Commission for Europe (UNECE) Regulation 104 sets out an international specification for retro reflective marking tape. Vehicles fitted with tape to this standard can be sold and circulate freely in UNECE countries. Another UNECE regulation (R48) sets out the requirements for the installation of lighting and light signaling devices on vehicles: this regulation currently allows (but does not mandate) the installation of conspicuity markings.

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The UK Department for Transport has carried out a consultation with interested parties on whether the reflective tape should be fitted to the rear and side of UK lorries and, possibly, minibuses, coaches and buses. The result was very positive. Italy has independently mandated the fitment of conspicuity marking tape on goods vehicles with a gross vehicle weight exceeding 3.5 tons. In Greece and Spain an obligatory application of UNECE-R104 is planned. Mandatory conspicuity is already in place in a number of countries and, especially in the US, has delivered good results.

In 2004, the European Commission has commissioned a Study[9] which indicates a positive benefit-cost ratio (between 2 and 4) when the tape is applied to new goods vehicles with a gross vehicle weight exceeding 3.5 tons. The highest benefit-cost ratio was achieved for vehicles exceeding 12 tons. This is due to the fact that larger goods vehicles are above-average involved in accidents compared to their share in the vehicle stock.

The Report recommends equipping the side and rear of vehicles heavier than 3.5 tons with a contour marking covering at least 80% of each side and with a line marking when contour marking is impossible. The study also recommends equipping all new vehicles with contour markings and, for the existing vehicle fleet, a transition period for retrofitting of at least six years. According to the study, this would save 165 lives, 857 serious injuries and 1,836 light injuries per year in the EU-15, which would represent a saving of 390 million Euros.

In its 3rd Road Safety Action Programme the European Commission has committed to "improve the visibility of heavy duty vehicles" but no concrete action has been taken so far.

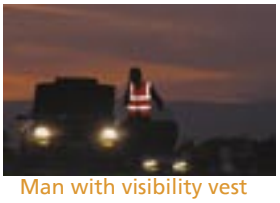
Visibility vests

Drivers, under various circumstances, might be forced to temporarily leave their vehicle. For instance, when an engine breaks down, or the need rises to secure or check the car load, or when there is a tyre puncture.

In such a case, and especially on high speed roads and on motorways, the driver is exposed to an increased risk of accident and should take extra precaution to be visible from the other motorists. A retro reflective vest is in many cases the solution to increase the driver's conspicuity.



Man without visibility vest



Man with visibility vest

Some European countries are taking steps to make the use of visibility vests compulsory for drivers who have to leave their vehicle outside urban areas.

In Portugal and Spain drivers need to carry a visibility vest in the car and wear it outside a broken-down vehicle on motorways or roads outside built-up areas. Austria and Italy have similar laws about wearing vests but no strict legal requirement to have one in the car. The visibility vest is also compulsory in the Czech Republic and Finland for professional drivers. In Germany, it is required (for professional drivers only) by the professional association for health and safety. Other European countries, including Belgium, Sweden and Denmark are discussing the possibility of making the visibility vest obligatory. There is no uniform approach in Europe on whether passengers should also wear a visibility vest in the above mentioned circumstances, and even more about the colour reflectivity of the vest material. The UN recommends in a resolution from 1998 the use of safety clothing made of fluorescent materials fitted with retro reflective bands".

To be effective visibility vests must be produced with high quality materials and comply with European standards (the EN 471 standard, for example, defines the requirements for high visibility clothing). The effectiveness of non-compliant vests is very low and their use could not entail any safety benefit.

A survey conducted on behalf of the Royal Spanish Automobile Club revealed that 63% of all vests sold in the market have safety problems either with regard to the design of the garments or their daytime visibility (coefficient of luminance) or night-time visibility (coefficient of retro reflection)[10]. Taking into account insufficient marking and information leaflets, the percentage of non-compliant garments increased to a total of 87%.

Conspicuity of pedestrians and cyclists

Pedestrians and cyclists can be difficult to see in the road traffic, especially at night and in dark weather conditions. Without wearing something reflective a pedestrian or cyclist is only likely to be visible 30 metres away, in low beam headlights. By wearing something reflective they become visible at 150 metres away. This gives drivers five times the distance to notice them and, more importantly, to avoid them.

In Finland in 2003 more than half of all pedestrian accidents happened during dark hours. The accident investigation teams estimated that at least six of the 55 pedestrian lives would have been saved had they worn a reflector[11]. In 2004 in Latvia 65% of the vulnerable road users' deaths occurred in darkness and twilight. Also, the level of seriousness of the accidents in darkness and twilight was twice higher than in daylight[12]. In The Netherlands a study[13] found that more than 30% of cycle crashes occurring at night or in twilight could have been avoided if the cyclist had been more visible.

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The main intervention pedestrians can make to be more visible and to protect themselves is to wear clothing that increases their visibility, especially in poor daylight and in darkness. The more conspicuous pedestrians are to motor vehicles, the more opportunity they will have to avoid collisions. The use of retroflective accessories or clothes by pedestrians could be particularly useful in avoiding accidents in dark, narrow rural roads and in roads where their presence would be unexpected.

The visibility of the cycle is also an important factor in preventing crashes. Cycles are seldom equipped with proper lamps even though these are available. One reason for this is that cyclists do not perceive a benefit from the lamps because they are too weak to help in seeing the road surface. Moreover, very often the lamps are dynamo-operated and only work when the bike wheels are turning. However, in order to avoid a potential collision, it is fundamental for cyclists to be seen by the other categories of road users. Improving the conspicuity of cycles can contribute to this objective to a great deal.

Therefore, retroflective equipment is as important for cyclists as for their cycles. The use of it will play a big role in avoiding an accident between a cyclist and a motor vehicle.

In Spain retroflective equipment is compulsory for cyclists and pedestrians at night and outside urban areas. In Denmark, legislation requires the fitting of lamps and of front, rear and wheel reflectors. In The Netherlands, all bike tyres' sidewalls must be provided with retro reflective elements. In the UK, the Highway Code recommends the use of retro reflective materials for pedestrian and cyclists in the dark.



References

1 This Fact Sheet does not deal with Daytime Running Lights (DLR), despite their contribution to conspicuity. The issue will be considered in another fact sheet published by ETSC.
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