E-street Initiative

Work Package 4.1

Development of legislation, recommendations and standards

24.3.2008

On behalf of the E-Street project (www.e-streetlight.com)

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1. INDRODUCTION

On public roads lighting is a cost effective accident counter measure. On city streets lighting provides general safety, driving comfort and city beautifications. There is no legislation for outdoor lighting. International standards and national guidelines are based on constant values.

This report gives state of the art, describes institutions in the field of lighting instructions. Considerations are given for development of legislation, standards and recommendations taking into account energy saving, environmental aspects and traffic safety.

2. LEGISLATION

The highest rules for road keeping are given in legislation decreed by the Parliament, These are e.g.

- Road Act
- Land use and construction law

Above mentioned laws do not include any technical details. E-street Project can not affect legislation.

A remarkable justification for the E-street project is the Directive 2006/32/EC of 5.4.2006 on energy end-use efficiency and energy services. In accordance with its general forgets member states shall adept and aim to achieve an overall national indicative energy savings target of 9 % for years 2008-2016 to be reacted by way of energy services and other energy efficiency improvement measures. Member states shall take cost-effective, practicable and reasonable measures designed to contribute towards achieving this target. These measures include among others outdoor lighting.

For instance in Finland Ministry of Commerce and Industry has already made agreements with several cities for the saving energy. By the end of 2008 there will be a law, statue or other specification concerning the authorities of government.

3. RECOMMENDATIONS

3.1 International Commission on Illumination (CIE)

3.1.1 General

The best known organisation preparing international recommendations is the CIE. The main goal is advancing knowledge and providing standardisation to improve the lighted environment.

The International Commission on Illumination - also known as the CIE from its French title, the Commission Internationale de l´Eclairage - is devoted to worldwide cooperation and the exchange of information on all matters relating to the science and art of light and lighting, color and vision, and image technology.

With strong technical, scientific and cultural foundations, the CIE is an independent, non-profit organisation that serves member countries on a voluntary basis. Since its inception in 1913, the CIE has become a professional organization and has been accepted as representing the best authority on the subject and as such is recognized by ISO as an international standardization body.

3.1.2 Objectives

The CIE is a technical, scientific and cultural non-profit organization whose objectives are:

- To provide an international forum for the discussion of all matters relating to the science, technology and art in the fields of light and lighting and for the interchange of information in these fields between countries.
- To develop basic standards and procedures of metrology in the fields of light and lighting.
- To provide guidance in the application of principles and procedures in the development of international and national standards.
- To prepare and publish standards, reports and other publications concerned with all matters relating to science, technology and art in the fields of light and lighting.
- To maintain liaison and technical interaction with other international organizations.

It is important to note that in these objectives light and lighting embraces such fundamental subjects as vision, photometry and colorimetry, involving natural and man-made radiations over the UV, the visible and IR regions of the spectrum, and application subjects covering all usage of light, indoors and out, including environmental and aesthetic effects, as well as means for the production and control of light and radiation.
From 1999 onwards also the optical, visual and metrological aspects of the communication, processing and reproduction of images, using all types of analogous and digital imaging devices, storage media and imaging media are covered by CIE.

3.1.3 Organization

The affairs of the CIE are vested in National Committees which have the responsibility for decisions on all matters relating to the organization. The composition of the National Committees varies from country to country, but each is required to represent and have the cooperation of all organizations having an interest in light and lighting. An important factor is the willingness and ability of those who represent the various National Committees to participate in and contribute to the technical activities of the CIE. At the present time the CIE comprises 38 member bodies from all continents.

The success of an organization such as the CIE depends upon the effectiveness of its technical committees. Indeed the objectives of the CIE could not be attained without a suitable and active committee structure which draws upon the expertise of people from all the member countries. Each major subject of interest to the CIE was assigned to one of seven Divisions.

- **Division 1**: Vision and Colour
- **Division 2**: Measurement of Light and Radiation
- **Division 3**: Interior Environment and Lighting Design
- **Division 4**: Lighting and Signalling for Transport

- **Division 5**: Exterior Lighting and Other Applications
- **Division 6**: Photobiology and Photochemistry
- **Division 7**: Not allocated
- **Division 8**: Image Technology

Technical Committees consisting of small groups of experts are established in each Division to work on single subjects. Technical Committee members are experts of the member countries and need not to be Division member. Each Committee is chaired by a TC Chairperson. The intent is that such committees are to concentrate on one specific topic and render a report to the Division for further discussion and approval within a reasonable period of time after which the committee will be discontinued.

3.1.4 Road lighting

3.1.4.1 General

All road lighting matters are included in field of activities of Division 4. Its terms of reference are as follows.

To study lighting and visual signaling and information requirements of transport and traffic, such as road and vehicle lighting, delineation, signing and signaling for all types of public roads and streets, and all kinds of users and vehicles, and visual aids for modes other than road transport.

From the adaptive road lighting point of view the most important technical committee is TC 4-44 “Management and Maintenance of Road Lighting. (Title of TC is developed due to historical reasons and does not in such describe real activities). Terms of reference are: To revise the report CIE 115-1995 “Recommendations for the lighting of roads for motor and pedestrian traffic” in such a way that lighting performance requirements may vary depending on actual status of environmental and traffic conditions.

3.1.4.2 State of the art

The present publication CIE 115-1995 specifies fixed values for lighting parameters and a simple definition for choice of lighting class on different situations. These restrict the modern use of adaptive road lighting in accordance with EuP program and Directive 2006/32/EC on energy end- use efficiency and energy services. Existing extracts are as follows. Quotations are written in italics.

> ***5. QUALITY CRITERIA AND LIGHTING CLASSES FOR MOTOR TRAFFIC***
>
> ***5.2 Choice of lighting class***
>
> *The lighting recommendations are in classes, M1 to M5, which are selected according to the function of the road, traffic density, traffic complexity, traffic separation, and the existence of facilities for traffic control, such as traffic lights. Typical examples are given in Table 5.1. The descriptions of the road are broad so that they can be interpreted to suit individual requirements for national recommendations. When a selection is made all*

road users, including motorists, motor and pedal cyclists, and pedestrians should be considered.

Table 5.1 Lighting Classes for different road types

DESCRIPTION OF ROAD	LIGHTING CLASS
High speed roads with separate carriageways, free of crossings at grade and with complete access control; motorways, express roads. Traffic density and complexity of road layout *(Note 1)*: High Medium Low	 M1 M2 M3
High speed roads, dual carriageway roads. Traffic control *(Note 2)* and separation *(Note 3)* of different types of road user *(Note 4)*: Poor Good	 M1 M2
Important urban traffic routes, radial roads, district distributor roads. Traffic control and separation of different types of road user: Poor Good	 M2 M3
Connecting less important roads, local distributor roads, residential major access roads. Roads which provide direct access to property and lead to connecting roads. Traffic control and separation of different types of road user: Poor Good	 M4 M5

Note 1 *Complexity of road layout refers to infrastructure, traffic movement, and visual surrounds.*
Factors which should be considered are:
- number of lanes, inclines
- signs, and signals.

Entrance and exit ramps, merging traffic, gores, etc., the presence of which should also be considered, are dealt with in chapter 8, the lighting of conflict areas.

Note 2 *Traffic control refers to the presence of signals and signs, and the existence of regulations.*
Method of control are:
- traffic lights, priority rules, priority regulations and signs, traffic signs, directional signs, and road markings.
Where these are absent or sparse the traffic control is regarded as poor, and vice versa.

Note 3 *Separation may be by means of dedicated lanes or by the restriction of use to one or more of the traffic types. The lower grade of lighting can be considered as appropriate when this separation exists.*

Note 4 *Different types of road user are, for example, motors cars, trucks, slow vehicles, buses, pedal cyclists, and pedestrians.*

5.3 Temporal variation of lighting class according to traffic density

Where the Lighting Class of a road is varied to accord with changes in traffic density during the night to conserve energy (for example, the Lighting Class is lowered after rush hours, the changes should be such that they meet all the requirements of the appropriate higher of lower Lighting Class (that is, if the average luminance of the road surface is reduced to that of lower class, the uniformity and glare criteria of that class shall be fulfilled).

6. REQUIREMENTS FOR MOTOR TRAFFIC – LUMINANCE CONCEPT

The controlling criteria are;

- *luminance level und uniformity of the carriageway*
- *lighting of the surrounds of the road,*
- *limitation of glare, both disability and discomfort,*
- *direct visual guidance*

The numerical description of the first three criteria and the recommended values for them under various traffic situations are given in Table 6.1. It is not possible at present to quantify direct visual guidance, but reference should be made to clause 6.8 for practical implementation. For advice on appearance and environmental aspects see chapter 10.

The lighting criteria used in Table 6.1 are maintained average road surface luminance (L_{ave}), overall (U_o). and longitudinal (U_l) uniformity of luminance, surround ratio (SR), and threshold increment (TI). A detailed description of these terms is given below. These apply to dry roads; clause 6.7 gives recommendation for wet roads.

Table 6.1. Lighting requirements for motor traffic, based on road surface luminance (NR is no requirement)

LIGHTING CLASS	EXTENT OF APPLICATION				
	All Roads	All Roads	All Roads	Roads with few or no Intersections	Roads with Footways not lit to Classes P1 to P4 in Clause 9.4
	$\bar{L}$ (cd.m^{-2}) Minimum Maintained *Clause 6.1*	U_o Minimum *Clause 6.2*	*TI* (%) Maximum Initial *Clause 6.3*	U_l Minimum *Clause 6.4*	*SR* Minimum *Clause 6.5*
M1	2,0	0,4	10	0,7	0,5
M2	1,5	0,4	10	0,7	0,5
M3	1,0	0,4	10	0,5	0,5
M4	0,75	0,4	15	NR	NR
M5	0,5	0,4	15	NR	NR

8. LIGHTING OF CONFLICTS AREAS

Table 8.1. Lighting requirements for conflict areas

LIGHTING CLASS	$\bar{E}$ (lx) over whole of used surface Minimum Maintained	U_0(E) Uniformity of Illuminance Minimum
C0	50	0,40
C1	30	0,40
C2	20	0,40
C3	15	0,40
C4	10	0,40
C5	7,5	0,40

Table 8.2 gives examples of the application of Table 8.1 to typical conflict areas. In this table the letter in brackets is the Class Number, so, for example, C(N) = M (N-1) would signify that the conflict area class is C2 if the most important road leading in to conflict area is M3.

Examples of the application of Lighting Classes in conflict areas where luminance is not applicable.

CONFLICT AREA	ILLUMINANCE LIGHTING CLASS
Underpasses	C(*N*) = M(*N*)
Junctions, gores, ramps, weaving sections, areas with restricted lane width	C(*N*) = M(*N*-1)
Railroad crossings: simple complex	 C(*N*) = M(*N*) C(*N*) = M(*N*-1)
Roundabouts with no signals: complex or large medium complexity simple or small	 C1 C2 C3
Queuing areas: complex or large medium complexity small or simple	 C1 C3 C5

09. ROAD LIGHTING FOR THE PEDESTRIAN

Table 9.1 Lighting Classes for different road as types in pedestrian areas.

DESCRIPTION OF ROAD	LIGHTING CLASS
High prestige roads	P1
Heavy night-time use by pedestrians or pedal cyclists	P2
Moderate night-time use by pedal cyclists or pedestrians	P3
Minor night-time use by pedal cyclists or pedestrians solely associated with adjacent properties	P4
Minor night-time use by pedal cyclists or pedestrians solely associated with adjacent properties. Important to preserve village or architectural character of environment	P5
Very minor night-time use by pedal cyclists or pedestrians solely associated with adjacent properties. Important to preserve village or architectural character of environment	P6
Roads where only visual guidance provided by the direct light from the luminaires is required	P7

Table 9.2 Lighting requirements for pedestrian traffic.

LIGHTING CLASS	HORIZONTAL ILLUMINANCE (lx) on whole of used surface Maintained	
	AVERAGE *Sub-clause 9.3.1*	MINIMUM *Sub-clause 9.3.1*
P1	20	7,5
P2	10	3
P3	7,5	1,5
P4	5	1
P5	3	0,6
P6	1,5	0,2
P7	Not applicable	Not applicable

3.1.4.3 Proposed new recommendations

Report CIE 115-1995 is under revision, Technical Committee TC 4-44 will revise the publication in such a way that lighting performance requirements may vary depending on actual status of environmental and traffic conditions.

Technical committee, consisting 23 active members and 5 advisors representing 15 countries, has carefully considered the whole content of report. The committee has met several times and has prepared the final draft in March 2008 for committee ballot Divisional and Board ballot will be conducted in summer 2008. The report will hopefully be published also during 2008.

It is also to be mentioned that five of the above mentioned committee members are active participants with E-street project.

Compared to the existing publication the revised version gives basis for the adaptive lighting and includes practical, easily used method for selection of lighting class. This selection procedure has same parameters as in the technical report CEN/TR 13201-1. See paragraph 4.2.2.1.

Because the draft is in the voting stage and it is not yet accepted by the CIE Board only few subjects are presented as an example.

From the E-Street Project point of view the most important chapters are presented in the following extract from the final draft. Quotations are written in italics.

1. INTRODUCTION

1.2 Need for road-lighting

Rehabilitation of obsolete and uneconomic installations is important. It is possible to obtain higher luminance values with lower energy consumption. Upgraded lighting and control systems will often result in good cost-benefit ratios and short amortization periods.

The visual needs of road users under reduced traffic volumes during certain periods of night or under varying weather conditions, and the positive benefits of reduced energy consumption and potential environmental improvements, are some of the considerations for the installation of adaptive road lighting. There are suitable instruments, devices and methods which can be used for the intelligent control of a road lighting installation. The control systems range from very simple to the most modern applications.

6. QUALITY CRITERIA AND LIGHTING CLASSES

6.2 Selection of lighting classes

6.2.1 Normal lighting

Normal lighting is that class which is appropriate if the same level is to be used throughout the hours of darkness, selected from table. In selecting the normal class the maximum value of the selection parameters likely to occur at any period of operation should be considered, e.g. for traffic volume consider peak hourly value.

The installation should be designed to comply with all the quantitative and qualitative requirements of the selected class.
Many countries have developed valid systems to determine the appropriate normal lighting class. (CEN CR 14380:2003, CEN TR 13201-1:2004, CERTU 2007, BS 5489-1:2003 Code of practice for the design of road lighting - Part 1: Lighting of roads and public amenity areas. A system which can be used to determine the normal lighting class for motor traffic, conflict areas and road lighting for pedestrians is given.

For simplicity only the most important parameters are summarized in table 1 for ordinary motorized traffic. The descriptions of the parameters and the associated options are broad so that they can be interpreted to suit individual requirements for national recommendations. In some cases risk analysis or other consideration (environmental for example) could lead to the consideration of other parameters. When a selection is made, all road users, including motorists, motor and pedal cyclists, and pedestrians should be considered.

Examples of the selection of lighting classes using this system are given.

6.2.1 Adaptive lighting

As indicated in clause 6.2.1, the normal lighting class is selected using the most onerous parameter values, and the application of this class may not be justified throughout the hours of darkness. (This might be under changing conditions e.g. weekends, different weather conditions) Temporal changes in the parameters under consideration when selecting the normal class could allow, or may require, an adaptation of the normal level of average luminance or illuminance, usually by reducing the level. The most important parameters in this respect are likely to be traffic volume and composition, weather conditions but ambient luminance can also have an influence.

The adapted lighting level or levels should be the average luminance or illuminance from a class or classes in the same table from which the normal class has been selected.

Table 1 can be used to select the appropriate adapted lighting class or classes for different periods of the hours of darkness when the value of the selection parameters is significantly different.

The examples of the use of the tables include the selection of the adapted lighting classes, and it can be seen that only the average level of luminance or illuminance is varied.

It is important that the changes in the average lighting level do not affect the other quality criteria outside the limits given in the system of lighting classes. Reducing the light output from every lamp by the same amount using dimming techniques will not affect luminance or illuminance uniformity, or the object contrast but the threshold contrast increases. Reducing the average level by switching off some luminaires will not fulfil the quality requirements and is not recommended.

The use of adaptive lighting can provide significant reduction in energy consumption, compared with operating the normal lighting class throughout the night.

Where the pattern of variation in parameter values is well known, such as from a record of traffic counts on traffic routes, or can be reasonably assumed, as in many residential areas, a simple time based control system may be appropriate.

In other situations an interactive control system linked to real-time data may be preferred. This approach will permit the normal class to be activated in the case of road works, serious accidents, or bad weather or poor visibility.

7. REQUIREMENTS FOR MOTORIZED TRAFFIC – THE LUMINANCE CONCEPT

The M lighting classes are intended for drivers of motorized vehicles on traffic routes, and in some countries also on residential roads, allowing medium to high driving speeds. The lighting recommendations, given in classes M1 to M6, depend on the geometry of the relevant area and on the traffic and time dependant circumstances. The appropriate lighting class has to be selected according to the function of the road, the design speed, the overall layout, the traffic volume and composition, to the environmental conditions.

For the determination of the M lighting class to be applied the appropriate weighting factors for the different parameters have to be selected and added up to find the sum of the weighting values (SWV). The number of the lighting class M is then calculated as:

Number of lighting class M = 6 - SWV

Careful selection of appropriate weighting factors will yield numbers between 1 and 6. In some cases it may be necessary to round to the nearest whole number, or to limit the range from one to six.

Table 1: Parameters for the selection of M lighting class

Parameter	***Options***	***Weighting Factor WV***	***WV Selected***
Speed	*High*	*1*	
	Moderate	*0*	
Traffic volume	*Very high*	*1*	
	High	*0.5*	
	Moderate	*0*	
	Low	*-0.5*	
	Very low	*-1*	
Traffic composition	*Mixed with high percentage of non-motorized*	*1*	
	Mixed	*0.5*	
	Motorized only	*0*	
Separation of car-riageways	*No*	*1*	
	Yes	*0*	
Intersection density	*High*	*1*	
	Moderate	*0*	
Parked vehicles	Present	1	
	Not present	0	
Ambient luminance	Very high	1	
	High	0.5	
	Moderate	0	
	Low	-0.5	
	Very low	-1	
Visual guidance / traffic control	Poor	0.5	
	Good	0	
	Very good	-0.5	
		Sum of **W**eighting **V**alues	**SWV**

The controlling criteria for the lighting of roads for motorized traffic are the luminance level and uniformity of the carriageway, the illuminance level of the surrounds of the road, the limitation of disability and discomfort glare, and the requirements for direct visual guidance. Recommended values are given in table 2 for the lighting classes M1 to M6, reflecting various traffic situations.

The lighting criteria used are the maintained average road surface luminance (L_{av}), the overall (U_o) and longitudinal (U_l) uniformity of the luminance, the surround ratio (SR), and the threshold increment (TI).
These values apply to roads which are sufficiently long so that the luminance concept can be used, outside conflict areas and/or outside areas with measures of traffic calming. The surround ratio is considered for roads with adjacent footpath/cycle path only when no specific requirements are given.

Table 2: Lighting requirements for motorized traffic, based on road surface luminance

Lighting class	Road surface luminance				Threshold increment	Surround ratio
	Dry			Wet *		
	L_{av} in cd/m^2	U_o	U_l	U_o	TI in %	SR
M1	2.0	0.40	0.70	0.15	10	0.5
M2	1.5	0.40	0.70	0.15	10	0.5
M3	1.0	0.40	0.60	0.15	10	0.5
M4	0.75	0.40	0.60	0.15	15	0.5
M5	0.50	0.35	0.40	0.15	15	0.5
M6	0.30	0.35	0.40	0.15	20	0.5

Applicable **in addition to dry condition, where road surfaces are wet for a substantial part of the hours of darkness and appropriate road surface reflectance data are available.*

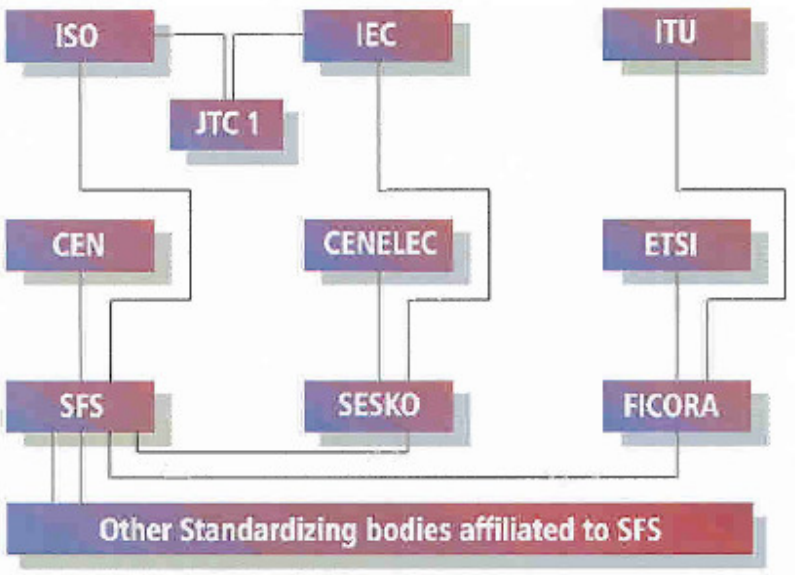
Furthermore is the draft there are considered in the same way as above the following subjects:

- *lighting of conflict areas*
- *road lighting for pedestrians*
- *appearance of environmental aspects*
- *vision concept*
- *references*
- *annexes*
  - *economic calculations*
  - *road lighting under snow conditions*
  - *threshold increment*
  - *control of glare in pedestrian and low speed traffic*
  - *examples for lighting classes*

4. STANDARDS

4.1 World map of standardisation

Standardisation is organized on the global, European and national levels. The structure is shown in the following chart. The figure is Finnish example but following chart. The figure is Finnish example but the system is similar in European countries .



- ISO International Organization for Standardization
  IEC International Electrotechnical Commission
  JTC 1 ISO/IEC Joint Technical Committee 1
  ITU International Telecommunication Union

  CEN Comité Européen de Normalisation
  CENELEC Comité Européen de Normalisation Electrotechnique
  ETSI European Telecommunication Standards Institute

  SFS Finnish Standards Association
  SESKO SESKO Standardization in Finland
  FICORA Finnish Communication Regulatory Authority

ISO (International Organization for standardization) is the world's largest developer and publisher of International standards.

ISO is a network of the national standards institutes of 157 countries, one member per country, with a central Secretariat in Geneva, Switzerland, that coordinates the system.

ISO is a non-governmental organization that forms a bridge between the public and private sectors. On the one hand, many of its member institutes are part of governmental structure of their countries, or are mandated by their government on the other hand, members have their roots uniquely in the private sector, having been set up by national partnerships of industry associations.

Therefore, ISO enables a consensus to be reached on solutions that meet both the requirements of business and the broader needs of society.

ISO forms a bridge between the public and private sectors.

CEN, the European Committee for Standardization, was founded in 1961 by the national standards bodies in the European Economic Community and EFTA countries.

Now CEN is contributing to the objectives of the European Union and European Economic Area with voluntary technical standards which promote free trade, the safety of workers and consumers, interoperability of networks, environmental protection, exploitation of research and development programmes, and public procurements.

CEN is a non-profit making technical organisation set up under Belgian law.

SESKO, Eletrotechnical Standardization in Finland is an independent standards organization composed of 21 private and governmental bodies representing the main interest groups in the electrical and electronics field. SESKO forms the Finnish National Committee of IEC and CENELEC.

At present, there exist mote than 600 (about 20 000 pages) published electrotechnical SFS-standards in Finnish. Almost 90 % of them are based on international (IEC) and European (EN) standards.

SESKO is a member of the Finnish Standards Association **SFS** which is responsible for the publication and sales of all national standards offered by various branch organizations.

4.2 State of the art in the field of road lighting

4.2.1 ISO

The existing joint ISO/CIE standards are as follows:

ISO 0526/CIE S005 CIE standard illuminants for colorimetry, 1999.
ISO /CIE 10527 Colorimetric observers, 1991 S002,1986)
CIE S004-2001 Colours of light signals, 2001
ISO 16508/CIE S006 Road traffic light – 200 mm roundel signals photometric properties, 1999
ISO 17166/CIE S007 Erythema reference action spectrum and standard erythema dose,1998.

ISO 8995/CIE S2008-2001 Lighting of indoor work places, 2001
CIE S2009:2002 Photobiological safety of lamps and lamp system, 2002.
ISO 15469/CIE S011:2003 Spatial distribution of daylight - CIE standard general sky.2003.
CIE A013:2003 International standard global UV index, 2003
CIE S010:2004 Photometry – The CIE system of physical photometry, 2004
DS012.3:2004 Standard method of assessing the spectral quality of daylight simulators for visual appraisal and measurement of colour, 2002.
DS015.2:2004 Lighting of work places – outdoor work places, 2002

4.2.2 CEN

There are four existing documents, one informative technical report and three standards. These are worked out by the Joint Working Group of CEN/TC169 “Light and Lighting” and CEN/TC226” Road Equipment”.

4.2.2.1 Selection of lighting classes

The document CEN/TR13201-1:2004 “ Road Lighting Part 1: Selection of lighting classes” has been prepared by Technical Committee CEN/TC 169 “Light and Lighting”. This informative technical report recommends the lighting classes set out in the standard EN13201-2 and gives guidelines on the application of these classes.

To do above mentioned, the report includes a system to define an outdoor public traffic area in terms of parameters relevant to lighting. To assist in the applications of classes, it suggests a practical relationship between the various series of lighting classes, in terms of comparable or alternative classes. The parameters used allow:
a) a lighting situation to be described in terms of
- the geometry of the area under consideration
- the use of the area
- the influence of the surrounding environment
b) a specific approach to situations to be taken to enable the effective use of energy.

The process is extremely detailed and complicated. Therefore planners and designers are reluctant to use this recommendation in their practical activities. Following extract from the document gives one representative example. Quotations are written in italics.

> ***4. Outline of selection procedure***
>
> *This document is arranged in such a way that a step selection procedure may be followed to arrive at the appropriate lighting recommendations:*
>
> *a) define the public traffic area in one or more relevant areas and select the set of lighting situations (5.1):*
> *b) go to table indicated for the selected set (see Annex A);*
> *c) define the relevant area in detail (see 5.2 and 5.3);*
> *d) select the range of lighting classes;*
> *e) select one lighting class from the range;*
> *f) find the lighting performance requirements for the selected lighting class(es);*
> *g) consider the general recommendations (see Clause 6).*

Table 1 — Grouping of lighting situations

Typical speed of main user km/h	User types in the same relevant area			Sets of lighting situations
	Main user	Other allowed user	Excluded user	
> 60	Motorised traffic		Slow moving vehicles Cyclists Pedestrians	A1
		Slow moving vehicles	Cyclists Pedestrians	A2
		Slow moving vehicles Cyclists Pedestrians		A3
> 30 and ≤ 60	Motorised traffic Slow moving vehicles	Cyclists Pedestrians		B1
	Motorised traffic Slow moving vehicles Cyclists	Pedestrians		B2
	Cyclists	Pedestrians	Motorised traffic Slow moving vehicles	C1
> 5 and ≤ 30	Motorised traffic Pedestrian		Slow moving vehicles Cyclists	D1
		Slow moving vehicles Cyclists		D2
	Motorised traffic Cyclists	Slow moving vehicles Pedestrians		D3
	Motorised traffic Slow moving vehicles Cyclists Pedestrians			D4
Walking speed	Pedestrians		Motorised traffic Slow moving vehicles Cyclists	E1
		Motorised traffic Slow moving vehicles Cyclists		E2

A.1 Lighting situations — set A1

Table A.1 — Recommended range of lighting classes

Main weather type	Separation of carriageways	Type of junctions		Traffic flow vehicles per day								
		Interchanges	Intersections	< 15 000			15 000 to 25 000			> 25 000		
		spacing, distance between bridges	density									
		km	intersections/km	←	o	→	←	o	→	←	o	→
Dry	Yes	> 3		ME5	ME4a	ME3a	ME4a	ME3a	ME2	ME4a	ME3a	ME2
		≤ 3		ME4a	ME3a	ME2	ME4a	ME3a	ME2	ME3a	ME2	ME1
			< 3	ME5	ME4a	ME3a	ME5	ME4a	ME3a	ME4a	ME3a	ME2
			≥ 3	ME4a	ME4a	ME3a	ME4a	ME3a	ME2	ME3a	ME2	ME 1
	No	> 3		ME4a	ME3a	ME2	ME3a	ME2	ME1	ME3a	ME2	ME1
		≤ 3		ME3a	ME2	ME1	ME3a	ME2	ME1	ME2	ME2	ME1
			< 3	ME4a	ME4a	ME3a	ME4a	ME3a	ME2	ME3a	ME2	ME1
			≥ 3	ME4a	ME3a	ME2	ME3a	ME2	ME1	ME2	ME2	ME1
Wet				Choice as above, but select MEW classes								

Table A.2 — Recommended selection from range

Conflict area	Complexity of visual field	Difficulty of navigational task	Ambient luminance		
			low	medium	high
No	Normal	Normal	←	←	o
		Higher than normal	o	o	→
	High	Normal	←	o	o
		Higher than normal	o	→	→
Yes			→ [a]		

[a] For conflict areas, luminance is the recommended design criterion. However, where viewing distances are short and other factors prevent the use of luminance criteria, illuminance may be used. Comparable CE classes to recommended ME classes can be found in Table 3.

Table 2 — Specific parameters

Parameters		Options
Area (geometry)	Separation of carriageways	Yes No
	Types of junctions	Interchanges Intersections
	Interchange spacing, distance between bridges	>3 km ≤ 3 km
	Intersection density	< 3 intersections/km ≥ 3 intersections/km
	Conflict area	No Yes
	Geometric measures for traffic calming	No Yes
Traffic use	Traffic flow of vehicles per day	< 4 000 4 000 to 7 000 7000 to 15 000 15 000 to 25 000 25 000 to 40 000 > 40 000
	Traffic flow of cyclists	Normal High
	Traffic flow of pedestrian	Normal High
	Difficulty of navigational task	Normal Higher than normal
	Parked vehicles	Not present Present
	Facial recognition	Unnecessary Necessary
	Crime risk	Normal Higher than normal
Environmental and external influences	Complexity of visual field	Normal High
	Ambient luminance	Rural Urban City centre
	Main weather type	Dry Wet

6.2 Lighting classes per sets of situations

The Lighting recommendations are specific to each relevant area. For each set of situations as specified in Table 1, specific recommendations are given in the Tables of Annex A, which each consist of a pair of Tables from Tables A1 to A20.

- *In the "odd numbered" Tables, by consideration of the relevant parameters, a box is selected containing three lighting classes which comprise the recommended range for the particular situation;*
- *In the "even numbered" Tables, a selection from that range is made:*
- *An arrow to the left indicates the lighting class at the left side of the select box;*
- *An Arrow to the right indicates the lighting class at the right side of the selected box*
- *A zero indicates the lighting class in the middle of the selected box*

6.3 Adjacent areas

There should not be a difference greater than two comparable classes between adjacent areas. The area with the highest recommended lighting level is the reference area.

In order for this recommendation to be applied when adjacent areas have lighting recommendations based on luminance and horizontal luminance, Table 3 gives lighting classes of comparable lighting level, using the " ME/MEW#, " CE " and "S" lighting classes from of EN 13201-2:2003, Tables 1, 2 and 3 respectively.

Table 3 — Lighting classes of comparable1) lighting level

	ME 1	ME 2	ME 3	ME 4	ME 5	ME 6		
	MEW 1	MEW 2	MEW 3	MEW 4	MEW 5			
CE 0	CE 1	CE 2	CE 3	CE 4	CE 5			
			S 1	S 2	S 3	S 4	S 5	S 6

[1] For ME / MEW classes: CIE road surface reflectance of CIE publication 66:1984, Table C.2.

When a carriageway is defined as a separate area, adjacent traffic areas should always be defined and this recommendation applied to ensure adequate lighting of these areas in relation to the carriageway.

When there are no traffic areas adjacent to the carriageway and "ME" lighting classes are used. The surround ratio is applied.

6.4 Alternative an additional lighting classes

The Tables in Annex A give recommendations based on illuminance or horizontal luminance.

In some countries there may be a preference for:

- *Using hemispherical illuminance alternatively to horizontal illuminance. In this case "Á" lighting classes of EN 13201-2:2003, Table 4 may be applied as alternatives to the recommended "S" lighting classes of EN 13201-2:2003, Table 3, acording to Table 4.*

Table 4 – "A" classes of alternative lighting level to "S" classes

Table 4 — « A » classes of alternative lighting level to « S » classes

Reference class	S1	S2	S3	S4	S5	S6
Alternative class		A1	A2	A3	A4	A5

- *Adding recommendations to horizontal illuminance by using semicylindrical or vertical illuminance. In this case "ES" or "EV" lighting classes of EN 13201.2:2003, Table 5 or Table 6 can be added to the recommended "CE" or "S" lighting, classes according to Table 5.*

Table 5 — « ES » and « EV » classes additional to « CE » or « S » classes

Reference class	CE0	CE1	CE2	CE3 S1	CE4 S2	CE5 S4 S3	S4	S5	SE6
Alternative additional classes	ES1	ES2 EV3	ES3 EV4	ES4 EV5	ES5	ES6	ES7	ES8	ES9

4.2.2.2 EN 13201-2: 2003-Part: Performance requirements

This part of this European Standard defines, according to photometric requirements, lighting classes for road lighting aiming at the visual needs of road users, and it considers environmental aspects of road lighting.

Lighting parameters are defined with fixed values.

One of the basic sources is CIE Publication 115:1995 “Recommendations for the Lighting of roads for roads and pedestrian traffic”.

4.2.2.3 EN 13201-3:2003-Part 3: Calculation of performance

The calculation methods described in this part enable road lighting quality characteristics to be calculated by agreed procedures so that results obtained from different sources will have uniform basis.

4.2.2.4 EN 13201-4: 2003-Part4: Methods of measuring lighting performance

This part of standard specifies the procedures for making photometric and related measurements of road lighting installations. Examples are given of the form of test report.

4.3 Proposal for revisions

4.3.1 ISO

When the report CIE 115:2008 is approved and published CIE CB will negotiate about the possible ISO standard.

4.3.2 CEN

CEN publication 13201 consists of four parts.

4.3.2.1 Selection of lighting class

Document CEN/TR 13201-1. Road lighting. Selection of lighting classes is a technical report. This is informative not a standard.

This document should be revised in accordance with the revised report CIE 115:2008. Selection of lighting class can not be standardised because the subject is depending of national lighting and traffic safety policy as well as financial possibilities and allocation.

The German delegate in CEN/TC169 has presented the situation in CIE/TC 4-44 and E-street project at the committee meeting 27.9.2007 in London.

The committee made the following resolution.

CEN TC/169 agreed to re-establish the CEN/TC 169/226 JWG under the Convenorship of David Coatham with the first task to develop EN 13201-5: Energy efficiency rquirements and subsequent revision of TR 13201 Part 1 and EN 13201 Parts 2-4.

4.3.2.2 Performance requirements, calculation and measuring methods

These standards, parts 2, 3 and 4 should be reviewed and revised, especially part 2, in accordance with the revised publication CIE 115:2008. Cf 3.1.4.3.

The Finnish delegate in CEN/TC 226 presented activities in CIE/TC 4-44 and E-street project at the committee meeting on 14.-15.6.2007 in Oslo. The committee will consider the revision of standards.

4.3.2.3 Organisation

Organisation and management of activities depends on the decisions of committees 169 and 226.

Easiest solution could be the re-start of the Joint Working Group (JWG).