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Foreword

This document (CEN/TR 13201-1:2014) has been prepared by Technical Committee CEN/TC 169 “Light and lighting”, the secretariat of which is held by DIN.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes CEN/TR 13201-1:2004.

This revised publication includes a simplified system of guidelines for selection of the lighting classes. The most important parameters are listed for the different lighting situations - motorised traffic areas, conflict areas, and pedestrian/low speed areas. The parameters include the design speed, the traffic volume and traffic composition, the function of the overall layout of the road, and the environmental conditions.

Road lighting is dealt with by CEN as follows:

— CEN/TR 13201-1: *Road lighting – Part 1: Guidelines on selection of lighting classes.*

— EN 13201-2: *Road lighting – Part 2: Performance requirements*

— EN 13201-3: *Road lighting – Part 3: Calculation of performance*

— EN 13201-4: *Road lighting – Part 4: Methods of measuring lighting performance*

— prEN 13201-5: *Road lighting – Part 5: Energy performance indicators*

Introduction

This document offers guidance on the selection of lighting classes and related aspects. It is applicable to fixed lighting installations intended to provide good visibility to users of outdoor public traffic areas during the hours of darkness to support traffic safety, traffic flow and public security.

The document offers two alternative examples of selection of lighting classes, one based on simple lighting class and the other giving a more refined result within the lighting class. Both methods provide comparable lighting classes and are interchangeable. Any adaptation of either of these methods or any other method can be used instead, on the national level.

1 Scope

This Technical Report specifies the lighting classes set out in EN 13201-2 and gives guidelines on the selection of the most appropriate class for a given situation. To do this, it includes a system to define appropriate lighting classes for different outdoor public areas in terms of parameters relevant to guarantee the aims presented in introductions.

The decision on whether a road should be lit is defined in the national road lighting policy. This varies by country or municipality. Specific guidelines are usually available at national level for each country. This Technical Report does not give the criteria on which a decision to light an area can be made, nor on how a lighting installation should be used. Further guidance is given in CIE 115:2010 (Paragraph 1.2 and Annex A).

The methods presented in Clauses 5, 6 and 7 have to be considered as the starting points of a comprehensive approach for the normal road lighting. In that sense, the models cannot cover all the different road cases; they introduce general parameters and the impact on lighting requirements. Only the real situation and its unique characteristics (geometry of the road, marking, visual environment, difficulty of the navigation task, lack of visibility, risks of glares due to existing elements, local weather, specific users such as high rate of elderly or visually impaired people, etc.) can lead to a final determination of the appropriate lighting class applying risk evaluation techniques.

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 which justify the installation of adaptive road lighting. There are a variety of 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 sophisticated applications. Annex B is of assistance in choosing the correct lighting level when adaptive lighting is used as it provides a more refined evaluation of the luminance or illuminance levels within the specific lighting class. Whilst the luminance or illuminance levels may be varied to suit reduced traffic volumes, weather conditions or other parameters the quality parameters of the applicable lighting class specified in EN 13201-2 should be maintained at all times.

Renewal or refurbishment of obsolete and uneconomic installations is important. It may be possible to obtain more adapted lighting levels with lower energy consumption using new designs and new technology. The upgrading of lighting and control systems will often give good cost-benefit ratios and short amortisation periods.

This document does not give guidelines on the selection of lighting classes for toll stations, tunnels or canals and locks.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 13201-2, *Road lighting - Part 2: Performance requirements*

EN 13201-3, *Road lighting - Part 3: Calculation of performance*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 13201-2 and EN 13201-3 and the following apply.

3.1
normal lighting class
class with the maximum value of average luminance or illuminance at any period of operation

3.2
adaptive lighting
temporal controlled changes in luminance or illuminance in relation to traffic volume, time, weather or other parameters

3.3
motorised traffic (M)
motor powered vehicles

3.4
conflict area (C)
relevant area where motorised traffic streams intersect each other or overlap areas frequented by other user types

3.5
pedestrians and low speed area (P)
relevant area reserved for use by people on foot or using bicycle, and drivers of motorised vehicles at low speed (≤ 40 km/h)

3.6
design speed
speed selected for purposes of design and correlation of the geometric features of a road and is a measure of the quality of design offered by the road

Note 1 to entry: It is the highest continuous speed at which individual vehicles can travel with safety on a road when weather conditions are favourable and traffic density is so low that the safe speed is determined by the geometric features of the road.

3.7
traffic volume
the number of vehicles passing a given point in a stated time period in both directions

Note 1 to entry: E.g. average daily traffic is measured as number of vehicles per day.

3.8
maximum capacity
maximum rate of flow at which vehicles can be reasonably expected to traverse a point or uniform segment of a lane or carriageway during a specified time period under prevailing road, traffic and control conditions

Note 1 to entry: Usually expressed as veh/h or veh/d.

3.9
traffic density
number of vehicles occupying a given length of lane or carriageway averaged over time

Note 1 to entry: Usually expressed as veh/km or veh/km/lane.

3.10
traffic composition
distribution of vehicle types in the traffic stream, directional distribution of traffic, lane use distribution of traffic, and type of driver population on a given facility

Note 1 to entry: In this report simplified: mixed and motorised only.

3.11
junction
place where several traffic routes meet, join, or cross each other, and a location where traffic can change between different routes

3.12
intersection
general area where two or more roads join or cross at the same level, within which are included the carriageway and roadside facilities for traffic movements

3.13
interchange
grade-separated junction with one or more turning ramps for travel between the through roads

3.14
ambient luminosity
assessed luminance levels of the surroundings

3.15
visual guidance / traffic control
means that ensure that motorists are given adequate information on the course of the road

3.16
facial recognition
visual task of pedestrians consisting of a recognition of a face at certain distances that allows to take evasive or defensive action if thought necessary

Note 1 to entry: Generally, facial recognition requires an overall minimum lighting value at a distance where the recognition of a face is possible.

Note 2 to entry: An ideal facial recognition distance is 10 m – the point of transition between “close” and “not-close” phases.

3.17
relevant area
part of the public traffic area under consideration

3.18
non-motorised
pedestrians and pedal cyclists

3.19
separation of carriageways
central reserve and/or guardrail

3.20
difficulty of navigational task
degree of effort necessary by the road user, as a result of the information presented, to select route and lane, and to maintain or change speed and position on the carriageway

Note 1 to entry: Visual guidance provided by the road is part of this information.

4 Outline of selection procedure

In this Technical Report, a number of the most important parameters are listed for the different lighting situations - motorised traffic areas, conflict areas, and pedestrian and low speed areas. These parameters include the design speed, the traffic volume and traffic composition, the function and the overall layout of the road, and the environmental conditions.

Selection procedures, parameters and weighting values presented in the main text of this document are based on ones defined in CIE 115:2010, *Lighting of roads for motor and pedestrian traffic*. Annex B is an alternative method of selection of lighting classes which allows refined evaluation of the luminance or illuminance levels given for each class in EN 13201-2.

In many cases public areas consist of more than just one traffic area, e.g. often there is a carriageway with adjacent footway or cycle path. As users of the different traffic areas have different visual demands, the respective relevant parameters have to be considered during the selection process.

In selecting the normal (design) lighting 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. For simplicity, in this document only the main parameters are summarized for ordinary motorised traffic, for conflict areas and for pedestrian and low speed areas. The descriptions of the parameters and the associated options are broad so that they can be interpreted to suit the individual requirements of national recommendations. In some cases risk analysis or other consideration (environmental for example) could lead to the consideration of other parameters.

As indicated above, the normal (design) lighting class is selected using the most onerous parameter values, however, the application of this class may not be justified throughout the hours of darkness due to changing conditions, e.g. weekends, different weather conditions, different traffic volumes, etc. Temporal changes in the parameters under consideration when selecting the normal (design) lighting 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, traffic composition, real time reflection properties of pavement and current state of road surface (dark, light, dry, wet, salty, snowy), but ambient luminosity can also have an influence.

The adaptive lighting level or levels should be the average luminance or illuminance selected from a class or classes in the same table from which the normal lighting class has been selected. Tables 1, 3 and 4 can be used to select the appropriate adaptive lighting class or classes for different periods of the hours of darkness when the value of the selection parameters is significantly different.

When using adaptive lighting 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 M, C or P lighting classes. Reducing the light output from every light source 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 generally fulfill 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. It can also be used to reduce energy consumption by reducing the light output of the light source to the maintained value when the installation is clean and the light sources are new.

Where the pattern of variation in parameter values is well known, such as from a record of traffic monitoring stations (TMS) and weather stations (AWS) 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 lighting class to be activated in the case of road works, serious accidents, bad weather or poor visibility.

The following Clauses 5, 6 and 7 describe the method of selecting lighting classes as defined in CIE 115:2010. Alternatively, Annex B provides supplementary guidance about the level of requirement in each class:

— maximum average maintained luminance or illuminance;

— refined average maintained luminance or illuminance within the range between minimum and maximum values.

Both methods are suitable for all cases.

5 Lighting classes for motorised traffic (M)

The lighting classes M are intended for drivers of motorised vehicles on traffic routes, and in some countries also on residential roads, allowing moderate to high driving speeds. The application of these classes depends 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, traffic composition, and the environmental conditions.

At the final engineering stage of a new road the predicted traffic volume 10 years after opening of the road can be used. For existing roads information from traffic monitoring systems can be used.

Table 1 incorporates the considered principles and values. At national level further developed code of practice for road lighting is recommended based on the administrative or functional classification of roads. Close cooperation with road lighting, traffic planning, highway engineering and traffic safety experts is required. Maximum capacity values shall be obtained from traffic planning expert because figures vary according to road and street classes.

For the determination of the lighting class M to be applied to a given situation the appropriate weighting values (VW) have to be selected and added to find the sum of the weighting values (VWS). The number of the lighting class M is then calculated as:

Number of lighting class M = 6 - VWS

Careful selection of appropriate weighting values in Table 1 will yield class numbers between 1 and 6. If the sum of the weighting values (VWS) is < 0 the value 0 shall be applied. If the result M is ≤ 0 the lighting class M1 shall be applied.

Table 1 — Parameters for the selection of lighting class M

Parameter	Options	Description [a]		Weighting Value V_W [a]
Design speed or speed limit	Very high	v ≥ 100 km/h		2
	High	70 < v < 100 km/h		1
	Moderate	40 < v ≤ 70 km/h		-1
	Low	v ≤ 40 km/h		-2
Traffic volume		Motorways, multilane routes	Two lane routes	
	High	> 65 % of maximum capacity	> 45 % of maximum capacity	1
	Moderate	35 % - 65 % of maximum capacity	15 % - 45 % of maximum capacity	0

Parameter	Options	Description [a]		Weighting Value V_W [a]
	Low	< 35 % of maximum capacity	< 15 % of maximum capacity	-1
Traffic composition	Mixed with high percentage of non-motorised			2
	Mixed			1
	Motorised only			0
Separation of carriageway	No			1
	Yes			0
Junction density		Intersection/km	Interchanges, distance between bridges, km	
	High	> 3	< 3	1
	Moderate	≤ 3	≥ 3	0
Parked vehicles	Present			1
	Not present			0
Ambient luminosity	High	shopping windows, advertisement expressions, sport fields, station areas, storage areas		1
	Moderate	normal situation		0
	Low			-1
Navigational task	Very difficult			2
	Difficult			1
	Easy			0

[a] The values stated in the column are an example. Any adaptation of the method or more appropriate weighting values can be used instead, on the national level.

When the layout of the road does not permit the evaluation of the road surface luminance, following the conventional rules described in EN 13201-2, classes C shall be adopted.

For drivers of motorised vehicles at low speed on shoulder or parking lanes classes P shall be adopted.

6 Lighting classes for conflict areas (C)

The lighting classes C are intended for use on conflict areas on traffic routes where the traffic composition is mainly motorised. Conflict areas occur wherever vehicle streams intersect each other or run into areas frequented by pedestrians, cyclists, or other road users. Areas showing a change in road geometry, such as a reduced number of lanes or a reduced lane or carriageway width, are also regarded as conflict areas. Their existence results in an increased potential for collisions between vehicles, between vehicles and pedestrians, cyclists and other road users, and/or between vehicles and fixed objects.

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 on a part of the conflict area, or the entire area if the luminance criteria cannot be applied to the whole area. The correspondence between luminance and average horizontal illuminance depends on the lightness of the road surface, as represented by the $Q0$ value of that surface. Table 2 gives comparable M and C classes for various values of $Q0$ for the road surface.

Table 2 — M and C lighting classes of comparable lighting level for different values of $Q0$ for the road surface

Lighting class M			**M1**	**M2**	**M3**	**M4**	**M5**	**M6**
Lighting class C if $Q0 \leq 0{,}05\ cd \cdot m^{-2} \cdot lx^{-1}$			C0	C1	C2	C3	C4	C5
Lighting class C if $0{,}05\ cd \cdot m^{-2} \cdot lx^{-1} < Q0 \leq 0{,}08\ cd \cdot m^{-2} \cdot lx^{-1}$		C0	C1	C2	C3	C4	C5	C5
Lighting class C if $Q0 > 0{,}09\ cd \cdot m^{-2} \cdot lx^{-1}$	C0	C1	C2	C3	C4	C5	C5	C5

As the lighting classes C are intended for the same users as the lighting classes M, Table 2 shall primarily be used for the determination of a lighting class C to be applied to a given conflict area. The conflict area should as a minimum have a lighting level no lower than that of the highest lighting class used for the connecting road or roads. However, it is recommended that the lighting class used for the conflict area should normally be one step higher than the highest lighting class used for the road or roads leading to the conflict area (e.g. M2 instead of M3). This will not be possible where the entrance roads are lit to Class M1. In this case, the conflict area should also be lit to class M1.

Row 1 of Table 2 gives the M classes from which the highest lighting class used for the road or roads leading to the conflict area are selected. The equivalent illuminance C class is then taken from the same column dependant on the $Q0$ value shown in column 1. The actual C class to be used in the conflict area is recommended to be one step higher than the equivalent class so determined.

For certain conflict areas e.g town and city centres or if specific national requirements apply Table 3 can be used for the determination of a lighting class C for the conflict area. If there is no lighting on a road or roads leading to the conflict area Table 3 can also be used to determine a lighting class C for the conflict area.

If Table 3 is used for the determination of a lighting class C to be applied to a given conflict area the appropriate weighting values (VW) have to be selected and added to find the sum of the weighting values (VWS). The number of the lighting class C is then calculated as:

Number of lighting class C = 6 - VWS

Careful selection of appropriate weighting values in Table 3 will yield class numbers between 0 and 5. If the sum of the weighting values (VWS) is ≤ 0 the value 1 shall be applied. If the result C is < 0 the lighting class C0 shall be applied.

The application of classes C depends on the geometry of the relevant area, e.g. roundabout and traffic circumstances. Further guidelines are defined at national level for each country in the national code of practice for road lighting.

Table 3 — Parameters for the selection of lighting class C

Parameter	Options	Description [a]	Weighting Value V_W [a]
Design speed or speed limit	Very high	v ≥ 100 km/h	3
	High	70 < v < 100 km/h	2
	Moderate	40 < v ≤ 70 km/h	0
	Low	v ≤ 40 km/h	-1
Traffic volume	High		1
	Moderate		0
	Low		-1
Traffic composition	Mixed with high percentage of non-motorised		2
	Mixed		1
	Motorised only		0
Separation of carriageway	No		1
	Yes		0
Parked vehicles	Present		1
	Not present		0
Ambient luminosity	High	shopping windows, advertisement expressions, sport fields, station areas, storage areas	1
	Moderate	normal situation	0
	Low		-1
Navigational task	Very difficult		2
	Difficult		1
	Easy		0

[a] The values stated in the column are an example. Any adaptation of the method or more appropriate weighting values can be used instead, on the national level.

7 Lighting classes for pedestrian and low speed areas (P)

The lighting classes P are intended predominantly for pedestrians and cyclists for use on footways and cycleways, and drivers of motorised vehicles at low speed on residential road, shoulder or parking lanes, and other road areas lying separately or along a carriageway of a traffic route or a residential road, etc.

The visual tasks and needs of pedestrians differ from those of drivers in many respects. Speed of movement is generally much lower and relevant objects to be seen are closer than those important for drivers of motorised vehicles. This is reflected in the parameters and associated options for the selection of a lighting class P for a pedestrian or low speed area as listed in Table 4.

The application of these classes depends on the geometry of the relevant area and the traffic and time dependant circumstances.

For the determination of a lighting class P to be applied to a given situation with a specific traffic composition the appropriate weighting values (VW) have to be selected and added to find the sum of the weighting values (VWS). The number of the lighting class P is then calculated as:

Number of lighting class P = 6 - VWS

Careful selection of appropriate weighting values in Table 4 will yield class numbers between 1 and 6. If the sum of the weighting values (VWS) is < 0 the value 0 shall be applied. If the result P is = 0 the lighting class P1 shall be applied.

This document does not give guidelines on the selection of lighting classes HS, SC and EV. The decision on whether these classes should be used for pedestrians and low speed areas is defined in the national road lighting policy and the code of practice for road lighting. This varies by country or municipality. Specific guidelines on the selection of lighting classes HS, SC, EV and the use of facial recognition parameter are available at national level for each country.

Table 4 — Parameters for the selection of lighting class P

Parameter	**Options**	**Description** [a]	**Weighting Value** V_W [a]
Travel speed	Low	v ≤ 40 km/h	1
	Very low (walking speed)	Very low, walking speed	0
Use intensity	Busy		1
	Normal		0
	Quiet		-1
Traffic composition	Pedestrians, cyclists and motorised traffic		2
	Pedestrians and motorised traffic		1
	Pedestrians and cyclists only		1
	Pedestrians only		0
	Cyclists only		0
Parked vehicles	Present		1
	Not present		0
Ambient luminosity	High	shopping windows, advertisement expressions, sport fields, station areas, storage areas	1
	Moderate	normal situation	0
	Low		-1
Facial recognition	Necessary		Additional requirements[b]
	Not necessary		No additional requirements

[a] The values stated in the column are an example. Any adaptation of the method or more appropriate weighting values can be used instead, on the national level.

[b] Specific guidelines on use of facial recognition parameter are defined at national level for each country.

Annex A
(informative)

Examples for M and P lighting classes

A.1 Examples for lighting class M

Urban motorway with separate carriageways, Table A.1.

Time dependent change of traffic volume only, four time intervals (Δt1, Δt2, Δt3 andΔt4) considered; e.g. from switch on time until end of evening rush hour (Δt1), from end of evening rush hour until midnight (Δt2), from midnight until begin of morning rush hour (Δt3), and from begin of morning rush hour until switch off time (Δt4).

For the determination of the lighting class M to be applied the weighting values for the different parameters have to be added for each of the time intervals considered. The maximum value of the sum of the weighting values (here VWS, max = 4) is used to calculate the number of the normal lighting class M as 6 – VWS = 2 to be applied (M2). The minimum value of the sum of the weighting values (here VWS, min = 2) leads to the adaptive lighting class M4 which could be applied in terms of the average luminance level in the time interval Δt3, whereas for the time interval Δt2 the adaptive lighting class M3 could be applied. It is important to note that the changes to the adaptive lighting class should only affect the average luminance levels and not the other requirements.

Table A.1 — Time dependent selection of parameters - lighting class M

Parameter	Options	Description [a]		Weighting Value V_W [a]	V_W selected Δt1	Δt2	Δt3	Δt4
Design speed or speed limit	Very high	v ≥ 100 km/h		2				
	High	70 < v < 100 km/h		1	1	1	1	1
	Moderate	40 < v ≤ 70 km/h		-1				
	Low	v ≤ 40 km/h		-2				
Traffic volume		Motorways, multilane routes	Two lane routes					
	High	> 65 % of maximum capacity	> 45 % of maximum capacity	1	1			1
	Moderate	35 % - 65 % of maximum capacity	15 % - 45 % of maximum capacity	0		0		
	Low	< 35 % of maximum capacity	< 15 % of maximum capacity	-1			-1	
Traffic composition	Mixed with high percentage of non-motorised			2				
	Mixed			1				

Parameter	**Options**	**Description** [a]		**Weighting Value** V_W [a]	V_W **selected Δt1 Δt2 Δt3Δt4**			
	Motorised only			0	0	0	0	0
Separation of carriageway	No			1				
	Yes			0	0	0	0	0
Junction density		Intersection/km	Interchanges, distance between bridges, km					
	High	> 3	< 3	1	1	1	1	1
	Moderate	≤ 3	≥ 3	0				
Parked vehicles	Present			1				
	Not present			0	0	0	0	0
Ambient luminosity	High	shopping windows, advertisement expressions, sport fields, station areas, storage areas		1	1	1	1	1
	Moderate	normal situation		0				
	Low			-1				
Navigational task	Very difficult			2				
	Difficult			1				
	Easy			0	0	0	0	0
				Sum of Weighting Values V_{WS}	**4**	**3**	**2**	**4**
				M = 6 - V_{WS}	**M2**	**M3**	**M4**	**M2**

[a] The values stated in the column are an example. Any adaptation of the method or more appropriate weighting values can be used instead, on the national level.

A.2 Example for lighting class P

Time dependent change of use intensity and ambient luminance, two time intervals (Δt1, and Δt2) considered; e.g. from switch on time until midnight and from begin of morning rush hour until switch off time (Δt1), and from midnight until begin of morning rush hour (Δt2).

Table A.2 — Time dependent selection of parameters - lighting class P

Parameter	Options	Description	Weighting Value V_W	V_W selected Δt1	Δt2
Travel speed	Low	v ≤ 40 km/h	1	1	1
	Very low (walking speed)	Very low, walking speed	0		
Use intensity	Busy		1		
	Normal		0	0	
	Quiet		-1		-1
Traffic composition	Pedestrians, cyclists and motorised traffic		2		
	Pedestrians and motorised traffic		1		
	Pedestrians and cyclists only		1	1	1
	Pedestrians only		0		
	Cyclists only		0		
Parked vehicles	Present		1		
	Not present		0	0	0
Ambient luminosity	High	shopping windows, advertisement expressions, sport fields, station areas, storage areas	1		
	Moderate	normal situation	0	0	
	Low		-1		-1
Facial recognition	Necessary		Additional requirements		
	Not necessary		No additional requirements		
			Sum of Weighting Values V_{WS}	**2**	**0**
			P = 6 - V_{WS}	**P4**	**P6**

For the determination of the lighting class P to be applied the weighting values for the different parameters have to be added for each of the time intervals considered. The maximum value of the sum of the weighting values (here VWS, max = 2) is used to calculate the number of the normal lighting class P as 6 – VWS = 4 to be applied (P4). The minimum value of the sum of the weighting values (here VWS, min = 0) leads to the adaptive lighting class P6 which could be applied in terms of the illuminance level in the time interval Δt2.

Annex B
(informative)

Alternative method for selection of lighting classes

B.1 General

This method is based on a functional or administrative road classification defined by highway authorities and provides a more refined solution within each lighting class. The road designations are the main entries in the first column of a table. In the table, the consecutive columns allow selecting progressively the weight of five different coefficients attached to the different parameters mentioned in the header of the table.

These parameters are:

a) road type and speed limit;

b) traffic composition;

c) traffic volume;

d) ambient light;

e) mental task load.

The overall weighted coefficient results from the product of the five coefficients attached to these parameters. It should be noted that the first three parameters are dependent and always have an influence on the overall coefficient. At the same time the last two parameters either may have an influence or not on the overall coefficient for the reason they are independent. In "normal" situations they have no influence and the value of their coefficient is 1, conversely when their influence is high a coefficient of 1,25 has been retained. Furthermore, a consideration is given for these last two parameters whether the occurrence of the situation is currently possible (●) or unlikely (▬). Depending on the resulting combinations, the overall coefficient can be found in one of the three columns titled: Line I, Line II and Line III. When a value is present in one of these three columns, it is the overall coefficient retained for the given situation.

The last step in the classification process is then to use this overall coefficient as the entry in the diagram of the figure attached to the table. In this diagram, three straight lines are drawn in a system of coordinates and are respectively named Line I, Line II and Line III with reference to the corresponding columns of the table. In abscissa of this diagram we can read the overall coefficient. In ordinate we can read average maintained luminances or illuminances. Parting from the overall coefficient of a given situation in abscissa, the level of luminance or illuminance is reached in ordinate on the corresponding straight Line I, II or III to give, at the same time, the range of classification spread along the scale of ordinates.

Two tables and two figures have been created:

— Table B.1 and Figure B.1 for M and C classes;

— Table B.2 and Figure B.2 for P classes.

In Figure B.1, the scale in ordinate has been primarily established for M classes in luminance. The correspondence in illuminance for C classes is based on 3 values of the $Q0$ factor of the road surface.

B.2 Lighting classes for motorised traffic and conflict areas

Table B.1 incorporates the considered principles and values. At national level further developed code of practice for road lighting is recommended based on the administrative or functional classification of roads. Road descriptors given in Column 1 of Table B.1 should be retained or amended.

For the determination of the lighting class M or C to be applied to a given situation, the appropriate coefficients are selected in the different lines of the table of a given road descriptor. Once the overall coefficient is determined in one of the three columns Line I, Line II or Line III, the results can be transferred on to Figure B.1.Two situations for the class search have been highlighted in two examples at the end of this annex using Table B.1 and Figure B.1.

Table B.1 — Selection of the M or C lighting class from the road or street characteristics

Roads or streets designation	CARRIAGEWAY & SPEED LIMIT				TRAFFIC									A	B	C	Overall coefficient	
	Carriageway		Speed	Coefficients carriageway speed	Composition				Volume			Ambient luminosity	Mental task load	Product speed traffic	Ambient luminosity	Mental task load	A x B or A x C	A x B x C
					Coefficients				Coefficients			Coefficients			Coefficients			
					1	2	3	4	3	2	1	1	1		1,25	1,25		
	single	separated	km/h		Not motorized	Motorized only	Mixed traffic	Mixed mainly not motorized	High	Medium	Low	Low to moderate		Line I *	High	High	Line II *	Line III *
Interurban motorway		X	≤ 130	5		2			3			●	●	30	—	●	38	
										2				20			25	
											1			10			12	
Urban motorway Expressway		X	≤ 110	5		2			3			—	—		●	●	38	47
										2							25	31
											1						12	16
Interurban main road	X		≤ 90	5			3		3			●	●	45	—	●	56	
										2				30			38	
											1			15			19	
Main crossing road	X		≤ 70	4			3		3			—	—		●	●	45	56
										2							30	37
											1						15	19
Main urban road Boulevard - Avenue	X		≤ 50	3			3		3			—	—		●	●	34	42
										2							23	28
											1						11	14
Secondary urban road Avenue - Street	X		≤ 50	3			3					●	●		●	—		
										2				18			22	
											1			9			11	
Urban service road	X		≤ 50	2			3					●	●		●	—		
										2				12			15	
											1			6			8	
Urban road Dangerous intersections Village crossing	X		≤ 50	3			3		3			●	●	27	●	●	34	42
										2				18			23	28
											1			9			11	14
Urban road in dangerous section	X		≤ 30	1				4	3			●	●	12	●	●	15	18
										2				8			10	12
											1			4			5	7

* see Figure B1

— Unlikely case

● Current possible case

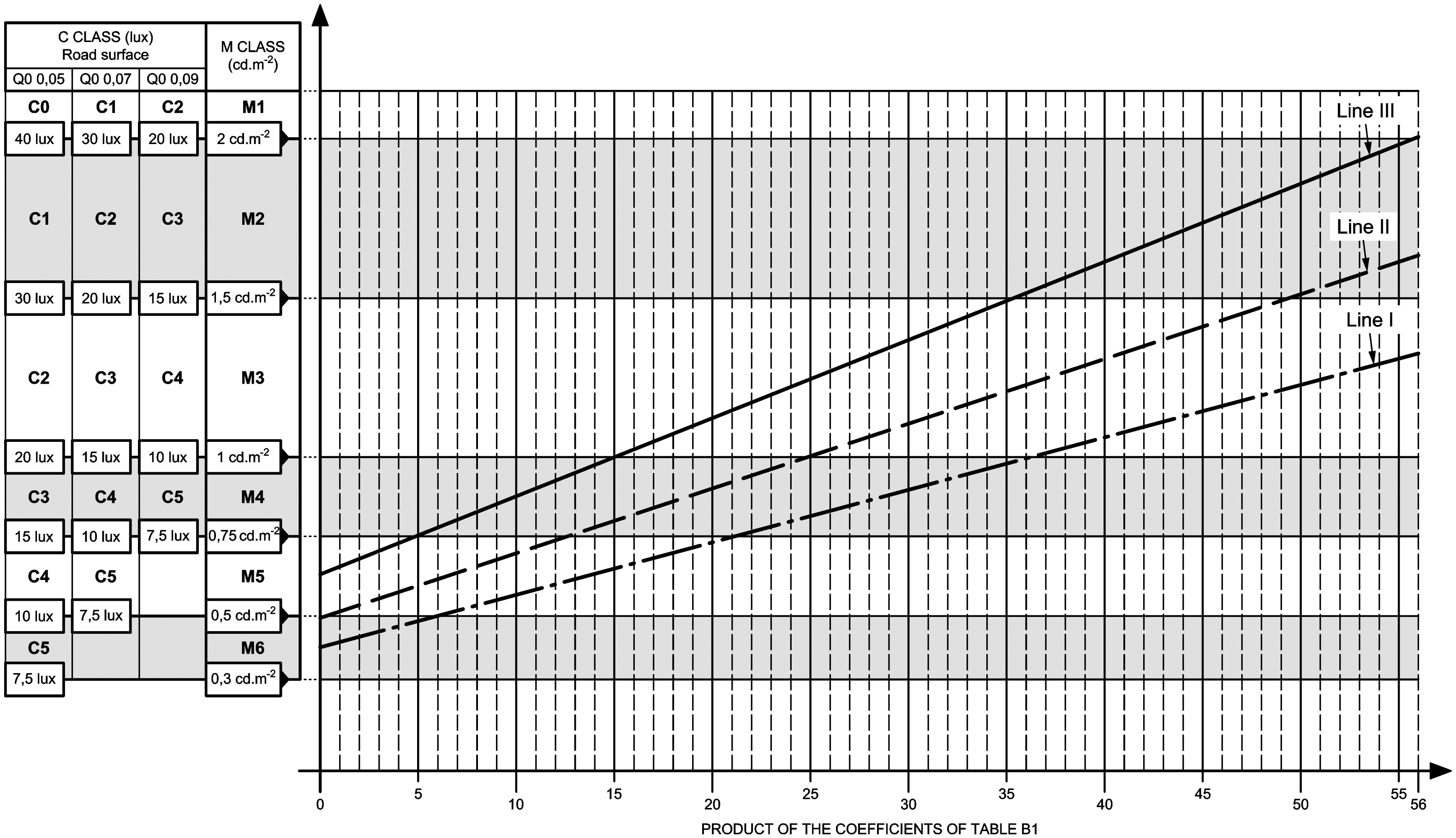

Figure B.1 — Selection of M or C lighting class versus the overall coefficient of Table B.1

B.3 Lighting classes for pedestrian and low speed areas

The lighting classes P are intended predominantly for pedestrians and cyclists on footways and cycleways, and drivers of motorised vehicles at low speed on residential road, shoulder or parking lanes, and other road areas lying separately or along a carriageway of a traffic route or a residential road, etc.

The visual tasks and needs of pedestrians differ from those of drivers in many respects. Speed of movement is generally much lower and relevant objects to be seen are closer than those important for drivers of motorised vehicles. This is reflected in the parameters and associated options for the selection of a lighting class P for a pedestrian or low speed area as listed in Table B.2.

The application of these classes depends on the geometry of the relevant area and the traffic and time dependant circumstances.

Table B.2 and Figure B.2 are based on the same principle as C classes: the level of performance is the average maintained illuminance whose scale is adapted to the P class.

This document does not give guidelines on the selection of lighting classes HS, SC and EV. The decision on whether these classes should be used for pedestrians and low speed areas is defined in the national road lighting policy and the code of practice for road lighting. This varies by country or municipality. Specific guidelines on the selection of lighting classes HS, SC, EV and the use of facial recognition parameter are available at national level for each country.

Table B.2 — Selection of P lighting class from the road characteristics

P Class	SPEED LIMIT		TRAFFIC								A	B	C	Overall coefficient	
			Composition			Volume			Ambient luminosity	Mental task load Face recognition	Product Speed x Traffic composition volume	Ambient luminosity	Mental task load - Face Recognition	A x B or A x C	A x B x C
Road designation	km/h	Coefficient	Mixed	Pedestrians and Cycles	Pedestrians or Cycles	High	Medium	Low	Low to moderate			High			
			coefficients									coefficients			
			3	2	1	3	2	1	1	1	Line I *	1,25	1,25	Line II *	Line III *
Low speed Roads with traffic priority - Mopeds Cycles and Pedestrians	S < 40	3	3			3			—	—		●	●	34	42
							2							23	28
								1						12	14
Roads without motorized traffic		2		2		3			●	●	12	●	●	15	19
							2				8			10	13
								1			4			5	7
Walkway	Pedestrian speed	1			1	3			●	●	3	●	●	4	5
							2				2			3	4
								1			1			2	3
Bicycle path	Bikes only	2			1	3			●	●	6	●	●	8	10
							2				4			5	7
								1			2			3	4

* see Figure B2

— Unlikely case

● Current possible case

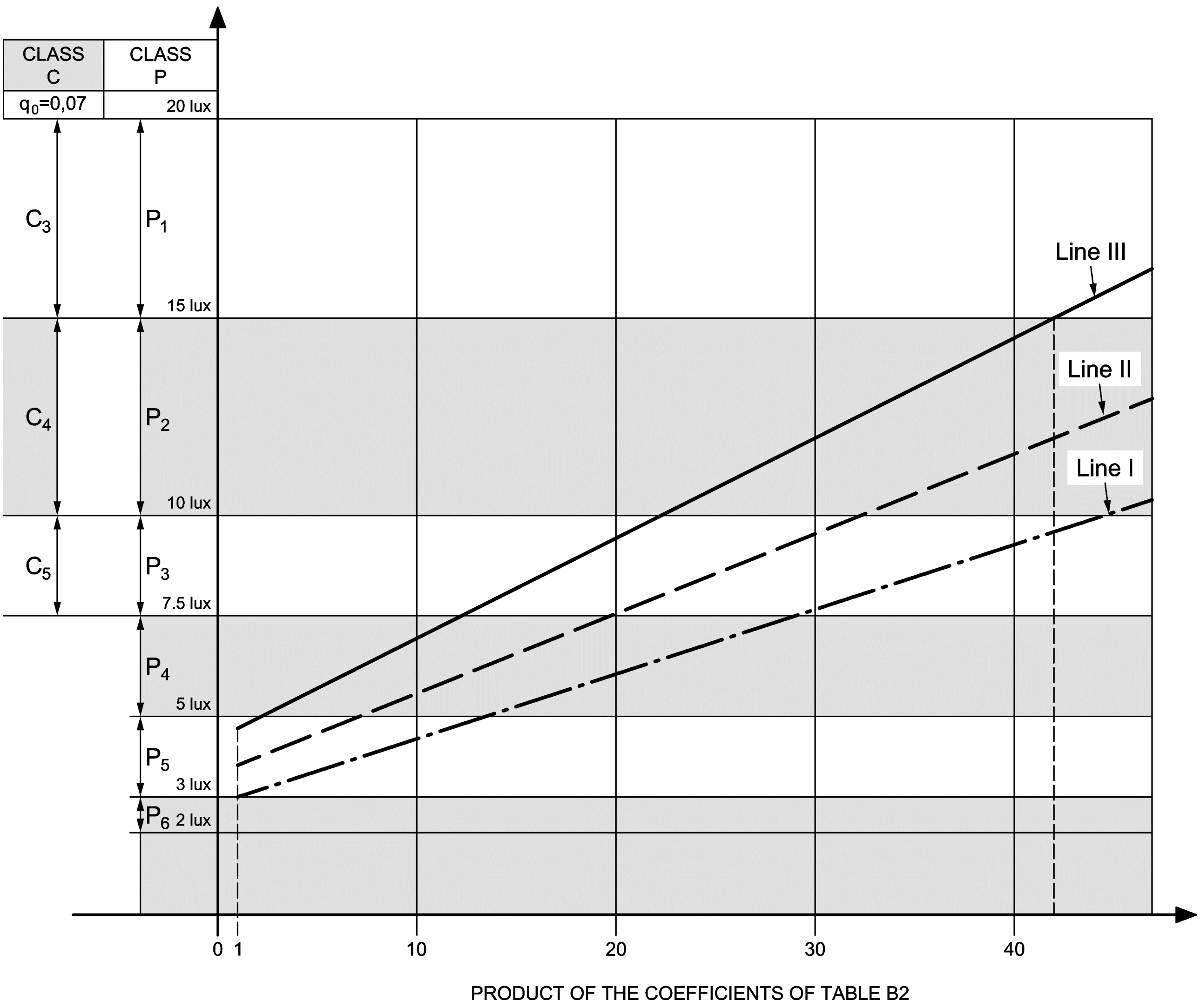

Figure B.2 — Determination of P class versus the overall coefficient of Table B.2

B.4 Example of use of Table B.1 and Figure B.1

In the following page, on Table B.3 and Figure B.3 are drawn arrows showing the search process of the M class number for a “main urban road” during two periods of the night.

First case (continuous lines) the determination with high traffic volume corresponding to rush hours: the overall coefficient is 42 (A x B x C = 42) on Line III cumulating the high conditions of “ambient light” and “mental load task” of drivers. Class M2 is defined with the average maintained luminance of 1,7 cd.m-2.

Second case (dotted lines), the same determination but with a lower traffic volume and a “normal” mental load task of drivers. The overall coefficient is 23 (A x B = 23) on Line II, keeping high the “ambient light” parameter.

Class M4 is defined with the average maintained luminance of 0,95 cd.m-2. This second case is a possibility of adaptive lighting of the first one at another period of the night, for example : from the end of evening rush hour until midnight.

Table B.3 — Determination of the M class of a "main urban road" for two traffic volumes with and without mental task load

Roads or streets designation	CARRIAGEWAY & SPEED LIMIT				TRAFFIC									A	B	C	Overall coefficient	
	Carriageway		Speed	Coefficients carriageway speed	Composition				Volume			Ambient luminosity	Mental task load	Product speed traffic	Ambient luminosity	Mental task load	A x B or A x C	A x B x C
					Coefficients				Coefficients			Coefficients			Coefficients			
					1	2	3	4	3	2	1	1	1		1,25	1,25		
	single	separated	km/h		Not motorized	Motorized only	Mixed traffic	Mixed mainly not motorized	High	Medium	Low	Low to moderate		Line I *	High	High	Line II *	Line III *
Interurban motorway		X	≤ 130	5		2			3			●	●	30	—	●	38	
										2				20			25	
											1			10			12	
Urban motorway Expressway		X	≤ 110	5		2			3			—	—		●	●	38	47
										2							25	31
											1						12	16
Interurban main road	X		≤ 90	5			3		3			●	●	45	—	●	56	
										2				30			38	
											1			15			19	
Main crossing road	X		≤ 70	4			3		3			—	—		●	●	45	56
										2							30	37
											1						15	19
Main urban road Boulevard - Avenue	X		≤ 50	3			3		3			—	—		●	●	34	42
										2							23	28
											1						11	14
Secondary urban road Avenue - Street	X		≤ 50	3			3			2		●	●	18	●	—	22	
											1			9			11	
Urban service road	X		≤ 50	2			3			2		●	●	12	●	—	15	
											1			6			8	
Urban road Dangerous intersections Village crossing	X		≤ 50	3			3		3			●	●	27	●	●	34	42
										2				18			23	28
											1			9			11	14
Urban road in dangerous section	X		≤ 30	1				4	3			●	●	12	●	●	15	18
										2				8			10	12
											1			4			5	7

* see Figure B.3

— Unlikely case

● Current possible case

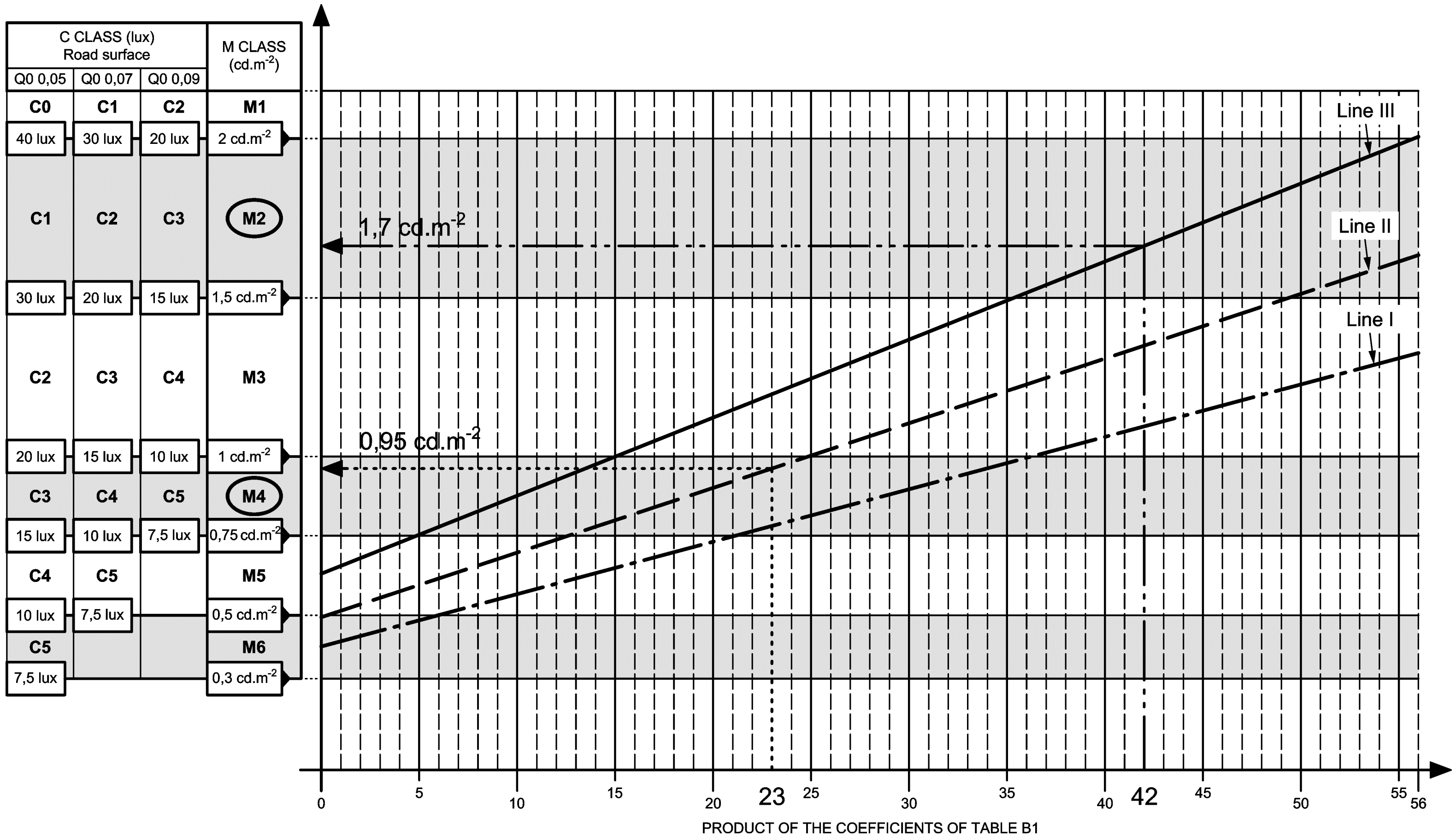

Figure B.3 — Determination of the M class of a “main urban road” for two traffic volumes with and without mental task load

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