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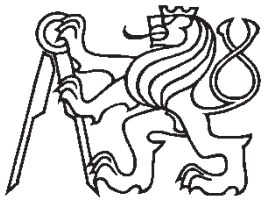

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THE HEADLIGHT ILLUMINANCE IN FRONT OF THE CAR

Master thesis

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Abstract: The aim of this thesis is to provide an insight look into the illuminance in the automotive industry concerning the front headlamps and low beam of light. This thesis is engaged in the summary of key points related to light and lighting matters; an explanation of terms related to the human eye and vision. It studies traffic accidents statistics in this matter and lighting legislations following the recent development. It mentions a short description of various directives, standards and related laws. The next part deals with a detailed description of the illuminance measurement, i.e. the place, cars, headlamps, the measuring device, and conditions. Subsequently, the work is focused on the measured data analysis presented in isolux diagrams, errors in the measurement, and uncertainty problems. The third part represents examples of usage in praxis – characterization of a glare, its definition and types, application of anti-glare system on motorways.

Key words: light, illuminance, headlamp, beam of light, glare, vision, traffic accidents, legislations

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List of Acronyms

IR	Infra-Red
UV	Ultra-Violet
LED	Light-Emitting Diode
HID	High-Intensity Discharge
AHL	Automatic, High Beams/Low Beams
DC	Direct Current
GPS	Global Positioning System
N	North
E	East
CSV	Comma-Separated Values
ČR	Česká republika (Czech Republic)

List of Physical Quantities

Quantity	Symbol	Unit / Unit Name			Relation to Other Units
Wavelength	λ	[m]	↔	metre	
Frequency	f	[Hz]	↔	hertz	s^{-1}
Luminous Flux	Φ	[lm]	↔	lumen	lm = cd·sr
Luminous Intensity	I	[cd]	↔	candela	
Luminance	L	[cd·m^{-2}]	↔	candela per square metre	
Illuminance	E	[lx]	↔	lux	lx = cd·m^{-2}
Voltage	V	[V]	↔	volt	V = m^2·kg·s^{-3}·A^{-1}
		[kV]	↔	kilovolt	1 kV = 1·10^3 V
Power	P	[W]	↔	watt	W = kg·m^2·s^{-3}
Electric Current	I	[A]	↔	ampere	
Temperature	T	[°C]	↔	degree Celsius	K
Time	t	[s]	↔	second	
		[min]	↔	minute	1 min = 60 s
		[h]	↔	hour	1 h = 3600 s
Speed	v	[m·s^{-1}]	↔	metre per second	
		[km·h^{-1}]	↔	kilometre per hour	1 m·s^{-1} = 3,6 km·h^{-1}
Length	l	[m]	↔	metre	
		[mm]	↔	milimetre	1 mm = 1·10^{-3}
		[km]	↔	kilometre	1 km = 1·10^3 m
		[nm]	↔	nanometre	1 nm = 1·10^{-9} m
Mass	m	[kg]	↔	kilogram	

INTRODUCTION

The main purpose to install headlamps to a vehicle was very simple. It was light. People used to search for any source of light from the beginning of the humankind. It allowed them to stay alert during the night time and simply to compensate the weakness that people don't have good vision in the dark environment. People are simply day living creatures.

Time has been running faster during the last hundred years and especially nowadays. People live in a very stressful era when time means mostly more than anything else. This leads to an idea that vehicle headlamps made people more independent and movable at night. Even the bicycle used to have a lamp before cars had had. This lamp provided lighting of an area in front the bicycle. The same still continues and the vehicle headlamps fulfil the identical necessities and needs.

Since the first headlamps were introduced technologies made a huge step forward. Only a few basic components have stayed unchanged and the rest is changing and improving constantly. It is necessary to meet all safety, price, endurance, regulation and legislation requirements which are increasing with the time. Therefore, only responsible and reliable systems of headlamps could achieve in this fight.

As it was said above, time is precious and people are always in a hurry. Subsequently, more and more traffic accident happens. Drivers are not concentrated, feel distracted and it is easy, for example, to overlook other vehicle, red traffic light or Stop road sign. This could happen during the day but also during the twilight and at night time when drivers don't notice even more details which contribute to a traffic accident. The headlamps and optimally aimed beam of light are key factors.

Moreover, it is important for the vehicle active safety and it can prevent many traffic accidents. [1] The collision consequences of vehicles and pedestrians [2] or, for example, vehicle crashes with slip roadways [3] can be elliminated and minimalized by obstacles' recognition in good time when the driver has enough time to pre-empt the accident.

The processing method of this thesis is to present matters concerning light, vision and accident statistics at the beginning. Than this theoretical part turns to the practical one which means that a detail analysis of the illuminance measurement is described:

- cars in the measurement,
- headlamps in the measurement,
- place of the measurement,

- measuring device,
- conditions of the measurement.

The illuminance data are collected, processed and shown in the form of isolux diagrams as a crucial part of this work. Measurement errors or uncertainty are not left out. Finally, these diagrams help and assist in order to define the optimal anti-glare system parameters.