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Specific problems with exterior glare

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1 Introduction

Car industry registers in the last years a big expansion and nowadays it is the one of the best prosperous branch. Many companies spend many ambitions to realisation of their new ideas, development of useful accessories , for increasing the safety and comfort. Day to day increases the amount of cars on roads.This progress means higher claims for safety of the traffic, what has to be compensated by superior road signs, constuct of new roads and together with the increasing of levels of illumination of public lighting.

For safety of road traffic has a big influence glare effect. At night is the eye adapted on considerably lower luminance as it is at night and therefore is also the eye more glared. In the traffic it can come to every grades of intensity of glare-from observe –to blind glare.

2 Classes of glare in the traffic

Psychological glare (observe and disturb) is mostly caused by the lamps from public lighting. It does not worse directly the ability to see, but it effects untimely endurance of the vision, and sinking of the attention of the car driver and so it increases the risk of accident of the motorways.

It is possible to precede for example to use correctly blinded lamps of public lighting located in adequate hight.

Physiological glare – limited to blinded, will cause measureable fail of recognising of vision. In traffic it should not appear at all. But this demand is hard to keep. By a good application of public lighting it does not come to disability glare, but this glare is caused by reflectors of oncoming vehicles.

From the aspect of trafic accident is very dangerous **mist** glare. This glare is caused by a higher luminance of the ambient before an object, than it has the observed object. Source of this glare is fog, rain, eventually smoke, on which the light from reflectors of a car is diffused, what causes, that barriers, which are below the car can not the car driver recognise, because their luminance, is higher than the surroundings in front of them.

Mist glare markedly sink the visibility and ability of the car driver to recognize barrier. To decrease the risk of traffic accident, can be by sinking the speed of a vehicle.

Fig. 1: Mist glare in the fog

Bizarre case of glare in traffic is the **adaptation** glare. This glare is caused by a sudden change of adaptation luminance and can occur for example by the access of a car driver in to a tunnel, there where does suddenly ends public lighting or by failure power supply of public lighting. This glare is extra dangerous on communications with a higher permited speed limit and with a high frequency of traffic, mostly on highways.

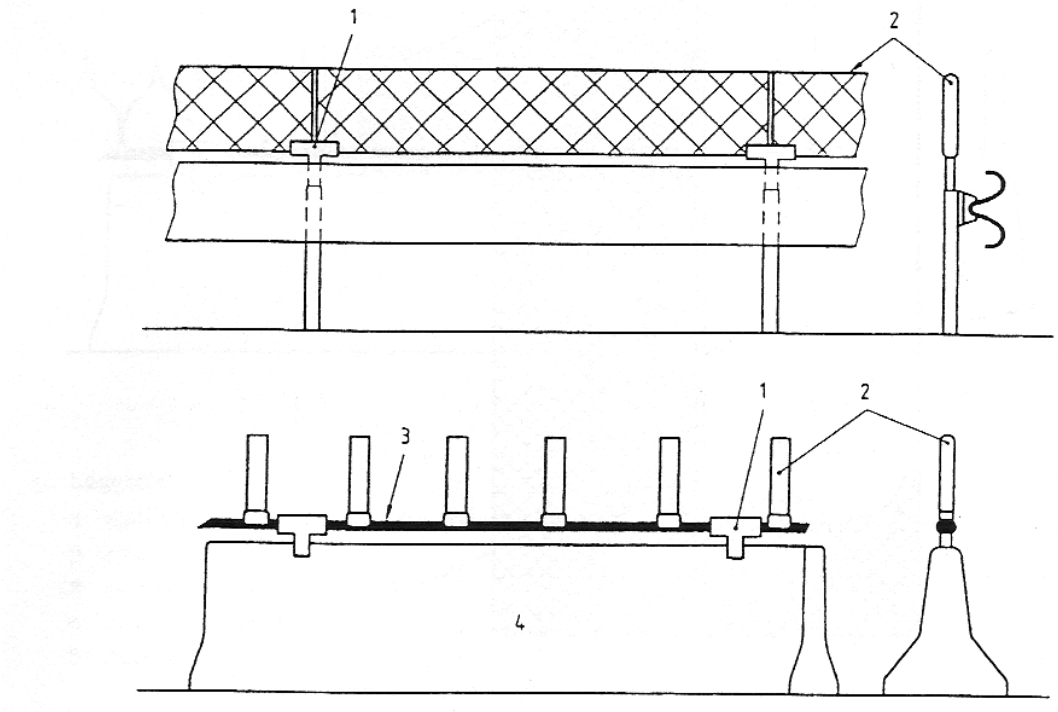
Risk of traffic accidents can be sunk through exactly designed lighting system with adaptation areas and with a quality roads marking.

3 Systems against glare

For prevention of glare from oncoming vehicle there are used systems constructed of shields. This shields reduce glare caused by the oncoming frontal flood-light of oncoming vehicle or by another external lightsources.

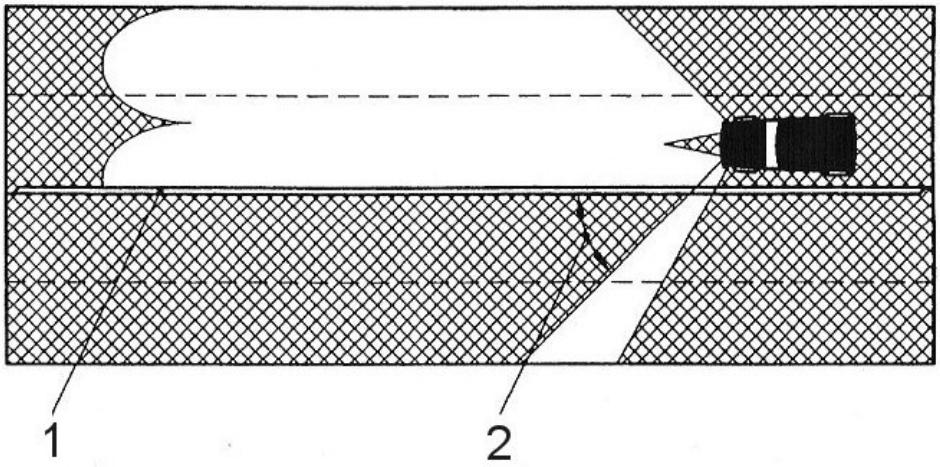
Systems agains glare are usually installed on surface communications there, where it is convenient to reduce the influence of glare.

For example:
-on middle separation line direction divided surface communications;
-between parallel or convergent surface communications with traffic in oncoming traffic;
-at the lightsources of glaring light, reflected on machinery and buildings in the near of oncoming traffic;
-in the near of glaring light from machinery and buildings along oncoming traffic;



1 - fastening device, 2 - antidazzling element, 3 - supporting structure, 4 - foundation

Fig.2: Examples of systems agains glare (according to STN EN 12676-1)



1 – system against glare, 2 – terminal angle

Obr.3: Inhibition of glare by systems of shields (STN EN 12676-1)

4 Reaction time in highway transportation

Impact of disability glare on a human is especially in the increase of reaction time. Reaction time is a time period, which passes from the uprise of a stimulus and answer of it. To this time is also counted discovery and resolution, then information processing and internal command for observance. After this comes a sector wider understood reaction, by which is on the inner order started a real movement (for example, the car driver leaves gas pedal and put his foot on brake pedal). This sector is called muscle reaction.

Braking action starts after the hit of the car driver realized on a perception. Time period between detected dangerous and appereance of braking track on a roadway is called delay time. At this way understood definition consist not just of reaction time, but also a technical delay of brakes and zoom-up braking action. Mean value is at normal conditions (without glare) between (Znalectvo, 1996) 2s, from which is ca.0,7 s reaction time of car driver.

To know the time of delay is very important. By the speed of car 60 $km.h^{-1}$ time of delay 2s will cause, that between detecting of barrier and starting of braking will the car go over 33,3 m, by the speed 90 $km.h^{-1}$ and space 50 m. To this we have to count braking way influenced by persistance of vehicle and we will get the space, on which is the car able to stop.

It is very certain, that the time of delay (reaction time) is by the influence of glare bigger. Nowadays there is passing off study, how will change this values by different conditions and by glare. It turned out, that different conditions from the aspect of visibility are reached by normal weather conditions and by rain. Level of luminance and illumination of roads, which are given by norms, are specified on a dry communication. By wet motorway, there is the character of reflectivity changed from mostly diffusing to mostly mirroring. Luminance of motorway from the wiev of a car driver sinks to about 1/5 opposite the luminance on a dry motorway, but the glare from oncoming vehicle influented by mirror properties of motorway is growing. This causes a significant degradation of visibility and essentially higher risk of traffic accident.

4 Research of exterior glare

First rate target of this research is the improvement of visibility and through this the increasing of safety of traffic. Because it deals with human lifes and big material attributes, any solutions are welcomed, which can help to increase the safety.

Research of exterier glare can be in many ways oriented, but we have to regard also technical and financial possibilities. First we have chosen the research in laboratory conditions. In the first phase there was created a workstation, where is mesaured a dependance differential threshold of the size of glare. This differential threshold of luminance is very nearly related with the visibility of barrier, when is the difference between the luminance of barrier and luminance of background, on which is human eye adapted at night, very low. Visual conditions on workplace were adjusted so, that in the biggest volume answered to real conditions in traffic, during which time were to the intuitus taken luminances of communication, surroundings, sky, intensity of illuminance on a eye of car driver by switched on lower beam and high-beam headlamp oncoming vehicle etc.

Methodics of research

Solitary methodics is found by on so called primary research, by which in laboratory condition based on statistical scoring measured values on chosen pattern of observers is studied the effect of glare of visibility of barrier and competence enough fast and exact reaction.

Measurement workplace is in dark laboratory, that it is prevented entrance of daylight. Different visual conditions in viewing field of observer are formated by a projection on a linen. Measurement is scored by a computer.

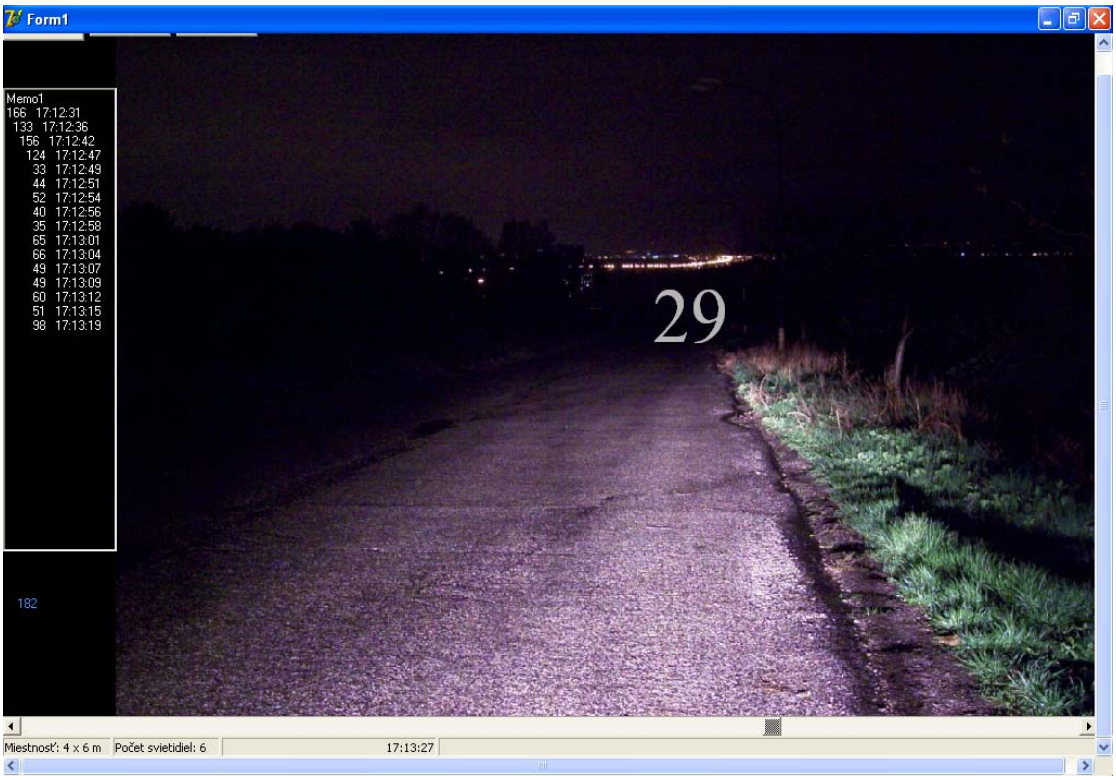


Fig.4: Measurement program for research of efefct from glare on visibility of barrier in traffic

4 Evaluation of measurements

Nowadays there are taking place initial measurements. Their task is the adjusting of border conditions and certification of correctness of suggested methodics. To the research are engaged ten observers in the age between 20 to 55 years.

From measured values we can claim, that by upping the glare is for to recognizing important a higher luminace of a barrier.

Results are presented in the next pictures.

Tab. 1: Average values treshold resolution of luminance
(by terminal conditions according to non-illuminated communication)

Type of glare	Luminance (cd/m^2)	Luminance (%)
Without glare	0,05009	100
Meeting lights	0,061521	123
Full beam	0,081539	163

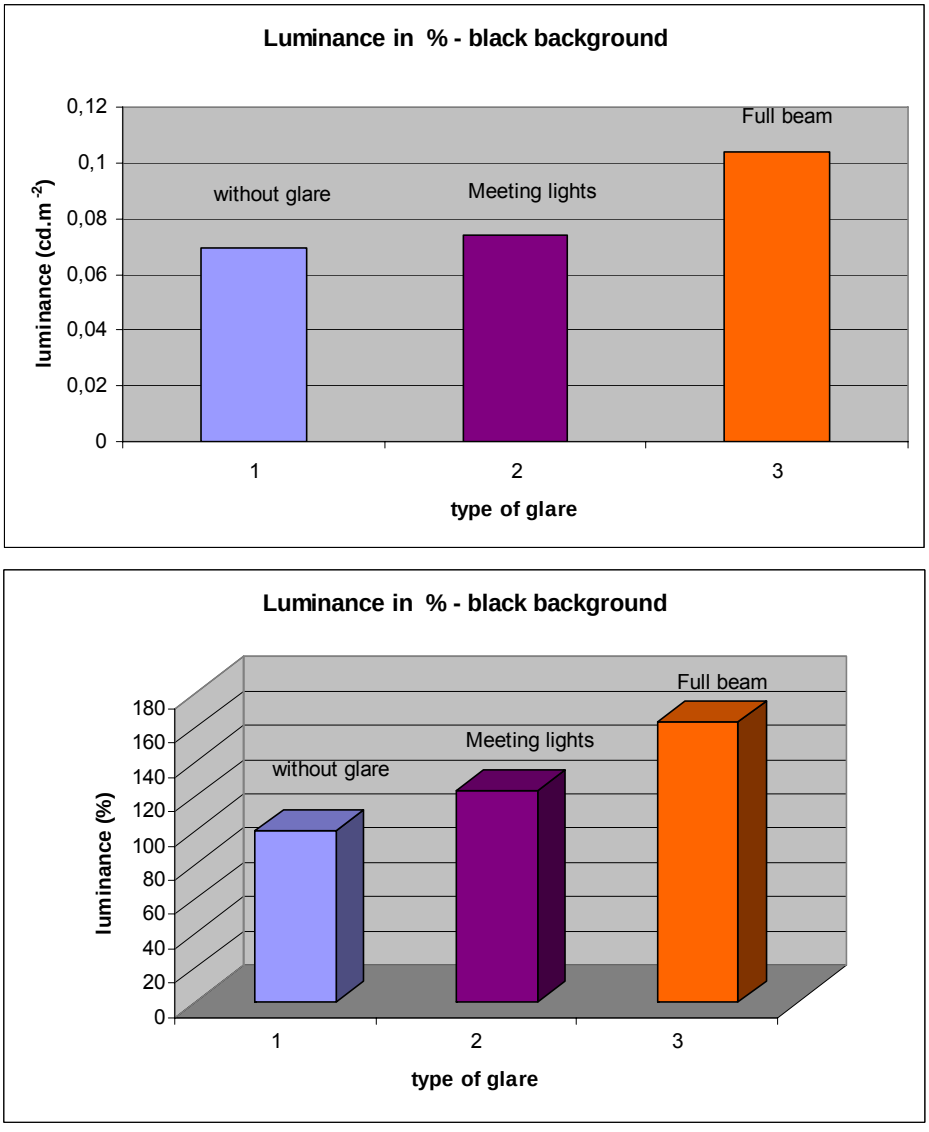


Fig.5,6: Grafical interpretation of values measured on a black background of screen

Tab. 2: Average values treshold resolution of luminance
(by terminal conditions according to illuminated communication)

Type of glare	Luminance (cd/m^2)	Luminance (%)
Without glare	0,069577	100
Meeting lights	0,074166	106,6
Full beam	0,104017	149,5

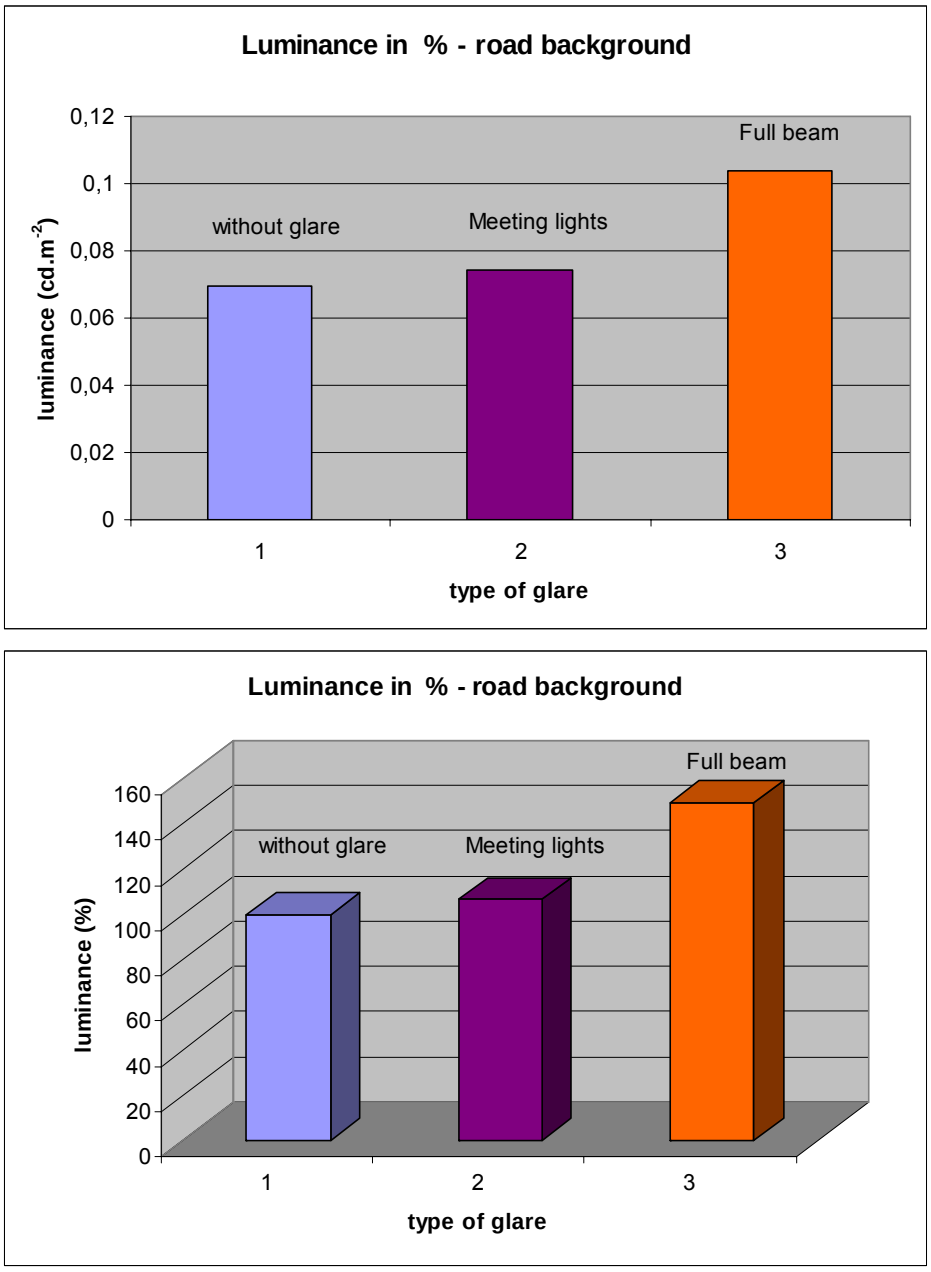


Fig.7,8: Grafical interpretation of values measured on a background of a screen with communication

5 Conclusion

Target of research is to find out the impact of exterier glare on visual performance. By the evaluation of the measurements we can observe, that a percentual growth of the value for a luminace which is useful to recognizing a barrier, depends on adaptive luminance. This growth was by a lower adaptive luminance by glare through lower beam 23 % and by glare through long distance beam did the value increased of 63 % in the comparison with the case without glare. By bigger adaptive luminance was this growth by glare through meeting beams only 6% and by a glare through long distance beams 49,5 % by the comparison without glare.

This means that a good lighting can very markedly decrease the risk of road traffic accidents and can ensure a higher safety on motorways. So much, that visual conditions are very various and dependence of weather conditions, we cannot this first results generalise. We trust, that a detailed research will bring the answer on the question, how can we increase the safety on roads.

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